Status Survey and Conservation Action Plan

The Cranes

Compiled by
Curt D. Meine and George W. Archibald
IUCN/SSC Crane Specialist Group

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Cover photo: The central population of the endangered Siberian Crane at Keoladeo National Park in India. The population contained more than 30 individuals through the early 1980s. No birds were seen on the wintering grounds in 1993-94 and 1994-95. Four individuals reappeared at Keoladeo National Park in February 1996. © International Crane Foundation.

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Preface

The fifteen species of cranes constitute one of the most endangered families of birds in the world. Cranes have also played an important role in the rise of the international conservation movement. In particular, the recovery of the Whooping Crane from near extinction has provided strong impetus to the conservation movement, and has opened the eyes of many people to the steep price that we pay for ignoring the damage we cause to the natural world.

The establishment of the International Crane Foundation (ICF) in 1973 and of Crane Working Groups in countries and regions around the world has stimulated unprecedented interest in cranes among specialists and the broader public in countries with diverse political and economic systems — including the USA, the former Soviet Union, Japan, China, South Korea, India, Iran, South Africa, and Australia. Thanks to the active programs of ICF, cooperative programs for the conservation of cranes have been initiated among many of these countries. Even during the most difficult years of the Cold War era, successful crane conservation programs were established and carried out such as: international projects for Siberian Crane conservation ("Operation Sterkh"); collaborative studies of the endangered cranes of the Far East; establishment of the joint Russian-Chinese nature reserve at Lake Khanka, as well as other protected areas; development of new centers for the captive propagation of endangered cranes at Oka and Khinganski Nature Reserves, Zhalong Nature Reserve in China, and other sites; and regular communications among colleagues from many nations. As a result, over the last twenty-five years we have been able to assess the status of all the crane species and their habitats, to identify possible threats, to establish many protected areas, and to sign various cooperative international agreements.

These results are especially valuable in that, for the first time in history, concerned individuals from throughout the world have been able to work closely together for the protection of a specific group of endangered species. In addition, these efforts have involved unprecedented close cooperation among the public and private sectors and national and international institutions in the development and implementation of specific projects. Through regular workshops and meetings, publications, newsletters, and the active involvement of the mass media, a broad-scale exchange of information, ideas, and experiences in crane conservation has been achieved, and a global network of enthusiasts has formed to protect and preserve these beautiful birds and their habitats.

In this way, cranes have come to play a unique role as ambassadors for peace, helping peoples from different countries to recognize the common ground that unites them. Principles and methods developed through the study and conservation of cranes have contributed to the foundation of broader national, international, and regional programs for the conservation of biological diversity and the implementation of the idea of sustainable land use. Cooperative crane conservation and habitat restoration projects have played a substantial role in the development of new forms of international collaboration. The cranes have accomplished what diplomats have been unable to do, bringing together scientists, conservationists, and government officials from countries whose relations for many years have been less than friendly.

As of today, however, many crane conservation goals have yet to be achieved. Often the most important and valuable information has been unavailable to those who need it. The situation in different crane habitats is highly dynamic, so that even small local changes in certain populations can significantly affect the status of species as a whole. The time is now ripe for a unified working document that coordinates the efforts and plans of all organizations and individuals involved in the conservation of cranes and their natural habitats.

This action plan provides such a document. This publication is unique in its highly detailed and complete treatment of crane conservation activities and needs, and in the extent to which crane scientists and conservationists from around the world have participated in its preparation. This plan represents the fruition of this highly productive period of activity in assessing and evaluating the status of cranes, selecting conservation priorities and mechanisms, and developing an international network of organizations and specialists. Its implementation will promote improved living conditions for the wide range of plants, animals, and people that live side-by-side with cranes.

Although this document is based on thorough scientific information, it has been written in lively and vibrant language, understandable to a broad audience, from scientists and conservationists to government officials and nature lovers in general. The plan effectively combines two approaches to cranes and their needs — by species and by geographic region. The fifteen species accounts present complete information on the population and status of each species, and on current conservation activities. The status of the cranes in different countries and regions is considered in the context of the varied political, economic, and cultural factors they face. Another beneficial feature of this action plan is the fact that it represents a working document that is open to additions and improvements. New information on the biology of the birds and the changes that their populations and habitats are undergoing can be easily and efficiently updated. The Ron Sauey Memorial Library at ICF, with its unique and extensive collection of crane literature from around the world, has been especially valuable in pulling this body of information together.

A great many specialists from around the world have participated in the preparation of this publication. Their contributions of advice, expertise, and information have helped to ensure this document's high quality and reliability. In this respect, the plan represents the product of an international

body of authors and contributors, and is now "ready to go to market" due to the hard work of the two compilers. One of the compilers, Dr. George Archibald, is among the world's leading experts on crane biology, ecology, and captive propagation, and has been the key organizer of crane conservation activities over the last twenty-five years. The other, Dr. Curt Meine, is a professional writer and conservation biologist who has dedicated many years to issues of nature protection. Through their efforts, and those of our many colleagues around the world, the cranes may now face improved chances for survival in the decades to come.

Dr. Sergei Smirenski
University of Moscow/Socio-Ecological Union of Russia

Executive Summary

The cranes are among the most ancient and distinctive families of birds on Earth. Their great size and beauty, unique calls, and complex behaviors have for centuries commanded the attention and respect of people on the five continents where they are found. Wary residents of wetlands and grasslands, cranes have also long symbolized natural grandeur and the special quality of wild places. Few groups of organisms have had so strong a claim upon the human mind, heart, and imagination.

Yet cranes are also among the world's most threatened groups of birds. Several of the family's fifteen species have neared the precipice of extinction; as many as eleven may now be globally threatened. Diverse threats, including habitat loss and degradation, pollution, exploitation, poisoning, and disturbance, beset the cranes. In South Africa, for example, planting of extensive tree plantations has wiped out large portions of the grassland ecosystems where the Blue Crane and a host of other endemic species once thrived. In the Hindu Kush valleys of the Indian subcontinent, hunting has been a leading factor behind the near extinction of the population of critically endangered Siberian Cranes that winters in India. In East Asia, extensive loss and degradation of wetlands, due in large part to rising human population pressures, threatens the region's endangered Siberian, White-naped, Hooded, and Red-crowned Cranes. In the southern United States, the remnant population of Mississippi Sandhill Cranes fails to reproduce at a level sufficient to sustain its numbers — possibly a response to chemical contamination and other factors affecting the quality of their habitat. These are only a few of the multiple threats facing the world's cranes and the ecosystems where they are found.

Yet in most cases cranes readily coexist with people if conservation measures are undertaken. In Japan and North America, for example, endangered cranes have been carefully studied and protected over the past half-century; their numbers are now increasing in these highly industrialized nations. In Germany and other portions of northern Europe, Eurasian Cranes are breeding again in areas from which they were long ago extirpated. For thousands of years the Hindu people of India have revered cranes. Today, in small wetlands amidst millions of rural farmers, thousands of Sarus Cranes still survive. Thus, there is substantial cause for hope for the cranes, if people care. And by conserving cranes we may also conserve the ecological health, biological diversity, and environmental quality of the ecosystems they inhabit — that they share with people.

Because the ranges and migration routes of cranes extend across the borders of many countries, international cooperation is key to crane conservation efforts. For decades Canada and the United States have collaborated closely on behalf of the Whooping Crane — an important example to other nations working with other species. Over the last twenty-five years, international partnerships have emerged and grown in many other parts of the world. For example, scientists throughout East Asia have worked together, using satellite technology and other modern methods to track the migration routes and identify important habitats used by the region's endangered cranes. In 1995, representatives from the range states of the Siberian Crane met for the first time in Moscow to lay the groundwork for a coordinated species recovery plan. The Eurasian Crane, which occurs in some 90 countries (more than any other crane species), has brought together biologists and conservationists on three continents, especially in Western Europe, where the species is recovering after centuries of decline. In 1993, more than 100 representatives from 19 African countries met at a crane and wetland training workshop in Botswana, the first gathering of its kind on the continent. Through these and similar efforts around the world, the prospects for the cranes and their habitats have begun to improve, despite mounting pressures and of continued vulnerability.

The conservation of cranes is a global challenge and a global task. But in the long run success can be gained only through well coordinated actions at the local, regional, and international level. This document seeks to provide the "big picture" in which crane conservationists can direct their special contributions. This action plan has been developed with a 10- to 15-year horizon in mind. It brings together for the first time information relevant to conservation of all the world's cranes. The goals of the plan are: to review existing knowledge of the world's cranes and the habitats that sustain them; to use this information to assess the current status of the cranes and of efforts to conserve them; to identify high priority measures that may enhance the conservation of cranes and the wetland and grassland ecosystems in which they occur; and to recommend and rank specific conservation actions based on these needs. In many cases, this action plan builds upon existing national-level crane action plans. Conversely, this plan offers guidance for the preparation and updating of more detailed national-level plans.

The action plan is divided into three sections. Section 1 provides a basic overview of the conservation biology of cranes. Section 2 presents comprehensive, up-to-date accounts of each of the fifteen crane species. Each species account includes discussions of subspecies and populations; population numbers; conservation status; historic and present distribution; distribution by country; habitat and ecology; principal threats; and current conservation measures. Each account concludes with a list of priority conservation measures, including many detailed recommendations for action under various categories (e.g., protected areas, surveys and monitoring, research, education, etc.). Building on the species accounts, Section 3 provides, for the family as a whole and for each region of the world, a more general overview of the actions needed to help the cranes endure.

This action plan is aimed at the many players that are now or may potentially be involved in crane conservation, including conservation biologists and other scientists; agency officials and other decision-makers; conservation organizations and other non-governmental organizations working at all levels; international development agencies; political, civic, and business leaders; funding agencies, foundations, and other organizations that provide critical support for conservation work; educators interested in the particular issues of crane conservation, as well as more general topics in environmental science and conservation biology; and members of the general public who wish to learn more about cranes, their status, and their future needs.

The state of the world's cranes and their habitats is precarious. Their fate will be determined in a large part by the daily actions and long-term aspirations of people on five continents, under widely varied circumstances. This action plan, through its combination of basic biological information, updated species status reports, and coordinated recommendations, seeks to provide direction in the global endeavor to ensure that these charismatic birds will find safe passage into and through the 21st century.

Contents

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During the preparation of this document, the cranes lost three of their most dedicated students and ardent admirers. Thomas T. Tacha devoted a substantial portion of his career as a wildlife biologist to advancing our understanding of North America's Sandhill Cranes, and contributed importantly to the Sandhill Crane account that appears in this volume. Gretchen Holstein Schoff was an early and constant supporter of the International Crane Foundation, and a devoted friend and advisor to the compilers of this action plan. Through the publication *Reflections: The Story of Cranes,* she continues to touch crane enthusiasts around the world. More than any other single individual, Lawrence Walkinshaw built the foundation upon which this action plan rests. His lifelong commitment as a scientist, writer, and conservationist continues to inform and inspire all those who work to ensure a secure future for the cranes. This action plan is dedicated to the memory of these three special individuals.

Introduction

When we hear his call we hear no mere bird. We hear the trumpet in the orchestra of evolution.

- Aldo Leopold, "Marshland Elegy" (1949)

Wherever it has resounded, the trumpet call of the crane has stirred admirers of natural beauty and the wild. Over the last 150 years, however, the music of cranes has diminished in the world. A majority of the cranes is now threatened with extinction in the wild, and the risks that they face are formidable. This action plan seeks to keep their trumpets sounding.

The crane family exemplifies many of the challenges and opportunities of modern biodiversity conservation. These include, for example, efforts to maintain viable populations of rare and endangered species; to pursue ecosystem management in response to local, regional, and global threats; to address problems associated with trade and exploitation; to coordinate protection in the wild with captive propagation and reintroduction programs; to anticipate and preclude potential human/wildlife conflicts; and to develop sustainable alternatives to destructive patterns of resource use. The family of cranes includes only fifteen species, but it embraces a rich record of conservation trials and achievements.

The goals of this action plan are: to review existing knowledge of the world's cranes and the habitats that sustain them; to use this information to assess the current status of the cranes; to identify high priority measures that may enhance the conservation of cranes and the wetland and grassland ecosystems in which they occur; and to recommend and rank specific conservation actions based on these needs.

The action plan is aimed at the full spectrum of individuals and organizations currently or potentially involved in crane conservation: conservation biologists and other scientists working on cranes, grasslands, and wetlands around the world; agency officials and decision-makers whose responsibilities include cranes and their habitats; local, national, and international conservation organizations; other NGOs working on related aspects of sustainable development; international development agencies, whose activities affect in diverse ways the ecosystems upon which cranes depend; political, civic, and business leaders who seek to bring human economic activity into closer harmony with natural systems; funding agencies, foundations, and other organizations that provide critical support for conservation work; educators at all levels who are interested in the particular issues of crane conservation as well as more general topics in environmental science and conservation biology; and members of the general public who wish to learn more about cranes, their status, and their future needs.

Cranes possess several attributes that make this action plan different from those that have been prepared for other taxonomic groups. They belong to one of the most threatened families of birds on earth. Because of their large size, distinctive behavior, extensive territories, and cultural significance, they have served as "umbrella" and "flagship" species in many conservation efforts. Scientific understanding of cranes is great compared to most other taxonomic groups. Moreover, over the last 25 years much has been done to promote their conservation, especially through the world-wide efforts of the International Crane Foundation (founded in 1973). More than 30 major crane workshops, conferences, and symposia have been held during this period, producing a substantial body of literature on crane biology and conservation. In 1992, the IUCN/SSC Conservation Breeding Specialist Group cosponsored a Crane Conservation Assessment and Management Plan (CAMP) Workshop, the findings from which provided the foundations for this action plan. For all these reasons, this document is unusually detailed compared to other global-scale conservation action plans.

Section 1 provides a broad overview of the conservation biology of cranes. Section 2 consists of individual accounts for each of the fifteen crane species. Each account includes discussions of subspecies and populations; population numbers; conservation status; historic and present distribution; distribution by country; habitat and ecology; principal threats; and current conservation measures. Each account concludes with a list of priority conservation measures in various areas (e.g., protected areas, surveys and monitoring, research, education, etc.). These priority measures in turn provide the basis for the global and regional recommendations outlined in Section 3. In some cases, the recommendations build on existing programs. In most cases, however, the recommendations are intended to guide scientists, NGOs, agency officials, and other conservationists in defining future activities. All text references are listed in the Literature section.

The appendices at the end of the action plan provide information on the IUCN/SSC Crane Specialist Group Members; the Crane Working Groups; the new IUCN Red List Categories and Criteria (which have been used to propose revisions in the classification of the cranes within the plan); preparation of national crane action plans; and securing support for crane conservation projects.

The action plan has been developed with a 10- to 15-year horizon in mind. The Crane Specialist Group will closely monitor progress in undertaking recommended actions, and will periodically update the plan. To achieve its goals, actions will need to be undertaken at the local level, but will need to be well coordinated. Thus, one of the underlying aims in preparing this plan has been to provide a "big picture" in which crane conservationists can see where their distinctive contributions fit. Finally, the plan identifies gaps in our knowledge of cranes and their habitats. This should challenge field biologists and supporting organizations to continually strengthen the foundations of knowledge upon which successful conservation

actions are built.

The state of the world's cranes and their habitats is precarious. Their fate will be determined in large part by the daily actions and long-term aspirations of people on five continents, under widely varied circumstances. We hope that this document will help to ensure that the cranes find safe passage into and through the 21st century.

Acronyms Used in Text

ADENEX	Asociación para la Defensa de la Naturaleza y los Recursos de Extremadura (Spain)
AWB	Asian Wetland Bureau
AWC	Asian Waterfowl Census
AWP	Aransas-Wood Buffalo population (Whooping Crane)
CAMP	Crane Conservation Assessment and Management Plan (IUCN/SSC/CBSG)
CBSG	Conservation Breeding Specialist Group (IUCN)
CMS	Convention on the Conservation of Migratory Species ("Bonn Convention")
CWS	Canadian Wildlife Service
DMZ	demilitarized zone (Korean peninsula)
ECWG	European Crane Working Group
EWT	Endangered Wildlife Trust (South Africa)
GASP	Global Animal Survival Plan (IUCN/SSC/CBSG)
GCAR	Global Captive Action Recommendations (IUCN/SSC/CBSG)
GIS	geographic information systems
ICF	International Crane Foundation
IUCN	International Union for Conservation of Nature and Natural Resources - also known as the World Conservation Union
IWRB	International Waterfowl and Wetlands Research Bureau
MOU	memo of understanding
NAS	National Audubon Society (USA)
NGO	non-governmental organizations
NWR	National Wildlife Refuge (USA)
PTT	platform transmitter terminal
PHVA	population viability analysis
SACF	Southern African Crane Foundation
SEU	Socio-Ecological Union (Russia)
SSC	Species Survival Commission (IUCN)
SSP	species survival plan
TNC	The Nature Conservancy
UNEP	United Nations Environmental Programme
USFWS	United States Fish and Wildlife Service
WGAC	Working Group on African Cranes
WBSJ	Wild Bird Society of Japan
WCCA	Whooping Crane Conservation Association
WCK	Wildlife Clubs of Kenya
WWF	World Wide Fund for Nature

SECTION 1
Conservation Biology of Cranes

1.1 Introduction

An understanding of the biology, ecology, and status of cranes is fundamental to the success of efforts to conserve them and the ecosystems within which they exist. Fortunately, cranes have drawn sustained attention from scientists and conservationists around the world. Walkinshaw (1973) and Johnsgard (1983) provide detailed reviews of crane biology and ecology. The species accounts in Section 2 provide summaries of recent research and conservation activities for each species, as well as additional literature sources for those seeking further information. This section focuses on the cranes at the family level, highlights contrasts among the species, and reviews the status of and threats to the family as a whole.

This section is adapted from text prepared for the *Handbook of the Birds of the World: Volume 3* (del Hoyo, J. and Elliot, A., eds. In prep. Lynx Editions and the ICBP, Barcelona). Section 1.5, "Conservation Status," was prepared based on the new categories and criteria as delineated in the *IUCN Red List Categories* (IUCN 1994). Section 1.8, "Captive Propagation and Reintroduction," was prepared by Claire Mirande of the International Crane Foundation in consultation with members of the Crane Specialist Group.

ICF

Black-necked Cranes and fishermen at Cao Hai Nature Reserve in southwestern China

1.2 Evolution and Classification

Within the order Gruiformes, cranes are closely related to the limpkins (which have similar flight patterns and loud calls), the trumpeters (which resemble Crowned Cranes in their dances and plumage), and the bustards (which are also large, long-legged, long-necked birds found in open lands). Recent studies of morphology, ethology, and DNA have shown similar patterns in the systematic relationships within this order of birds (see Archibald 1976a, 1976b; Wood 1979; Krajewski 1989; Krajewski and Fetzner 1994; Krajewski and Archibald in prep.).

The crane family (Gruidae) is divided into two subfamilies, the Crowned Cranes (Balearicinae) and the Typical Cranes (Gruinae) (Figure 1.1). Crowned Cranes date back in the fossil record to the Eocene, 37-54 million years before present. Eleven species of Crowned Cranes are known to have existed in Europe and North America over the last 50 million years. The two species of Crowned Cranes that survive are found exclusively in Africa (Urban 1987). Modern Crowned Cranes cannot withstand extreme cold, and it is conjectured that as the earth cooled these cranes died out on the northern continents and held on only in Africa, where tropical conditions persisted through the Pleistocene. The Typical Cranes, by contrast, are more cold hardy. They first appear in the fossil record in the Miocene, 5-24 million years ago. It was during this period that the thirteen surviving species of Gruinae evolved. Seven other species of Gruinae cranes are known to have gone extinct during this period (Brodkorb 1967).

Crowned Cranes are distinguished from the Typical Cranes by their lack of a coiled trachea, their loose body plumage, and their inability to withstand severe cold. They retain the ability to roost in trees, and are the only cranes able to do so. Their calls are also simpler than those of the Typical Cranes (Archibald 1976a, 1976b). There are two species: the Black Crowned Crane (*Balearica pavonina*) of the African Sahel Savannah from Senegal to Ethiopia, and the Grey Crowned Crane (*B. regulorum*) of the East African savannahs from Kenya to South Africa.

The Typical Cranes are divided into three genera: *Anthropoides, Bugeranus,* and *Grus.* The Demoiselle Crane *(Anthropoides virgo)* and Blue Crane *(Anthropoides paradisea)* have bustard-like short toes and bills, and like the bustards live in grasslands. Although the morphological features of the Anthropoides species and the larger Wattled Crane *(Bugeranus carunculatus)* are dramatically different, studies

of their behavior and DNA indicate a close relationship between them (Archibald 1976a, 1976b; Krajewski 1989; Krajewski and Fetzner 1994). The Wattled Crane is a much more aquatic species, and undoubtedly its large size is an evolutionarily convergent feature that it shares with the *Grus* species that are primarily aquatic.

The species in the genus *Grus* are placed in four groups (Archibald 1976a, 1976b; Krajewski 1989; Krajewski and Archibald in prep.). The Sandhill Crane (*Grus canadensis*) stands alone, as does the Siberian Crane (*Grus leucogeranus*). The "Group of Three" includes the Sarus Crane (*Grus antigone*), the Brolga (*Grus rubicundus*), and the White-naped Crane (*Grus vipio*). The "Group of Five" consists of the Eurasian Crane (*Grus grus*), Whooping Crane (*Grus americana*), Hooded Crane (*Grus monachus*), Black-necked Crane (*Grus nigricollis*), and Red-crowned Crane (*Grus japonensis*).

The differences between the Siberian Crane and the other *Grus* species are greater than those that separate the remaining eight species. There are some morphological and ethological similarities between the Siberian and Wattled Crane, although DNA evidence suggests that these are due to convergent evolution. Many scientists hold that the Siberian Crane should be placed within its own distinct genus, *Sarcogeranus.* The Sandhill Crane has features in common with both the Group of Three and the Group of Five, which suggests that it might be (or might resemble) the common ancestor of the two groups. Although the Sarus Crane and Brolga are similar morphologically, DNA analysis suggests that the Brolga and White-naped Crane are actually more closely related. The Common Crane is closest to the Whooping Crane, and the Hooded Crane closest to the Black-necked Crane. Within the Group of Five, the Red-crowned Crane is the most distantly related to the other four species (Krajewski and Fetzner 1994).

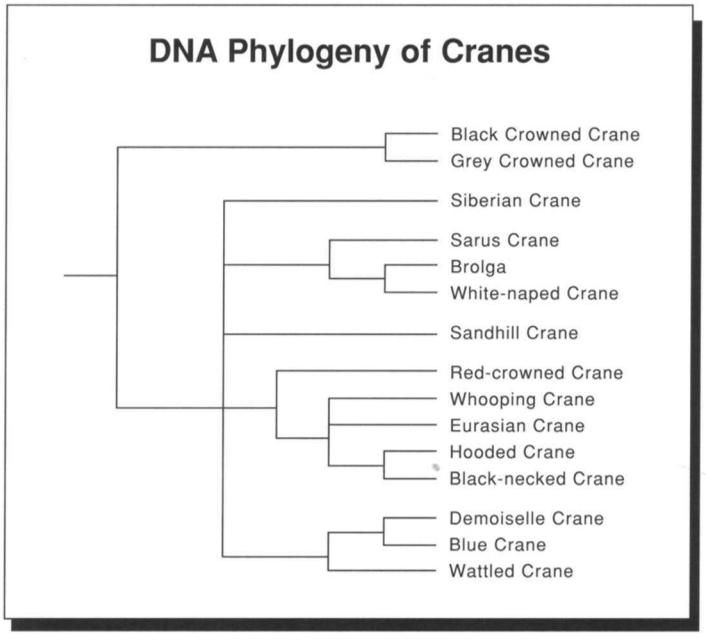


Figure 1.1 (Courtesy C. Krajewski)

Each of the two Crowned Crane species has two subspecies. The Grey Crowned Crane is divided into the South African Crowned Crane (*B. r. regulorum*) and the East African Crowned Crane (*B. r. gibbericeps*). The Black Crowned Crane is divided into the West African Crowned Crane (*B. p. pavonina*) and the Sudan Crowned Crane (*B. p. ceciliae*). The Sarus Crane has three subspecies: the Indian (*G. a. antigone*), Eastern (*G. a. sharpii*), and Australian (G. *a. gilli*). The Philippine Sarus Crane (*G. a. luzonica*), which is presumed to be extinct, may have been a discrete subspecies. Six subspecies of Sandhill Cranes are currently recognized: the Lesser (*G. c. canadensis*), Canadian (*G. c. rowani*), Greater (*G. c. tabida*), Mississippi (*G. c. pulla*), Florida (G. *c. pratensis*), and Cuban (G. *c. nesiotes*) Sandhill Cranes. In the past, the Eurasian Crane was split into two subspecies—the western (*G. g. grus)* and eastern (G. *g. lilfordi*)—and the Brolga into Northern (G. *r. argentea*) and Southern (G. *r. rubicundus*) subspecies, but these divisions have not been validated and are not widely accepted. (See the species accounts in Section 2 for further discussion of the taxonomic status and characteristics of subspecies).

1.3 An Overview of Crane Biology

1.3.1 Morphology

Cranes are large to very large birds with long necks and legs, streamlined bodies, and long rounded wings. In the field, they are readily recognized by their imposing size and graceful proportions. Cranes are among the world's tallest birds, ranging in length from 90 to more than 150 cm. The smallest is the Demoiselle Crane. The Sarus Crane is the tallest. The Indian subspecies of the Sarus, which can stand as high as 175 cm, is the world's tallest flying bird. The Red-crowned Crane is the heaviest crane, weighing up to 11 kg when fat deposits peak in the autumn. Male and female cranes of all species are identical in their external features, although males are usually somewhat larger than females (Johnsgard 1983). Compared to the other tall wetland birds, cranes generally have longer legs and hold their necks straighter than day-herons; larger bodies than egrets; and longer legs, lighter bodies, and proportionately smaller bills than storks.

Distinctive features within the family reflect the varied evolutionary history and ecological niches of the different species. The long, prehensile hind toe (hallux) of Crowned Cranes allows them to roost in trees. Demoiselle Cranes and Blue Cranes have short, bustard-like toes adapted for rapid running in their grassland habitats. The relatively short bills of these cranes allow them to forage more efficiently for seeds, insects, and other food items in upland habitats. All the other

cranes display adaptations to more aquatic conditions: elongated necks and bills, long bare legs, and broader feet. Siberian Cranes, the most aquatic of all cranes, have the longest bill and toes—adaptations for probing and walking in mud. Brolgas, which use salt marshes and other saline wetlands more extensively than the other species, have specialized salt glands near their eyes, through which they are able to secrete concentrated salts.

The length and position of the trachea are critical features of crane anatomy, and shape the distinctive voices of the various cranes (Niemeier 1983). The non-Gruinae cranes have shorter tracheas that are impressed slightly against the sternum. In the Gruinae cranes, the trachea actually penetrates the sternum to varying degrees. In Siberian and Wattled Cranes the trachea makes a slight indentation on the sternum, an indentation twice as deep as that found in the *Anthropoides* cranes. With the exception of the Siberian Crane, the trachea of all *Grus* species coils on the vertical plane within the sternum. In the Brolga, Sandhill, and Sarus Cranes, the coiled trachea fills most of the anterior half of the sternum, while in the White-naped, Eurasian, Whooping, Hooded, Black-necked, and Red-crowned Cranes the trachea penetrates the entire sternum. The bony rings of the trachea fuse with the sternum to create thin plates. When cranes vocalize, the plates vibrate. This amplifies the cranes' calls, which can carry several kilometers (Gaunt et al. 1987).

Crane eggs are ovule-pointed and in most species heavily pigmented. Cranes inhabiting tropical and subtropical areas lay either light bluish eggs (Crowned Cranes) or white eggs (Sarus, Brolga). Species inhabiting the coldest regions—Siberian, Black-necked, and Lesser Sandhill Cranes—produce darker eggs. This tendency for eggs to be light-colored in warmer climates and dark in colder climates is probably an adaptation to environmental conditions, allowing eggs to reflect heat in the former case and to absorb heat in the latter. Red-crowned Cranes lay both white and pigmented eggs, an indication that the species may have evolved under warmer climatic circumstances (G. Archibald pers. obs.).

The chicks of most crane species are predominantly brown. The exceptions are the Demoiselle, Blue, and Brolga Cranes, whose chicks are silver-grey. Chicks lose their egg tooth within a few days of hatching. The initial down is replaced by a second down that is in turn replaced by feathers (Kashentseva 1988, 1995; Kashentseva and Tsvetkova 1995). The rate of chick growth is astonishing, especially among chicks of the northernmost species. Legs grow rapidly during the first six weeks, followed by more rapid development of the wings.

Juvenile Demoiselle, Blue, Wattled, and Brolga Cranes are predominantly grey at the time of fledging (possibly affording camouflage in upland habitats). Juveniles of all the other species are russet brown, providing cryptic coloration as a defense against predation. This is of particular importance to Siberian, Whooping, and Red-crowned Crane chicks, which are destined to be primarily white as adults. During the second year of growth, adult plumage gradually replaces the juvenile plumage. By the end of their second year, many juvenile cranes are difficult to distinguish from adults.

The varied features of the heads of the fifteen species are distinctive and diagnostic (see Figure 1.2). Crowned Cranes have elaborate tawny crests, bare cheeks, and a gular wattle. Unlike any of the Typical Cranes, mated Crowned Cranes preen one another's head plumage. Demoiselle Cranes and Blue Cranes have completely feathered heads, and during display can elongate the plumes on the sides of the head. This is especially pronounced in the Blue Crane, and gives this species its unusual "cobra-like" appearance. Wattled and Black-necked Cranes are similarly able to raise the feathers on the sides of their heads.

All cranes except for the Blue and Demoiselle have bare red skin patches on their heads. Wattled and Siberian Cranes have the red skin on the front of the face. The red skin extends down the upper mandible to the nares, and in the Wattled Crane extends further down the front of the two fleshy dewlaps suspended from its cheeks. The Siberian Crane can expand the dorsal portion of its comb backward when displaying, and the Wattled Crane can extend its wattles downward. The red comb of the White-naped Crane covers the face to a point behind the ear. In the Brolga the red skin surrounds the back of the head, and in the Sarus Crane it covers the side and back of the head and continues down the neck several centimeters. In sharp contrast, the red comb in the remaining species is on the top of the head and expands down the back of the head during display.

The cranes that dwell in vast open wetlands, where the pressure from terrestrial predators is relatively low, are either entirely white (Siberian, Whooping, Red-crowned) or partially white (White-naped, Wattled), and are generally larger in size. Their size and bright white plumage makes these cranes conspicuous to conspecifics, and presumably facilitates defense of the breeding territory. The cranes that nest in smaller and/or forested wetlands are generally smaller and colored various shades of grey. Their size and plumage color may help these cranes to hide on their nests. At the onset of the breeding season, Sandhill Cranes and Eurasian Cranes paint their feathers with mud, staining them russet brown. Cranes painted in this way are much more difficult to see on their nests than unpainted cranes. At the onset of its breeding period, the Siberian Crane paints dark mud on the base of its neck, but this behavior is part of the species' sexual display rather than a camouflaging exercise.

Cranes have ten functional primary feathers (most species have a vestigial eleventh) and from eighteen to twenty-five secondaries. With the exception of the Red-crowned Cranes, which has white primary flight feathers, the primaries of all the cranes—including the mostly white Siberian and Whooping Cranes—are black or dark grey. The dark pigment apparently strengthens the structure of the feathers, thereby improving their effectiveness on long migrations. Red-crowned Cranes may once have been predominantly non-migratory (as they are today in northern Japan) and could "afford" to sacrifice durability for display. The inner secondaries of many species are elongated, and when the wings are

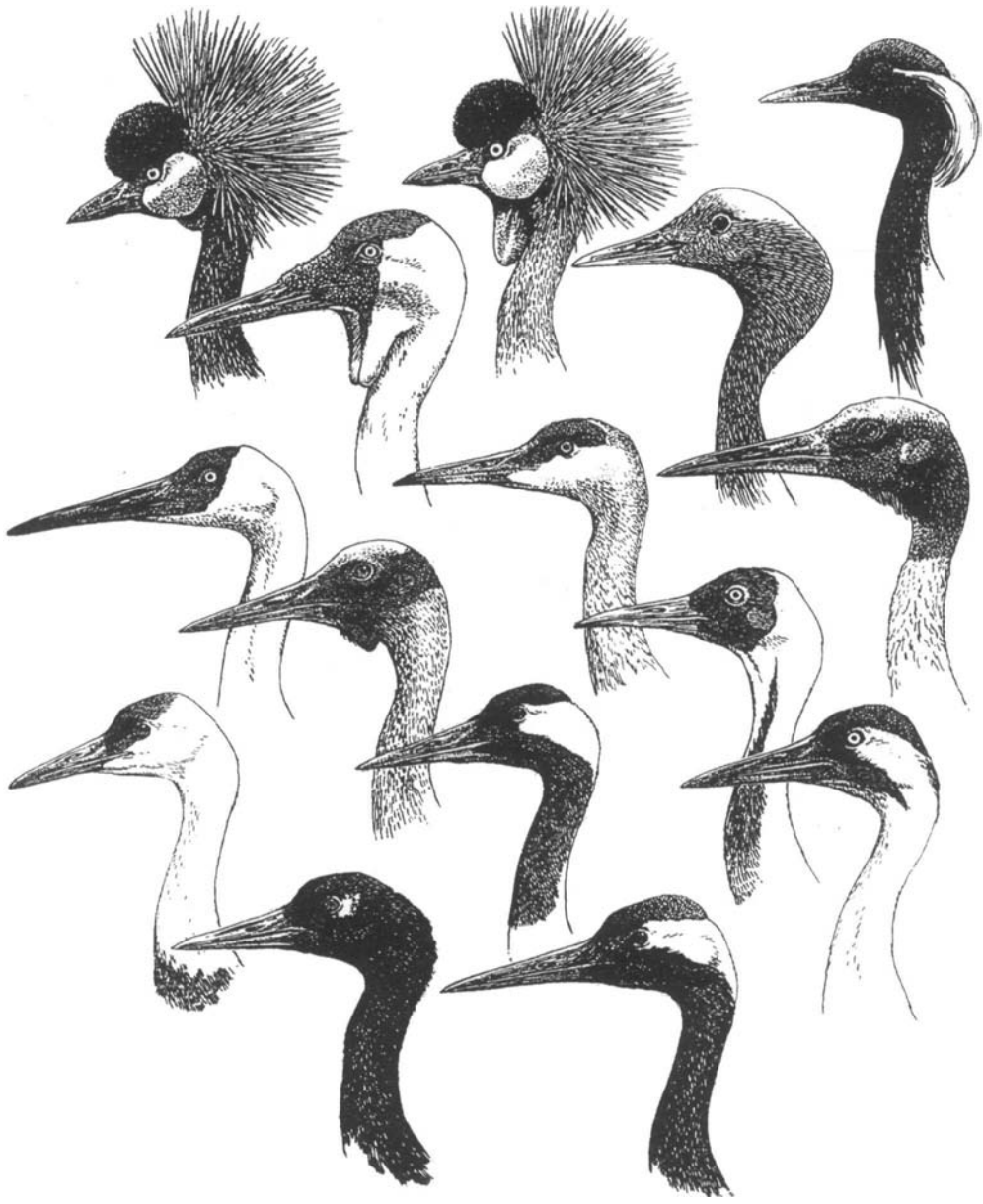


Figure 1.2. ROW 1: Black Crowned Crane *(Balearica pavanina),* Grey Crowned Crane (*Balearica regulorum*), Demoiselle Crane (*Anthropoides virgo*) ROW 2: Wattled Crane (*Bugeranus carunculatus*), Blue Crane (*Anthropoides paradiseus*) ROW 3: Siberian Crane (*Grus leucogeranus*), Sandhill Crane (*Grus canadensis*), Sarus Crane (*Grus antigone*) ROW 4: Brolga (*Grus rubicundus*), White-naped Crane *(Grus vipio)* ROW 5: Hooded Crane (*Grus monachus*), Eurasian Crane (*Grus grus*), Whooping Crane (*Grus americana*) ROW 6: Black-necked Crane (*Grus nigricollis*), Red-crowned Crane (*Grus japonensis*)

(Prepared by Victor Bakhtin)

folded produce the impression of a prominent "tail" or "bustle." This is especially pronounced in the Blue, Demoiselle, and Wattled Cranes. In most species, adults molt annually during the postbreeding period. The main flight feathers are lost at this time, rendering the birds flightless. Molting patterns, however, vary among and within species. The wing molt in Brolgas, Demoiselle, and Crowned Cranes occurs gradually, so that these species do not actually experience an extended flightless period.

Cranes take flight with a running start, usually into the wind, quickly gaining speed before lifting into the air with a push of the wings. When flap-flying, cranes flick their wings with a distinctive rhythm, pushing deliberately on the downstroke and rising rapidly on the upstroke. This rhythm is especially apparent when cranes are disturbed or otherwise eager to gain altitude quickly. Cranes, like storks, flamingos, geese, and swans (and unlike the large herons) fly with their necks extended straight forward. With their long legs trailing directly behind them along a single axis with their bills, necks, and bodies, cranes in flight present an elegant silhouette, resembling perhaps most closely that of the flamingos. In cold weather, cranes sometimes pull their legs in against their bodies. When landing, cranes approach the ground with their head semi-erect, wings extended, and legs dangling. They descend with wings and tail spread out and down, and with a final flapping of the wings alight in a normal standing stance.

1.3.2 Distribution and Habitat

Cranes are cosmopolitan in their distribution, occurring from the North American and Asian tundra to the Asian, Australian, and African tropics. East Asia, with seven species occurring on a regular basis, has the highest level of species diversity. Five species occur during the year in the Indian subcontinent. Africa has four species year-round, resident and wintering populations of a fifth (the Demoiselle), and wintering populations of a sixth (the Eurasian)[1]. Why cranes never colonized South America remains a biogeographic mystery.

Most of the cranes prefer relatively open spaces and require territories with a wide range of visibility. Space and solitude are especially important requirements during the breeding season. Most species nest in shallow wetlands, where the cranes meet both their feeding and nest-building needs. The Crowned Cranes roost in trees, nest in wetlands, and forage predominantly in grasslands. The two *Anthropoides* species usually nest, and almost invariably feed, in open grasslands and roost in wetlands. In central Asia, the Demoiselle Crane will nest in arid grasslands, and even true deserts, as long as water is available.

The degree to which cranes use and require wetlands varies widely among, and within, species. The Cuban Sandhill Crane lives in pine-palmetto savannas and nests and rears its young on dry ground. Other Sandhill Cranes and the Sarus, Brolga, White-naped, Eurasian and Black-necked Cranes nest in wetlands; however, soon after the chicks hatch they are led to neighboring uplands to forage, returning to wetlands for the night. Wattled Cranes in the enormous floodplains of south-central Africa nest when water levels peak during the annual floods, but remain in the wetlands throughout much of the year. Wattled Cranes in the montane wetlands of South Africa, Zimbabwe, and Ethiopia nest at the end of the dry season on small wetlands bordered by grasslands. The large white cranes (Siberian, Whooping, and Red-crowned), and perhaps also the Hooded Crane (which nests in isolated tamarack swamps), remain in wetlands throughout the nesting and rearing period.

In the migratory species, family groups join together into flocks at premigration staging areas soon after the chicks fledge. A staging area usually contains safe roosting sites as well as a dependable source of food. The number of cranes using a staging area continues to increase until inclement weather forces the cranes to move south to join even larger prestaging congregations. The major portion of the migration flight then commences. Along the way there may be several stopover points. Most species of migratory cranes remain in large flocks throughout the winter non-breeding period, roosting at night in shallow wetlands and foraging during the day in wetlands and upland areas, including agricultural fields. Species that feed primarily on sedge tubers and other aquatic vegetation (Siberian, Sandhill, White-naped, Brolga) forage in flocks, while those that feed more on animals (Whooping, Red-crowned) are more territorial and often forage in family groups.

Non-migratory cranes also gather in groups during the non-breeding season. They are somewhat opportunistic and nomadic in choosing habitats, moving from area to area in search of food and security. Although the availability of food is always of paramount importance during these times, social needs such as pairing and the introduction of juveniles to flocks also contribute to habitat choice and flocking behavior in the non-migratory cranes.

Cranes generally try to maintain a distance of at least several kilometers between themselves and areas of human activity. If, however, they are not harmed or disturbed, cranes can acclimate to the presence of people. Thus, Sarus Cranes in India have adapted to the high human population density in that country, and commonly nest and roost in small village ponds and jheels (Gole 1989b, 1991b, 1993a). In recent decades recovering populations of Sandhill Cranes in North America and Eurasian Cranes in Europe have taken to using smaller, less isolated, and lower quality wetlands closer to human settlements (Gluesing 1974, Mewes 1994). In parts of Kazakhstan and Ukraine, the Demoiselle Crane has been able to continue breeding in steppes that have been converted to agriculture as long as farming operations are timed so as to minimize disturbance (Winter 1991, Kovshar et al. 1995).

Agricultural development has had varying impacts on cranes and their habitats. The drainage of wetlands for agriculture has deprived most cranes of habitat to one degree or another, with the more wetland-dependent species—the Wattled, Siberian, Whooping, and Red-crowned—being most profoundly affected. Other species have adapted to and even benefitted from agriculture. For some cranes, wetlands bordered by agricultural fields often provide more favorable breeding habitat than do pristine regions where wetlands are surrounded by forests or other wetland types. In general, the species that can subsist on gleanings of waste grain in agricultural fields during migration and on their wintering grounds are faring better than those that depend exclusively upon wetlands throughout the year.

1.3.3 Behavior

Cranes are isolated on their territories during the breeding season and gregarious during the non-breeding period. All cranes are basically diurnal in their habits. During the day they forage, rest, and preen, attend to their young (during the breeding season), and socialize within flocks (in the non-breeding season). At night during the breeding season, cranes stay on or

[1] In this document, "population" refers to a group of interbreeding cranes of the same species that occupies a distinct geographic area or region. In most cases this area or region is within the species' breeding range (the term "breeding population" is also sometimes used). If the area is within the species' winter range, the term "wintering subpopulation" is used (since birds from different wintering areas may breed in the same area). When used in reference to the species as a whole or to subspecies, "population" refers to the total number of individuals in the taxon.

near their nests, brooding their chicks and standing guard against predators and other dangers. In the non-breeding season, cranes roost at night in more or less large flocks at traditional roosting sites.

The non-breeding season pattern of feeding by day and roosting by night is universal. Roosting provides security for the flock and offers juvenile and "single" birds opportunities for pair formation. Crowned Cranes roost in trees. The other species usually roost in shallow water, but occasionally use dry ground, mudflats, or sandbars. Within roosting flocks, each crane stands about a "peck distance" away from its neighbors. Cranes rest on one leg during the night, with the head and neck tucked on or under a shoulder. They defecate at regular intervals, and may switch from one leg to the other several times during the course of a night. One unfamiliar sound or alarm call from a flock member is all that is required for the birds to become alert and prepared to fly.

At dawn the cranes awaken, stretch, preen, and drink, then begin the day's activity. They fly off in small groups to an open upland area near the evening's roost—the post-roosting staging area. There they land and continue to preen. Cranes from several roosting sites might join together at the staging area. From there, initially in small groups but then in larger congregations, they will move to the day's feeding areas.

IGF

"Ruffle threat" of Sandhill Crane

Depending on the availability of food, cranes feed for extended periods in the early morning, then move to loafing areas. There they drink, preen, and engage in social displays to facilitate the pairing of unmated birds and to establish a pecking order among families. If temperatures are unusually hot, the cranes may escape the heat by spiraling skyward on rising thermals, eventually disappearing from view. Later in the day they return to watering and/or feeding areas, where they again feed, before moving to pre-roosting staging areas. Here they may again engage in social displays before flying to the evening's roost, where they remain silent and still through the night unless disturbed.

The behavior of individual cranes can be divided into those activities that are self-directed and those that are undertaken in response to other cranes and other external stimuli. In addition to such fundamental activities as eating, drinking, sleeping, walking, and flying, self-directed activities include preening, bathing, shaking, stretching, ruffling, scratching, and feather painting. Behavioral studies of cranes have revealed some 90 or more specific behavioral patterns within these categories (Ellis et al. 1991).

The social behaviors of cranes include a wide array of visual displays. These ritualized displays serve many intra- and interspecific functions, and are often accompanied by vocal displays (see Section 1.3.4 below). Thirteen species have bare red skin patches on their heads, this too plays an important communication role. Cranes can vary the extent of skin displayed by contracting or relaxing the subcutaneous muscles, and can change the intensity of the skin's color by engorging it. The color and exposure of the skin changes in response to various stimuli, and often accompanies other behavioral displays.

When cranes are aggressive, they assume an upright posture with their body feathers sleeked, thighs protruding, and the head features expanded. They walk in a stilted manner that has been likened to the goose-step of parading soldiers. They will follow this threatening posture with a variety of flaps, ruffles, bows, false preenings, stomps, nasal snorts, and growls. If a crane takes to the air in this emotional state, it will fly with rigid flaps with narrow arcs, with its feet and neck arched upward.

Cranes also engage in a variety of more circumscribed threat gestures. In the "crouch threat," the crane bends its legs, lowers itself to the ground, folds its wings loosely against the ground and body, and places its head forward with the red patch prominent. In the "ruffle threat," the crane raises the feathers of its neck, wings, and back, partially opens and lowers its wings, ruffles them alternately, and then lowers its bill to its lower breast or leg in a preening movement, often concluding this sequence with a low growl. In a "charge," the crane points its neck and head straight down and lifts the feathers along its neck and back, holding this stance for several seconds. In all

such threat displays, the red skin patch is bright and conspicuous (Voss 1976, Nesbitt and Archibald 1981).

A crane that is filled with fear (when, for example, confronting a predator) spreads its wings, arches forward as if ready to strike, and approaches the feared animal. A submissive crane, by contrast, lowers its neck, elevates it body feathers, and diminishes the threatening display of its head features by lowering the feathers and reducing the size of its comb. In this state of accommodation, the crane walks loosely and warily.

Of all the behaviors of cranes, none is as spectacular or as well known as their elaborate and enthusiastic dancing. Cranes are not the only birds known to dance; trumpeters and egrets, for example, engage in somewhat similar displays, although not so habitually. All species of cranes dance. It is apparently an ancient and complex behavior within the family, and serves a variety of functions (Masatomi 1994). Dancing is undertaken by even very young birds as a part of their behavioral and physical development. Unpaired subadult birds probably dance more than other age groups. For these birds, dancing facilitates the processes of socialization and pair formation. Among adults, dancing can be a form of displacement activity when cranes are nervous. Among pairs, it may serve to maintain pair bonds and synchronize sexual response prior to breeding. New pairs dance during courtship. Well established pairs, on the other hand, have less need to synchronize their behavior or to ward off rivals, and hence dance less often. Cranes do not always dance in response to apparent stimuli. Within flocks, it is often a contagious activity that spreads readily among the excited birds.

The pattern and intensity of dancing vary somewhat among the crane species, but the dances of all cranes consist of long and intricate sequences of coordinated bows, leaps, runs, and short flights. In the course of dancing, cranes often pick up with their bills whatever small objects—sticks, moss, grass, feathers—happen to be in the area, randomly tossing them into the air. Dancing in the smaller species, such as the Crowned and Demoiselle, tends to be the most energetic. Crowned Cranes perhaps dance most distinctively, bobbing their heads up and down prior to bowing, spreading their wings, leaping and flapping their wings, then often landing and circling one another. The sequence of courtship dancing among Blue Cranes has been observed to last from half an hour to as long as four hours (Van Ee 1966). The dance of the Demoiselle Crane has been described as "more balletlike" than those of the Gruinae species, with fewer, less theatrical jumps (Johnsgard 1983). Among the Gruinae cranes, dancing is slightly more deliberate, and punctuated often with high, flapping leaps.

TS. HAYASHIDA

Red-crowned Cranes dancing, Hokkaido, Japan

1.3.4 Vocalizations

Cranes have evolved elaborate vocal displays to help them communicate with one another (see Archibald 1976a, 1976b; Johnsgard 1983). From barely audible contact calls to trumpet-like notes that can carry out across their extensive territories, cranes employ a variety of calls with different meanings. The typical volume and tone likewise varies widely from species to species. The Crowned Cranes have soft honks. The voices of the *Anthropoides* cranes are low and raspy, and those of the *Grus* species high-pitched and extremely loud. The Sandhill Cranes have a distinctive low-pitched rattle. The Siberian Crane's voice is noted for its clear, flute-like quality.

The "languages" of the various cranes develop differently, depending on the nature of the adult voice, but in all cases the "vocabulary" begins to emerge early in life. Hatching chicks emit high-pitched peeps that persist through the first year of life. Newly hatched chicks quickly acquire a low, purring "contact call" to maintain regular contact with their parents and a louder, more insistent "stress call" to draw their more immediate attention. Within a day or so of hatching, chicks develop a "food-begging call," a soft peeping that signals the parents to provide food. Within its first year of life, the young bird also learns the "flight-intention call" and "alarm call."

By the end of the bird's first year, the voice deepens and gains in strength and volume. The contact, flight-intention, and alarm calls are retained, while others develop. A "guard call" is generally given as an intraspecific threat. The "location call" allows the newly mobile bird to gain its bearings if visual contact is lost. The "precopulatory call" begins to be heard at about the age of 24 months. Fully adult cranes augment these calls with an assortment of other specialized vocalizations.

The most penetrating of all the calls in the vocal repertoire of cranes, and among the most spectacular of all avian sounds, are the special duets of mated pairs. The duets, known as "unison calls," can last from a few seconds to as long as one minute and may be repeated regularly through the course of a day, though it is most commonly heard prior to the breeding season. Unison calling begins to develop in the second or third year of a bird's life. The call serves a variety of important functions in the individual and social lives of cranes. It plays a critical role in the initiation, development, and maintenance

of pair bonds. Unison calls of very young pairs are typically loosely coordinated compared to the highly synchronous calls of well established pairs. Unison calling allows the partners to come into breeding condition at the same time, and seems to be especially important in the ovarian development of females (Archibald 1976a, 1976b). The call is also used more generally to demarcate territories, to ward off potential intruders, and to respond to other threats.

Unison calls vary among the species. During sexual displays, Crowned Cranes lower their heads to shoulder level, inflate their gular sacs, and emit a long sequence of low booming calls. The Gruinae unison calls can be used to determine the sex of the individual cranes: the female usually has the higher-pitched voice. In the case of the Siberian Crane, the pitch of the call is the only outward diagnostic feature that allows one to distinguish males from females. In the *Anthropoides* and Wattled Cranes, the male and female assume distinct postures during the unison call. The female Demoiselle Cranes calls with her bill pointed upward, while the male calls with the bill held horizontal. Male Blue and Wattled Cranes elevate their wings at the conclusion of the unison call. All the *Grus* species except the Siberian Cranes have sexually distinct voices during the unison call, with the female emitting two or three calls for every call produced by the male. Male Sarus, Brolga, and White-naped Cranes always elevate their wings over their back and droop their primaries during the unison call. In the Eurasian, Whooping, Hooded, Black-necked, and Red-crowned Cranes, the amount of wing-posturing depends on the intensity of the aggression associated with the display.

ICF

Red-crowned Cranes unison calling

1.3.5 Diet and Foraging Behavior

Although some species are more specialized than others, most cranes are generalists and opportunists, feeding on a remarkably wide variety of plant and animal foods. Among cranes that use upland areas, the diet includes seeds, leaves, acorns, nuts, berries, fruits, waste grains, worms, snails, grasshoppers, beetles, other insects, snakes, lizards, rodents and other small mammals, and even small birds. Wetland food items include the roots, bulbs, rhizomes, tubers, sprouts, stems, and seeds of submergent and emergent plants, and mollusks, aquatic insects, crustaceans, small fish, and frogs. Cranes readily shift their feeding strategies on a daily or seasonal basis to take advantage of available food items. For example, Eurasian Cranes wintering on the Iberian Peninsula subsist primarily on cereal grains in the early part of the winter, switch to acorns of the holm oak in mid-winter, and may turn again to germinating cereals and legumes in the late winter (Alonso et al. 1987, Sanchez et al. 1993).

The anatomy of cranes reveals much about their feeding preferences. Cranes with shorter bills usually feed in the dry uplands, while those with longer bills usually feed in wetlands. Crowned Cranes stamp the ground to scare up insects, which they then grasp in their short bills. These species, together with the two *Anthropoides* species, the Sandhill Cranes, and the Eurasian, Hooded, and Black-necked Cranes, also use their shorter bills for grazing in a goose-like manner. The taller cranes with the largest and longest bills (Wattled, Siberian, Sarus, Brolga, White-naped) are diggers, and use their powerful mandibles to excavate tubers and roots from the muddy soils of wetlands. The long-billed Whooping Cranes and Red-crowned Cranes use their bills to gently probe the bottom of shallow wetlands for crustaceans and other small aquatic animals.

The foraging behavior of cranes reflects their varied strategies, niches, and diets. The diggers usually stay in the same area for extended periods of time, excavating holes that are continually enlarged to expose the tubers that proliferate in certain types of wetland soils. Unlike herons, which stand motionless and wait to strike for prey, the hunting cranes walk slowly through the water searching and probing for prey to grab. Upland feeders usually walk with their heads lowered, hunting and pecking at the ground for insects, seeds, and other morsels. Generalist feeders use different strategies under different circumstances. Sarus Cranes, for example, often dig for tubers and other subsurface plant materials, but are effective upland foragers and hunters, and have also been observed stripping grains of rice from their stalks (Gole 1989b, 1991b).

Crane parents begin to feed their chicks almost immediately after hatching occurs. Both parents contribute to the feeding of young. Adults carry small food items to the chicks

Y. AKAO

White-naped Cranes typically probe for food in shallow wetlands

and either present the food directly to them by holding it at the tip of their bills or by dropping it before them. Chicks eventually begin to follow their parents to nearby food sources, although in some cases adults will continue to bring food until the chicks are several months old. Demoiselle Crane chicks are unusually mobile at an early age (G. Archibald pers. obs.).

Where several species of cranes occur together, the varied feeding strategies and adaptations tend to minimize the degree of niche overlap. This occurs most noticeably in wintering areas in China, where four species may coexist in the same area. Thus, at Poyang Lake in Jiangxi Province, Siberian Cranes have been observed feeding in the shallow water and mud flats, White-naped Cranes along the wetland borders, Hooded Cranes in adjacent croplands, and Eurasian Cranes in the available "spaces" in between (Zhou and Ding 1987, Chen and Wang 1991). When Sarus and Siberian Cranes have occurred together at Keoladeo National Park in India, the Siberians have foraged for sedge tubers in deeper waters while the Sarus have fed on a broader variety of plants and animals in shallower waters (Sauey 1985). A somewhat analogous situation has been observed in parts of Australia where Brolgas and Sarus Cranes are sympatric. The former tend to use larger, more open sedge marshes in the lowlands; the latter to use smaller wetlands in more forested areas as well as drier habitats (Archibald and Swengel 1987; A. Haffenden pers. comm.).

Many species of cranes benefit from the food provided by agricultural fields during the breeding and/or non-breeding phase of their annual cycle. At one time or another, most cranes forage in crop lands and pastures that border the wetlands where they nest or roost. At migration stopovers and on the wintering grounds, those species that feed on gleanings from agricultural fields usually find an abundance of food, and interfere minimally with farming operations. For example, the great congregations of migrating Sandhill Cranes that stop along the Platte River in the central United States in the spring subsist largely on waste corn gleaned from nearby fields. Crop damage can occasionally be a serious problem (e.g., Mizoguchi 1985, Parasharya 1986, McIvor and Conover 1994, Bouffard in press). This usually occurs during the fall migration or early in the winter, when crops are being harvested, or in the early spring, when new crops are germinating. During these times, not only are the field foods available, but the cranes are usually in large flocks (see Box 1, page 18).

For several species, artificial feeding has come to play an important role not only in their annual cycle, but in their survival and recovery as species. Some three-fourths of the world's population of Hooded Cranes, and about 40% of the White-naped Crane, are sustained by artificial feeding on the

Japanese island of Izumi, a program that was initiated in the 1950s (Goto 1986; Ohsako 1987, 1994; Matano 1995). The Hokkaido population of Red-crowned Cranes, about one-third of the total population, has used feeding stations since 1952 (Archibald 1978). In both cases, artificial feeding has contributed to the rapid growth of small remnant populations. However, the success of such programs now presents its own conservation challenges (see Box 1, page 18).

1.3.6 Breeding

Cranes are generally monogamous. Mated birds stay together throughout the year, and typically remain paired until one bird dies. The age of sexual maturity has seldom been studied in wild cranes, but individuals in most species probably begin to establish pairs in their second or third years. Pair bonds form within flocks of non-breeding birds, or outside of the breeding season within mixed flocks. Many, if not most, pairs fail to breed successfully in their initial attempts. Among Sandhill Cranes, whose breeding biology has been most extensively studied, it has been shown that pairs that are unsuccessful in their first attempts to breed often dissolve, while successful pairs remain together (Nesbitt 1989). A strong pair bond is maintained as long as the pair successfully reproduces. However, if breeding efforts continually fail, the pair bond weakens and new mates are eventually taken. Most studies indicate that individuals do not successfully reproduce until they are between four and eight years old (Drewien 1973, Kuyt and Goossen 1987). Other species may share this general pattern.

Securing a breeding territory is a prerequisite of reproduction, and in areas where all available territories are occupied, young birds may need to wait to breed. Cranes of the northern temperate and arctic zones begin to establish breeding territories soon after their arrival from the wintering grounds, usually between mid-April and mid-June. The breeding seasons of cranes in the tropical and subtropical zones are much more variable, but generally coincide (and vary) with local rainy seasons. The breeding seasons of the Brolga and Sarus Cranes are closely associated with the distinct monsoons of southeast Asia and Australia. By contrast, Sarus Cranes in India and Wattled and Grey Crowned Cranes in southern Africa may breed throughout the year, although breeding usually peaks in response to localized conditions. Such variability is evident even within species. Sandhill Cranes breeding in Alaska produce almost all of their eggs in June. The breeding season for Florida Sandhill Cranes extends from December to June, with most eggs produced from February to April (Johnsgard 1983).

Breeding densities and territory sizes are poorly known for most cranes, but in some species are apparently quite variable in response to local conditions. In India, for example, nesting territories as small as one hectare are sufficient for Sarus Cranes if the quality of the water and vegetation is adequate and human disturbance is minimized (Gole 1989b, 1991b). In Cambodia, by contrast, Eastern Sarus Cranes establish extensive nesting territories in remote and isolated wetlands (Barzen 1994). Similarly, Eurasian and Sandhill Cranes have both adapted to the intensification of human settlement by establishing breeding territories in smaller, less natural wetlands. Once territories are established, pairs defend them through unison calls, threat postures, and attacks. The male is primarily responsible for defense, while the female is more involved in domestic affairs.

S. TRANEVING

Eurasian Crane on nest, southern Sweden

New pairs engage in long bouts of dancing before attempting copulation, whereas established pairs copulate with facility and without tension. The copulatory sequence can be initiated by either sex. One member of the pair will elevate its bill, arch slightly forward, and emit a low purr-like call. If the mate reciprocates with similar behavior, one (usually the male) will circle the other with exaggerated steps. The female then spreads her wings and the male approaches. With wings flapping he jumps on her back, and crouches. The female elevates her tail as the males lowers his, and their cloaca meet. The male then jumps forward over his mate's head and performs threat displays for a few seconds. Both members of the pair then engage in a long sequence of preening. Cranes copulate for several weeks in

advance of laying, usually before sunrise, although copulation can occur at any time during the daylight hours.

Both sexes participate in nest building. They select a secluded spot within their territory and unison call from that spot. Walking away from that selected spot, they toss nesting materials (mainly the stems and leaves of sedges, cattails, and other wetland plants) behind them over their shoulders. They return to the nest site and pull in the materials within their reach before walking slowly away from the nest and throwing additional materials behind them. As they repeat this sequence many times, large quantities of nesting material accumulate at the low platform nest, while a "moat" of water forms around the platform.

This nest-building behavior holds for those species that nest within wetlands. Two species—the Blue and Demoiselle Cranes—nest on dry ground. In both cases, eggs are usually laid directly on the ground. The pair may gather together some small stones or vegetation to provide protection and camouflage, but otherwise the nests show little if any preparation. In some portions of their range, Sandhill Cranes also nest on dry sites. On rare occasion, Grey Crowned Cranes will nest in trees (and have even been observed using the abandoned nests of other large tree-nesting species).

Cranes almost invariably lay two eggs. Exceptions are the Crowned Cranes, which regularly lay three and sometimes four eggs, and the Wattled Crane, which usually lays only one egg. In the Crowned Cranes, incubation begins after the clutch is complete. In the Gruinae species, incubation begins after the first egg is laid. Incubation in cranes averages between 28 and 32 days in most species (Johnsgard 1983). Wattled Cranes, at 33-36 days, have the longest incubation period. Species breeding in higher latitudes and at higher elevations tend to have the shortest incubation periods (<30 days). The female usually incubates at night; during the day the sexes exchange incubation duties several times. The non-incubating member of the pair usually flies to a favorite feeding area far from the nest. Crowned Crane chicks hatch synchronously, while Gruinae chicks hatch asynchronously. Wattled and Siberian Cranes have been observed to leave the nest after only the first egg has hatched, and typically only a single chick is raised in these species. In other species, the parents frequently rear two chicks, but one of these soon becomes dominant. If food is scarce, the weaker chick often dies.

The extent to which multiple clutching can or does occur in cranes is little known. Repeat clutches have, however, been reported for Grey Crowned, Blue, Wattled, Sandhill, Eurasian, White-naped, and Red-crowned Cranes. Florida Sandhill Cranes have been observed laying third, and in one case fourth, clutches (Mirande et al. in press b). Cranes of the northern latitudes, including the Whooping and Siberian Cranes, experience such short growing seasons that even if they did produce second clutches, it would be difficult to fledge the young in time to undertake migration. In captivity, however, females of these and other species have been induced to lay repeatedly through the removal of the eggs, either one at a time or as clutches. In this manner, females have regularly produced up to ten or more eggs in a single breeding season.

Adults care for their chicks continuously through the prefledging period. The length of the fledging periods varies widely among the cranes (Johnsgard 1983). Fledging periods are shortest in species that inhabit upland areas (Grey Crowned, Black Crowned, Demoiselle, Blue) and that nest in the high arctic (Siberian and Lesser Sandhills). In general, chicks of these species fledge at between 50 and 90 days. On average, the Demoiselle Crane has the shortest fledging period, usually between 55 and 60 days. Cranes that inhabit permanent wetlands in warmer climates (Wattled, Sarus, Brolga) have the longest prefledging periods. Chicks of these species usually fledge at between 85 and 100 or more days. The Wattled Crane has the longest fledging period at about 90-130 days.

The productivity of a given crane population can be measured in several ways, but is most easily determined by counting the number of juveniles in the flocks during the non-breeding period. In general, about 10-15% of a healthy population will consist of non-breeding juveniles.

Juvenile cranes remain with their parents throughout the non-breeding period. At the conclusion of the non-breeding period, juveniles either voluntarily leave their parents or are driven off by the adults after the family returns to the breeding territory. Unpaired juvenile birds gather in non-breeding flocks and are often nomadic throughout the breeding period. By the end of their second year, juvenile birds have usually initiated their own attempts to form pair bonds.

1.3.7 Movements

Cranes can be divided into two groups: migratory and non-migratory. Non-migratory cranes move relatively short distances between breeding and non-breeding areas, and gather in large flocks prior to the onset of the breeding period. Local and seasonal movements of varying lengths are typical of the lower latitude species—the Crowned Cranes, the Blue, Wattled, Brolga, and Sarus Cranes. In most cases, their breeding seasons and hence their movements are tied to, and vary with, the duration and intensity of the local rainy seasons. Local and seasonal movements are also characteristic of southern, non-migratory populations of some of the northern migratory species. This may be seen among populations of the Demoiselle Crane in northern Africa and Sandhill Cranes in Cuba, Florida, and Mississippi.

Such limited and seasonal movements are modest in comparison with the epic migrations of the northern cranes. Some of the migration routes stretch thousands of kilometers, during which the cranes must confront broad deserts, high mountain ranges, and other formidable obstacles. This achievement is even more remarkable for the northernmost species, the Siberian and Sandhill Cranes breeding in the arctic latitudes of Eurasia and North America. Among these populations, the young of the year must in one short growing season gain the size, strength, and endurance to join their adult companions on

the long journey south.

Migratory cranes spend several days or weeks at premigration staging areas building up their fat reserves and integrating into life as a flock. Then they commence migration. After feeding for several hours in the early morning (often on a clear day with northwest breezes gusting) they rise into the sky, flap-flying in wide circles, lifted by thermals. After climbing as high as 2000 meters, they stop flapping, extend their wings, assume a "V" formation, and glide southward propelled by gravity and wind. After losing altitude, they repeat the cycle, again spiralling skyward and gliding south. While flying over land, they follow this pattern throughout the day. However, when forced to fly over water, where there are no thermals, they flap-fly in "V" formation. Crane chicks fly close to their parents and during their first migration south learn the migration route. While migrating, cranes call constantly. Their voices can often be heard even before the birds are spotted as tiny spots against the blue sky.

Migration has been studied closely in several species. Whooping Cranes, for example, have been shown to migrate as much as 800 km in a single day, although 300 km is more typical (Howe 1989). A review of Sandhill Crane migration data showed average flight lengths of 267 km/day, with individual flights of up to 740 km (Melvin 1982, Melvin and Temple 1982). Estimated flight speeds in Sandhill Cranes average between 23 and 83 km/h depending on wind speed and direction (Melvin 1982). This range is probably similar to that of most migratory cranes. Several crane migrations stand out as especially impressive. Eurasian Cranes from central Eurasia fly over the Himalayas at altitudes approaching 10,000 meters, while Demoiselle Cranes negotiate the passes in these highest mountains on earth. Other Demoiselles migrate across the wide deserts of the Middle East and northern Africa to wintering grounds in the upper reaches of the Nile basin. Siberian Cranes in the remnant Central population in Eurasia and Lesser Sandhill Cranes breeding in eastern Siberia undertake the longest of all crane migrations, in excess of 5000 km. The Siberian Sandhills move east across the Bering Sea into North America and continue south as far as northern Mexico.

An understanding of crane migratory patterns and behaviors is critically important in assessing the conservation status and needs of the different species. The problems cranes face during migration often constitute the "weak links" in the chain of conservation actions. Even if the cranes are secure in their breeding and wintering areas, they may be vulnerable to habitat changes at traditional staging and resting areas, and often face other dangers associated with human activity along the migration routes. Historically, for example, collisions with utility lines and accidental shooting have been important mortality factors along the Whooping Crane's narrow migration corridor (Faanes and Johnson 1992, Lewis et al. 1992b).

Because migration is such a critical phase in the annual cycle of cranes, crane biologists have in recent years devoted much time and effort to the study of migration through banding, radio telemetry, and satellite tracking programs. Such studies have been especially important in developing recovery and reintroduction plans for the Siberian and Whooping Cranes. Because knowledge of migration routes is passed along to new generations of cranes by experienced older birds, conservation programs for these most endangered species emphasize the maintenance of existing routes and the development of new techniques for teaching migration. Perhaps most significant, the conservation needs of cranes during migration have necessitated extensive cooperation across national boundaries, sometimes among countries otherwise in conflict with one another (Lewis 1991, Shibaev 1995).

ICF

Eurasian Cranes in typical v-formation on migration through China

1.4 Cranes and People

For centuries, cranes have evoked strong emotional responses in people. Their size, behavior, social relations, unique calls, graceful movements, and stately appearance have inspired expression through human art, artifacts, mythology, and legend in cultures around the world. This appreciation of cranes was conveyed in prehistoric cave paintings in Africa, Australia, and Europe. In the western tradition, evidence of human appreciation of cranes dates to the ancient Egyptians, whose tombs are adorned with images of Demoiselle Cranes. The ancient Greeks are known to have domesticated cranes, and according to myth the flight of cranes inspired the god Mercury to invent the Greek alphabet. Throughout the classic period, cranes provided symbolic meaning in allegories and histories. Cranes appear often in the literature of the ancient Greeks and Romans, including the works of Aristotle, Cicero, Homer, Pliny, and Plutarch. The Latin word for crane, *grues*, is thought to have been an imitation of their call. In later Christian expressions, cranes came to signify watchfulness,

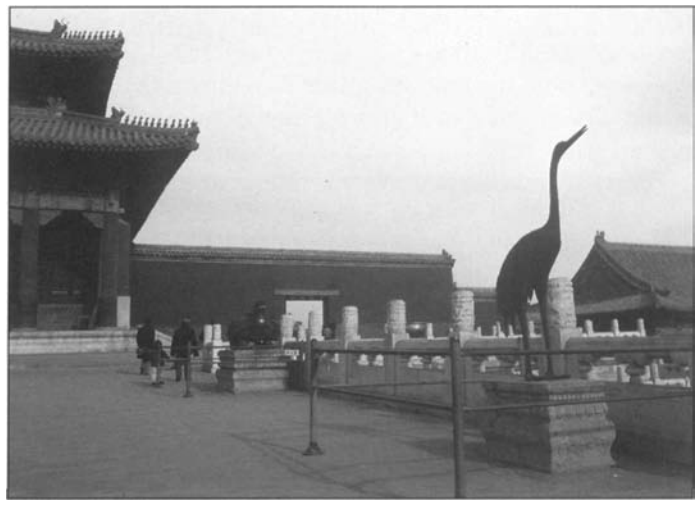
steadiness, and mutual aid (Johnsgard 1983).

In the east, cranes have for millennia occupied a prominent place in mythology and religious tradition. In China, cranes have long symbolized longevity, and often appear in artworks carrying the souls of the departed to heaven after death. Similar spiritual and symbolic associations appear in many parts of Asia. In China, Korea, and Japan, the Red-crowned Crane symbolizes happiness, good luck, long life, and marital bliss, appearing regularly in paintings, tapestry, and other decorative arts. The Emperor's throne in Beijing's Forbidden City is flanked by statues of cranes. Cranes are featured on bridal kimonos in Japan, and one of Japan's most popular folktales involves a crane that transforms itself into a maiden (Britton and Hayashida 1981, Scott 1990).

In the New World, cranes begin to appear in pictographs, petroglyphs, and ceramics from what is now the American Southwest after the year 900 A.D. (Frisbie 1986). Modified crane bones also first appear from middens of this era in other parts of North America. Crane clans developed among the Hopis and Zunis in the Southwest, while cranes served as totems for the Ojibwa and other tribal groups. Warriors of the Crow and Cheyenne made small whistles from the wing bones of Sandhill Cranes, and blew upon them in preparing for battle.

Crane-associated dances have been recorded in many parts of the world, including the Mediterranean, China, Siberia, and Australia. A "dance of the white cranes" is known from 500 B.C. in China. Aboriginal Australians named the Brolga after a young woman whose exquisite dancing drew attention from numerous suitors, but who rejected all proposals of marriage. Among her admirers was an evil magician who, in his disappointment, transformed her into a crane (Schoff 1991).

Cranes continue to be used in new symbolic ways around the world. Crowned Cranes are the national birds of Nigeria and Uganda, and Blue Cranes of South Africa. The coins and stamps of many countries have borne cranes. In part, perhaps, because of their beauty in flight, cranes have also been selected as the corporate logo for several commercial airlines. The emergence of the conservation movement, and in particular the near demise of the Whooping Crane, invested cranes with added symbolic value as emblems of humanity's changing relationship with nature (Leopold 1949, McNulty 1966). Perhaps the best known, and most poignant, example of the enduring symbolic significance of cranes emerged from the ashes of World War II. A young Japanese girl who had lived through the bombing of Hiroshima, but who was fatally stricken during its impact, resolved to fold a thousand paper cranes during her effort to recover. Although she was unable to complete the task, other children took up the task. Since then, children in Japan have annually prepared paper cranes to symbolize the hope for peace (Britton and Hayashida 1981).



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Crane sculpture at entrance to the Forbidden City, Beijing, China

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Images of Grey Crowned Cranes in African textiles, Francistown, Botswana

The human relationship with cranes extends beyond the symbolic. Cranes have occasionally been used as a source of food, although this has rarely been a widespread custom. Historically, crane hunting contributed to the regional extirpation of cranes in portions of North America, Europe, and Asia. Hunting of cranes is now illegal in most countries where they occur. In areas, however, where hunger is a persistent problem, cranes and other large birds are seen as important sources of food, and are occasionally taken (see Box 1).

Cranes have long been popular birds in private collections and, more recently, in zoos. Records of cranes being kept in captivity by Chinese nobility date back more than two thousand years. Marco Polo described Kublai Khan's efforts at crane "management" in the 13th century (Leopold 1933). Several of the species had bred in captivity by the late 1800s; all fifteen have now been bred under artificial conditions. In general, most breed readily in captivity if provided with space, privacy, and a balanced diet. This facility for propagation in captivity is now an important conservation tool for the highly endangered cranes, and many techniques first developed for

cranes have been employed for other endangered bird species (see Section 1.8 below).

The relationship between cranes and people is by no means idyllic. Species that face growing pressures on their natural habitats have in some cases turned to using cultivated lands. Under most circumstances there is little conflict with farmers' interests. In some situations, however, cranes have been intentionally poisoned or shot (see Box 1). These and other threats are outlined in Section 1.6.

1.5 Conservation Status

Table 1.1 presents proposed threat categories for the cranes under the revised IUCN Red List Categories system (IUCN 1994; see Appendix 3). The Red List Categories proposed here are based on information gathered during the preparation of this Action Plan, and are updated from those published in Birds to Watch 2. However, the updating process was not completed in time for the proposed categories to be published in the 1996 IUCN Red List. The Crane Specialist Group will be working with IUCN and BirdLife International to review and finalize the categories, and invites comments on the listings proposed here. Table 1.2 summarizes the current estimates of population levels and trends presented in the species accounts in Section 2 of this document.

The cranes are among the world's most endangered families of birds. Under the new categories, eleven of the fifteen species are likely to be listed as Threatened (which includes the categories Critically Endangered, Endangered, and Vulnerable). As applied to the cranes, the new criteria tend to stress recent trends in populations in addition to total numbers. Thus, the Blue Crane is listed as Critically Endangered due to its steep decline in recent decades. Five species (Wattled, Siberian, Sarus, Whooping and Red-crowned) are listed as Endangered, and five others (Black and Grey Crowned, White-naped, Hooded, and Black-necked) as Vulnerable. The remaining species (Demoiselle, Sandhill, Brolga, and Eurasian) are considered Lower Risk due to their higher population numbers, although several subspecies and populations are listed as Threatened to varying degrees.

Three species—the Whooping, Red-crowned, and Siberian Cranes—now exist in such low numbers (205, 1700-2000, and 2900-3000 respectively) that special steps, including captive propagation, are being taken to assure their survival. The Whooping Crane, in particular, has been among the world's most carefully monitored and managed wildlife species since reaching the brink of extinction in the 1940s (Allen 1952, Doughty 1989, Edwards et al. 1994, USFWS 1994). The intensive conservation work undertaken for these species reflects the vulnerability of their small populations and restricted habitats. The Blue, Wattled, Sarus, White-naped, Hooded, and Black-necked Cranes still exist in the low thousands. However, unless these birds and their habitats are effectively protected, they could easily follow the path of the more critically imperiled species. For example, South Africa's endemic Blue Crane still numbers about 21,000. However, since 1980 the species has declined significantly in many portions of its range due to intentional and unintentional poisoning, as well as the extensive loss of its grassland habitat to afforestation (Allan 1994).

Although the two Crowned Cranes are threatened to a lesser degree at the species level, they are nonetheless of growing concern from a conservation standpoint. The Black Crowned Crane has declined precipitously in much of its range in sub-Saharan West African, mainly as a result of heavy human population and development pressures, compounded by long-term drought in the region. The species has been, or is on the verge of being, extirpated from several countries, including Nigeria, where it is the national bird. The Grey Crowned Cranes face somewhat similar pressures in eastern Africa.

Other cranes are threatened at the subspecies and population levels. The Indian Sarus Crane, though still relatively common in northern India, is declining in numbers, and has been extirpated from much of its historic range. The Eastern Sarus Crane has been reduced to no more than 1500 birds in Southeast Asia. Although the Sandhill Crane is the most abundant of the world's cranes, two of its six subspecies—the Mississippi and Cuban Sandhill Cranes—number only about 120 and 300 birds respectively. Several other species include small isolated populations whose conservation status and needs are little known. These include, for example, populations of the Eurasian Crane in Turkey and Tibet, the Sarus Crane in Australia, and the Brolga in New Guinea.

The most abundant and extensively distributed crane species—the Sandhill, Demoiselle, and Eurasian—offer other conservation lessons and challenges. All three of these species have experienced declines, sometimes severe, in portions of their historic ranges. Some populations of these species have also recovered dramatically. For example, the Eastern population of Greater Sandhill Cranes in the Great Lakes region of North America and the Eurasian Cranes in western Europe have increased steadily in numbers in recent decades (Dietzman and Swengel 1994, Prange 1989). At the same time, these species are being forced to adapt to dynamic forces affecting their distribution, habitats, and population structure. All three species have been affected to one degree or another by fragmentation of formerly more contiguous populations. This has likely occurred, for example, in the southeastern United States, where resident Sandhill Cranes were more abundant in the past. Similarly, the Demoiselle and Eurasian Crane populations across Eurasia are becoming increasingly concentrated in discrete populations.

In addition, the future of these abundant species is unpredictable due to accelerating changes in their habitats. Changes in land use in western Europe will play a key role in determining the future of the Eurasian Crane in that portion of the species' range. Similarly, the rapid conversion of the Eurasian steppes to cropland is forcing the Demoiselle Crane to adapt to artificial conditions during its breeding period (Kovshar et al. 1995, Winter et al. 1995). Changes in hydrology and vegetation

Table 1.1 Proposed conservation status of cranes under the revised IUCN categories (IUCN 1994).

See Appendix 3 for an explanation of the revised categories and criteria.

Taxon	IUCN Category	Criteria
Black Crowned Crane	Vulnerable	A1c,d A2c,d
West African Crowned Crane	Endangered	A1c,d
Sudan Crowned Crane	Vulnerable	A1c,d A2c,d
Grey Crowned Crane	Vulnerable	A2c,d,e
South African Crowned Crane	Endangered	A1a,b,c,d,e
East African Crowned Crane	Vulnerable	A2c,d,e
Blue Crane	Critically Endangered	A1a,c,e
South Africa pop.	Critically Endangered	A1a,c,e
Namibia pop.	Critically Endangered	D
Demoiselle Crane	Lower Risk (lc)	
Atlas pop.	Critically Endangered	A1a,c,d A2c,d C1 C2b D
Turkey pop.	Critically Endangered	A1a,c,d A2c,d C2b D
Black Sea pop.	Endangered	A1c C2a
Kalmykia pop.	Lower Risk (lc)	
Kazakhstan/C. Asia pop.	Lower Risk (lc)	
E Asia pop.	Vulnerable	A1c
Wattled Crane	Endangered	A1b,c,d,e A2c,d,e
Ethiopia pop.	Endangered	D
SC Africa pop.	Endangered	A2c
South Africa pop.	Critically Endangered	C1
Siberian Crane	Endangered	A1c C1 C2b
Eastern pop.	Endangered	A1c C1 C2b
Central pop.	Critically Endangered	A1a,c,d A2b,d B1c,e C1 C2b D E
Western pop.	Critically Endangered	A1a,c A2b,c B1 B2e C1 C2b D E
Sandhill Crane	Lower Risk (lc)	
Lesser Sandhill Crane	Lower Risk (lc)	
Canadian Sandhill Crane	Lower Risk (lc)	
Greater Sandhill Crane	Lower Risk (lc)	
Florida Sandhill Crane	Lower Risk (nt)	
Mississippi Sandhill Crane	Critically Endangered	C2b
Cuban Sandhill Crane	Critically Endangered	C2a
Sarus Crane	Endangered	A1b,c
Indian Sarus Crane	Endangered	A1b,c,d,e
Eastern Sarus Crane	Endangered	A1c,d,e A2c,d,e C1
Australian Sarus Crane	Data Deficient	
Philippine Sarus Crane	Extinct	
Brolga	Lower Risk (lc)	
Northern pop.	Lower Risk (lc)	
Southern pop.	Vulnerable	C1b,c D
New Guinea pop.	Data Deficient	
White-naped Crane	Vulnerable	A1c,d A2c C1
Hooded Crane	Vulnerable	A2c C1
Eurasian Crane	Lower Risk (lc)	
W Europe pop.	Lower Risk (lc)	
E Europe pop.	Lower Risk (lc)	
European Russia pop.	Vulnerable	A1a,c,d
Turkey pop.	Data Deficient	
W Siberia pop.	Lower Risk (nt)	
C Siberia/N China pop.	Vulnerable	A1 C1
Tibet Plateau pop.	Data Deficient	
Whooping Crane	Endangered	D
Black-necked Crane	Vulnerable	A1b,c,d A2c C1
Red-crowned Crane	Endangered	C1
Mainland pop.	Endangered	A1c,d A2c C1
Hokkaido pop.	Endangered	C2b

Table 1.2 Population estimates for crane taxa

Species Subspecies/population/ Wintering subpopulation	Number	Trend
Black Crowned Crane		
B. p. pavonina	11,500-17,500	Declining. Extirpated (or nearly extirpated) in some nations.
B. p. ceciliae	55,000-60,000	Uncertain. Generally stable, but possibly declining locally. Still fairly abundant in Sudan.
Total	66,500-77,500	Declining
Grey Crowned Crane		
B. r. gibbericeps	75,000-85,000	Declining
B. r. regulorum	~10,000	Unknown
Total	85,000-95,000	Declining
Demoiselle Crane		
Atlas (N Africa) population	<50	Declining
Black Sea population	~500	Declining
Turkey population	<100	Unknown
Kalmykia population	30-35,000	Stable
Kazakhstan/Central Asia population	100,000	Stable to increasing
Siberia/East Asia population	70-100,000	Stable to declining
Total	200,000-240,000	Stable
Blue Crane		
Southern population	21,000	Declining
Namibia (Etosha Pan) population	<100	Stable
Total	21,000	Declining
Wattled Crane	13-15,000	Declining throughout range
South Africa population	250-300	Declining
South-central Africa population	13,000-15,000	Declining
Ethiopia population	several hundred	Unknown
Total	13,000-15,000	Declining
Siberian Crane (winter count)		
Eastern population	2900-3000	Unknown
Central population	4	Steadily declining. Observed on the traditional wintering grounds in February 1996 after a two-year absence.
Western population	9	Holding at 9-11 birds on the wintering groundss since mid-1980s. Highly vulnerable.
Total	2900-3000	Unknown. C and W populations highly vulnerable.
Sandhill Crane		
G. c. canadensis and		Probably stable
G. c. rowani	~450,000[1]	Unknown due to difficulty in distinguishing from Lesser Sandhills *G. c. canadensis;* probably stable.
G. c. tabida	65-75,000	Increasing rapidly in the eastern portion of its range. Generally stable elsewhere. Some western populations may be declining.
G. c. pratensis	4,000-6,000	Generally stable, with local increases and declines. Includes the Okefenokee portion of the population (about 400 individuals).
G. c. pulla	120	Numbers in wild increasing through augmentation. Reproduction in the wild is below replacement level.
G. c. nesiotes	300	Generally stable. New populations recently discovered.
Total	520,000	Stable to increasing.
Sarus Crane		
G. a. antigone	8,000-10,000	Declining
G. a. sharpii	500-1500	Unknown; likely declining
G. a. gilli	<5,000	Unknown
Total	13,500-15,500	Declining

continued...

table1.2continued

Brolga		
Northern Australia	20,000-100,000	Generally stable
Southern Australia	~1000	Stable to declining
New Guinea	Unknown	Unknown
Total	20-100,000	Generally stable; possibly declining in SE Australia
White-naped Crane (winter counts)		
Japan (Izumi)	1800-2100	Increasing
Korean Peninsula	100-200	Declining
China (Poyang Lake)	~3,000	Unknown
Total	4900-5300	Stable to declining (based on loss of breeding habitat)
Hooded Crane (winter counts)		
Hubei (China)	up to 425	Unknown
Dongting Lake (China)	up to 200	Unknown
Poyang Lake (China)	up to 360	Unknown
Shengjin Lake (China)	300	Stable, but habitat declining
West Taegu (South Korea)	180-250	Unknown
Yashiro (Japan)	50	Declining
Izumi (Japan)	~8,000	Stable
Total	9400-9600	Stable
Eurasian Crane		
West European population	60-70,000	Stable to increasing
East European population	>60,000	Stable to increasing
European Russia population	~35,000	Declining
Turkish population (non-migratory)	200-500	Declining
West Siberia population	~55,000	Declining
C Siberia/NE China population	5,000	Declining
Tibetan Plateau population	1000	Stable
Total	220,000-250,000	Increasing overall, but with local declines
Whooping Crane (adult birds as of August 1996)		
Aransas-Wood Buffalo population	150	Increasing slowly
Rocky Mountain population	3	Declining
Florida population	52	Increasing through artificial augmentation
Wild population sub-total	205	Increasing slowly
Patuxent Env. Science Center	39	
International Crane Foundation	29	
Calgary Zoo	18	
San Antonio Zoo	4	
White Oak Conservation Center	1	
Captive population sub-total	91	
Total	296	
Black-necked Crane (winter counts)		
NE Yunnan/W Guizhou	1300-1600	Unknown
NW Yunnan	<100	Stable to declining
SC Tibet	3900	Stable
E Tibet	<20	Declining
Bhutan	360	Stable
India-Arunachal Pradesh	<10	Declining
Total	5600-6000	Stable but vulnerable
Red-crowned Crane (winter counts)		
Mainland China	600-800	Unknown
North Korea	300-350	Increasing
South Korea	200-300	Unknown
Japan	594	Stable to increasing
Total	1700-2000	Stable to declining (based on loss of breeding habitat)

[1] Population estimates of the mid-continental populations of Sandhill Cranes do not distinguish between Lesser and Canadian Sandhill Cranes (a relatively small number of Greater Sandhill Cranes are also included in the total). Estimates are based on 3-year running averages of spring counts conducted on the Platte River during migration. The figure given here represents the 1995 survey results for the midcontinental populations (420,866) plus about 25,000 Lesser Sandhill Cranes from California.

along the Platte River in the central United States have affected habitat conditions in an area used by approximately 80% of the total population of the Sandhill Crane during spring migration (Currier et al. 1985, Vanderwalker 1987). Large-scale and long-term factors such as these are of vital importance to these species if they are to avoid the declines that have affected the more endangered members of their family.

BOX1
Key Controversies in Crane Conservation

For most crane taxa, the critical conservation issues revolve around the protection, maintenance, and restoration of the ecosystems and habitats where cranes occur. However, three other topics—legal hunting (as opposed to poaching), crop damage, and artificial feeding stations—are of broad concern in crane conservation, and are often controversial.

Hunting

Cranes are legally hunted for sport in parts of Canada, Mexico, the United States, and in Pakistan. Widespread subsistence hunting still occurs in Afghanistan, Canada, Nepal, Russia, and many African nations. In some areas, there may often be a fine line (or no line) between sport hunting and subsistence hunting.

The migratory Sandhill Cranes in North America number in excess of 500,000 birds, and the harvest of more than 25,000 annually does not appear to harm the population as a whole. There is concern, however, that Greater Sandhill Cranes of the southern prairie regions of Canada may be seriously jeopardized by current management practices. They bear the brunt of the hunting in September, before most of the abundant Canadian and Lesser Sandhills arrive and before the season is closed to provide protection for the migrating Whooping Cranes.

Hunting of Eurasian Cranes and Demoiselle Cranes in Pakistan is a popular sport among wealthier hunters (see the Demoiselle Crane species account in Section 2). When capture techniques were restricted to the traditional method—tossing *soya* (ropes with weighted ends) into low-flying flocks at night—only a limited number of cranes was taken. In recent years, however, the number of firearms used by local people in Pakistan and neighboring Afghanistan has risen, and more cranes have been shot. Although laws preventing the hunting of cranes in most areas of Pakistan are now being enforced, hunting continues unabated in tribal areas of the Northwest Frontier Province.

Hunting that occurs as a "spillover" effect of human conflict is often indiscriminate. In recent years, wildlife and wildlife habitat have suffered along with local people in many regions torn by war, civil unrest, and poverty. Such has been the case, for example, in Mozambique, Rwanda, and Cambodia. Under such circumstances, the margin of hope for survival of cranes and other large wild animals is thin.

Crop Damage

The success of the Sandhill, Eurasian, and Demoiselle Cranes can be attributed in part to the benefits they derive from foraging in agricultural landscapes. There is speculation that their numbers may now be much higher than in the past due to the abundance of available crop foods. In some areas, and at some times of the year, foraging cranes can cause damage to crops. Such damage can be especially severe in the spring when cranes probe for newly planted seeds or pull up and consume seedlings. Damage can also occur in the fall when migratory cranes are in large flocks and crops are ripening.

Hazing cranes from agricultural fields is a temporary and often ineffective solution to the problem; the birds simply move to another farmer's fields. However, the planting of lure crops near roosting areas has been effective in keeping cranes away from commercial crops. Incentive and compensation programs may also reduce the economic burden for farmers who occasionally experience heavy damage. In all cases, additional research is needed to ascertain the actual timing and extent of damage, and to devise mitigation techniques and programs.

Feeding Stations

With the possible exception of the Siberian Crane, cranes are readily attracted to baiting sites. Without artificial feeding stations in Japan, the numbers of Hooded, White-naped, and Red-crowned Cranes might well have remained much below current levels. Feeding stations for Red-crowned Cranes have also been established on the species' wintering grounds in Korea and China.

Although successful in increasing populations, feeding stations have also concentrated cranes to an historically unprecedented degree. This increases the risk from disasters related to weather, hunting, communicable diseases, and poisons. This is why artificial feeding programs are not being used to provide for Whooping Cranes on their wintering grounds in Texas—despite concern that the territorial requirements of the cranes may limit the number that are able to utilize the available protected areas.

Many (though not all) crane conservationists oppose the hunting of cranes and the establishment of artificial feeding stations. Alternatives to hunting and artificial feeding include the protection and restoration of natural habitats and planting of lure crops in areas where crop damage is substantial. However, extenuating circumstances make hunting and/or feeding necessary. Especially for species and populations of cranes whose numbers are increasing, these issues are likely to present a growing challenge to conservationists seeking to harmonize human needs with those of cranes and other wildlife.

1.6 Threats

The world's cranes face a wide array of existing and potential threats. The threats and their approximate levels of impact on the various crane species are summarized in Table 1.3. Particular threats for each species are discussed within the species accounts in Section 2. Anthropogenic threats to cranes can be divided into several categories: habitat loss and degradation; direct exploitation; poisoning; and other anthropogenic threats.

1.6.1 Habitat Loss and Degradation

Habitat loss and degradation is the most important class of threats to the world's cranes (Archibald et al. 1981, Harris 1994a). Declines in habitat availability and quality affect the distribution, movement, and breeding success of cranes, and involve all habitat types—breeding grounds, migration stopover points and staging areas, wintering grounds, resident habitats, and roosting areas. Major forms of habitat loss and degradation affecting cranes include the following:

Conversion of wetlands

Conversion of wetlands for agricultural and non-agricultural purposes (including urban, commercial, and recreational development, oil exploration, and road construction) is the most significant factor affecting cranes and their habitats around the world (see Harris 1994a, Hussain 1994 Zhang 1994),. The process of converting wetlands usually involves extensive clearing of natural vegetation, draining and other alterations of hydrological processes, burning, cultivation, and other activities that render former crane habitats unsuitable for nesting, feeding, roosting, and stopping during migration. All of the wetland-dependent crane species have been affected by this process to a greater or lesser degree.

Over-exploitation of wetland resources

Cranes and people have long coexisted successfully in many wetland areas, but increasing pressures related to human population growth and economic constraints have in some areas overtaxed wetland ecosystems and the resources they provide. Overexploitation of the plant, animal (especially fish), and water resources of these wetlands can have negative impacts upon cranes and other species (e.g., Ma and Su 1991,Wang Q. 1991, Harris 1992a, Su 1992). This problem is perhaps greatest in areas of Africa and Asia where population pressures are greatest and wetland resources are used to meet expanding subsistence needs.

Conversion of grasslands

Agricultural expansion into grasslands has also appropriated crane breeding and foraging habitat, especially in sub-Saharan Africa, parts of South Africa, the steppe regions of Eurasia, and savannas and prairies in North America (Vernon et al. 1992, Allan and Nuttall 1995, Winter et al. 1995,Allen 1952).

Changes in agricultural land use

In areas where cranes have adapted to feeding and breeding in traditional agricultural lands, changes in the choice of crops, fallow and rotation schedules, cropping patterns, field preparation, and cultivation and harvesting practices can have subtle but important effects (e.g., Bishop 1991, Khachar et al. 1991, Mafabi 1991, Winter et al. 1995).

Other agricultural impacts

In many landscapes, agricultural practices in upland areas have brought about increased rates of soil erosion. The resulting sediment loads alter the hydrological processes and vegetation in downslope wetlands. This has had direct impacts on crane habitat in Japan, China, Australia, and other areas (Archibald 1987, Li F. and Li M. 1991, A. Haffenden pers. comm.). Intensified livestock grazing has resulted in the degradation of crane habitat through disturbance, alterations in wetland hydrology, and trampling of wetland vegetation (including crane nests and cover vegetation) (e.g., Duc 1991, Gole 1991a, Urban and Gichuki 1991, Mustafa and Durbunde 1992). Increased use of pesticides and fertilizers in agricultural systems impacts cranes directly through exposure and ingestion and indirectly through eutrophication and contamination of wetlands, accumulation in food sources, and changes in the trophic structure of ecosystems (Gole 1989b, 1991b; Kawamura 1991; Muralidharan 1992).

Dams and water diversion

Construction of dams and irrigation systems has profoundly altered the hydrological regimes and stream channel characteristics of river systems and associated wetlands critical to many crane species. Dam construction and water diversion has already affected large river and wetland systems such as the Senegal, Zambezi, Lake Chad, Danube, and Platte, as well as many smaller streams and wetlands. Other major river systems that are critically important for cranes—including the Mekong, Yangtze, and Amur Rivers, the Okavango system,

ICF

Agricultural and industrial development threaten wetlands in Vietnam

Table 1.3 Threats to cranes

C **Critical threat (has been, or has the potential to be, a major factor in the decline of the population size and/or restriction of the species' range)**

S **Significant threat (has been, or has the potential to be, an important though not leading factor in the decline of the population size and/or restriction of the species' range)**

L **Lesser threat (has been, or has the potential to be, a detrimental factor in some localities or for some populations, but not with a significant or critical impact on the species as a whole)**

Type of Threat	B.p.	B.r.	A.v.	A.p.	B.c.	G.l.	G.c.	G.an.	G.r.	G.v.	G.m.	G.g.	Gam.	G.n.	
Habitat Loss and Degradation															
Conversion of wetlands	S	C	L	L	C	C	S	C	S	C	S	S	L	S	C
Over-exploitation of wetland resources	S	S	L	L	C	C	L	C	S	S	S	S	S	L	S
Agricultural conversion of grasslands	C	L	C	S			L[1]			C		L	L	L	S
Changes in agricultural land use		C	S	C	S		C	S	S	S	S	S		S	S
Other agricultural impacts (see text)	S	S		S		S			L	L				L	L
Dams and water diversions	C	L		L	C	C	C	S		C	S	S	S	S	C
Urban expansion and land development				L		L	L[2,3]	S	L[5]	S	S		S	L	S
Deforestation	S	S									L	L		L	L
Afforestation				C	L		L[2]				L				
Other changes in vegetation (see text)					L	S			S				C		C
Coastal marsh and shoreline erosion													C		S
Pollution and environmental contamination					L	S		L		S	S		C	S	C
Oil development	L					S					L	L	C		C
Collision with utility lines			L	L	L		L		L		L	L	S		L
Direct exploitation															
Overhunting			S			C[4]	L					S			
Poaching	S	C		L									L	S	
Live trapping for commercial trade	S	S	L	S	L			S							
Live trapping for domestication	L	L		L					L			L			
Poisoning		L	L	C	S	L	L		L	L	L				L
Other anthropogenic threats															
Human interference or disturbance	C	S	S		L	L	L[2]	S	L[5]	L	L	L	S	L	L
Warfare and political instability	C	S			L	L		S	S	S	L	L	L	S	S
Lack of effective legislation and administration	L	L								S					L
Lack of knowledge and public support	S	S	L	S	S	S	L[1]	L	S	L	L			L	L
Biological factors															
Predation							L[2]		L		L		L[6]	L	
Exotic species								L	L						
Genetic and demographic problems of small populations						C	L[1,2]						S		L
Disease							L			S	S		L		L
Other environmental factors (storms, drought, etc.)	S	L			L	S	L						S		

Notes

1. Cuban Sandhill Crane
2. Mississippi Sandhill Crane
3. Florida Sandhill Crane
4. Central population (Siberian Crane)
5. Southern population (Brolga)
6. Florida population (Whooping Crane)

and the Sudd wetlands—are currently under threat from major dam and diversion projects (Su 1992, Pearce 1993, Smirenski 1995, Topping 1995, Garba in press).

Urban expansion and land development

The development of wetlands and other crane habitat for human habitation has been an important factor in the restriction of the ranges of several species, including the Whooping Crane, Red-crowned Crane, and White-naped Crane. Land subdivision and development also lead to habitat fragmentation. As large properties are subdivided, previously expansive fields, pastures, meadows, and wetlands are reduced in size and often fenced. The effective reduction in foraging range can pose problems to cranes that have traditionally taken advantage of these lands, and especially to those with flightless young. Unable to follow their parents to food sources, the young can become tangled in fences or even starve **within** these enclosed areas. Over the last several decades, Red-crowned Cranes and Brolgas in particular have been affected by this form of fragmentation (Archibald 1987, P. Du Guesclin pers. comm.). Urban expansion and other forms of land development also affect cranes by increasing the exposure of cranes to human disturbance.

ICF

Shoreline erosion is a long-term threat to the Whooping Crane's wintering habitat in coastal Texas, USA

Deforestation

Because few crane species depend heavily upon forested habitats, deforestation does not usually pose a serious direct threat to cranes. However, because deforestation has long-term and far-reaching impacts upon watershed hydrology, and hence on wetlands, deforestation can be considered a significant indirect threat (Archibald 1987, Li F. and Li M. 1991). The problem is perhaps most serious in the savannahs of Africa and in key watersheds of China and other parts of East Asia. In areas where deforestation contributes to disrupted flooding cycles, it feeds the demand for dams and other flood control structures.

For the cranes that either require or tolerate trees in their habitats, deforestation poses a more direct threat. Deforestation may reduce the security of roost sites for the Crowned Cranes (R. Beilfuss pers. comm.). For some species in certain portions of their range—for example, Red-crowned Cranes in Hokkaido—deforestation has also had direct impacts (Archibald 1987). Deforestation is of increasing concern in previously unexploited crane habitats that are now subject to development. This includes, for example, the breeding grounds of the Hooded Crane in the boreal forests of eastern Russia (Smirenski 1989).

Afforestation

Afforestation threatens both grassland and wetland crane habitats. Conversion of grasslands to tree (usually pine) plantations impairs visibility, reduces the availability of nesting and foraging areas, and subjects nearby wetlands to reduced run-off and desiccation. These impacts can leave the wetland-upland habitat complex unsuitable for cranes. Afforestation has affected extensive areas of Blue and Wattled Crane habitat in South Africa (Johnson 1992a, 1992b; Tarboton 1984, 1992b; Allan 1994). Mississippi Sandhill Cranes and Hooded Cranes are also affected by afforestation (Smith and Valentine 1987, Valentine 1987, Kawamura 1991).

Other changes in vegetation

In many parts of the world, the quality of crane habitat is threatened by changes in plant community composition and processes. These changes are often induced, in turn, by broad anthropogenic changes in fire, grazing, and hydrological regimes. A well known example is that of the Platte River in North America, where dams in the upper stretches of the river have moderated the flooding cycle, allowing woody vegetation to take hold in the formerly open riparian zone (Currier et al. 1985, Currier 1991). This has reduced the availability of prime roosting sites for migrating Sandhill and Whooping Cranes.

Marsh and shoreline erosion

Erosion of coastal marshes and shorelines is a major threat in several key crane habitats. In these areas, the dredging of channels and the subsequent wave action of boat and barge traffic gradually erodes shoreline soils and vegetation. This is a significant problem on the wintering grounds of the Whooping Crane at Aransas National Wildlife Refuge in the United States (Halpern 1992, Sherrod and Medina 1992, Zang et al. 1993).

Pollution and environmental contamination

Crane habitats around the world are threatened by many forms of household, agricultural, and industrial pollution. Some pollutants, such as chemicals and organic wastes, constitute long-term threats to habitat (primarily water) quality,

with attendant effects on crane physiology and reproductive success and on ecological conditions (including crane food sources) within their wetland habitats (Wang Q. 1991, Kawamura 1991, Zhang 1994). Pollution also poses an acute threat to cranes through the potential for catastrophic spills and other accidents. The presence of chemical transportation and production facilities along coastlines and major rivers makes wetlands in these areas especially vulnerable to such accidents. For example, barges loaded with benzene, xylene, and other toxic substances traverse the Gulf Intracoastal Waterway near the Aransas National Wildlife Refuge on a daily basis; even one spill in this area could have a devastating impact on the Whooping Cranes and their habitat (Lewis et al. 1992a, Lewis 1995b).

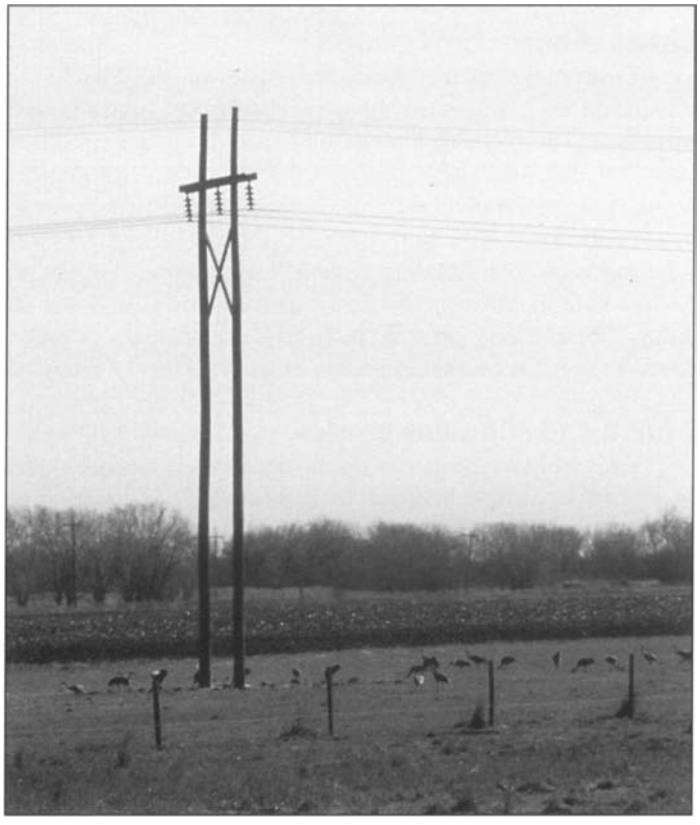
Oil development

Oil exploration, drilling, extraction, transport, and processing constitute a special class of pollution threats (e.g., Liu et al. 1991, Su 1992, Kanai et al. 1993, Dai and Qi 1994, Ojok in press). Many important crane habitats around the world contain known or suspected oil reserves. Oil development activities take place within the Aransas National Wildlife Refuge, but are prohibited when the Whooping Cranes are present. An accident at other times of the year could have long-term impacts on environmental quality throughout the refuge. Chronic low level discharges related to oil production and transportation are also of concern (Robertson et al. 1993, Lewis 1995b).

Oil has been discovered in and near the breeding grounds of Siberian Cranes in eastern Russia. Drilling rights have been granted on the Yamal Peninsula near the Kunovat Nature Reserve, where the small Central population of Siberian Cranes breeds (Archibald 1990). Oil exploration and oil field development have taken place within several key crane reserves in China (Dalainor, Panjin, Shuangtaizi, and Poyang Lake Nature Reserves) (Liu et al. 1991, Su 1992).

Collision with utility lines

Accidental collision with utility lines has become a significant source of mortality in several species of cranes. This has been most carefully studied and documented in the case of the Sandhill Crane in western North America, but accidental crippling and mortality have been studied or reported in several other species (e.g., Kyu and Oesting 1981, Archibald 1987, Brown et al. 1987, Howard et al. 1987, Neumann 1987, Goldstraw and Du Guesclin 1991, Masatomi 1991, Faanes and Johnson 1992, Morkill and Anderson 1992, Ward and Anderson 1992). Although collision with utility lines does not pose a major threat to the existence of the more abundant species (such as the Sandhill Crane), it is a significant consideration in efforts to maintain and recover the more threatened species, especially the Whooping and Red-crowned Cranes (Akiyama 1981, Brown et al. 1987, Kuyt 1987, Masatomi 1991, Faanes and Johnson 1992, Lewis et al. 1992b). The threat, however, can be successfully mitigated by moving, removing, burying, or marking the utility lines (Morkill and Anderson 1993, Alonso et al. 1994, Brown and Drewien 1995). Other structures on the landscape, such as fences, can also result in accidental injury and death in cranes (White 1987, Allen and Ramirez 1990, Filmer and Holtshausen 1992).



A. MORKILL

Utility lines present a threat to cranes in many developed regions around the world

1.6.2 Direct Exploitation

In general, hunting and trapping do not now constitute an overwhelming threat to cranes. For several species and populations, however, direct exploitation has been a critical factor in the past, and hinders current protection and recovery efforts.

Overhunting

Hunting of cranes is prohibited in most countries where they occur. The most serious problem involving the legal hunting of cranes occurs along the Afghanistan-Pakistan border, where Eurasian Cranes, Demoiselle Cranes, and the Central population of Siberian Cranes pass during the spring and autumn migrations, and where crane hunting is a long-standing tradition. Sport hunting of the more abundant species still occurs, and in some areas has been reinstituted. From a strict management standpoint, the main threat associated with legal sport hunting involves the lack of accurate information on population status, harvests, and the impacts of hunting on specific populations. Accidental shooting is a significant concern

in the case of the Whooping Crane and the other rare species (Lewis et al. 1992b).

Subsistence hunting of cranes is relatively uncommon, but does occur in limited portions of Africa, Asia, and North America. In the past, crane populations have tolerated such hunting, and could theoretically continue to do so if the kill rate remained below the recruitment rate. However, the impact of subsistence hunting is likely to become increasingly acute as human populations grow, firearms become increasingly available, cultural traditions of restraint weaken, and habitat continues to be lost. It has been an intermittent problem in areas where rural human population density is high, most commonly in parts of Africa and China.

Poaching

Laws prohibiting the killing of cranes are widely ignored and poorly enforced in many countries. Most instances of poaching involve shooting, but trapping and other forms of exploitation have been reported. Cranes that are subject to poaching are usually used for food. In some cases, parts of the cranes have been used for their supposed medicinal properties. Crane feathers have reportedly been sold in Hong Kong for the production of fans.

Live trapping for commercial trade

Live trapping of cranes takes place both legally and illegally. In most cases, cranes are trapped for commercial purposes, usually for export, but also for sale in domestic markets. Grey and Black Crowned, Demoiselle, Blue, Wattled, and Sarus Cranes are the species most affected. The majority of documented cases of live trapping for trade come from Africa (Urban and Gichuki 1991, Mafabi 1991, W. Tarboton pers. comm.). About 100 prefledged Demoiselle Cranes are captured and sold each year in the Kalmykia region of Russia, but this practice is not thought to present a critical threat to the local population (which is estimated at more than 30,000).

Live trapping for domestication

In some countries, cranes are captured and kept as pets. Sometimes adults are taken, but more often crane chicks are captured and hand-raised. Blue Cranes, Grey and Black Crowned Cranes, and Brolgas are the most commonly domesticated species (e.g., Mafabi and Pomeroy 1988). In Pakistan, where many people keep Demoiselle and Common Cranes in their yards as pets, trappers capture and sell cranes (Ahmad and Shah 1991).

1.6.3 Poisoning

Poisoning, both intentional and unintentional, is a direct cause of mortality in many crane species (e.g., Khachar et al. 1991, Van Ee 1981, Tyson 1987, Vernon 1987, White 1987, Zhmud 1988, Tarboton 1989, Urban and Gichuki 1991, Johnson 1992b, Wang Y. 1991). Grey Crowned, Blue, Demoiselle, and Wattled Cranes are the most widely affected

D. WENNING

Siberian Crane killed by poachers at Poyang Lake, China

species. Although poisoning is widely reported, precise information on the cause and extent of poisoning, and the poison involved, is often lacking. Intentional poisoning of cranes is usually undertaken by farmers to prevent crop depredation and damage. Unintentional poisoning of cranes usually occurs as a result of ingestion of or exposure to various pesticides. Consumption of tainted seeds, grains, insects, and fish, and the bioaccumulation of toxic substances, may affect cranes either by directly killing them or by reducing their reproductive capacity.

1.6.4 Other Anthropogenic Threats

In addition to pressures stemming from habitat loss and degradation, direct exploitation, poisoning, and other forms of persecution, cranes are subject to several other broad anthropogenic threats, including:

Human interference or disturbance

Interference or disturbance by people can be an indirect cause of reproductive failure and mortality in cranes. Such interference can occur in any phase of the cranes' life cycles, but is most critical during the breeding season, when adults are establishing territories and nesting birds and young are most vulnerable (Winter 1991, Ma and Su 1991, Bylin 1987). Encroachment upon or disturbance of crane nests renders eggs and young birds more vulnerable to predation.

Warfare and political instability

Warfare and political upheaval have had negative impacts on many crane species. Because cranes are present in or migrate through many political "hotspots"—including the frontiers of hostile nations—they have often been influenced by human conflicts. Cranes (and other species) can be affected

in various ways: through direct mortality, disturbance, and habitat loss and degradation; through the taking of birds to meet subsistence needs (which is also a major problem under famine conditions); and through the inability to enforce laws, manage protected areas, and conduct research (Barzen 1991, Archibald 1992c, Beilfuss 1995).

Lack of effective legislation and administration

Lack of effective legislation and conservation administration is a general threat, especially in developing countries where the legal and political framework to support conservation is often weak. In some countries, laws are either lacking or inadequate to protect cranes and their habitats. Ineffective management of protected areas is a threat in many regions. Finally, the lack of cooperation among different agencies at the local, national, and international levels can be an obstacle to effective coordination and implementation of crane conservation plans.

Lack of knowledge and public support

In general, cranes are well studied relative to other taxonomic groups. Nevertheless, important gaps in scientific knowledge about their populations, populations dynamics, life histories, migratory patterns, habitats, and ecological relationships remain. This is especially true for the lesser known and more remote species and populations (mainly the Siberian, Hooded, White-naped, and Black-necked Cranes). Such gaps in scientific knowledge hinder accurate assessments of their conservation status and needs. At least as important as the gaps in technical knowledge, however, is the lack of knowledge and support among elected officials, agency personnel, and other leaders in different sectors of society, as well as among educators and the local public (Archibald et al. 1981).

1.6.5 Biological Factors

Predation

Human activities have under some circumstances increased predation pressures on cranes. For example, crow and raven predation of crane nests has increased in areas where garbage dumps have led to high corvid numbers and human disturbance frightens nesting cranes (Archibald 1987). Such changes in predation dynamics often involve other changes in habitat conditions. In particular, alterations of the natural hydrologic regimes of wetlands can result in generally or periodically drier habitats, opening opportunities for predators. Drier habitat conditions have magnified the effects of recent coyote colonization in the range of the Mississippi Sandhill Crane (S. Hereford pers. comm.). In several cases, "predator release"—the halting of systematic predator persecution—has had impacts on cranes in protected areas (Littlefield and Thompson 1987).

Exotic species

The introduction or unanticipated spread of exotic species due to human activity has occasionally affected cranes and their habitats. Throughout the world, both wetland and grassland crane habitats have been altered by the spread of exotic species. Although most of these alterations have had only minor effects on cranes, exotic plant invasions have had detrimental effects in many wetland areas around the world. Instances of animal invasions affecting cranes are rare, but not unknown. For example, minks *(Mustela vison)* that have escaped from captivity have established themselves in the marshlands of Hokkaido, and may be important predators of the resident Red-crowned Crane (Archibald 1987; H. Masatomi pers. comm.).

Genetic and demographic problems of small populations

In several cases, the decline and fragmentation of crane populations has rendered them susceptible to genetic and demographic problems associated with small populations, including decreased resistance to disease, skewed sex ratios and age distributions, and susceptibility to storms, disease outbreaks, and other catastrophic events. These threats are most serious for the Whooping Crane, the Mississippi and Cuban Sandhill Cranes, and the Western and Central populations of the Siberian Crane.

Disease

Wild and captive cranes are vulnerable to a variety of infectious and parasitic diseases, including salmonellosis, avian tuberculosis, avian cholera, inclusion body disease of cranes (IBDC), crane herpes virus, eastern equine encephalitis, coccidiosis, avian pox, and Newcastle's disease (Docherty and Romaine 1983, Carpenter and Derrickson 1987, Dein and Langenberg and Dein 1992). Relatively little research, however, has been done on the incidence of these and other diseases; most of the available information comes from studies of Sandhill and Whooping Cranes in North America or from studies of captive cranes (Forrester et al. 1976, Carpenter and Derrickson 1987, Mirande 1991). In general, pathogens seldom pose a serious threat to wild crane populations, and then only during periods of high population density or environmental stress, or when there is contact with domestic poultry (Carpenter and Derrickson 1987, J. Langenberg pers. comm.). The risk of disease outbreaks may be increasing among artificially concentrated populations, including the Sandhill, White-naped, Hooded, and Red-crowned Cranes (Archibald et al. 1981, Eguchi et al. 1991, Kawamura 1991). This potential is likely to increase further as the loss of habitat continues and cranes are forced to concentrate on smaller breeding, staging, and wintering areas.

Disease among captive cranes is also of concern from a conservation perspective. Disease outbreaks can set back captive propagation programs for the endangered species and subspecies. In addition to the loss of the individual birds themselves, outbreaks can disrupt long-term plans for sound genetic management of captive populations. Captive management and

husbandry techniques have reduced these risks, but constant monitoring is essential to minimize the potential for outbreaks. This is especially important as release programs expand and increase the possibility of introducing disease into wild populations.

1.6.6 Other Environmental Factors

Abiotic factors play an important role in both the short-term and long-term fate of cranes, especially in cases involving the effect of stochastic events on small or concentrated populations. Storms and other weather events can have important, and sometimes catastrophic, effects on crane populations (Merrill 1961, Tacha and Vohs 1984, Johnson and Barnes 1991). Drought not only dries up wetland breeding areas, but can lower production of young birds by reducing food supplies and increasing the vulnerability of nests and chicks to predation (Neumann 1991, Kuyt et al. 1992). Drought may also increase the pressure to expand agricultural production into wetland areas. Fires can pose a significant threat when young cranes are present (Allan 1990, Windingstad 1988, Johnson and Barnes 1991, S. Smirenski pers. comm.). Finally, the climatic changes predicted under most global warming scenarios would have profound impacts on existing crane habitats.

1.7 Crane Conservation Measures

Even as the world's cranes have declined in response to multiple threats, their cultural value, high visibility, extraordinary beauty, dramatic migrations, and striking behavior have inspired widespread conservation efforts. The special characteristics of cranes have provided conservationists with unique opportunities for action. Because cranes require large territories and are among the most prominent inhabitants of wetlands, they have served as important symbols for wetland protection, and conservation activities undertaken on their behalf have benefitted a wide range of other plant and animal species (Schoff 1991). Because most cranes have extensive year-round species ranges, they have stimulated many innovative conservation measures at the international level. These same qualities also make cranes effective vehicles for conveying lessons through conservation education and environmental awareness programs (e.g., Dietzman and Swengel 1994, Landfried et al. 1995). Captive propagation and reintroduction programs have been undertaken for several species, providing important experience in combining *in situ* and *ex situ* conservation methods for other endangered species (see Section 1.8).

Conservation measures undertaken for each species are described in detail in the species accounts in Section 2. These measures include: legal and cultural protections; international agreements and other cooperative international programs; establishment of protected areas; habitat protection and management activities; surveys and censuses; research; activities of non-governmental organizations; education and training programs; and captive propagation and reintroduction. Local and species-specific actions in these areas are often organized and supported through broader cooperative efforts of crane researchers and conservationists. The following groups and activities have been especially important in coordinating crane conservation work at the regional and international levels.

ICF

Cranes have provided the focus for wetland and biodiversity education projects in Vietnam and many other parts of the world

IUCN/SSC Crane Specialist Group

In 1970 the International Council for Bird Protection (now BirdLife International) asked George Archibald (who was then conducting his doctoral studies on crane biology at Cornell University in the United States) to organize a World Working Group on Cranes. Approximately 40 crane researchers joined the working group and provided information that was subsequently published in reports of the ICBP and of IUCN's Survival Service Commission (now the Species Survival Commission). When Archibald and his colleague Dr. Ron

ICF

Siberian Crane experts meet in Moscow in 1995 to develop coodinated conservation plans for the species

Sauey co-founded the International Crane Foundation in 1973, they and their colleagues worldwide became the World Working Group on Cranes, a core group of which in turn became the IUCN/SSC Crane Specialist Group. The specialist group currently has 79 members from 28 nations (see Appendix 1). Reports of the group's activities appear regularly in *Species*, the newsletter of the Species Survival Commission.

Crane Working Groups

Over the years, crane working groups have played a key role in supporting research, facilitating information exchange, and identifying and addressing crane conservation needs. Crane working groups have been organized at the regional, national, and local levels. At the regional level, working groups are active in North America and Europe. National-level working groups are best developed in Europe, where teams have formed in Estonia, Finland, France, Germany, Portugal, Russia, Spain, Sweden, and Ukraine. The Soviet Working Group on Cranes has been inactive since 1989 after meeting jointly with the European Crane Working Group in Estonia. China's crane researchers formerly met on a regular basis, but economic constraints have impeded meetings in recent years. India's working group meets irregularly. Local groups include the Friends of the Brolga in southeast Australia, and the Highlands and Overberg Crane Groups in South Africa. Several local working groups in South Africa have recently joined together under the umbrella of the Southern African Crane Foundation. A Black Crowned Crane Working Group has also been organized in Africa, but has met only intermittently.

Crane Workshops and Meetings

National, regional, international, and species-specific crane workshops and meetings have been held regularly over the last twenty years (Table 1.4). The gatherings have provided an important forum for the exchange of information on crane research and conservation activities, and have allowed scientists and conservationists from throughout the world to meet and learn from one another. Proceedings from most of the workshops have been published, making this information available to an even broader audience.

International Crane Foundation (ICF)

Since 1973, ICF (located in Baraboo, Wisconsin, U.S.A.) has served to stimulate, coordinate, and support crane conservation activities around the world. ICF's international programs in field ecology, aviculture, research, education, and training have helped to strengthen the global network of crane conservationists (Schoff 1991, Katz 1993). ICF's publications, including workshop proceedings as well as a quarterly newsletter *The ICF Bugle*, provide important communication links for that network.

Due to these ongoing cooperative efforts, the cranes as a taxonomic group are in a somewhat better position than most other forms of threatened biodiversity. The priority measures and recommended actions described in Section 3 are intended to build upon these previous efforts and to take advantage of the existing "infrastructure" of institutions, organization, and people involved in crane conservation. In so doing, it is hoped than many other components and functions of the ecosystems in which cranes occur will also benefit, as will the people who share these ecosystems.

1.8 Captive Propagation and Reintroduction

Cranes, because of their great size and beauty, have long been maintained and propagated in captivity (Mirande 1991). Due largely to rising conservation concerns, research into breeding techniques has intensified since the 1960s. Captive management techniques have now been summarized in a crane propagation and husbandry manual (Ellis et al., in press). With few exceptions—the West African Crowned Crane, Wattled Crane, and Hooded Cranes—all the species can be reliably

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The International Crane Foundation, Baraboo, Wisconsin, USA. "Crane City," ICF's captive propagation facility, is in the foreground.

Table 1.4 Crane workshops and symposia

This table lists the major crane meetings that have been held since 1975. A number of other meetings have also been held, often In conjunction with larger ornithological congresses or conferences. This list contains only those meetings that have focused specifically on cranes. Citations for the published proceedings follow the meeting name (see "Literature" section of text).

Year	Meeting	Location
1975	International Crane Workshop (First North American Crane Workshop) (Lewis 1976)	Baraboo, Wisconsin, USA
1977	Eastern Greater Sandhill Crane Symposium (Feldt 1978)	Michigan City, Indiana, USA
1978	Second North American Crane Workshop (Lewis 1979)	Rockport, Texas, USA
1980	International Crane Symposium (Lewis and Masatomi 1981) First Meeting of the USSR Crane Working Group	Sapporo, Japan Moscow, USSR (Russia)
1981	1981 Crane Workshop (Third North American Crane Workshop) (Lewis 1982) Second Meeting of the USSR Crane Working Group (Neufeldt 1982)	Grand Teton National Park, USA Leningrad, USSR (St. Petersburg, Russia)
1982	Third Meeting of the USSR Crane Working Group	Oka Nature Reserve, USSR (Russia)
1983	1983 International Crane Workshop (Archibald and Pasquier 1987)	Bharatpur, India
1984	First Symposium on Crane Research in China (Ma 1986) First Annual Meeting of the Crane Conservation Committee of China Fourth Meeting of the USSR Crane Working Group (Neufeldt 1989, Neufeldt and Kespaik 1989)	Harbin, China Nanjing, China Matsulu State Nature Reserve USSR (Estonia)
1985	1985 Crane Workshop (Fourth North American Crane Workshop) (Lewis 1987) First Meeting of the European Crane Working Group (Bankovics 1987) Second Annual Meeting of the Crane Conservation Committee of China	Grand Island, Nebraska, USA Oroshaza, Hungary Qiqihar, China
1986	Third Annual Meeting of the Crane Conservation Committee of China Fifth Meeting of the USSR Crane Working Group (Litvinenko and Neufeldt 1988)	Nanchang, China Arkhara, USSR (Russia)
1987	International Crane Workshop (Harris 1991; Heilongjiang Forestry Bureau 1987, 1990)	Qiqihar, China
1988	Fourth (1988) North American Crane Workshop (Wood 1982) Fourth Annual Meeting of the Crane Conservation Committee of China Sixth Meeting of the USSR Crane Working Group (Kovshar and Neufeldt 1991)	Lake Wales, Florida, USA Panjin, China Karaganda, Kazakhstan
1989	First Southern African Crane Conference (Porter et al. 1992) Palearctic Crane Workshop (Prange 1995) Asian Crane Congress	Natal, Republic of South Africa Talinn, USSR (Estonia) Rajkot, Gujurat, India
1990	International Sarus Crane and Wetland Workshop (Duc 1990)	Tarn Nong, Vietnam
1991	Sixth North American Crane Workshop (Stahlecker 1992)	Regina, Saskatchewan, Canada

continued...

table 1,4 continued

1992	International Crane Symposium (Whitaker 1992)	Kearney, Nebraska, USA
	International Conference on the Black Crowned Crane and its Habitats in West and Central Africa (Beilfuss et al. in press)	Kano, Nigeria
	International Workshop on Cranes and Storks of the Amur River Basin (Halvorson et al. 1995)	Amur River basin, China/Russia
	Fifth Annual Meeting of the Crane Conservation Committee of China	Guiyang, China
	Crane Conservation Assessment and Management Plan Workshop (Mirande et al. in press a)	Calgary, Alberta, Canada
1993	Second Annual International Crane Symposium (Whitaker and Schimmel 1994)	Kearney, Nebraska, USA
	International Symposium on the Future of Cranes and Wetlands (Higuchi and Minton 1994)	Tokyo/Sapporo, Japan
	African Crane and Wetland Training Workshop (Beilfuss et al. in press)	Maun, Botswana
1994	Third Annual International Crane Symposium (Schimmel 1995)	Kearney, Nebraska, USA
	The Conservation of the Common Crane in Europe (Prange 1995)	Orellana la Vieja, Spain
1996	Seventh North American Crane Workshop	Biloxi, Mississippi, USA
	Meeting of the European Crane Working Group	Rügen-Bock, Germany
	Salim Ali International Crane Workshop	Bombay, India
	East African Crane and Wetland Training Workshop (planned)	Kipsaina, Kenya

bred. Based on this success, the emphasis in captive programs has shifted from the management of individual birds to the management of healthy populations to meet conservation needs.

Under the auspices of the IUCN/SSC Conservation Breeding Specialist Group (CBSG), a series of workshops has been held to assess available information and develops strategies and priorities for the conservation of wild and captive cranes. CBSG has played a major role in linking *ex situ* propagation efforts with *in situ* conservation programs. At a Conservation Assessment and Management Plan (CAMP) workshop in August 1992 it was determined that for 26 of 30 crane taxa, maintenance of a captive population was a necessary component of an overall strategy for ensuring viable populations in the wild (Mirande et al. in press a) (see individual species accounts for further details). The protection of wild populations received highest priority, with captive populations supporting field conservation efforts. For the threatened taxa, captive and wild populations should be managed with exchange of birds and genetic material occurring as needed and feasible. Types of captive management programs and time frames for initiation were identified (see species accounts).

The appropriate integration of captive propagation techniques (e.g., double clutching or single egg removal, translocation, rearing at release sites, hatching of eggs collected from the wild, releasing young, supplemental feeding) and field management techniques is a critical need that continues to challenge the creativity and ingenuity of crane conservationists. In addition to providing birds for release and reintroduction, captive programs contribute to field efforts through research (e.g., on the effectiveness of eastern equine encephalitis (EEE) vaccine, genetic relationships among wild populations, development of ethograms, effects of satellite transmitters on health and behavior); education (e.g., technical training programs, films, community outreach, lectures, curriculum packets, exhibits); and financial support (e.g., for surveys, releases, health care, facility construction, and technical assistance).

In 1993 a Global Captive Action Recommendations (GCAR) workshop was held to design strategies for implementing and refining the CAMP recommendations (Mirande et al., in press a). The workshop document summarizes information on current global and regional captive population sizes; the degree of difficulty in maintaining and breeding the taxon in captivity; and the status of studbook development, management programs, and release programs. At the workshop, participants discussed a wide range of topics, including approaches to genetic and demographic management; research priorities; studbook and management program needs; potential release projects; and methods for coordinating global and regional captive management programs. Global targets for captive populations were established based on conservation priorities.

At the GCAR workshop, a Global Captive Crane Working Group was established. Through this working group, captive crane advisory groups (often called Taxon Advisory Groups, or TAGs) have been established for six regions (Table 1.5). These programs develop regional plans for implementing the GCAR, which individual institutions then apply to their flocks. They set regional target populations, define genetic and

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Captive propagation techniques include the alteration of photoperiod to induce reproductive behavior of the Siberian Crane

demographic objectives, allocate limited space among species, and coordinate work with other TAGs and with field projects.

Individual species management programs or studbooks have been established for twelve species of cranes (Table 1.5). Global Animal Survival Plan (GASP) workshops have been held for Red-crowned Cranes (Mirande et al. in prep. b) and Siberian Cranes (Mirande et al. in prep. c). The Red-crowned Crane is an example of a species that can be managed as regional subpopulations with periodic exchange of individuals. By contrast, the low numbers of Siberian Cranes in captivity make it necessary to manage the species through international collaboration. A GASP for Wattled Crane is under development, and GASPs have been recommended for Black-necked, Hooded, and White-naped Cranes. Other species are currently managed on a regional level. With rare exceptions, wild eggs or birds no longer need to be collected for captive propagation programs. Adequate numbers of wild lineages (>20) are represented in the captive populations and with effective management adequate genetic diversity can be maintained. Wild stock should only be collected if founding lines are lost (i.e., die out).

Captive breeding centers have also organized intensive, species-oriented workshops aimed at ensuring a high probability of survival and adaptive evolution of threatened cranes in the wild. Population and Habitat Viability Analysis (PHVA) workshops have been conducted for the Whooping (Mirande et al. 1993) and Mississippi Sandhill Crane (Seal and Hereford 1993). Preliminary workshops have been held for Red-crowned (Mirande et al. in prep. a), Siberian (Mirande in prep. d), and Wattled Cranes (U. Seal pers. comm.). Follow-up workshops involving broader participation and conducted in the range countries are recommended. A workshop for Eastern Sarus Cranes is scheduled for 1996 in Thailand (M. Wellington pers. comm.). At PHVA workshops, diverse experts collaborate to conduct detailed examinations of the life history, status, and threats to a given taxon. Computer models are used to help assess a population's vulnerability to extinction under current and potential scenarios. The effects of alternate management approaches are evaluated. Through small interactive working groups, conservation strategies are examined and refined. Although these workshops are primarily focused on wild populations, captive populations and releases can also be incorporated into the models.

Captive propagation centers have worked closely with field researchers to develop release techniques. Active reintroduction programs currently exist for the Whooping, Siberian, Mississippi Sandhill, Red-crowned, White-naped, and Wattled Cranes. Sandhill Cranes have been used as surrogates to develop release methods for endangered cranes (Horwich 1989, Horwich et al. 1992, Nagendran 1995). Releases are being considered for the West African Crowned Crane, the Atlas population of Demoiselle Crane, and the Eastern Sarus Crane (see individual species accounts for further discussions).

Releases to date have met with mixed success. Greater Sandhill Cranes have been released onto breeding grounds with conspecifics and have successfully migrated (85%) and bred (Horwich 1989, Urbanek and Bookhout 1991). Migratory releases have also been conducted for Siberian (Sorokin 1994), Red-crowned (Andronova and Andronov 1994, Xu J. et al. 1991) and White-naped Cranes (Andronova and Andronov 1994). One of the main obstacles to successful releases has been the difficulty of teaching migration routes to young birds, especially when wild conspecifics are not available to do so. Techniques to teach migration routes are now under investigation. These include the use of guide birds (Drewien et al. 1995a, Urbanek and Bookhout 1993, Sorokin 1994); ultralight aircraft (K. Clegg pers. comm., W. Lishman pers. comm.); and trucking birds between resting areas (D. Ellis pers. comm.). Attempts to release birds on their wintering grounds have failed to date (Nagendran 1991, A. Brar pers. comm.).

ICF

Costume-rearing techniques have been developed to prepare crane chicks for introduction into the wild

Table 1.5 Crane studbook keepers and program coordinators*

Regional Taxon Advisory Group (TAG) Coordinators for Cranes

Conservation Breeding Specialist Group (CBSG) Captive Crane Working Group:
Claire Mirande, International Crane Foundation (Baraboo, Wisconsin, USA)

North America:
Claire Mirande, International Crane Foundation (USA)

Europe:
Gunter Schleussner, Wilhelma Zoological Garden (Stuttgart, Germany)

U.K. and Ireland:
Nick Lindsay, Whipsnade Zoo (Dunstable, Bedfordshire, England)
David Coles, Child Beale Trust (Berkshire, England)

Africa:
Alan Abrey, Umgemi River Bird Park (Durban, South Africa)

China:
To be determined

Japan:
Kazuaki Nippashi, Saitama Children's Zoo (Saitama, Japan)

White-naped Crane

International Studbook Keeper and SSP (North America) Coordinator:
Christine Sheppard, Wildlife Conservation Society (New York, USA)

Global Animal Survival Plan (GASP) Coordinator:
To be determined

EEP (Europe) Coordinator:
Peter Muhling, Nuremberg Zoo (Germany)

JMSC (U.K.) Studbook Keeper:
Nick Lindsay, Whipsnade Zoo (England)

SSCJ (Japan) Coordinator, Studbook Keeper and Regional Coordinator:
Kazuaki Nippashi, Saitama Children's Zoo (Japan)

Wattled Crane

GASP Coordinators
Fred Beall, Franklin Zoological Park (Boston, USA)
Lindy Rodwell, South African Crane Foundation (Parkview, South Africa)

International Studbook Keeper and SSP Coordinator:
Fred Beall, Franklin Zoological Park (USA)

JMSC Studbook Keeper and JMSP Coordinator:
Nick Lindsay, Whipsnade Zoo (England)

SSCJ Studbook Keeper and Coordinator:
Masanori Kobyashi, Chiba Zoo (Chiba, Japan)

Hooded Crane

International Studbook Keeper and SSP Coordinator:
Bruce Bohmke, Phoenix Zoo (USA)

GASP Coordinator:
To be determined

JMSC Studbook Keeper and JMSP Coordinator:
Nick Lindsay, Whipsnade Zoo (England)

SSCJ Studbook Keeper & Regional Coordinator:
Takeshi Sakoh, Hirakawa Zoo (Kagoshima, Japan)

Siberian Crane

International Studbook Keeper and International GASP Coordinator:
Vladimir Panchenko, Oka State Nature Reserve (Lakash, Russia)

Chinese Studbook Keeper:
Zhao Qingguo, Chinese Association of Zoological Gardens (Beijing, China)

continued...

table 1.5 continued

Red-crowned Crane

GASP Coordinator:
To be determined

International Studbook Keeper and SSCJ Coordinator:
Teruyuki Komiya, Tokyo Ueno Zoo (Japan)

North American Studbook Keeper:
Scott Swengel, International Crane Foundation (USA)

SSP Coordinator:
Claire Mirande, International Crane Foundation (USA)

Chinese Studbook Keeper and Regional Coordinator:
Liu Dajun, Shenyang Zoo (Shenyang, China)

EEP Coordinator and Regional Studbook Keeper:
Robert Belterman, Rotterdam Zoo (Netherlands)

JMSC Studbook Keeper and JMSP Coordinator:
Nick Lindsay, Whipsnade Zoo (England)

Blue Crane

International Studbook Keeper:
Ferdi Schoeman, National Zoological Gardens of South Africa (Pretoria, South Africa)

North American Studbook Keeper:
To be determined

JMSC Studbook Keeper and JMSP Coordinator:
Nick Lindsay, Whipsnade Zoo (England)

West African Crowned Crane

North American Studbook Keeper:
Susan Haeffner, Denver Zoo (USA)

JMSC Studbook Keeper:
Roger Wilkinson, Chester Zoo (Cheshire, England)

Black-necked Crane

GASP Coordinator:
To be determined

Chinese Studbook Keeper:
Zhao Qingguo, Chinese Association of Zoological Gardens (Beijing, China)

Whooping Crane

Studbook Keeper and Genetic Advisor to Recovery Team
Claire Mirande, International Crane Foundation (USA)

Mississippi Sandhill Crane

Studbook Keeper
Joanna Taylor, Patuxent Environmental Science Center (USA)

Brolga Crane

Coordinator, Australian Regional Association of Zoological Parks and Aquariums
Elizabeth Romer, Currumbin Sanctuary (Palm Beach, Queensland, Australia)

Eastern Sarus Crane

International Studbook Keeper
Jumpon Kotchasit, Khao Kheow Open Zoo (Chenburi, Thailand)

[2] As of October 1995. For addresses and phone numbers of these individuals and institutions, contact Claire Mirande at the International Crane Foundation, E-11376 Shady Lane Road, Baraboo, Wisconsin, USA. T: 608-356-9462. F: 608-356-9465.

Non-migratory releases have been conducted for the Mississippi Sandhill Crane (Ellis et al. 1991, Seal and Hereford 1993) and the Whooping Crane (Lewis and Finger 1993). The released birds are able to forage effectively and show signs of normal pair formation. However, problems have been encountered with disease and poor reproductive success among the Mississippi Sandhills and with high bobcat predation on the Whooping Cranes. Since these release programs began, progress has been made in overcoming these problems.

The methods used in raising birds plays a key role in their success after being released. For Sandhill and Whooping Cranes, the highest survival rates have been observed among offspring that have been raised by costumed humans and released as juveniles. Parent-reared birds have survived at lower rates and do better when mixed with costume-reared chicks. Captive-reared Red-crowned and White-naped Cranes have been released into marshes near breeding centers. These birds have bred with one another or with wild birds. The semi-wild birds and their young are brought into captivity for the winter. In the spring the families are released into the marshes, and the young generally join the wild birds and migrate their second fall (Andronova and Andronov 1994, Xu J. et al. 1991).

Cross-fostering eggs into the wild nests of a more abundant species has been attempted with Whooping Cranes (Ellis et al. 1992) and Siberian Cranes (Sorokin 1994). In these cases, the young generally survive and migrate, but improper sexual imprinting on the surrogate parent species has been observed (Lewis 1995b, Mahan and Simmers 1992). This technique is being tested on Siberian Cranes in the hope that the chicks cross-fostered by Eurasians can serve as guide birds for Siberians reared using other methods.

Releases and reintroductions should only be undertaken as part of an approved conservation plan, and should follow the guidelines established by the IUCN/SSC Reintroduction Specialist Group[2]. Releases should not be conducted as a response to surpluses in captive populations. It is especially important that proper precautions be taken to guard against the introduction of diseases into wild populations (Langenberg and Dein 1992).

1.9 Building Integrated Crane and Crane Habitat Conservation Programs

Cranes present excellent opportunities to build programs that combine various conservation goals, activities, and techniques. As well known birds that serve as "umbrella" and "flagship" species in many ecosystems around the world, they are able to draw attention to, and provide protection for, a broad array of other species as well as the ecological functions that maintain ecosystem health. They exemplify the need to consider biodiversity at all levels—genetic, population, species, community, and ecosystem—in designing and implementing conservation programs. They also provide a focus for actions that address local development and conservation needs in an integrated fashion.

Sections 2 and 3 provide many recommendations for priority conservation actions. These recommendations have been developed on the premise that specific actions should be undertaken in a well coordinated and mutually reinforcing manner. Many tools are available to promote the protection, recovery, and perpetuation of the world's cranes, from establishment of protected areas and captive propagation programs to habitat restoration and sustainable development projects. Choosing which tools to use, in which combinations, is the key to success (Soulé 1991).

Fortunately, crane conservationists have over the last several decades gained a great deal of experience and expertise in integrating conservation programs. Many examples can be found in the species accounts in Section 2. Several basic guiding principles can be derived from this experience.

- In the long run, the conservation of cranes must be seen within a larger landscape, watershed, or ecosystem context, and conservation activities must be coordinated at these scales. This is important not only for avoiding conflicts (as, for example, in areas where afforestation has resulted in the loss of crane habitat), but to protect and restore the ecosystem functions that maintain healthy habitat conditions. This includes not only wild landscapes, but those areas where human activities are dominant.

- *In situ* conservation programs must be broadly conceived, and combine legal protection, research, habitat protection and management, education, community participation, and other components. All of these can and must contribute to balanced programs that sustain crane populations, crane habitats, and local human communities.

- *Ex situ* (captive propagation and reintroduction) programs should be undertaken only as a last resort, and not as a substitute for *in situ* programs. Should *ex situ* programs become necessary, they should be developed based on clear goals and management guidelines. Priority should be placed on the maintenance and enhancement of genetic diversity within the population, on safe and effective methods for reintroduction, and on the assurance of high quality care for captive populations.

- Because most cranes are migratory, successful conservation requires clear consensus on goals and responsibilities among parties from different parts of the species range,

[2] The IUCN guidelines and further information on reintroduction programs is available through the IUCN Reintroduction Specialist Group (Chair, Dr. Mark Stanley-Price. African Wildlife Foundation, P.O. Box 48177, Nairobi, Kenya).

constant communication of scientific information, and support from international governments, institutions, and non-governmental organizations.

These are only a few of the basic considerations that should be borne in mind in undertaking the measures recommended in the following sections. The cranes, along with much of the world's biodiversity, will face difficult circumstances in the coming decades. Although their survival—or, in some cases, recovery—cannot be assured, there are steps that can be taken to enhance their chances. But these steps will only be effective if those who are most concerned about and involved in crane conservation coordinate their efforts well.

ICF

Crane and wetland scientists examine wetlands in the Mekong River delta, Tram Chim National Reserve, Vietnam

SECTION 2
Species Accounts

In this section, the conservation status and needs of the world's cranes are examined on a species-by-species basis. These accounts are not intended to provide comprehensive coverage of existing biological knowledge for each species, but rather to summarize the most recent information relevant to their conservation. Readers interested in additional basic information on crane biology and ecology are encouraged to consult Walkinshaw's *Cranes of the World* (1973), Johnsgard's *Cranes of the World* (1983), the proceedings of crane conferences and workshops, and the sources listed within the Literature section at the end of this document. Additional resources are also available through the Ron Sauey Memorial Library for Bird Conservation at the International Crane Foundation (see Box 3).

In preparing the species accounts, the authors and contributors have followed a standard but flexible format. For each species, information is provided under the following headings.

Summary

Each account includes a brief summary of the account as a whole, with information on: subspecies and populations, population numbers, conservation status, historic and present distribution; distribution by country; habitat and ecology; principal threats; current conservation measures; and priority conservation measures.

Subspecies/populations

Recognized subspecies, populations, and (in some cases) wintering subpopulations are identified here. Subspecies have been described for four species (Black Crowned, Grey Crowned, Sandhill, and Saras Cranes). Distinguishing characteristics of the subspecies are briefly noted. Where the intraspecific taxonomic structure has not been fully resolved, this too is noted. Populations are distinguished for eight species (Blue, Demoiselle, Wattled, Siberian, Sandhill, Brolga, Eurasian, and Whooping Cranes). Wintering subpopulations are distinguished for four of the migratory species (White-naped, Hooded, Black-necked, and Red-Crowned Cranes).

Population Numbers and Trends

Estimates of population numbers and general assessments of population trends are provided for each species. An effort has been made to provide this information at the lowest taxonomic level (species, subspecies, population, or subpopulation). In most cases, trends are reported on the basis of changes in the population numbers over the last 10-25 years. Although population estimates for cranes are more readily available and more reliable than for most other kinds of organisms, sizable margins of error still exist for many populations (especially among the most abundant species). These cases are noted. Sources of population data are also noted. Where several sources have been used to derive or corroborate a total, all are noted.

Conservation Status

This section presents the proposed conservation status of the cranes at the species, subspecies, and in some cases population level under the new categories and criteria outlined in *IUCN Red List Categories* (1994). Appendix 3 provides a full explanation of the new IUCN Red List Categories and the criteria on which they are based. The proposed crane categorisations are to be finalized after further review by members of the IUCN/SSC/BirdLife Crane Specialist Group and other crane experts. This section also lists the species' status under the Convention on International Trade in Endangered Species (CITES), as well as additional international conventions where relevant.

Historic and Present Distribution

Each species account includes information on the historic and present distribution of the species. Although reliable information on past distribution is usually scarce, an effort has been made to assess for each species recorded changes in the species range. For most of the cranes, historic records date back at most to the mid- to late-1800s. This is the general time frame covered in these discussions.

Distribution by Country

Because many conservation actions are organized and implemented at the national level, the distribution and status (breeding, migratory, wintering, resident, vagrant/occasional, extirpated) of each species is recorded here on a country-by-country basis. These listings also allow for cross-referencing with the regional-scale priorities described in Section 3.

Habitat and Ecology

Brief discussions of the species' habitat and ecology are provided in this section. As noted above, these are not intended to be comprehensive reviews of existing knowledge on each species, but summaries of information relevant to their conservation status and needs.

Principal Threats

Leading threats to the species as a whole and to particular populations are described. Sympatric species (primarily those in East Asia) are often threatened by similar factors, and an effort has been made to minimize redundancy among these discussions.

Current Conservation Measures and Priority Conservation Measures

Each account includes a review of recent and continuing conservation measures undertaken for each species and a series of specific priority measures that are recommended for the future. Priority measures are listed in order of importance and have been formulated and ranked based on information provided by the IUCN/SSC/BirdLife Crane Specialist Group and other reviewers with expertise in particular species or regions. These priorities have been developed based on a 10- to 15-year timeframe, with critical shorter-term actions receiving higher priority. Current measures are discussed, and priority measures listed, under several general categories, including:

Legal and Cultural Protection

Available information on the legal status of cranes is provided here. Religious traditions and cultural mores have played an important role in the conservation of many crane species, and these too are noted. Priority measures pertain to legal actions needed to protect cranes as well as their habitats.

International Agreements and Cooperation

International cooperation is a critical factor in the conservation of all the cranes (especially the migratory species) and their habitats. Existing formal agreements and other cooperative actions are described here, along with the most significant needs for the future.

Protected Areas

In many cases, protected areas have been established specifically to safeguard cranes and key crane habitats. In other cases, cranes may not depend on protected areas, but use those that have been established for broader purposes. An effort has been made to describe existing protected areas of both types. Priority measures deal with the establishment of new reserves in areas critical to cranes, as well as the expansion and improved management of existing reserves.

Habitat Protection and Management

The fate of most crane species will be determined by the availability and quality of habitat outside of strict reserves. Thus, the maintenance, restoration, and management of habitat often depends on integrating crane conservation efforts with other human activities on the landscape. The status of non-reserved habitat protection and management efforts is reviewed here. Priority measures pertain primarily to habitat that is unlikely to be included within reserves in the future.

Surveys/Censuses/Monitoring

Successful conservation depends upon an understanding of the size of and trends in crane populations. For each species, the extent and duration of surveying and monitoring efforts are summarized, along with the most critical needs for the future. Habitat surveys are generally discussed under the sections "Habitat Protection and Management" (above) or "Research" (below), but are described under this heading if they have been undertaken in conjunction with population surveys.

Research

As a family, the cranes have benefitted from the sustained interest of ornithologists and conservation biologists around the world. Especially since the mid-1970s, research on cranes has expanded significantly. The development and status of research efforts, including important avenues of research and the geographic areas in which they have been conducted, are summarized here. Emphasis is placed on field research with conservation applications. Extensive research has also been undertaken on cranes in captivity. Where such research is particularly relevant for conservation actions, it is noted. Readers interested in research on cranes in captivity are urged to contact the IUCN/SSC Conservation Breeding Specialist Group (CBSG) and the Crane Conservation Department of ICF. Research priorities have been formulated in response to gaps in knowledge that are critical to future conservation projects and programs. These priority topics are intended to strengthen the foundation upon which other recommended actions are built.

Population and Habitat Viability Analyses (PHVA) and Recovery and Management Plans

PHVAs and PVAs (population (and habitat) viability analyses) have been undertaken for several crane taxa. Findings from these analyses are summarized. Similarly, recovery and management plans have already been developed and implemented for several taxa. The provisions and goals of these plans are also summarized. PHVAs are recommended for several crane taxa.

Non-governmental Organizations (NGOs)

Non-governmental organizations have played a significant

role in the conservation of cranes and crane habitat throughout the world. These activities are highlighted in several species accounts. In most cases, support for NGOs is not included specifically under the lists of priority measures. However, many (if not most) of the priority actions will take place under the auspices, or with the close involvement, of NGOs. *Continued support for their efforts should be considered a general priority.*

Education and Training

Cranes have unusual value as the focus of education projects, and offer special opportunities for more broadly conceived conservation education programs. Educational programs involving cranes have been developed in many parts of the world for children, communities, and the general public, as well as for more specific audiences (such as hunters and farmers). Current programs are described, and priority needs identified. In addition, directed professional training programs and needs are discussed under this heading.

Captive Propagation and Reintroduction

The threatened status of cranes at the species and subspecies level has stimulated concerted captive propagation, release, and reintroduction programs. These have been, and are likely to remain, an integral part of comprehensive conservation planning, especially for the Whooping Crane, Siberian Crane, and several crane subspecies.

Programs for the management of captive crane populations for conservation purposes, and for dovetailing *in situ* and *ex situ* conservation actions, are well developed. *The Crane Conservation Assessment and Management Plan* (CAMP) summarizes the status and needs of these programs (see Section 1.8 and Mirande et al. in press a). The CAMP has been developed under the auspices of the IUCN/SSC Conservation Breeding Specialist Group; the Crane Specialist Group; ICF; the Regional Captive Propagation Programs (which includes the major zoological associations in North America, Europe, and China); and the Calgary Zoological Society. Information and recommendations from the CAMP and from the *Global Captive Action Recommendations* (GCAR) for cranes are presented (and occasionally updated and/or supplemented) under this heading.

For all species, the CAMP recommends that management of captive crane populations be carried out at one of four levels: "Intensive-1," "Intensive-2," "No," or "Pending."

Intensive-1 management is defined as follows:

> The captive population should be developed and managed in a manner sufficient to preserve 90% of the genetic diversity of a population for 100 years (90%/100). The program should be developed within 3 years. This is an emergency program based on the present availability of genetically diverse founders.

Intensive-2 management is defined as follows:

> Initiate a captive program within three or more years. Captive population should be developed and managed in such a manner that a nucleus of 50-100 individuals is organized, with the aim of representing as much of the wild gene pool as possible. The program may require periodic importation of individuals from the wild population to maintain the high level of genetic diversity in a limited captive population. This type of program should be viewed as protection against potential extirpation of wild populations.

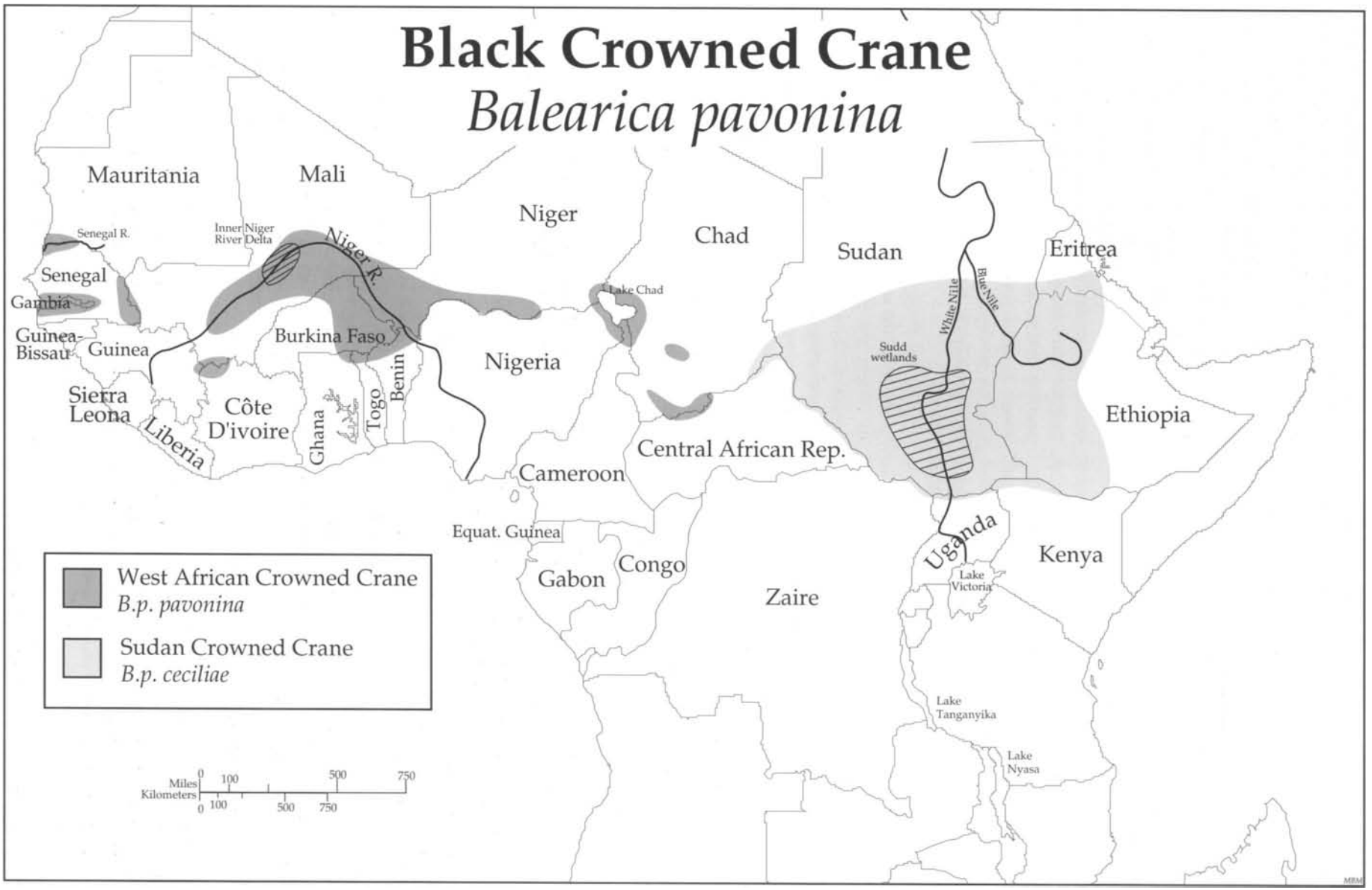
Species for which captive programs are not currently recommended are assigned a No rating. Species for which captive programs are not now recommended but may be considered pending further data are assigned a Pending rating. Assigned levels in the CAMP are reported here under this heading. Captive management programs were also ranked according to their priority (A, B, or C priority), and these rankings are also reported.

Many of the species accounts include additional categories of current and priority conservation measures. These reflect special actions or needs, often particular to the species or a given population. In some cases (efforts to deal, for example, with poisoning or crop depredation), they reflect special problems that require well coordinated responses. In a number of cases, several crane species share priorities and benefit from the same conservation measures. This is most often the case with the cranes of East Asia. As in the discussions of principal threats, an effort has been made to minimize redundancy within the text.

2.1 BLACK CROWNED CRANE (*Balearica pavonina*)

2.1.1 Summary

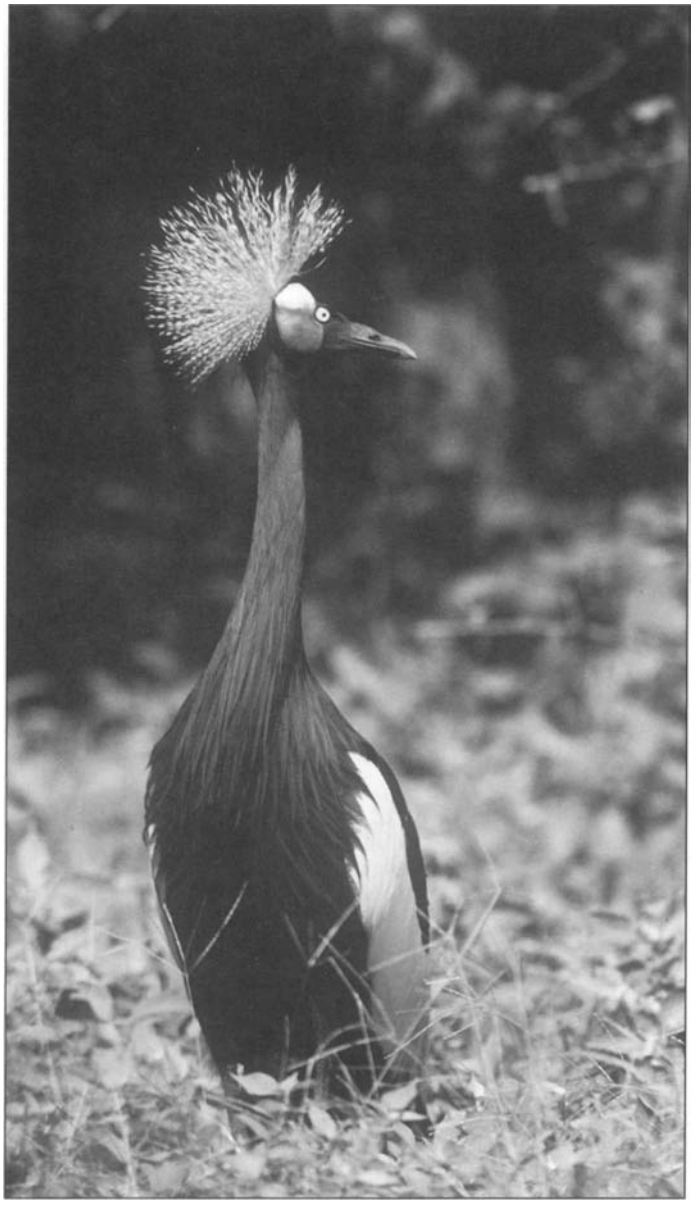
The Black-Crowned Crane is found in the Sahel and Sudan Savanna region of Africa from the Atlantic coast to the upper Nile River basin. Two subspecies are recognized. *B. p. pavonina* (the West African Crowned Crane), with an estimated population of 11,500-17,500, occupies the western part of this range and is divided into eight or more disjunct populations *B. p. ceciliae* (the Sudan Crowned Crane), with an estimated population of 55,000-60,000, occurs in eastern Africa, with the largest concentrations in southern Sudan. Historically, the species was more numerous and more evenly distributed than at present. In the eastern part of its range, its population is stable and relatively abundant. In the western portions of the range, however, its numbers have declined and its range has been reduced dramatically over the last two decades. The species is


Black Crowned Crane
Balearica pavonina
Mauritania
Mali
Niger
Chad
Sudan
Eritrea
Senegal R.
Inner Niger River Delta
Niger R.
Lake Chad
White Nile
Blue Nile
Senegal
Gambia
Guinea-Bissau
Guinea
Burkina Faso
Nigeria
Sudd wetlands
Sierra Leona
Liberia
Côte D'ivoire
Ghana
Togo
Benin
Ethiopia
Central African Rep.
Cameroon
Equat. Guinea
Gabon
Congo
Zaire
Uganda
Kenya
Lake Victoria
Lake Tanganyika
Lake Nyasa
West African Crowned Crane
B.p. pavonina
Sudan Crowned Crane
B.p. ceciliae
Miles
Kilometers
0
100
500
750
0
100
500
750

classified as Vulnerable under the revised IUCN Red List Categories. *B. p. pavonina* is classified Endangered, and *B. p. ceciliae* Vulnerable.

Black Crowned Cranes use both wet and dry open habitats, but prefer a mixture of shallow wetlands and grasslands (especially flooded lowlands in the sub-Sahelian savannahs). They can be considered both year-round residents and local migrants, flocking together during the dry (non-breeding) season and moving from large permanent wetlands to smaller temporary wetlands formed during the rainy season. Although they are non-migratory, daily and seasonal movements may in some areas range up to several dozen kilometers.

The principal threat facing the Black Crowned Crane is the loss, transformation, and degradation of its habitat. Behind this threat lies a combination of causal factors: extended drought in the Sahel and sub-Sahelian savannas, high human population pressures, intensive agricultural development and expansion, and extensive changes in hydrological systems as a result of dams, drainage, and irrigation projects. These factors are most pressing in West Africa, but also affect the species in the east. In some areas, these cranes are hunted for meat or captured and sold for trade. Ineffective enforcement of laws and the shortage of scientific research may also be considered long-term threats to the survival of the species.



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Black-crowned Crane (*Balearica pavonina*)

The decline of the Black Crowned Crane in West Africa has begun to stimulate conservation efforts on behalf of the species. It is legally protected in most countries where it occurs, and many protected areas established in these countries harbor cranes. Several local surveys have recently been undertaken. In 1992, Nigeria hosted an International Conference on the Black Crowned Crane and Its Wetlands Habitat in West and Central Africa, and a Black Crowned Crane Coordinating Centre was established. No reintroduction program has been undertaken for the Black Crowned Crane, but the potential for reintroduction of the West African subspecies has been under discussion, and an experimental release has taken place in Nigeria.

Priority conservation needs for the species include: transfer of the species to CITES Appendix I; ratification of the Ramsar Convention by range countries and adoption of stronger national wetland protection policies and legislation; requirements for environmental impact assessments of large-scale development schemes affecting Black Crowned Crane habitat; increased support for existing protected areas and designation of new areas used by cranes; ecological research on wetlands and crane habitat requirements; a coordinated surveying and monitoring program for the species; collaborative projects involving local communities in the conservation and sustainable use of wetlands; establishment of a West African Crane Recovery Team; development of educational programs involving Black Crowned Cranes and wetlands; and expanded training opportunities for crane and wetland conservation specialists.

2.1.2 Subspecies/populations

West African Crowned Crane	*B. p. pavonina*
Sudan Crowned Crane	*B. p. ceciliae*

The Grey and Black Crowned Cranes were combined within a single superspecies in the past, but are now considered separate species with two subspecies each. The subspecies of the Black Crowned Crane are most easily distinguished by differences in the coloration of their cheek patches. In *B. p. pavonina,* the lower half of the cheek patch is red; in *B. p. ceciliae,* the red extends into the upper half of the cheek patch (Johnsgard 1983, S. Haeffner pers. comm.).

2.1.3 Population Numbers and Trends

Subspecies	Number	Trend	Source
B. p. pavonina	11,500-17,500	Declining. Extirpated (or nearly extirpated) in some nations.	Urban in press
B. p. ceciliae	55,000-60,000	Uncertain. Generally stable, but possibly declining locally. Still abundant, perhaps expanding in Sudan.	Urban in press
Total	66,500-77,500	Declining	

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Black-crowned Cranes at Lake Chad, Nigeria (with Sacred Ibises)

2.1.4 Conservation Status

Species	
IUCN category	Vulnerable, under criteria A1c,d A2c,d
CITES	Appendix II

Subspecies	IUCN Category
West African *(B. p. pavonina)*	Endangered, under criteria A1c,d
Sudan *(B. p. ceciliae)*	Vulnerable, under criteria A1c,d A2c,d

2.1.5 Historic and Present Distribution

The Black-Crowned Crane is found in the Sahel and Sudan Savanna region of Africa from Senegal and Gambia on the Atlantic coast east to the upper Nile River basin in Sudan and Ethiopia (Walkinshaw 1964). Major wetlands—including the delta of the Senegal River, the inland delta of the Niger River in Mali, the delta of the Wazi River at Lake Chad in Camaroon, and the extensive Sudd wetlands in southern Sudan—are strongholds for the species (Eljack in press). *B. p. pavonina* occurs in the western part of this range, from Chad to Senegal, and is now thought to be divided into eight or more disjunct populations. *B. p. ceciliae* is found in eastern Africa, with the largest concentrations (an estimated 50,000 birds) in southern Sudan (Urban in press).

Historically, the Black Crowned Crane was more numerous than at present, and distributed more widely and evenly in the Sahel and sub-Sahelian savannas. The eastern portion of the population remains relatively abundant, although the population may be declining in eastern Sudan (Eljack in press). In western Africa, both the numbers and range of the Black Crowned Crane have declined dramatically since the onset of persistent drought in 1973 (Mustafa and Durbunde 1992). The drying up of wetlands, combined with increasing human population pressures, loss of habitat, and other threats, has fragmented the range of the subspecies and brought it to the verge of extinction in several countries. The population in Nigeria (where it was once abundant and is still the national bird) has been reduced to no more than 50-100 individuals (Urban in press, P. Hall pers. comm.).

2.1.6 Distribution by Country

Country	Subspecies	Distribution Status
Benin	*B. p. pavonina*	r
Burkina Faso	*B. p. pavonina*	r
Cameroon	*B. p. pavonina*	R
Central African Republic	*B. p. pavonina*	r
Chad	*B. p. pavonina*	R
Congo	*B. p. pavonina*	U
Cote d'lvoire	*B. p. pavonina*	r
Egypt	*B. p. ceciliae*	r
Equatorial Guinea	*B. p. pavonina*	U
Ethiopia	*B. p. ceciliae*	R
Eritrea	*B. p. ceciliae*	r
Gabon	*B. p. pavonina*	r
Gambia	*B. p. pavonina*	r
Ghana	*B. p. pavonina*	r
Guinea	*B. p. pavonina*	U
Guinea-Bisseau	*B. p. pavonina*	U
Kenya	*B. p. ceciliae*	r
Liberia	*B. p. pavonina*	U
Mali	*B. p. pavonina*	R
Mauritania	*B. p. pavonina*	r
Niger	*B. p. pavonina*	r
Nigeria	*B. p. pavonina*	r
Senegal	*B. p. pavonina*	R
Sierra Leone	*B. p. pavonina*	X
Sudan	B. *p. ceciliae*	R

Togo	*B.p. pavonina*	r
Uganda	*B.p. ceciliae*	r

R = Resident (population > 1000)
r = Resident (population < 1000)
U = Distribution Status unknown
X = Extirpated

2.1.7 Habitat and Ecology

Black Crowned Cranes use both wet and dry open habitats, but prefer freshwater marshes, wetter grasslands, and the edges of water bodies. The West African subspecies prefers a mixture of shallow wetlands and grasslands, especially flooded lowlands in the sub-Sahelian savannahs during the rainy season (generally June-September). They also forage and nest along river banks, in rice and wet crop fields, and even in abandoned fields and other dry lands, although always close to wetlands. In the eastern portion of its range, the Black Crowned Crane typically inhabits larger freshwater marshes, wet meadows and fields, and open areas of emergent vegetation along the margins of ponds, lakes, and rivers. These landscapes often include acacias and other trees, in which the cranes will roost.

Black Crowned Cranes can be considered both year-round residents and local migrants, flocking—often in large numbers—during the dry (non-breeding) season and moving from large permanent wetlands to smaller temporary wetlands during the rainy season. Their circular platform nests are built of grasses and sedges within or along the edges of densely vegetated wetlands. The average clutch size is about 2.5 eggs/nest.

ICF

Black-crowned Crane chicks (<1 week old)

The incubation period is 28-31 days. The fledging period is 60-100 days (Walkinshaw 1973, Johnsgard 1983).

Soon after the chicks hatch, the cranes move into nearby open upland/grassland areas where they forage on insects and the fresh tips of plants. During the dry season, they forage in upland areas, frequently near herds of domestic livestock where invertebrates occur in greater abundance. If the rains fail, or if nesting habitat is deleteriously affected by drainage or overgrazing, crane pairs will remain in flocks throughout the year. Daily and seasonal movements between feeding and roosting areas are thought to be extensive (perhaps up to several dozen kilometers), but there has been little research on this aspect of their life history (Urban 1981).

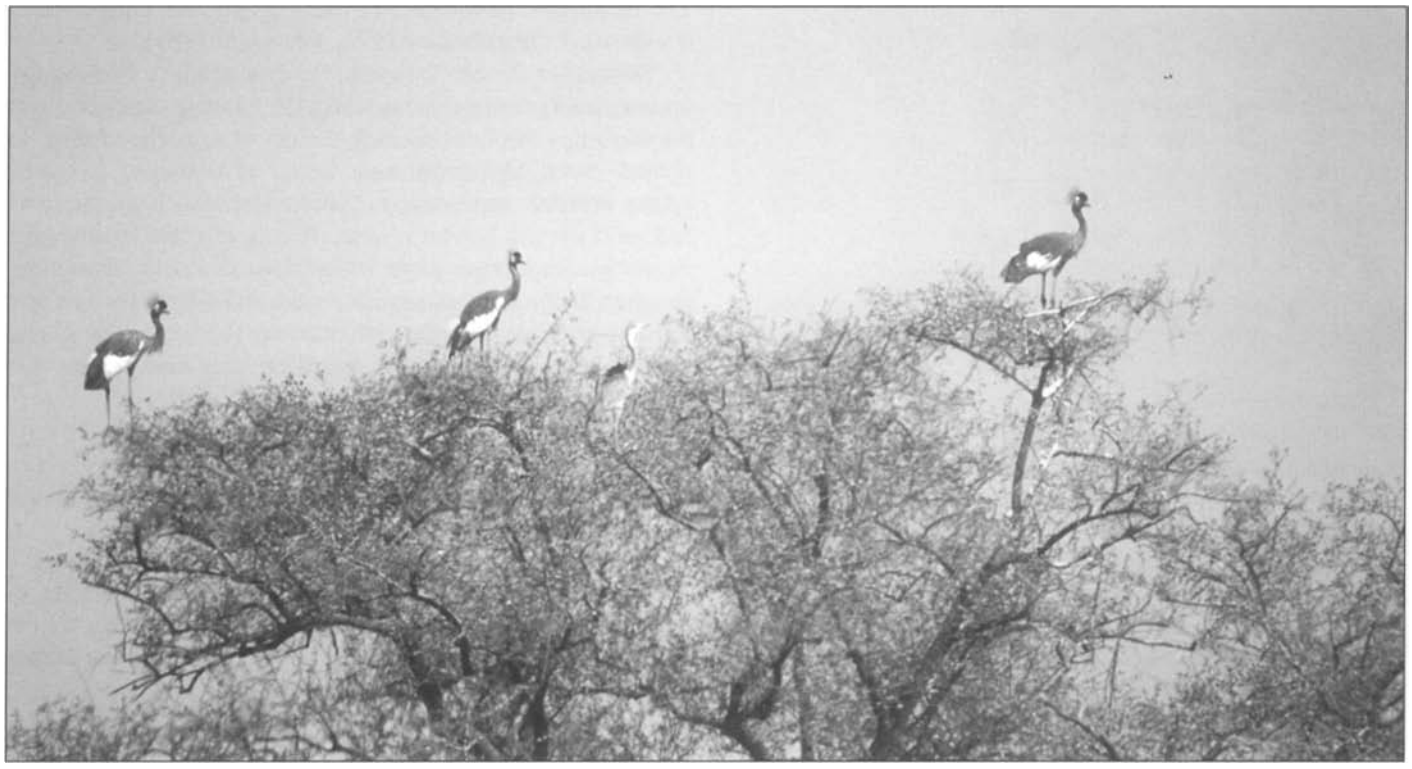
2.1.8 Principal Threats

The principal threat facing the Black Crowned Crane is the loss, transformation, and degradation of habitat (Treca in press). In the last two decades, wetlands and grasslands across the Sahel and Sudan Savanna regions, but especially in West Africa, have been devastated by natural forces and by the intensification of human land use. Drought and increased human pressures (especially overgrazing and destruction of tree cover) are widely considered to have contributed to the southward expansion of the Sahara Desert.[1] Many seasonal and permanent wetlands (even those within protected areas) have been lost to desertification. At the same time, dramatic increases in human population have placed increased pressure on forest, range, and wetland resources (again, most severely in the west). In many areas, traditional forms of resource use have broken down, while intensified agricultural and industrial activities and large-scale development projects have been undertaken (Daddy and Ayeni in press). The environmental consequences, as they pertain to the Black Crowned Crane, are numerous and interrelated:

- Drought and population growth have forced people to migrate to relatively moist, less populated regions (in, for example, Burkina Faso, Nigeria, and Chad) containing prime crane habitat.
- Wetlands have deteriorated as a result of overgrazing and erosion in adjacent lands, pollution, and heavy use of agricultural chemicals (Mustafa in press, Scholte in press). In some areas, such as the Senegal delta, roost trees *(Acacia nilotica)* have disappeared as a result of human demand for fuel and building material.
- Wetlands have been drained to expand agricultural production (of, for example, rice in Senegal) and to provide water for large irrigation projects. Drainage and irrigation schemes have had a significant impact in Nigeria (in, for example, the Hadejia floodplain and the Chad basin) and other parts of West Africa (Fry 1987, P. Hall pers. comm.).[2]

[1] In 1994, abundant rains occurred through many parts of the Sahel, resulting in flooding to levels that had not occurred since the 1960s.

[2] B. Tréca (pers. comm.) notes that, in Senegal, Black Crowned Cranes often use harvested (dry) rice fields for feeding and resting, even when people are in close proximity. He notes that "the expansion of rice fields is not always a threat for Black Crowned Cranes, as long as some wetlands [are] left nearby."



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Black-crowned Cranes roosting near Lake Chad, Nigeria

- Dam construction has been a major thrust of national and international development programs, especially in Cameroon, Nigeria, and Senegal. Impounded waters behind the dams flood wetlands formerly used as nesting habitat by cranes. Downstream, the reduced inflow and resultant changes in flooding cycles desiccate riparian wetlands and allow floodplains to be converted to cropland.
- Intensification of agricultural systems has increased the level of pesticide use and the incidence of indiscriminate pesticide application. In particular, aerial spraying of pesticides has been heavily employed in the effort to control locusts, aphids, and other insect pests, as well as rodents and flocks of Black-faced Dioch (*Quelea quelea*) and Golden Sparrows (*Passer luteus*). This may directly impact cranes through the ingestion of poisoned food items, and indirectly through reduction of the food base (Mustafa and Durbunde 1992, Treca in press).

Although these factors are especially pressing in West Africa, many also affect Black Crowned Cranes in the central and eastern portions of its range. In Sudan, the major threats to crane habitat include overgrazing and mismanagement of livestock, agricultural expansion in the Sudd wetlands, the planned Jonglei Canal in the Sudd, and oil exploration in and near the wetlands (Eljack in press). In addition, ongoing civil war in the region has left national parks and other reserved areas unprotected, prevented the implementation of conservation plans, and hindered international assistance efforts (Ojok in press).

In some areas, the species is hunted for meat or captured and sold. Hunting traditions vary widely within the species' range. In some areas, the eating of cranes is taboo. In Sudan, the species is not normally hunted and is not considered edible (Eljack in press), but it has been hunted during times of war-induced famine. In Chad, Nigeria, and other countries, crane hunting still occurs when the opportunity arises, but cranes no longer occur in sufficient numbers to sustain the practice. Live-trapping probably poses a more significant threat. Black Crowned Cranes are trapped and sold at a considerable profit domestically and also to dealers for foreign export. During the 1970s, the trade in cranes was a problem in Nigeria in particular; the trade has since collapsed due to the decline in the crane population.

Beyond these direct threats, Black Crowned Cranes are also affected throughout their range by ineffective law enforcement, insufficient penalties for illegal activities, inadequate policies and legislation to protect key habitats, and a lack of educational programs emphasizing the importance of wetlands. Finally, there is a basic lack of detailed information on, and little ongoing research concerning, the Black Crowned Crane, its status, and its habitat.

2.1.9 Current Conservation Measures

Legal and Cultural Protection

Black Crowned Cranes are fully protected by law in most of the countries where they occur, although this protection is often ineffective. All the West African countries have enacted legislation protecting cranes. In some countries, such as Burkina Faso, cranes also benefit from the high regard in which they are held under local cultural traditions. There is little hunting pressure on the species in the eastern part of its range.

International Agreements and Cooperation

About half of the range countries of the Black Crowned Crane are parties to the Ramsar Convention (see Table 3.2).

In 1994 it was proposed that the species be transferred from CITES Appendix II to Appendix I. The proposal was withdrawn, but may be resubmitted.

In February 1992, an International Conference on the Black Crowned Crane and Its Wetlands Habitat in West and Central Africa was held in Kano, Nigeria. This meeting focused attention on the decline of the Black Crowned Crane in western Africa and served to launch the Black Crowned Crane Working Group. The 1993 African Crane and Wetlands Training Workshop in Maun, Botswana provided an opportunity to exchange information and to assess the status of the species across its range (Urban in press). The proceedings of the workshop include many of the papers from the 1992 conference as well (Beilfuss et al. in press).

Protected Areas

Black Crowned Cranes use many of the national parks, reserves, and other protected areas that have been established within their range. These include: Djoudj and Nikolo-Koba National Parks in Senegal; Diawling and Banc d'Arguin National Parks in Mauritania; Parc du W in Nigeria; Mare aux Hippopotames International Biosphere Reserves, Arli and Kabore Tambi National Parks, and Pama Game Reserve in Burkina Faso; Penjari National Park in Benin: Waza and Kalamaloue National Parks in Cameroon; Chad Basin National Park in Nigeria; the Ouadi Rime-Ouadi Achim Reserve in Chad; Bamingui-Bangoran and Manovo-Gounda-Saint Floris National Parks in Central African Republic; Randam and Dinder National Parks in Sudan; and Abijatta Shala, Gambella, and Mago National Parks in Ethiopia. However, protected areas in the region are often constrained by limited budgets and ineffective administration.

Habitat Protection and Management

Little habitat management has been undertaken specifically to protect or restore Black Crowned Crane habitat. However, many of the sustainable agriculture, agroforestry, reforestation, and wetland conservation projects undertaken in West Africa offer direct and indirect benefits for Black Crowned Cranes. No sustained habitat restoration studies are underway.

Surveys/Censuses/Monitoring

Urban (in press) provides country-level estimates of Black Crowned Crane populations based on information presented at the 1993 African Crane and Wetlands Training Workshop. The species has been reliably surveyed only in limited portions of its range. Local surveys were undertaken on the Inner Niger River Delta in the mid-1980s (Skinner 1988). Surveys have been conducted in Senegal since 1989 (Treca and Ndiaye in press). Brouwer and Mullie (in press) report recent and historical observations in Niger. Portions of Nigeria and Cameroon have also been surveyed in recent years. Black-crowned Cranes have also been counted during the African Waterfowl Census conducted by the International Waterfowl and Wetlands Research Bureau (IWRB) (Taylor and Rose 1994, Davies in press). One of the main objectives of the proposed West Africa Subregion Management Plan Project (see below) is to undertake coordinated aerial and ground surveys of the species in the western portion of its range. Few surveys of the Sudan Crowned Crane have been undertaken. Eljack (in press) reports a probable total of 5000-7000 at Lake Kundi in western Sudan in 1993.

Research

Of the African cranes, the Black Crowned Crane is the most in need of detailed field studies. This reflects not only its rapid decline and threatened status in the western portion of its range, but also the limited extent of previous research (Urban 1987). Johnsgard (1983) summarized available information on the two subspecies (treating them together with the two Grey Crowned Crane subspecies). No range-wide surveys of the population and very few ecological studies of the species and its habitats have been carried out. Mustafa and Durbunde (1992) provide an overview of the species range and numbers in West Africa, while Urban (in press) summarizes the current status of the species throughout its range.

Non-governmental Organizations

A Black Crowned Crane Coordinating Centre was established in 1992 to carry out the work of the Black Crowned Crane Working Group. It is based in Kano, Nigeria and is currently headed by Hadi Mustafa of Nigeria. The Working Group on African Cranes (WGAC) also promotes research and conservation projects involving the Black Crowned Crane. The WGAC's newsletter, *The Crowned Crane*, serves as a medium for information exchange.

Other non-governmental organizations, working at the national level, have also supported crane and wetland conservation projects. Naturama, a private conservation group in Burkina Faso, has worked to develop public interest in crane conservation. In Nigeria, Pro-natura, a community-oriented conservation organization, assists in crane protection programs (P. Hall pers. comm.). Also in Nigeria, the Hadejia-Nguru Wetlands Conservation Project was established in 1987 through a partnership of the Nigerian government and the Royal Society for the Protection of Birds with support from the Nigerian Conservation Foundation, BirdLife International,

the Finnish International Development Agency, the Finnish Association for Nature Conservation and the British Council (Nigerian Conservation Foundation 1989, Hollis et al. 1993).

West Africa Subregion Management Plan Project

The International Crane Foundation and the Wildlife Conservation Research Centre in Accra, Ghana, have outlined a West Africa Subregion Management Plan Project for the Black Crowned Crane. The goal of the project is to develop a management plan for the West African Crowned Crane that will be endorsed by the governments of all the range countries in West Africa. The specific objectives of the project are to: (1) establish (in partnership with the Black Crowned Crane Coordinating Centre) a survey coordinating center, and contact cooperating individuals and institutions in the region; (2) undertake a region-wide survey and conservation status assessment; and (3) develop and gain support for a management plan for the subspecies. Further information on this project is available through ICF.

Education and Training

In Nigeria, public education programs have begun to draw attention to the precarious state of the species within the country. The Hadejia-Nguru Wetlands Project has undertaken a comprehensive "Keep the Wetlands Wet" campaign to promote conservation education and awareness (R. Beilfuss pers. comm.). Several Nigerian conservationists have received training with ICF and the United Kingdom Jersey Wildlife Preservation Trust (Mustafa and Durbunde 1992). ICF has also developed long-term plans to provide further training, both in-country and at ICF's training center.

Propagation and Reintroduction

The GCAR for cranes estimated that 448 Black Crowned Cranes were maintained in captivity worldwide as of 1993. Of these 31 were reported as *B. p. ceciliae,* and 122 as *B. p. pavonina*; the remainder had no subspecies designation. Regional studbooks for the species are maintained in North America and in the United Kingdom (Table 1.5), and regional captive management plans exist in North America and Europe. The species is considered moderately difficult to maintain in captivity and does not breed predictably (Mirande et al. in press a).

As yet, no ongoing reintroduction program has been undertaken for the Black Crowned Crane. The potential for reintroduction in West Africa has been under discussion, and one experimental release took place in Nigeria in 1992 in connection with the West African Crowned Crane Conference (Taylor and Rose 1994, Daddy and Ayeni in press, Garba in press). Discussions have also been held concerning the development of a captive propagation program in Borno State, Nigeria that can be linked with a release program at the Chingurme-Duguma sector of Chad Basin National Park, which probably holds Nigeria's last remaining population. The GCAR has recommended that a release program be initiated only after existing habitat conditions have been thoroughly assessed and sound habitat management plans implemented.

2.1.10 Priority Conservation Measures

Legal and Cultural Protection

1) Adopt stronger wetland protection policies and legislation at the state and national level throughout the species range. In particular, stronger laws are needed to protect wetlands against over-exploitation, to prevent indiscriminate use of pesticides and other harmful agricultural practices, and to discourage encroachment upon and conversion of key crane habitats.

2) Strengthen enforcement of existing laws prohibiting hunting and live-trapping of cranes and safeguarding cranes within protected areas.

3) Review and update existing laws and penalties to enhance the conservation status of the Black Crowned Crane at the national level, to prohibit trapping and shooting throughout its range, and to bring trade under control.

International Agreements and Cooperation

1) Secure ratification and implementation of the Ramsar Convention in all the range countries.

2) Transfer the species from CITES Appendix II to Appendix I.

3) Establish a West African Crowned Crane Recovery Team to oversee and guide long-term conservation planning for the subspecies. The team should develop a regional management plan that coordinates all recovery efforts within the subspecies' range.

4) Provide increased support for the Black Crowned Crane Working Group. This support should allow the working group to play a more active role in informing policy makers on crane and wetland conservation policy, to strengthen contacts among the range countries, to coordinate research and conservation activities, to promote exchange of information, and to draw attention to specific problems at the local level.

Protected Areas

1) Strengthen existing protected areas that are important for Black Crowned Cranes. Adequate funding, equipment, staffing, and training are needed to allow these areas to function effectively.

2) Assess the status of all areas where large concentrations of Black Crowned Cranes are know to occur and identify

core and buffer areas for potential designation as protected areas.

3) Designate new areas (especially key breeding areas) for protected status. In areas where the Black Crowned Crane is scarce or has been extirpated, designate for protection remaining habitat that is suitable for cranes. Such areas may be designated, for example, as Wetlands of International Importance under the Ramsar Convention, as national wetland reserves and crane sanctuaries, or (in transfrontier areas with large wetland expanses) as international reserves. Key areas for consideration include:
   - the Inner Niger River Delta in Mali;
   - the Senegal River basin in Senegal and Mauritania;
   - the Hadejia-Nguru wetlands in northern Nigeria;
   - the Lake Chad basin (especially the Chingurme-Duguma sector of Nigeria's Chad Basin National Park, which is contiguous with Camaroon's Waza National Park, allowing for possible designation of an international protected area); and
   - the Sudd wetlands in southern Sudan.

Habitat Protection and Management

1) Undertake national-level inventories of wetlands, including all sites known to, or potentially able to, support cranes.

2) Develop integrated land use and conservation programs for critical wetlands within the species range, including those of the Senegal River basin, the Inner Niger River Delta, the Hadejia-Nguru wetlands, the Lake Chad basin (especially those of Chad Basin National Park/Waza National Park region), and the Sudd wetlands.

3) Develop and implement plans for the restoration of degraded wetlands and adjacent lands. Wetland restoration projects are most urgently required in the western portion of the species' range.

4) Require environmental impact assessments for all large-scale development schemes affecting Black Crowned Crane habitat. Coordination of development and conservation projects should take place in accord with the provisions of the Ramsar Convention.

Surveys/Censuses/Monitoring

1) Verify the status, distribution, size, and trends of the Black Crowned Crane population through a coordinated surveying and monitoring program. This program should focus initially on *B. p. pavonina*, and then be expanded to include the species' entire range. Among its other goals, the program should seek to:
   - conduct biannual surveys (aerial surveys during the nesting season and ground surveys during the flocking period) throughout the species' range;
   - delineate the distribution of populations and determine the degree of fragmentation in the range; and
   - monitor trends in the population and its habitats by establishing standard observation sites (e.g., at Lake Chad) throughout the species' range.

2) Provide support for the West Africa Subregion Management Plan Project and the Black Crowned Crane Coordinating Centre in Kano, Nigeria, to coordinate surveying efforts and to disseminate results.

3) Develop an updated species range map for the species.

Research

In addition to research connected with other conservation measures (national-level inventories of wetlands, population and habitat surveys, refinement of husbandry techniques, etc.), research on the Black Crowned Crane should focus on:

1) limiting factors in West Africa;

2) basic ecological studies of wetlands and habitat requirements;

3) the potential for reflooding to restore wetland habitat conditions in West Africa;

4) studies of various aspects of Black Crowned Crane biology, especially population density, nesting success, productivity, feeding habits, and behavior;

5) banding studies to understand local and seasonal movements and the demographics of the populations;

6) development of sustainable land use practices appropriate for the wetland-upland complexes of the Sudan Savanna region; and

7) studies of the status and environmental characteristics of specific protected areas and other critical habitats.

Community Conservation Programs

Community conservation projects are key to the long-term survival of the Black Crowned Crane and other wetland species in the species' range. As specific projects are proposed, emphasis should be placed on involvement of various partners, including government agencies, local communities, non-governmental organizations, and schools and universities. The following activities should be given high priority:

1) Develop and implement demonstration projects that involve communities in the protection and management of local wetlands.

2) Develop and implement integrated conservation programs for cranes that take into account the basic needs of local people and that coordinate economic development and

conservation goals.

3) Promote alternative employment opportunities for crane trappers and dealers.

4) Work with community-based NGOs to develop monitoring, research, education, and habitat restoration programs for the species.

Education and Training

1) Develop comprehensive conservation education and awareness programs involving Black Crowned Cranes and their savannah/wetland habitats. These should be aimed at the general public, focusing on communities that depend on wetlands.

2) Develop education programs aimed at target groups—including crane trappers and dealers, policy makers, students, agency personnel, and communities adjacent to or within protected areas—within the range of the West African Crowned Crane. In particular, extension programs employing a wide range of outreach methods (e.g., lectures, posters, television, radio) are needed to disseminate information on cranes, wetlands, and sustainable land use practices to farmers and other land users.

3) Expand opportunities for professional training in crane censusing and monitoring techniques, ecological research, wetland management and restoration, and conservation education.

4) Provide support for publication and distribution of *The Crowned Crane,* the newsletter of the Working Group on African Cranes.

Captive Propagation and Reintroduction

1) Implement the recommendations outlined in the crane GCAR and CAMP (Mirande et al. in press a). These are to:
   - Determine the subspecies status of as many of the captive birds as possible. Guidelines for differentiating between the subspecies are available through the Denver Zoo in Colorado, U.S.A.
   - Manage the captive population of *B. p. pavonina* at the Intensive-1 (B priority) level, with a target population of 200 birds. *B. p. ceciliae* is not currently recommended for captive management.
   - Establish an international studbook for the species.
   - Develop a regional captive management plan in Africa.
   - After measures to ensure sound management of habitat have been effectively implemented, examine the potential for a release program aimed at reestablishing the species in portions of its range from which it has been extirpated.
   - Undertake research to differentiate subspecies through genetic analysis and to refine captive propagation techniques.

2) Develop in-country expertise in crane propagation and reintroduction techniques through increased training opportunities.

2.2 GREY CROWNED CRANE (*Balearica regulorum*)

2.2.1 Summary

The Grey Crowned Crane is the most abundant of the resident African cranes. Although precise population numbers are not available, recent estimates place the total population at 85,000-95,000. Two subspecies are recognized. *B. r. gibbericeps* (the East African Crowned Crane) comprises the majority of the total population. It occurs in East Africa from northern Uganda and Kenya south to Zimbabwe, Botswana, and Namibia. *B. r. regulorum* (the South African Crowned Crane) is found in Zimbabwe and South Africa. Although the species remains relatively abundant, the total estimated population has declined from more than 100,000 over the last decade. It no longer occurs in certain portions of its historic range (especially the drier areas). The species is classified as Vulnerable under the revised IUCN Red List Categories. *B. r. regulorum* is classified Endangered, and *B. r. gibbericeps* Vulnerable.

Grey Crowned Cranes use mixed wetland-grassland habitats for nesting and foraging, and along with Black Crowned Cranes are the only cranes able to roost in trees. The species' generalist feeding strategy has allowed it to adjust to human settlement and activity; most populations in East Africa now live in human-modified habitats. The abundance and distribution of food and nest sites are the key ecological factors determining the size of the home range. These, in turn, are largely influenced by local rainfall regimes. Grey Crowned Cranes are non-migratory, but undertake local and seasonal movements in response to changing moisture levels and food availability.

Although Grey Crowned Cranes and people have long coexisted, the decline in the species' population over the last decade reflects widespread threats to their habitats as a result of rapid human population growth, drought-related changes in land use, intensified agricultural practices, and other factors. Loss and deterioration of wetland breeding habitat constitute the most significant threats to the species. Other problems include increased use of agricultural pesticides, declines in the fallowing of croplands, high rates of wetland sedimentation due to deforestation, and altered flooding regimes due to dam construction. The capturing of Grey Crowned Cranes for domestication and for export is also a serious threat.

In many areas, the Grey Crowned Crane is considered a sacred bird, and its cultural significance has provided a high

level of local protection. No range-wide surveys of the species have been undertaken, but crane counts and localized surveys have been undertaken intermittently in a number of countries. In recent years, field studies have begun to provide basic biological information on the species, although the knowledge base remains relatively limited compared to other crane species. The increasing number and effectiveness of protected areas, especially in East Africa, has benefitted the species. However, since most Grey Crowned Cranes nest and forage outside protected areas, the overriding conservation challenge has been to develop sustainable alternatives to the overexploitation of non-reserved wetlands. This goal has stimulated a number of community-based wetland conservation projects as well as the development of national-level crane and wetland conservation plans. Non-governmental organizations have often played a key role in these efforts.

Priority conservation measures for the species include: transfer of the species to CITES Appendix I; strengthened laws to restrict trade and protect wild cranes; expansion of community-based wetland conservation programs; designation of additional reserves to protect key breeding areas; development and implementation of national crane and wetland conservation plans, and of more specific management programs for key breeding habitats outside protected areas; organization of national-level crane counts; establishment of long-term monitoring programs; research on the basic biology and ecology of the species, critical habitat, local and regional movements, and the incidence of crop damage; and development of broad-based public awareness programs as well as more specialized educational programs.

2.2.2 Subspecies/populations

East African Crowned Crane	*B. r. gibbericeps*
South African Crowned Crane	*B. r. regulorum*

The subspecies are most easily distinguished by their facial features: *B. r. gibbericeps* has a larger area of bare red skin above the white cheek patch than does *B. r. regulorum.*

2.2.3 Population Numbers and Trends

Subspecies	Number	Trend	Source
B. r. gibbericeps	75,000-85,000	Declining	Urban in press, N and C. Gichuki pers. comm.
B. r. regulorum	~10,000	Unknown; perhaps stable	Urban in press, N. and C. Gichuki pers. comm., D. Allan, pers. comm.
Total	85,000-95,000	Declining	

2.2.4 Conservation Status

Species	
IUCN category	Vulnerable, under criteria A2c,d,e
CITES	Appendix II

Subspecies	**IUCN Category**
East African (*B. r. gibbericeps*)	Vulnerable, under criteria A2c,d,e
South African (*B. r. regulorum*)	Endangered, under criteria A1a,b,c,d,e

2.2.5 Historic and Present Distribution

The range of the Grey Crowned Crane in eastern and southern Africa stretches from eastern Zaire, Uganda, and Kenya to southeastern South Africa (Walkinshaw 1964). Grey Crowned Cranes are non-migratory, but undertake variable local and seasonal movements in response to the abundance

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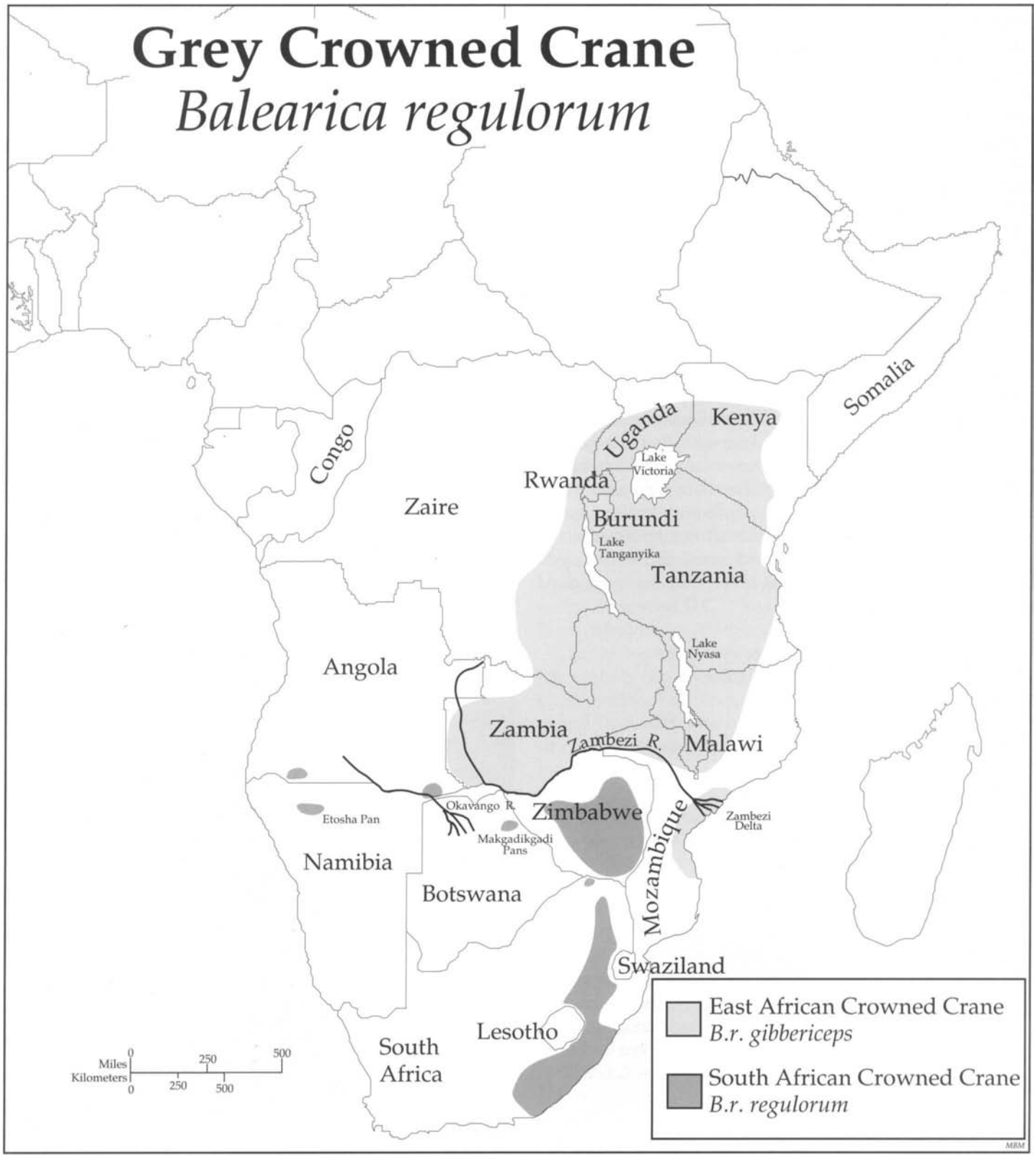
Grey-crowned Crane *(Balearica regulorum),* South African subspecies


Grey Crowned Crane
Balearica regulorum
Congo
Zaire
Uganda
Kenya
Somalia
Lake Victoria
Rwanda
Burundi
Lake Tanganyika
Tanzania
Lake Nyasa
Angola
Zambia
Zambezi R.
Malawi
Okavango R.
Zimbabwe
Zambezi Delta
Etosha Pan
Makgadikgadi Pans
Namibia
Botswana
Mozambique
Swaziland
Lesotho
South Africa
Miles
Kilometers
0
250
500
East African Crowned Crane
B.r. gibbericeps
South African Crowned Crane
B.r. regulorum
MBM

and distribution of food and nest sites (Pomeroy 1980, 1987). The range of *B. r. gibbericeps* meets that of *B. pavonina* in northern Uganda and northwest Kenya (although further field studies are needed to verify the extent of *B. pavonina*'s occurrence in this region). The species' range extends south to Zimbabwe and Botswana, and west along the Okavango River into Namibia. The species is most abundant (~60,000-70,000 birds) in Uganda, Kenya, and Tanzania (N. and C. Gichuki pers. comm.). *B. r. regulorum* occurs in Angola and Zimbabwe, and in South Africa to as far west as East London (Allan 1994, D. Johnson pers. comm.). A gap of several hundred kilometers separates the populations of *B. r. regulorum* in Zimbabwe and those in South Africa.

The distribution of Grey Crowned Cranes seems to have changed little through most of this century, and the species remains relatively abundant (Pomeroy 1987). Between 1985 and 1994, however, the total estimated population declined by approximately 15% (Urban in press). This trend is based on country-level estimates and is corroborated by recent surveys conducted in Kenya, Uganda, and South Africa (Urban and Gichuki 1988, Johnson 1992a, Urban in press). Reductions in the species' range have been reported in Namibia, South Africa, Namibia, and Zambia (Brown 1992, Tarboton 1992a, Allan 1994, Katenekwa in press).

2.2.6 Distribution by Country

Country	Subspecies	Distribution Status
Angola	both	r
Botswana	*B. r. regulorum*	r
Burundi	*B. r. gibbericeps*	r
Kenya	*B. r. gibbericeps*	R
Malawi	both	r
Mozambique	both	R
Namibia	*B. r. regulorum*	r
Rwanda	*B. r. gibbericeps*	r
South Africa	*B. r. regulorum*	R
Tanzania	*B. r. gibbericeps*	R
Uganda	*B. r. gibbericeps*	R
Zaire	*B. r. gibbericeps*	R
Zambia	both	R
Zimbabwe	*B. r. regulorum*	R

R = Resident (population > 1000)
r = Resident (population <l000)

2.2.7 Habitat and Ecology

Grey Crowned Cranes require mixed wetland-grassland habitats. They typically nest within or on the edges of wetlands while foraging in wetlands, nearby grasslands, and croplands. Nesting usually occurs in areas where wetland vegetation is of sufficient height to conceal the cranes on their nests. Their preferred foraging habitat consists of expanses of short- to medium-height open grasslands adjacent to wetlands. There they feed on the tips of grasses, seeds, insects and other invertebrates, and small vertebrates. They also forage in croplands for groundnuts, soybeans, maize, millet, and other items (Johnsgard 1983, Pomeroy 1980). Both the Grey and Black Crowned Cranes may roost in water or perch in trees (or on utility line posts). While rearing chicks, adult birds will sometimes hide their young in the wetland in the evening, and then fly to roost in trees. Thus, while Grey Crowned Cranes may breed in wetlands as small as 1.4 ha, the availability of upland feeding and roosting areas may determine breeding success as much as the availability of wetlands (Gichuki 1993).

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Grey-crowned and Black-crowned Cranes are the only cranes able to perch in trees

The Grey Crowned Crane's generalist feeding strategy has allowed the species to adapt to human settlement. Most crane populations in East Africa now live in human-modified environments (Pomeroy 1987). They are commonly found in a variety of agricultural land types (pastures, grasslands, cultivat-

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Heavy grazing pressure on wetland breeding habitat is a significant threat to the Grey-crowned Crane

ed croplands, and irrigated lands), with sizable flocks occurring on farms and ranches in Kenya and Uganda. They are generally not found on small holdings or among perennial crops (D. Pomeroy pers. comm.). They have adapted especially well to commercial farms with man-made wetlands (reservoir shallows, seeps, etc.). In South Africa, Grey Crowned Cranes use permanent and temporary marshes in both grassland and savanna areas (utilizing smaller wetlands than do Wattled Cranes), but are also found at dam sites, in croplands and fallow fields, and in irrigated areas (Filmer and Holtshausen 1992, Vernon et al. 1992).

The abundance and distribution of food and nest sites are the key ecological factors determining the size of the home range and the extent of local and seasonal movements in Grey Crowned Crane populations (Pomeroy 1987, Gichuki and Gichuki 1991, Gichuki 1993). In areas where food is abundant and suitable breeding sites available, home ranges are relatively small and local movements limited. Gichuki (pers. comm.) found an average breeding territory of 630 ha and an average home range of 2880 ha in Kenya, but noted that the ranges of individual birds varied with age, breeding condition, and season of the year. In drier regions (such as Namibia), local movements are more extensive (Brown 1992).

Seasonality plays a critical role in determining behavioral patterns through the course of the year (Pomeroy 1980, 1987). The breeding season of the species varies depending on the duration and intensity of local dry and wet seasons (Walkinshaw 1964). In drier portions of the species' range, breeding peaks during the rainy season. In other areas the cranes breed over a longer period, and if they are unsuccessful in raising a chick they can renest as long as wetlands are sufficiently flooded (Konrad 1987a, Gichuki and Gichuki 1991, P. Mafabi pers. comm.). Although Grey Crowned Cranes are normally seen in pairs, flocks consisting of as many as 200 birds are frequent in some areas during the non-breeding (late dry/early wet) season (Pomeroy 1980, 1987; Mafabi 1991). Studying the species in Transvaal, South Africa, Tarboton (1992a) found that between one-third and one-half the population occurred in pairs during the breeding season, while less than 10% occurred in pairs in the winter months'.

Grey Crowned Crane are sexually mature at three (rarely two) years. The species has the largest average clutch size (2.5+) of any crane. Clutch size can vary with altitude. Nests consist of uprooted grasses and sedges piled and flattened into a circular platform. The incubation period is 28-31 days. The fledging period is variable, generally between 56-100 days.

2.2.8 Principal Threats

Although the species remains abundant over much of its historic range, it faces widespread (and probably accelerating) threats to its habitat, particularly in the species' stronghold in East Africa. Especially in Kenya and Rwanda, Grey Crowned Crane habitat has been lost or degraded due to rapid increases in the human population, rising demands for land for farming, and the pressures of economic development and drought (Archibald 1992a).

These general threats are reflected in several more specific habitat-related problems. Loss and deterioration of wetland breeding habitat, primarily due to drainage or overgrazing, are the most significant threats to the species. Most of the loss of breeding sites has resulted from drainage of wetlands for urban and agricultural expansion (Gitahi 1993, Mmari in press). Wetland reclamation is widespread in Uganda and Kenya, especially along the shores of Lake Victoria, and in areas where rice agriculture has expanded (Mafabi 1991, Zambia Crane Action Plan in press). The potential for accelerated wetland drainage in much of the species' range remains high (Pomeroy 1987).

Livestock grazing practices have subtle impacts on habitat suitability. Sound pasture management and moderate grazing are essential to the maintenance of the supply of grass seeds used by cranes. Livestock also flush insects that are eaten by cranes, and deter domestic dogs and other potential predators (Gichuki 1993). In some areas, however, the increasing livestock population has resulted in the overgrazing of wetlands, reducing the amount of emergent vegetation. Nesting is inhibited as the vegetation cover is removed. In addition, heavy livestock grazing has been shown to disrupt foraging behavior (Mmari in press). As a result, cranes must increasingly use more marginal habitats, especially nesting habitats.

Although Farming has in the past sometimes improved conditions for Grey Crowned Cranes, recent changes in farming

[1] The four former provinces of the Republic of South Africa have been replaced by nine new provinces. Natal is now known as KwaZulu/Natal, and Orange Free State as Free State Province. The other provinces are: Northwest, Eastern Cape, Western Cape, Northern Cape, Northern Transvaal, Gauteng. and Mpumalanga (eastern Transvaal).

practices have begun to have detrimental impacts. Intensified agricultural land use has shortened (or entirely eliminated) fallow periods, when cranes may safely use wheat, young maize, and rice fields for foraging (Mafabi 1991). Heavy application of pesticides has been identified as a threat in many countries, including Uganda, Malawi, Zambia, Zimbabwe, and South Africa. Where cranes are abundant, crop damage has been reported (Katondo in press b, P. Mundy pers. comm.). This seems to be a problem especially when drought reduces food supplies for cranes. As a result, the incidence of shooting and intentional poisoning has increased from time to time in some portions of the species' range (Urban and Gichuki 1991, Johnson 1992b, Gichuki 1993, Allan 1994, McGann and Wilkins 1994).

Longer-term environmental fluctuations may contribute to some of the recent changes in the species' numbers and distribution. Populations are highly responsive to changes in precipitation levels, the numbers rising and the range expanding during wetter years. In drier years, grassland and wetland fires may take their toll. The apparent reduction in the population in the upper Okavango River in Namibia may be due in part to drought conditions and shifting climatic patterns (Brown 1992). In many parts of the range, groundwater extraction has increased due to drought and rising demands for water for domestic, agricultural, and industrial uses. This has lowered the water table in some regions (most notably in South Africa), affecting especially the smaller wetlands.

Grey Crowned Cranes are also threatened by egg-collecting, hunting, and live-trapping. Gichuki (1993) determined that hunting of the species for food was responsible for about 15% of total mortality in a western Kenya study area. Grey and Black Crowned Cranes have long been valued as ornamental birds in private collections and thus are highly attractive to traders (Pomeroy 1987). The cranes are frequently captured as chicks and taken into captivity, where most perish (N. Gichuki pers. comm.). Capture for domestication and for the export trade is most extensive in Kenya, Uganda, and Tanzania, and should be considered a serious threat (Mafabi 1991, Katondo in press a, Mirande et al. in press a).

Conservation of Grey Crowned Cranes is also hindered by the general lack of biological knowledge about the species, the low level of public awareness of their conservation needs, and the ineffectiveness of existing laws intended to protect the cranes.

2.2.9 Current Conservation Measures

Legal and Cultural Protection

The degree of protection for the Grey Crowned Crane varies. It is legally (although not always effectively) protected in Kenya, Uganda, Zimbabwe, and South Africa (Morris 1987, Mafabi 1991, Johnson 1992b). In many areas, the species benefits from its special cultural significance. It is the national bird of Uganda, and is regarded as a sacred bird or important symbol in parts of Kenya, northern Namibia, Zambia, and other parts of its range. As a result, the species has done well in western and central Kenya despite high human population density (N. and C. Gichuki pers. comm.). Similarly, in the Transkei region of South Africa, the high regard in which the species is held has allowed it to thrive locally despite significant habitat deterioration. In some areas of Kenya, it is considered an inauspicious omen if Grey Crowned Cranes are found close to homes (C. Budde pers. comm.). However, this has apparently not led to persecution of cranes in these areas.

International Agreements and Cooperation

As of June 1995, Kenya, South Africa, Uganda, Zambia, and South Africa had signed and ratified the Ramsar Convention, while Tanzania and Namibia were advancing toward ratification.

Community Conservation Programs

Community-based wetland conservation programs have been most fully developed in Kenya. The Kaisagat Environmental Conservation Youth Group and the Kipsaina Wetland Conservation Organization provide successful models for this approach. By integrating a variety of conservation activities—soil and water conservation practices, gardening and fish farming, tree nurseries and afforestation—and providing networking and education opportunities, these programs have provided a foundation for sustainable resource use and development. Cranes have proven in these two instances to be an effective means of communicating the need for conservation and for stimulating action at the community level (N. Gichuki pers. comm., Wanjala in press).

Protected Areas

Most Grey Crowned Cranes nest and forage outside of protected areas. However, many national parks and other protected areas in East Africa do provide protection for Grey Crowned Crane habitat (Pomeroy 1987). These include: Abijatta-Shala Lakes, Gambella, and Mago National Parks in Ethiopia; Saiwa Swamp and Amboseli National Parks in Kenya; Queen Elizabeth and Lake Mburo National Parks in Uganda; Akagera National Park in Rwanda; Nyika National Park and Rwaza Nature Reserve in Malawi; and South Luangwa, Lochinvar, and Blue Lagoon National Parks in Zambia. In South Africa, the Wakkerstrom Wetland Reserve and Crane Sanctuary, the Steenkampsburg Nature Reserve, and the Umvoti Vlei and Umgeni Vlei Nature Reserves are significant sites for Grey Crowned Cranes.

Habitat Protection and Management

Although habitat management has not usually been undertaken specifically for the Grey Crowned Crane, wetland conservation in general has been the subject of increased attention in eastern and southern Africa. Throughout the species' range, the overriding habitat conservation challenge has been to improve the welfare of the rural people by devising sustainable alternatives to drainage and overgrazing of

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Wakkerstrom Wetland Reserve and Crane Sanctuary, South Africa

wetlands. This goal has been pursued at both the local and national level. In Kenya, for example, community-based wetland conservation projects have been developed with an emphasis on cranes and other wetland wildlife (see above).

Since the mid-1980s, several range countries, including Rwanda, Malawi, and Zambia, have developed national wetland management plans and programs, often with the assistance of the IUCN, the World Wide Fund for Nature, and other conservation organizations (see Jeffery et al. 1992). Most recently (in July 1994), the Ugandan government approved and adopted a national wetland policy, and enabling legislation is now being enacted (P. Mafabi pers. comm.). At the 1993 African Crane and Wetland Training Workshop in Maun, Botswana, 12 of the Grey Crowned Crane range countries prepared preliminary crane and wetland action plans (Beilfuss et al. in press).

Surveys/Censuses/Monitoring

Urban (in press) provides country-level estimates of Grey Crowned Crane populations based on information presented at the 1993 African Crane and Wetlands Training Workshop. No range-wide surveys of the species have been conducted. In the last decade, however, surveys have been undertaken intermittently in a number of range countries, including Kenya (Gitahi 1993), Uganda (Mafabi 1991), Namibia (Brown 1992), and South Africa (Johnson and Barnes 1986, Johnson 1992a, Filmer and Holtshausen 1992, Tarboton 1992a, Vernon et al. 1992, McCann and Wilkins 1994). In Kenya, local crane counts were organized in the late 1980s, but have not been conducted on a regular basis since 1990 (Hill 1988, Mafabi 1989, M. Hill pers. comm.). Grey-crowned Cranes have also been counted during the African Waterfowl Census conducted by the IWRB (Taylor and Rose 1994, Davies in press).

Research

Although information on the biology and ecology of Grey Crowned Cranes remains relatively scarce, researchers have begun to fill in many of the knowledge gaps over the last two decades. Field studies have been undertaken at the regional level in East Africa by Pomeroy (1987), and at the national level in Kenya (Gichuki 1993), Tanzania (Frame 1982, Katondo in press a), Rwanda (Kanyawimba in press), Uganda (Pomeroy 1980, Mafabi 1991), Zambia (Konrad 1987a, Dodman in press, Katenekwa in press), and in Natal (Johnson 1992a), Transvaal (Tarboton 1992a), and eastern Cape

Province (Vernon et al. 1992) in South Africa.

Several recent studies have focused on topics especially relevant to crane conservation efforts. Gichuki's (1993) study of factors affecting the reproductive success of the Grey Crowned Crane in Kenya represents the most extensive field research undertaken on the species. Katondo (in press) studied the incidence of crop damage in irrigated rice fields in Tanzania. Mmari (in press) focused on the impact of livestock grazing on cranes in Tanzania. Much of this information may be found in the *Proceedings of the First Southern African Crane Conference* (1992) and the *Proceedings of the 1993 African Crane and Wetland Training Workshop* (in press). In South Africa, Eskom and the Endangered Wildlife Trust are now collaborating in a research program involving the Wattled, Blue, and Southern Crowned Crane in the Natal midlands. These studies are expected to contribute to the development of a management plan for these three species (McCann and Wilkins 1994).

Daut (1994) conducted an epidemiological survey of Inclusion Body Disease of Cranes (IBDC) among Grey Crowned Cranes at Saiwa Swamp National Park in Kenya and in several zoos in South Africa. There were no indications that the birds were infected with the disease. Vocal communication between parental cranes and their juveniles is the main focus of another study at the crane and wetland research center in Saiwa National Park in Kenya. This study provides a logical follow-up to studies carried out at the site since 1986 (N. Gichuki pers. comm.).

Non-governmental Organizations

Conservation activities involving the Grey Crowned Crane have been coordinated and implemented through a number of NGOs, including: Crane Study Groups in Kenya and Uganda; the Wildlife Clubs of Kenya (WCK); the World Wide Fund for Nature (which has sponsored crane conservation work in Kenya and Uganda); and IUCN (which has supported the national wetland conservation program in Uganda). Non-governmental organizations (often in collaboration with national and international conservation organizations) have often played a key role in developing community-based conservation programs by facilitating the participation and involvement of the local population, and by monitoring progress to ensure their effectiveness.

ICF has helped to coordinate Grey Crowned Crane counts in Kenya (with the WCK) and in Uganda (with the Wildlife Clubs of Uganda), and has supported research, training, and information exchange among African crane biologists and conservationists. In South Africa, the Southern African Crane Foundation, the Southern African Ornithological Society, and the Highlands Crane Group of the Endangered Wildlife Trust have all supported work on the species (Allan 1994, McCann and Wilkins 1994, Rodwell 1994).

Education and Training

Because Grey Crowned Cranes are familiar to local people, held in high regard, and often found in heavily populated areas, they are unusually well suited for use in conservation education projects. Crane counts have proven to be particularly effective tools for stimulating local interest in wildlife protection and for involving students and others in projects involving conservation and sustainable development. The community-based conservation projects described above have emphasized education about cranes, wetlands, and sustainable use of wetlands and other natural resources. ICF has developed a curriculum involving cranes and wetlands for use in Uganda's secondary schools that could be adapted to other countries (M. Hill pers. comm.).

Professional training opportunities involving crane and wetland conservation have expanded in recent years, particularly in connection with the 1993 African Crane and Wetland Training Workshop. ICF has provided training courses in environmental education and crane and wetland biology for biologists from Kenya, Uganda, Malawi, Zambia, and South Africa.

Captive Propagation and Reintroduction

The GCAR for cranes estimated that 1212 Grey Crowned Cranes were in captivity worldwide as of 1993 (Mirande et al. in press a). However, this figure does not include a substantial number of additional birds held in the private sector. Of the total identified in the GCAR, 389 were reported as *B. r. gibbericeps*, and 69 as *B. p. regulorum*; the remainder had no subspecies designation. No studbook has yet been developed for the species. The species breeds readily in captivity and a significant number have reproduced. Interbreeding between the two subspecies and with Black Crowned Cranes has occurred (Mirande et al. in press a). No reintroduction program has been undertaken for the species and none is recommended at present.

2.2.10 Priority Conservation Measures

Legal and Cultural Protection

1) Enact strict controls at the national level to prevent the export of Grey Crowned Cranes from range countries.

2) Strengthen national laws to protect cranes, especially through increased penalties for trapping, hunting, capture, and illegal possession. This is of particular importance in Kenya, Tanzania, Uganda, and Zimbabwe.

International Agreements and Cooperation

1) Secure ratification and implementation of the Ramsar Convention in all the range countries.

2) Transfer the species from CITES Appendix II to Appendix I.

Community Conservation Programs

The overriding need through much of the Grey Crowned Crane's range is for conservation programs that promote crane and wetland protection along with improvements in local resource use practices. In order to promote such programs:

1) Develop, with the active participation of the local people, long-term conservation projects involving the Grey Crowned Crane and associated wetlands.

2) Strengthen existing community-based conservation organizations that work on Grey Crowned Cranes and wetlands, such as the Kipsaina Wetland Conservation Organization and the Kaisagat Environmental Conservation Youth Group in Kenya.

3) Evaluate and communicate the success of these existing programs, and adapt these programs to other portions of the species range.

Protected Areas

1) Determine the presence of breeding and non-breeding populations within protected areas.

2) Identify key breeding areas for possible designation within new wetland reserves.

3) Cooperate with landowners and communities near protected areas to strengthen reserve management programs and to harmonize conservation and development goals.

4) Develop ecosystem restoration programs in protected areas where habitat conditions for cranes and other wildlife have declined.

Habitat Protection and Management

1) Develop and implement national-level crane and wetland conservation policies and plans in range countries. In some cases, national programs and action plans already exist and require support for their full implementation; in other cases, such plans have yet to be developed, or require further development. These efforts should coincide with moves to adopt and carry out the provisions of the Ramsar Convention.

2) Provide increased protection and improved management programs for key breeding habitats outside protected areas. This should involve, among other measures: surveys of existing and potential breeding habitat; development of community-based wetland restoration programs; development of wetland uses compatible with crane conservation requirements; adjustments of agricultural practices to improve habitat conditions for cranes; and incentives for farmers who set aside suitable nesting habitat for cranes and waterfowl.

3) Develop incentive and reimbursement programs for landowners in areas where crop damage occurs. Such programs should include provisions for monitoring their effectiveness.

Surveys/Censuses/Monitoring

1) Organize crane counts in all range countries. Non-governmental organizations can and should play a key role in organizing and coordinating these counts.

2) Establish a long-term monitoring program to determine trends in population size and habitat conditions at national and regional levels. It is especially important to census and monitor established flocking and nesting sites. In portions of southern Africa where the Grey Crowned Crane's range overlaps with those of the Blue and Wattled Cranes, the three species can be monitored simultaneously.

Develop an updated species range map based on data from these programs.

3)

Research

1) Identify critical habitat, especially breeding habitat, for the species. In particular, inventories and surveys of breeding areas outside of existing protected areas are needed. In conjunction with these surveys, nesting densities on the breeding grounds should be assessed.

2) Identify additional habitats used throughout the year, and determine local and regional movements throughout the species' range.

3) Determine the degree to which the ranges of the Grey and Black Crowned Cranes overlap in northern Uganda and Kenya.

3) Assess the impact of Grey Crowned Cranes on agricultural crops and determine the factors that influence the timing and location of crop damage.

4) Conduct basic studies of the species' distribution, population, ecology, recruitment rates, interactions with people, and conservation threats throughout the species' range.

5) Conduct research focusing on factors (including human activities) that affect productivity in different parts of its range.

6) Assess the extent and impact of the capture, sale, and export of the species.

Education and Training

1) Integrate public education efforts into all local crane research and conservation projects.

2) In conjunction with crane counts, undertake public education campaigns to promote awareness of the importance of wetland conservation.

3) Develop special educational programs aimed at groups critical to the conservation of Grey Crowned Cranes, especially teachers; small farmers and other rural landowners whose lands include wetlands; and those who are involved in the capturing of cranes for trade. These programs should emphasize concepts of sustainable use and conservation of wetlands; the conservation status of cranes and required conservation measures; and the need to protect cranes during the breeding season.

4) Provide increased funding for the publication and distribution of *The Crowned Crane*, the newsletter of the Working Group on African Cranes.

5) Provide increased training opportunities for in-country crane researchers, wetland conservationists, and reserve management staff. In particular, reserve managers require advanced training in emerging concepts of ecosystem-based wetland management.

Captive Propagation and Reintroduction

1) Implement the recommendations outlined in the Crane GCAR and CAMP (Mirande et al. in press a). These are to:
   - Determine the subspecies status of as many of the currently maintained birds as possible. Guidelines for differentiating between the subspecies are available through the Denver Zoo in Colorado, U.S.A.
   - Expand, improve, and maintain International Species Information Service (ISIS) data on the species.
   - Manage a subset of individuals with known genealogies to meet goals for a captive population of *B. r. regulorum* at the Intensive-1 (C priority) level, and of *B. r. gibbericeps* at the Intensive-2 (C priority) level, with target populations of 200 birds for each subspecies.

2) Restrict, if necessary, the reproduction rate among captive Grey Crowned Cranes to allow more space for Black Crowned Cranes.

2.3 DEMOISELLE CRANE (*Anthropoides virgo*)

2.3.1 Summary

The Demoiselle Crane is the second most abundant of the world's cranes (only the Sandhill Crane is more numerous). The total population is estimated at 200-240,000, but reliable surveys of the species have been conducted in only limited portions of its range. There are no known subspecies. Six main populations are distinguished here. The three eastern populations—the Eastern Asia, Kazakhstan/Central Asia, and Kalmykia—are abundant, numbering in the tens of thousands. The Black Sea population consists of approximately 500 individuals. A disjunct resident population in the Atlas Plateau of northern Africa is believed to include no more than 50 individuals. A small breeding population exists in Turkey.

Historical records indicate that the species' range has contracted substantially in western Eurasia and northern Africa, as well as in Kazakhstan and other areas further east. The species is classified Lower Risk (Least Concern) under the revised IUCN Red List Categories. However, the Atlas and Turkey populations are classified Critically Endangered, and the Black Sea and East Asia populations Endangered and Vulnerable respectively.

The species breeds in the Eurasian steppes from the Black Sea to northeastern China. The main wintering grounds are in India, Sudan, and other portions of eastern Africa to Chad. Demoiselle Cranes are primarily grassland birds, but are usually found within a few hundred meters of rivers, shallow lakes, depressions, or other natural wetlands. If water is available, they will inhabit even semi-deserts and true deserts. Their winter habitats in east-central Africa include acacia savannahs, grasslands, and riparian areas. In India, they feed in agricultural fields and stubble fields, and roost in shallow water or on sandbars and mudflats surrounded by water.

The future of the Demoiselle Crane is more secure than most crane species due to its large total population, broad range, abundant breeding habitat, adaptability, and high rate of breeding success (even in areas inhabited by people). However, the species faces a number of serious threats. Its breeding habitats in natural steppe areas are highly attractive for agricultural conversion (although it has adapted to agricultural fields under some circumstances). Its wintering grounds are subject to increased disturbance and agricultural development as a result of rising human populations. Other threats include collecting, indiscriminate hunting, and persecution as a result of the crop damage they can sometimes cause. These threats have brought about the species' decline in the western part of its range, and have endangered local populations in other areas.

Conservation measures that have benefitted the Demoiselle Crane include: protection, either through cultural traditions or formal legal restrictions, in many range countries; establishment of numerous protected areas; extensive local surveys and studies of several key migration routes; development of a monitoring program for the threatened Black Sea population; exchange of information on the species in several international forums; and intensive crane education programs in India and Pakistan. No release or reintroduction programs are underway, but releases into areas from which the species has been extirpated (or where it exists in critically low numbers) have been considered.

Priority conservation measures for the species include: expanded conservation efforts focused on the Atlas, Turkey,

Y. SHIBBNaEV

Demosielle Crane *(Anthropoides virgo)*

and Black Sea populations and their habitats; expansion of key protected areas and establishment of new protected areas in important habitats; development and adoption of agricultural practices that can minimize the degree of interference between cranes and farmers; coordinated international surveys of the species; studies of the migration routes, resting areas, and wintering grounds of various populations; public education programs in the species' breeding range and along its migration routes; and development of a more specialized education program involving hunters in Pakistan and Afghanistan.

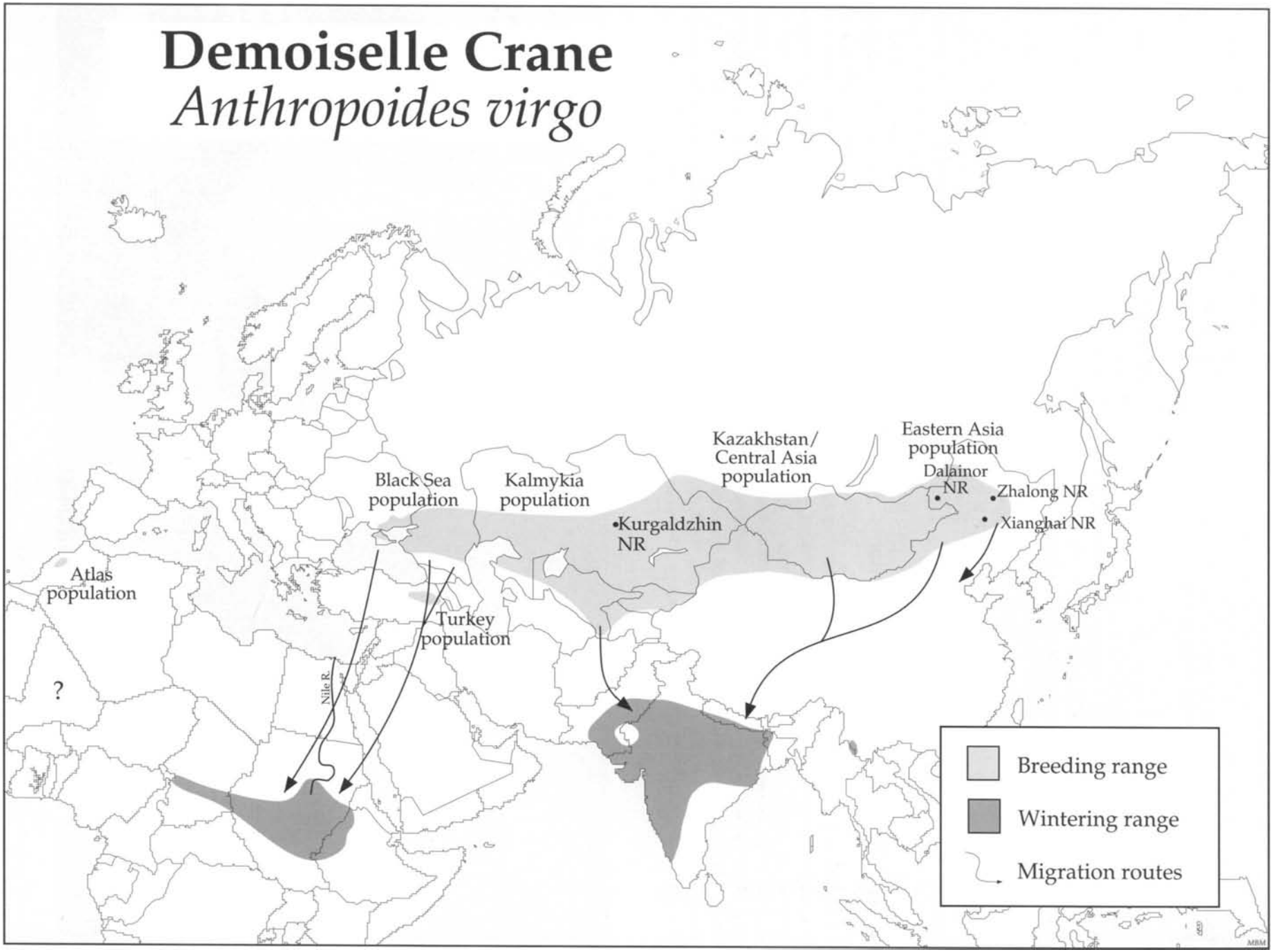
2.3.2 Subspecies/populations

No known subspecies. The species is broadly distributed and occurs in at least six main populations. The small resident population in northwest Africa may be taxonomically distinct.

2.3.3 Population Numbers and Trends

Population	Number	Trend	Source
Atlas (northern Africa)	<50	Declining	Brahim in press, Newton in press b
Black Sea	~500	Declining	J. van der Ven pers. comm., Y. Andryushchenko pers. comm.
Turkey	<100	Unknown	Kasparek 1988
Kalmykia	30-35,000	Stable	Kovshar et al. 1995, V. Flint pers. comm., S. Newton pers. comm.
Kazakhstan/ Central Asia	100,000	Stable to increasing	Kovshar et al. 1995
Eastern Asia	70-100,000	Stable to declining	Fujita et al. 1994, Kovshar et al. 1995, Bold et al. 1995, J.Harris pers. comm.
Total	200-240,000	Stable	

Demoiselle Crane
Anthropoides virgo



2.3.4 Conservation Status

Species	
IUCN category	Lower Risk (least concern)
CITES	Appendix II

Populations	IUCN Category
Atlas	Critically Endangered, under criteria A la,c,d A2c,d C1 C2b D
Black Sea	Endangered, under criteria Alc C2a
Turkey	Critically Endangered, under criteria A1a,c,d A2c,d C2b D
Kalmykia	Lower Risk (Least Concern)
Kazakhstan/Central Asia	Lower Risk (Least Concern)
Eastern Asia	Vulnerable, under criterion Alc

2.3.5 Historic and Present Distribution

Historical records indicate that the species' breeding range has contracted substantially in western Eurasia and in some portions of central and eastern Asia (Sudilovskaya 1963, Kovshar 1987, Winter et al. 1995). The species originally bred throughout the southern Eurasian steppes, from Mongolia in the east to the Dobrudzha region of Romania and Bulgaria in the west, with known outlier breeding populations in the Atlas Plateau of northwest Africa and in eastern Turkey. The species was recorded in Spain through the 1800s, but information on its occurrence is scarce and unreliable (J. A. Alonso pers. comm.). The species last bred in Tunisia and Algeria in the early part of the 20th century (Johnsgard 1983). It was extirpated as a breeding bird in Dobrudzha in the 1920s, and now occurs in the Balkan Peninsula only irregularly during migration (Flint 1987, Kovshar 1987, T. Michev pers. comm.). Since the 1950s the Black Sea population in Romania, Moldova, and Ukraine has declined substantially (Winter et al. 1995). Little is known about historic changes in the small breeding populations of Turkey and North Africa (Kasparek 1988, Eames 1989, Newton in press a).

Although still abundant in many areas, the species has declined (in some cases rapidly) in Central Asia, and other parts of its range over the last several decades. These populations seem to have stabilized, and may now be increasing, in areas where human density is low and agricultural conversion of their steppe habitats is limited, as in portions of Kazakhstan (Kovshar 1987). The eastern steppes, especially in central Mongolia, are the species' stronghold. However, even the large eastern populations are now vulnerable as their steppe habitats are developed and as human pressures mount in their wintering areas. The wintering populations in eastern Nepal have declined over the last 15 years as a result of direct persecution (R. Suwal pers. comm).

The species is broadly dispersed during the breeding season. Six populations have been identified.

R. SUWAL

Demoiselle Crane migrating through the Himalayas in Nepal

1) Atlas population

This population probably numbers no more than 50. Recent estimates suggest that it contains only 10-12 individuals, and may no longer be breeding (Brahim in press, Newton in press a). The breeding grounds are in the Middle Atlas Mountains in Morocco. The wintering grounds have not been definitively established, but are likely along the Niger River (J. van der Ven pers. comm.) or possibly in the vicinity of Lake Chad (Scholte in press).

2) Black Sea population

This population numbers approximately 500 (J. van der Ven pers. comm., Y. Andryushchenko pers. comm.). The breeding grounds are mainly in the Kerch Peninsula of Crimea and other portions of southeastern Ukraine (Grinchenko 1988b, Winter et al. 1995). The population migrates across and around the Black Sea through Turkey, Cyprus, and Egypt to wintering grounds in Ethiopia and Sudan. This population has declined steadily since the 1950s. It no longer occurs as a breeding bird in Romania, Moldova, or Bulgaria, nor as a wintering bird in Egypt (Atta 1995, T. Michev pers. comm.).

3) Turkey population

This population is poorly studied. It is believed to include fewer than 100 individuals (Kasparek 1988). These birds breed in Eastern Anatolia in Turkey and probably migrate with the Black Sea and Kalmykia birds to Sudan and other areas of East Africa. This population and the Black Sea population are separated by the Caucasus Mountains. In the past, both were probably part of a single contiguous population, now interrupted by local extirpations, that surrounded the Black Sea (J. van der Ven pers. comm).

4) Kalmykia population

This population numbers 30,000-35,000 and is considered stable. The breeding grounds are located between the Black and Caspian Seas. The population migrates through Georgia, eastern Turkey, Iraq, Iran, and the Middle East to wintering grounds in Sudan, Ethiopia, and other areas of east Africa (Newton in press b).

5) Kazakhstan/Central Asia population

This population is estimated at 100,000. The breeding grounds are east of the Caspian Sea throughout Kazakhstan. The population migrates through Afghanistan and Pakistan to wintering grounds in the western portions of the Indian subcontinent. The Indian state of Gujarat is the core wintering area. The states of Maharashtra and Karnataka are also important wintering areas, while Madhya Pradesh and Andhra Pradesh are critical during severe droughts (Perennou and Mundkur 1991). The degree of concentration in wintering flocks also varies in response to monsoon patterns (Perennou and Mundkur 1991). This population declined sharply in the 1950s and 1960s, but stabilized and eventually began to increase in the 1980s (Kovshar et al. 1995).

6) Eastern Asia population

No complete survey of this population has been undertaken. Estimates derived from partial surveys suggest a total of 70-100,000 (Fujita et al. 1994, Kovshar et al. 1995, Bold et al. 1995, J. Harris pers. comm., G. Archibald pers. obs.). The breeding grounds are in Mongolia, northern China, and southeastern Russia (Bankovics 1987, Ma 1991). The population migrates across China and through the Himalayan range (Martens 1971). Some of the birds winter in southern China, Nepal, and other portions of the eastern Indian subcontinent, but most join the birds from the Kazakhstan/Central Asia population in the wintering areas of western India. The population is thought to be generally stable, but may be declining in some localities.

2.3.6 Distribution by Country

Afghanistan	M
Algeria	X(b)
Bangladesh	W (irregular)
Bhutan	M
Bulgaria	M (irregular), X(b)
Camaroon	V
Chad	W
China	B,W
Cyprus	M
Egypt	M, X(w)
Eritrea	M
Ethiopia	W
Georgia	B
Hungary	M (irregular)
India	M,W
Israel	M
Iran	W (rare)
Iraq	M, X(b)?
Japan	V
Jordan	M
Kazakhstan	B
Kirghizia	B
Lebanon	M
Libya	M (irregular)
Mali	W?
Moldova	M (irregular), X(b)
Mongolia	B
Morocco	B
Myanmar	W (rare)
Nepal	M,W
Nigeria	W (rare)
Oman	W
Pakistan	M,W
Romania	M (irregular), X(b)
Russia	B,M
Saudi Arabia	M, W (rare)
Spain	X(b)
Sudan	W

Syria	M
Tadzhikistan	B
Tunisia	X(b)
Turkey	B, M
Turkmenistan	B
Ukraine	B
United Arab Emirates	W (rare)
Uzbekistan	B
Yemen	W?

B = Present during breeding season
M = Present during migration
W = Present during winter
V = Vagrant
X = Extirpated: (b) as a breeding species; (m) as a migrant (w) as a wintering species; (r) as a permanent resident
? = Unconfirmed

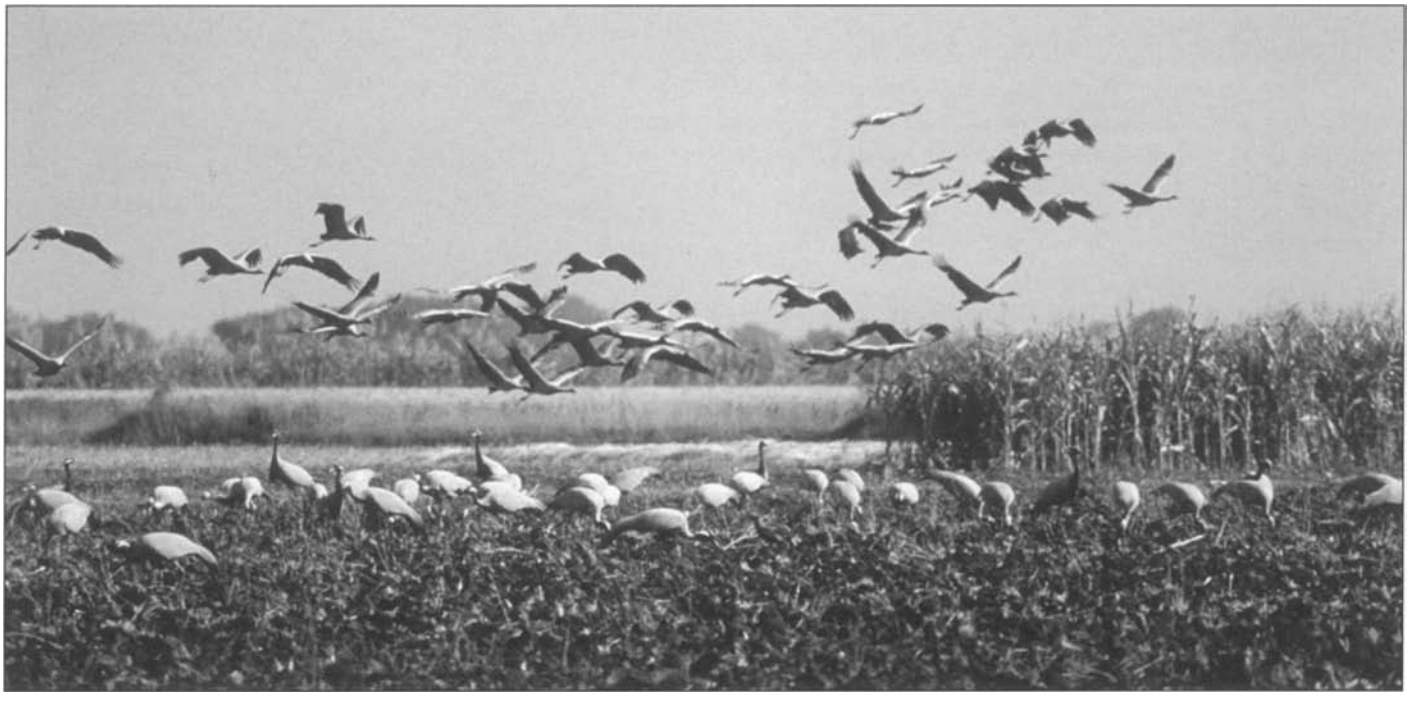
2.3.7 Habitat and Ecology

Demoiselle Cranes are primarily birds of dry grasslands (savannahs, steppes, and semi-deserts). They do, however, utilize agricultural fields and wetter steppe areas, and are normally found within a few hundred meters of stream and rivers, shallow lakes, depressions, and other natural wetlands (Winter 1991, Yang and Tong 1991, Fujita et al. 1994). The breeding sites of the Turkey population are found in wetlands along rivers and creeks (Kasparek 1988). The density of breeding birds and size of breeding territories can vary widely from year to year in response to precipitation levels. Where water is available, they will inhabit semi-desert areas and even true deserts, alkali flats, and other vegetation-poor lands. They have been found nesting as high as 3000 m above sea level in mountain valleys and steppes of Kirghizia (Kydyraliev 1995).

In nesting areas, Demoiselle Cranes prefer patchy vegetation (e.g., *Artemesia* spp., *Stipa* spp., *Festuca* spp.) of sufficient height to conceal them and their nests, but short enough to allow them to look out while incubating. Nest sites near the tops of slopes are especially valued. In recent years, as extensive areas of their steppe habitats have been converted to cropland, Demoiselle Cranes have begun to adapt to agricultural fields. This trend has been observed in Kazakhstan, Ukraine, and other steppe regions (Baranov 1982, Kovshar 1987, Kovshar et al. 1995, Winter et al. 1995). In Ukraine, the Black Sea population may now preferentially select agricultural fields for breeding sites. Their success in these regions, however, depends upon the extent, type, and timing of local farming practices (Winter et al. 1995, Y. Andryushchenko pers. comm.).

Nests are found on small open patches of grass, cultivated ground, or gravel, and show minimal preparation. Small pebbles and some thin bedding may be gathered together, but eggs are often laid directly on the ground. Usually two eggs are laid. The incubation period is 27-29 days, and the fledging period of 55-65 days is the shortest of any crane (Johnsgard 1983, S. Swengel pers. comm.).

Demoiselle Crane families are mobile soon after the chicks hatch. Their diet consists primarily of plant materials, insects, and other small animal foods. During the growing season and along migration routes, they will feed as well on cereal grains, peanuts, beans, and other crops. During the prefledging period, adults and chicks can cover considerable distances in their



S.TRANEVING

Wintering Demoiselle Cranes at Gujarat, India

search for insects and other food items. In dry years, they may become essentially nomadic. After the chicks fledge in mid-summer, the cranes gather in flocks and move to agricultural fields, where grains and other gleanings are abundant.

Migration begins in late summer. The various populations encounter diverse terrain, from sea level to Himalayan mountain passes, during migration. Several populations undertake significant sea crossings (the Red Sea and the eastern Mediterranean). By early autumn most Demoiselle Cranes have arrived on their wintering grounds. Birds from the Black Sea and Kalmykia populations winter primarily in cultivated fields as well as acacia savannahs, grasslands, and riparian areas in Sudan and other parts of northeastern Africa (Hogg et al. 1984). The wintering birds in India forage in agricultural fields, stubble fields, and riverbeds, and roost in shallow water or on sandbars and mudflats surrounded by water (Gole 1993a).

2.3.8 Principal Threats

Habitat loss and degradation are the main current threats to the Demoiselle Crane. The breeding grounds in the Eurasian steppes—especially those with nearby water sources—are highly attractive for agricultural development, resulting not only in conversion of habitat but increased pressures from grazing, disturbance, poaching, and other human activities. The Black Sea population has declined due to conversion of the steppes, the use of pesticides, and the intensification of agricultural methods (Winter et al. 1995). At the opposite end of the species' range, in Mongolia, conversion of the steppes has been less extreme, but has begun to have similar impacts on breeding populations (Bold et al. 1995). Although the relationship between farmers and Demoiselle Cranes in many breeding areas of Kazakhstan and Ukraine has improved, changes in agricultural practices (such as spring plowing and increasing use of pesticides) continue to have negative impacts on nesting and feeding behavior.

Many migratory habitats have been lost or altered in recent decades, primarily through the building of dams and the drainage of wetlands (Jan and Ahmad 1995, T. Michev pers. comm.). The wintering grounds in India and Sudan are subject to increasing disturbance as a result of rising human populations. The breeding population in Morocco is threatened by grazing, mining, and disturbance from other human activities (Brahim in press). Pesticides pose a problem in some areas, especially India and Morocco.

Because Demoiselle Cranes can (with adequate protection and the adoption of appropriate farming practices) reproduce successfully in agricultural fields, its demise in the western portion of its historic range likely involved indiscriminate hunting, egg collecting, and other forms of human disturbance. At present, Demoiselle Cranes are hunted most extensively—primarily for sport, but occasionally for food—in Pakistan and Afghanistan (Ferguson 1993, Jan and Ahmad 1995, Landfried et al. 1995). Following traditional hunting practices, the crane hunters in Pakistan station themselves in valleys where the cranes pass on migration and use tame cranes to lure wild birds within range of rock-weighted slings (known as *soya).* Hunters hurl the soya into the air to entangle the flying cranes. In recent years, increasing numbers of hunters have taken up this traditional practice, while firearms have also been used with greater frequency. The Eurasian Crane and the critically endangered central population of the Siberian Crane are also affected by this practice (Roberts and Landfried 1987; see the Siberian Crane account in this volume). As many as 5000 cranes of all three species (10-15% of the total population of migrating cranes) have been shot or captured in Pakistan in a single season, and the popularity of the sport continues to grow (Ahmad and Shah 1991, Jan and Ahmad 1995).

In areas where they gather in large numbers, Demoiselle Cranes can cause significant crop damage. This is particularly

S.TRANEVING

Demoiselle Crane and hunter along the Blue Nile in Sudan

a problem at premigration staging areas in Kazakhstan, during migration through Nepal, and on wintering grounds in Sudan and India. The Demoiselle Cranes stopping in Nepal in the autumn can inflict serious damage to ripened millet and other crops on the small terraced fields that are found where farmland is scarce (R. Suwal pers. comm). In most such problem areas, farmers attempt to drive the cranes off, but do not directly persecute them. In some areas, however, cranes are shot or poisoned (Khachar et al. 1991).

2.3.9 Current Conservation Measures

Legal and Cultural Protection

Demoiselle Cranes are protected by cultural tradition in many portions of its range. In many Islamic areas, they are held in high regard (in part because the Koran mentions Demoiselle Cranes) (Newton in press a). In Mongolia and parts of India they are considered auspicious birds and are protected by local people (Harris 1991b, Gole 1993a).

Formal legal protection is provided in most range countries, including China, Russia, Mongolia, Kazakhstan, Turkmenistan, and Ukraine. Beginning in 1984, regulations pertaining to the hunting of cranes were adopted in Pakistan (Jan and Ahmad 1995, Landfried et al. 1995). In 1994, China requested that the government of Nepal restrict the hunting of Demoiselle Cranes in order to assure that the populations in China remain abundant (R. Suwal pers. comm.).

International Agreements and Cooperation

International conservation measures involving the Demoiselle Crane have usually been undertaken in conjunction with activities to benefit other crane species. Current efforts to create an international protected area in the China-Mongolia-Russia border area, for example, are especially important for the White-naped Crane, but also provide important benefits for Demoiselle Cranes due to the predominance of steppe vegetation in the region (Harris 1991b). Similarly, the international campaign to protect the Central population of the Siberian Crane necessarily entails measures that protect the Demoiselle and Eurasian Cranes that share its migration route (Jan and Ahmad 1995, Landfried et al. 1995). Conservationists from Saudi Arabia and five countries in North Africa have identified the priority needs of the Atlas population and the wintering populations in Africa (Newton in press a). Information about Demoiselle Cranes has been exchanged at the international crane conferences convened in India (1983), China (1987), Kazakhstan (1988), Estonia (1989), and Botswana (1993).

Protected Areas

Most Demoiselle Cranes are found outside of protected area, but do use many areas throughout their summer and winter range. Within the breeding range, Demoiselle Cranes are found in the Zhalong, Momoge, Xianghai, Keerqin, and Dalainor Nature Reserves in China; Toreiski and Kara-Chingliski Nature Reserves in Russia; the Daurski Reserve in Mongolia; and Kurgaldzhin Nature Reserve in Kazakhstan (Smirenski 1985; Tong 1986; Harris 1986, 1991b, 1992a; Ma and Li 1994). In Pakistan, the Lakki Crane Reserve near the Kuram River is used as a resting area during migration (wild cranes are lured to the area by some 100 captive cranes that are held within a large fenced enclosure). In recent years, only one Demoiselle pair from the Black Sea population has bred within a protected area, at Azov-Sivash National Park in Ukraine (Y. Andryushchenko pers. comm.). In Nepal, the Annapurna Conservation Area Project protects the main flyway of the Demoiselle Crane through the Himalayan massif (R. Suwal pers. comm.).

Habitat Protection and Management

Because most Demoiselle Cranes are found outside of protected areas, the development of habitat protection and management programs are of special importance for the species. In most cases, such programs involve the coordination of agricultural production and crane conservation practices. Thus far, this work has focused on analyzing the factors affecting Demoiselle Cranes in agricultural settings, and identifying methods to reduce negative impacts. Research on the situation has been undertaken mainly in breeding areas in Kazakhstan and Ukraine (Winter et al. 1995, Y. Andryushchenko pers. comm.).

Surveys/Censuses/Monitoring

Although no systematic survey of the Demoiselle Crane population has been conducted across the entire species range, smaller scale surveys have been undertaken increasingly in recent years. *The Demoiselle Crane in the USSR* (Kovshar and Neufeldt 1991) provides information from field surveys in many parts of the Demoiselle Crane's breeding range. Autumn migrations have been most closely monitored in several key mountain passes of Nepal. *Crane Research and Protection in Europe* (Prange 1995) contains information on surveys in Ukraine, Georgia, Tuva, the Minusinsk basin, the Altai territory, central Kazakhstan, and central Asia. The wintering populations in India were first surveyed in 1982, and have been counted reliably since 1988 through the Asian Waterfowl Census (AWC), which is organized by the International Waterfowl Research Bureau and the Asian Wetland Bureau (Perennou and Mundkur 1991). The AWC has also provided numbers intermittently from Iran, Pakistan, China, and Nepal.

Ornithologists in Saudi Arabia began to monitor spring migrations of Demoiselle Cranes in 1992, and have endeavored to establish an annual monitoring program (Newton and Symens 1993, Newton in press b). In 1992, the Azov-Black Sea Ornithological Station in Ukraine established "The Virgo Programme" to monitor the Demoiselle Crane and other rare and disappearing bird species of the Ukrainian steppes. Economic and political constraints have hindered the realization of this program, but if carried forward it will provide a foundation for the long-term monitoring of the Black Sea population (Y. Andryushchenko pers. comm.). The Atlas population has

not been reliably surveyed in recent years.

Research

Until recently, relatively little research had been undertaken on the Demoiselle Crane. Over the last decade, however, research has expanded rapidly throughout its range. The most extensive collection of information on the species is *The Demoiselle Crane in the USSR* (Kovshar and Neufeldt 1991), which includes 38 scientific papers on Demoiselle Crane distribution, population numbers, biology, flock movements, and migration patterns from various portions of its main breeding range. Additional scientific papers on Demoiselle Cranes in the former Soviet Union can be found in *Cranes in the USSR* (Neufeldt 1982), *The Palearctic Cranes* (Litvinenko and Neufeldt 1988) and *Crane Research and Protection in Europe* (Prange 1995). Since the mid-1980s, Chinese researchers have also expanded studies of the species (e.g., Gao and Pan 1985, Tong 1986, Ma et al. 1993).

Several recent studies have focused on the species' breeding ecology (see Kovshar and Neufeldt 1991, Winter 1991, Yang and Tong 1991, Ma M. et al. 1993, Fujita et al. 1994). Research on migration has been undertaken in a number of countries, including China, Mongolia, Kazakhstan, Nepal, Pakistan, and Saudi Arabia (Martens 1971, Gavrilov 1977, Bankovics 1987, Kovshar and Neufeldt 1991, Ahmad and Shah 1991, Newton and Symens 1993, Xu et al. 1995). Landfried et al. (1995) have combined studies of the impact of hunting on migrating cranes in Pakistan with efforts to involve local hunters and conservationists in future crane research.

Scientists at Ukraine's Azov-Black Sea Ornithological Station have carried out extensive field studies of the Black Sea population over the last decade, providing a foundation for future protection and restoration efforts (Winter 1991, Winter et al. 1995). The breeding populations in the Atlas Mountains and Turkey populations are the least studied. Moroccan researchers have recently tried to locate Demoiselle Cranes near Fez, where over the last decade bird watchers have sighted them in April.

Non-governmental Organizations

Non-governmental organizations that have been active in various aspects of Demoiselle Crane conservation include the Wild Bird Society of Japan, the International Crane Foundation, the Mongolian Ornithological Society, the Annapurna Conservation Area Project, the Ecological Society (India), the Bombay Natural History Society, WWF-India, WWF-Pakistan, the International Center for Conservation Education, and BirdLife International.

Education and Training

The most intensive educational projects involving the Demoiselle Crane have been developed in India and Pakistan (Ahmad and Shah 1995, Landfried et al. 1995). These efforts have been undertaken in connection with the campaign to raise public awareness of the Central population of the Siberian Crane and to counteract heavy crane hunting pressures along the population's migration route (which Eurasian Cranes from the Central Siberian population also use). Education programs involving Demoiselle Cranes have also been initiated in Ukraine (Winter et al. 1995), Saudi Arabia (Newton in press b), and Nepal (R. Suwal pers. comm.). Demoiselle Cranes are also featured in public education programs in wetland refuges and reserves of Russia and northeast China where they breed.

Captive Propagation and Reintroduction

The GCAR for cranes estimated that 1048 Demoiselle Cranes were in captivity as of 1993. Most are believed to be descended from birds from the eastern populations (Mirande et al. in press a). Demoiselle Cranes breed readily in captivity, and have long been popular in zoos. As a result, a large but unknown number of birds are maintained in the private sector, and unknown lineages are common within the captive population. A small but increasing percentage of the captive Demoiselle Cranes that are held as pets in Pakistan are bred. Captive propagation for conservation purposes has not been necessary, and at present there are no active or planned release programs for the species. However, reintroduction and releases are being considered for areas where the species is extinct or exists in critically low numbers (primarily in the case of the Atlas population).

2.3.10 Priority Conservation Measures

Developing a Conservation Program for the Atlas Population

A coordinated program is urgently needed to assess the status and conservation needs of the dwindling Atlas population of Demoiselle Cranes. The following measures should receive priority in developing this plan:

1) Undertake field surveys at the earliest opportunity to determine the numbers and status (in particular, the breeding status) of the population.

2) Provide the population and its habitats with protection from disturbance and egg collecting. As a part of this effort, an educational program involving dissemination of information about the population should be undertaken.

3) Locate and provide greater protection for the population's non-breeding habitats, including possible sites along the Niger River and at Lake Chad and Lake Fitri.

4) Assess the status of the population's breeding and wintering habitat and the potential of these areas to support successful releases.

5) Develop a program for the systematic monitoring of the population and its habitats.

6) Conduct genetic analyses of the population to determine the need for, and means of, supplementing the population with released birds. The decision to supplement the population should not be made until habitat assessments and genetic studies have been conducted. Translocation of birds from other parts of Africa may be the best option. If the Atlas population is supplemented with birds produced in captivity, it may be better to use existing stocks of birds of Asian origin than to establish a captive population from the African birds. This will depend on the significance of genetic differences (if any) between the Asian and African populations.

Developing a Conservation Program for the Black Sea Population

A coordinated program to protect the Black Sea population of Demoiselle Cranes should be elaborated and implemented. The following measures should be included as key components of this program.

1) Provide stronger protection for the Black Sea population and its habitats by strengthening the network of protected areas. Specific needs include:
   - Expansion of Azov-Sivashki National Park (Ukraine) to include the staging area just south of the current boundary. (This area is also a critical habitat for the Eurasian Crane). The island of Churyuk should also be incorporated into the park (only about 1/4 of the island is currently within park boundaries).
   - Establishment of a new protected area in the southeastern part of the Kerch Peninsula in Crimea.
   - Establishment of new protected areas at resting areas along migration routes.
   - Surveys of other critical breeding habitats in Ukraine for potential protection.
   - Identification of the wintering grounds and assessment of the need for stronger protection.
2) Protect breeding habitat outside of protected areas by working with landholders to implement conservation measures. These measures include: halting of afforestation projects in the steppe regions (and removal of existing plantations); fallowing of strips within large cropfields; cultivation of appropriate crops; removal of sheep from nesting areas; reduction of additional disturbance factors; and development of educational materials concerning the methods and timing of cultivation (see Winter et al. 1995). Such measures are required especially in the population's breeding range in the Zaporizhya, Dnipropetrovski, Khersonski, and Donetski regions, and in Crimea.
3) Develop a long-term monitoring capacity by providing full support for "The Virgo Programme" of the Azov-Black Sea Ornithological Station in Ukraine.
4) Conduct research on the breeding biology of the population and on the location, status, and ecology of its wintering and staging areas in eastern Africa.
5) Organize migration watches in the Balkan Peninsula and Cyprus.
6) Develop educational programs for use throughout the population's range. It is especially important to publish booklets for farmers and other landholders with information about the need for their assistance in protecting cranes.
7) Examine the historic range and habitats of the Black Sea population, and the potential for its eventual reestablishment in areas from which it has been extirpated or now occurs only during migration (including Bulgaria, Romania, Moldova, and southwestern and central Ukraine).

Developing a Conservation Program for the Turkey Population

Little is known about the conservation status or needs of this population. The following steps are recommended to provide the foundation for future conservation efforts.

1) Conduct field surveys and interviews to determine the size and distribution of the population.
2) Assess the status of the population's habitat and any existing or potential threats.
3) Establish a locally based population and habitat monitoring program.
4) Identify key local officials, citizens, and organizations with an interest in the conservation of this population and its habitats.

The following priority needs are of particular importance in the central and eastern portions of the species range, but will also provide important benefits for the Atlas, Black Sea, and Turkey populations.

Legal and Cultural Protection

1) Strengthen enforcement of existing restrictions on the hunting of cranes (especially in Nepal, Pakistan, Georgia, and Afghanistan).
2) Assess the legal status of the species in all range countries.

International Agreements and Cooperation

1) Address the conservation needs of the Demoiselle Crane within an umbrella international agreement on the conservation of the migratory cranes of East Asia (Japan, Russia, China, Mongolia, and North and South Korea).

2) Expand cooperative international efforts to determine the size and status of Demoiselle Crane populations, to study migration routes, and to assess conservation needs.

3) Establish an international monitoring network to gather and disseminate information on the status of the species.

Protected Areas

1) Establish new protected areas in the Borgoi steppe and Eravninsky regions of Buryatia and in the Republic of Tuva (Russia).

2) Identify and establish new protected areas in Kalmykia (Russia).

3) Expand the Kurgaldzhinski Nature Reserve (Kazakhstan).

4) Establish a new protected areas in the Turgaiski region of Kazakhstan.

5) Survey other key breeding areas in the eastern portions of the breeding range and identify important sites for potential establishment of protected areas.

6) Assess the effectiveness of the protected areas in Pakistan and the need for expansion and/or upgrading.

Habitat Protection and Management

1) Undertake a comprehensive assessment of the impact of agricultural development on the Kalmykia, Kazakhstan/Central Asia, and Eastern populations.

2) Develop and disseminate information on agricultural production practices that minimize interference between cranes and people at different times of the year.

2) Develop lure crops to minimize crop damage at staging areas of the Kazakhstan/Central Asia population.

3) Support development of crane conservation activities (e.g., migration monitoring programs and educational programs) through Nepal's Annapurna Conservation Area Project.

Surveys/Censuses/Monitoring

1) In conjunction with efforts to monitor the Atlas and Black Sea populations, develop a coordinated and standardized monitoring program to determine the size of, and trends in, the Kalmykia, Kazakhstan/Central Asia, and Eastern populations.

2) Continue migration monitoring in Saudi Arabia, and expand the program to include other countries along the Middle East migration corridors.

3) Strengthen efforts to monitor migration and migratory habitats in Pakistan.

4) Expand winter surveys in Sudan, western Ethiopia, and the Lake Chad basin.

5) Continue regular winter surveys in India, and expand current efforts to cover the entire Indian subcontinent.

Research

1) Determine more precisely, through banding and radio tracking programs, the breeding range, migration routes, resting areas, and wintering grounds of all populations.

2) Conduct additional studies of the factors affecting breeding success in agricultural areas, giving special attention to the impact of various production methods.

3) Expand studies of the impacts of hunting on the crane populations migrating through Pakistan.

4) Conduct coordinated international studies to understand better the timing of migration, the numbers involved, flight behavior, and climatic influences on migration patterns.

5) Undertake a comprehensive review of the incidence of crop damage by migrating Demoiselle Cranes (including a compilation of available information on timing, location, types of crops involved, contributing factors, and farmer response).

6) Undertake specific studies of the status and environmental characteristics of protected areas and other critical habitats.

7) Determine through genetic research the degree of divergence between the African and Asian populations.

Education and Training

1) Develop locally-based education programs for students and the general public to better protect the species on its breeding grounds. Emphasis in these programs should be given to the ecology of the Eurasian steppes, changing land use in the steppes, and efforts to protect cranes, other grassland birds, and native steppe vegetation.

2) Develop public education programs along the migration routes of the Demoiselle Crane, with special emphasis on crane counts and the biology of migration. In many areas, these can be coordinated with similar efforts for the Eurasian Crane.

3 Expand targeted education programs in Pakistan and Afghanistan to address the problems resulting from high hunting pressure and to increase the level of awareness of crane conservation among hunters, students, and local citizens and officials.

Captive Propagation and Reintroduction

1) Implement the following recommendations of the crane GCAR and CAMP (Mirande et al. in press a):
   - Organize the genealogical data on the captive population.
   - Based on this information, manage a subset of birds with known genealogies representing at least 20 lines, with a target population of 200 individuals.
   - Manage the Eurasian populations at the Intensive-2 (C priority) level.
   - Determine the need for, and possible means of, supplementing the Atlas population (see above).

2) Examine the need for and feasibility of reintroduction in portions of the species' historic range where it has been extirpated, has reached critically low numbers, or occurs only during migration (e.g., Spain, Ukraine, Bulgaria, Romania, Iraq, Tunisia, Algeria).

3) Monitor the growth of the captive population to avoid competition with higher priority crane species and other avian taxa for the space and resources of captive breeding programs.

4) Conduct a training workshop in Pakistan to encourage the propagation of birds already in captivity (rather than the capture of wild birds) for pets.

2.4 BLUE CRANE (*Anthropoides paradisea*)

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Blue Crane *(Anthropoides paradisea)*

2.4.1 Summary

The Blue Crane, the national bird of South Africa, is still abundant in parts of its historic range, but has experienced significant declines in many areas over the last twenty years. Its distribution is the most restricted of the fifteen crane species. It is endemic to southern Africa, with the vast majority of the population occurring in eastern and southern South Africa. A small disjunct population occurs in the Etosha Pan of northern Namibia, while breeding pairs are occasionally found in five other countries. As recently as 1980, there was little concern about the Blue Crane from a conservation standpoint. Since then, however, the species has largely disappeared from the Transkei region, Lesotho, and Swaziland. In other areas, including eastern Cape Province, Natal, northern Orange Free State, and Transvaal, populations have declined by as much as 90%[1]. The total population is estimated at 21,000 and is declining. Due to its rapid decline, the species is classified Critically Endangered under the revised IUCN Red List Categories. The Namibian population, because of its small size, is also Critically Endangered.

The Blue Crane is primarily a bird of dry, upland grass-

[1] See note 1 in the Grey Crowned Crane species account regarding the political realignment of the South African provinces.


Blue Crane
Anthropoides paradisea
Mozambique
Zimbabwe
Etosha Pan
Botswana
Namibia
Swaziland
Lesotho
South Africa
Miles
Kilometers
0
100
150
300
0
100
150
300
MBM

lands. In South Africa, the species occurs in the grassland, Karoo, and fynbos biomes. Blue Cranes use natural grass- and sedge-dominated habitats in these biomes for both nesting and feeding, but will roost in wetlands if available. Preferred nesting sites are secluded grasslands in higher elevations, although they also nest in wetlands. In agricultural areas (especially converted farms in the fynbos region), they nest in pastures, fallow fields, and crop fields. Blue Cranes migrate locally across elevation gradients, spending the breeding season in higher elevation grasslands and moving to lower elevations for the fall and winter. Flocking occurs year-round, but intensifies in the winter.

Intentional and unintentional poisoning, afforestation of South Africa's grasslands, and the impacts of growing human population pressure constitute the most significant threats to the Blue Crane. As these threats have taken their toll, conservation efforts have accelerated. These measures include: stricter legal protection for the species; local and national surveys of the population; expanded research on the species' biology, ecology, and conservation status; increased attention to habitat management, especially on private lands; the emergence and active involvement of non-governmental organizations in Blue Crane conservation programs; and the development of new education programs focussing on the status and needs of the species.

Priority conservation measures for the future include: stronger enforcement of existing conservation laws; transfer of the species to CITES Appendix I; development of a coordinated plan to halt the poisoning of cranes; identification and protection of critical habitat, especially traditional wintering grounds; adoption of habitat management programs on farms and other private lands; requirements for impact assessments of proposed timber plantation projects; expanded surveys and monitoring programs throughout the species range; further research on population dynamics, demographics, seasonal movements, breeding habitat requirements, and the threats posed by poisoning and commercial afforestation; and development of educational programs specifically directed toward private landowners, farm laborers, and students.

2.4.2 Subspecies/populations

No subspecies. The vast majority of the population is found in southern and eastern South Africa. A small breeding population exists in northern Namibia.

W TAREBOTON

Family of Blue Cranes

2.4.3 Population Numbers and Trends

Population	Number	Trend	Source
Southern	~21,000	Declining	Allan 1993
Namibia	<100	Stable	Hines in press
Total	~21,000	Declining	

Long-term, range-wide data on the size and trend of the population are lacking. Recent population estimates have ranged between 10,000 and 23,000. The current estimate is based on Allan's (1993) study of Blue Crane distribution and abundance. Significant local declines have been reliably reported from many areas, mostly in the grassland portion of the species' range. Declines have been documented in Natal, Transvaal, and other areas where the species was formerly common, and where the species' natural grassland habitats are likely to remain at risk (see Allan 1993, Urban in press). In the semi-desert habitats of the Karoo and in the agricultural fields of southwest Cape Province, the population is stable or increasing.

2.4.4 Conservation Status

Species	
IUCN category	Critically Endangered, under criteria A1a,c,e
CITES	Appendix II

Populations	IUCN Category
Southern	Critically Endangered, under criteria A1a,c,e
Namibia	Critically Endangered, under criterion D

2.4.5 Historic and Present Distribution

The Blue Crane is endemic to southern Africa, with more than 99% of the population occurring within South Africa (Allan 1993). While locally abundant in limited parts of its range, it is now rare in most areas. Until recently, it was abundant in the uplands of eastern Cape Province, northern Orange Free State, southern and eastern Transvaal, and western Natal (Urban 1987, Johnson 1992a, Vernon et al. 1992, Allan 1993). A small (<100) disjunct breeding population exists in northern Namibia in and around Etosha Pan. The species occurs as an occasional vagrant in northwestern Cape Province, northern Transvaal, Lesotho, and Botswana (Allan 1993, Morris 1987). Swaziland, on the eastern edge of the species' range, has a small breeding population (Brown 1992, Hines in press). Several reports of its occurrence in Zimbabwe have been published, and occasional birds may wander into Mozambique, but these observations have not been confirmed.

As recently as 1980, the Blue Crane population was considered to be "healthy throughout South and Southwest Africa" and "nowhere endangered" (Van Ee 1981). Although the species is still found throughout much of its historic range, it has experienced significant and rapid local declines over the last twenty years. The species range has retracted from the Transkei region (where it may never have been very abundant), most of Swaziland, and the lower-lying portions of Lesotho. In some areas, populations may have declined by as much as 90% (Allan 1994, Urban in press). Losses are most evident in the grassland strongholds of eastern Cape Province, western Transvaal, northern Orange Free State, Lesotho, Transkei, and Natal (Vernon et al. 1992, Tarboton 1992a, Stretton 1992, Allan 1994, Urban in press).

Due to declines in the central part of the species' historic range, the South African population may now be divided in two, with one portion of the population centered in southern Transvaal, Natal, and northern Orange Free State, and the other in southern and eastern Cape Province (Allan 1994). However, the species appears to be stable in South Africa's Karoo regions, and is thriving in the fynbos (where it is a relatively recent colonizer of agricultural areas) (Allan 1992, 1993). In recent years, the Namibian population has held steady at approximately 80 birds (Brown 1992, Hines in press).

2.4.6 Distribution by Country

Botswana	r (occasional)
Mozambique	r (occasional)
Namibia	r
South Africa	R
Swaziland	r
Zimbabwe	r (occasional)

R = Resident (population >1000)
r = Resident (population <1000)

2.4.7 Habitat and Ecology

The Blue Crane, like the Demoiselle Crane, is a bird of dry grasslands and other upland habitats. In South Africa, it is largely restricted to three biomes—the grasslands, the semi-desert Karoo, and the fynbos (the botanically diverse region of western and southern Cape Province). Within the grasslands, the species is more abundant and more evenly distributed in the eastern "sour" grasslands (where natural grazing of small livestock is the predominant land use) than in the central and western grasslands (where crop farming is widespread). In the arid Karoo, the species is found in areas where perennial grasslands are dominant over the more typical dwarf shrublands of the region. In the fynbos, the species is restricted almost exclusively to intensively cultivated habitats (mainly cereal crops and small livestock farming areas), and is largely absent from areas of natural vegetation. Allan (1993) notes that the Blue Crane has benefitted from the advent of widespread cereal farming and the extirpation and control of predators in the region. Etosha Pan, where Namibia's disjunct population is

found, is a relatively limited (1400 km^2) area of grassy plains and dwarf shrub savannah distinct from the surrounding woodlands of the region. The occasional sightings of the species in other parts of southern Africa have generally occurred in similarly isolated grassland habitats.

Habitat use varies among the different regions used by the cranes according to the time of the year and food availability (Allan 1993, 1994). Principal food items include the seeds of sedges and grasses, waste grains (mainly wheat, barley, and maize), insects, and small vertebrates. Where shallow wetlands (pans, reservoir edges, etc.) are available, Blue Cranes will roost in them at night (Allan 1993). In the southern Cape, Aucamp (in press) found an average density of .57 breeding pairs per km^2 of suitable habitat.

Blue Cranes use natural grass- and sedge-dominated habitats for both nesting and feeding. Blue Cranes nest in the summer (generally from late September to February). Preferred nesting sites are secluded grasslands in higher elevations, where eggs are laid amid the grass or on bare ground. The vegetation at such sites tends to be relatively thick and short. Occasionally Blue Cranes breed in or near wetlands, building platform nests of reeds and other aquatic plants (Allan 1994, Aucamp in press). In agricultural areas, they nest in pastures, in fallow fields, and in crop fields as stubble becomes available after harvest (Allan 1993, Aucamp in press). Usually two eggs are laid. The incubation period is 30-33 days. The fledging period varies from 3-5 months (Schoeman 1994).

Blue Cranes have long been known to engage in seasonal movements within South Africa, but research involving the pattern of movements has been limited. Existing records indicate that Blue Cranes migrate locally across elevation gradients, spending the summer breeding season (October-March) in higher elevation grasslands and moving with chicks to lower elevations for the fall and winter (this pattern is best documented in Natal). Recent studies have suggested a general pattern of movement into the Karoo biome during the winter (Vernon et al. 1992, Allan 1993). However, Allan (1993) concludes that "the Blue Crane is a partial migrant and... some birds are found throughout its South Africa range throughout the year." Flocking can occur year-round, but intensifies in the winter, when groups of several hundred birds form (Vernon et al. 1992, Allan 1993).

2.4.8 Principal Threats

Poisoning and habitat alteration are the most significant threats to the Blue Crane. Poisoning affects not only the Blue Crane, but South African populations of the Grey Crowned Crane and, to a lesser extent, Wattled Crane. The documented decline of Blue Cranes within the grassland portions of its range has coincided with numerous reports of poisoning (e.g., Holtshausen and Ledger 1985, Tyson 1987, Vernon 1987, Tarboton 1992b, Vernon et al. 1992, Scott 1992). Up to 600 Blue Cranes have been killed at a single time (Johnson 1992b).

Poisoning of cranes in southern Africa can take three forms: it can be intentional and aimed at killing cranes that cause crop damage; it can be inadvertent and aimed at killing other species that cause crop damage; or it can occur during the application of pesticides to crop fields (Filmer and Holthausen 1992; Johnson 1992b; Allan 1993, 1994). Intentional poisoning of cranes is illegal in South Africa, but has occurred increasingly in the last fifteen years. Tarboton (1992) notes that the new types of poisons being used have made it easier to kill cranes, both deliberately and accidentally.

Most reports of poisoning of Blue Cranes have come from southwestern Cape Province. This probably reflects the greater effort expended in finding and documenting episodes of poisoning in this region rather than a greater concentration of such incidents. It is unclear why the species has apparently declined in the face of poisoning in the grasslands but not in the intensively cropped areas of southwestern Cape Province. Precise details involving incidents of poisoning have often been lacking in the published reports. The best evidence indicates that poisoning occurs disproportionately in the late winter-early spring (August-October). This is the period when crops are planted or are germinating and when livestock receive supplementary feed (upon which cranes forage). In addition, the cranes are still in their large winter flocks at this time. Thus, they are more likely to congregate in large numbers at feeding sites and are more vulnerable to mass mortality through poisoning.

The other major threat facing the Blue Crane is the commercial afforestation of South Africa's natural grasslands (Macdonald 1989, Johnson 1992a, Stretton 1992, Tarboton 1992). In most cases, grasslands have been converted to pine and eucalyptus plantations for eventual production of pulp and timber. Such plantings deprive Blue Cranes of the dry, open conditions they require, especially for breeding. In addition, afforestation alters hydrological processes within the affected watersheds by reducing the amount of run-off and groundwater flow, leading to the desiccation of wetlands. Approximately 1.2 million hectares have already been afforested in South Africa, and existing plans call for this area to double (W. Tarboton pers. comm.). The impact has been greatest in the eastern sourveld, and in the future is likely to intensify in eastern Transvaal, Natal, and eastern Cape Province.

Blue Cranes are also affected by development pressures and high human population density, which have combined to exacerbate the incidence of intensive livestock grazing, disturbance, active persecution, and loss of habitat to agricultural expansion (both crop farming and grazing). This has led to the extirpation or heavy reduction in Blue Crane numbers in several areas, including Swaziland, Lesotho, and Transkei (Allan 1993). The development of irrigated agriculture in the Karoo as a consequence of the construction of the Orange-Fish River Canal may pose a long-term threat to the population in northeastern Cape Province by increasing the level of crop predation and subsequent poisoning (Stretton 1992, Allan 1994).

Other anthropogenic threats include: urban and residential expansion; mining; collisions with utility lines and fences;

spraying of wetlands with poisons to destroy passerine seedeaters (primarily *Quelea quelea*); predation of eggs and chicks by domestic dogs; the drowning of chicks in water troughs; and other forms of human activity and disturbance (Geldenhuys 1984; Filmer and Holtshausen 1992; Johnson 1992a, 1992b, 1992c; Scott 1992; Vernon et al. 1992; McCann and Wilkins 1994). Some trade in Blue Cranes may be occurring. Although it is illegal to take cranes from the wild in South Africa, chicks are sometimes taken into captivity for pets. A survey conducted in 1985 revealed that at least 439 were being kept in private gardens under permit (Allan 1985). Many more are illegally held.

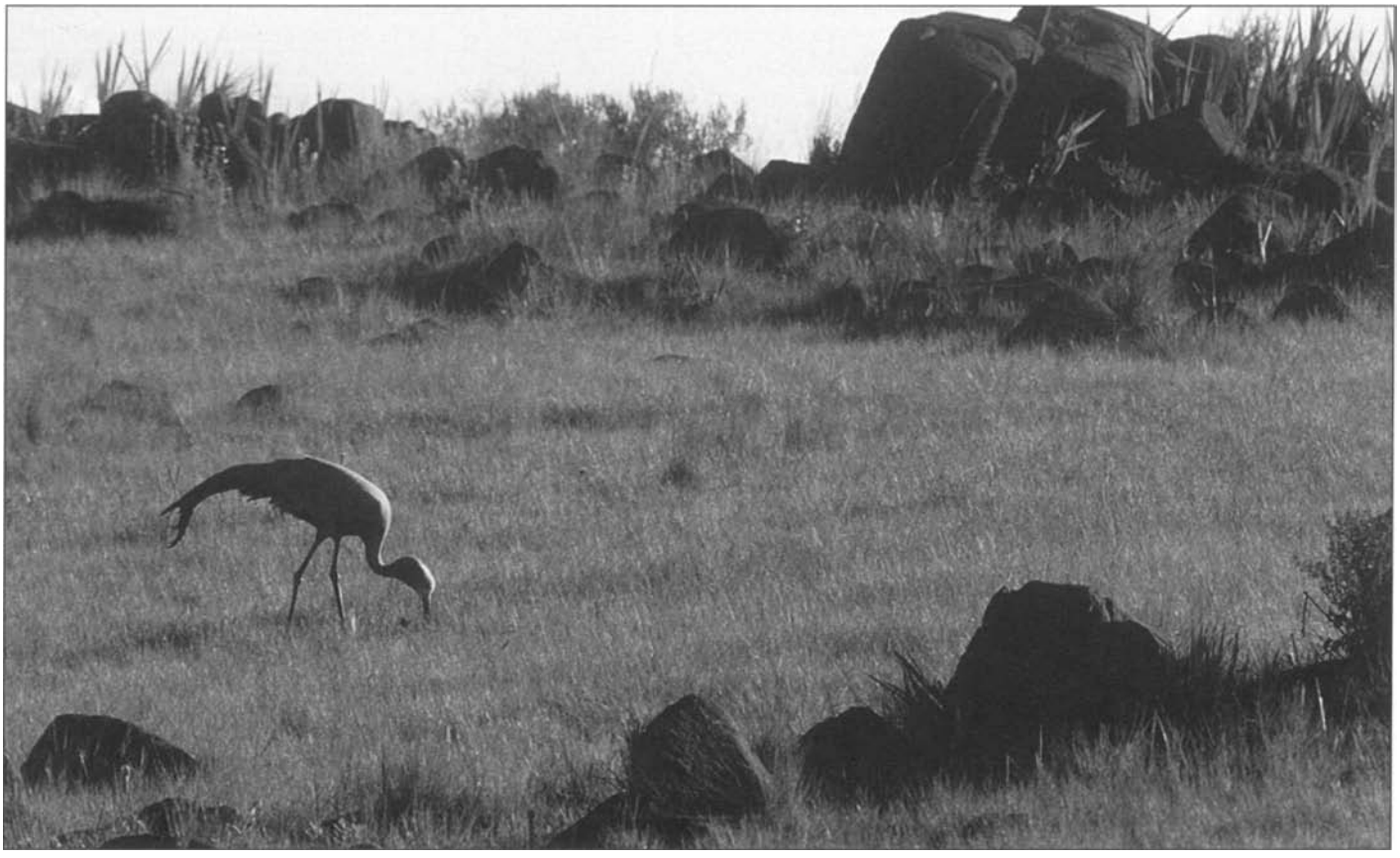
2.4.9 Current Conservation Measures

Legal and Cultural Protection

The Blue Crane is the national bird of the Republic of South Africa. The capture and export of Blue Cranes has been forbidden in South Africa since the 1970s, and existing laws stipulate that cranes cannot be poisoned, shot, collected, or otherwise disturbed without a permit. However, this legal protection has been largely superficial. Legislation to protect the Blue Crane and other crane species in South Africa has recently been strengthened, and penalties for violations increased. Cape Nature Conservation hopes to adopt new policies to discourage the illegal keeping of cranes in captivity, but these have not yet been officially approved (A. Scott pers. comm.).

A Conservation Program for the Blue Crane in the Overberg

In 1993, the Overberg Crane Group developed and published *A Conservation Programme for the Blue Crane in the Overberg* (A. Scott 1993). This comprehensive program emerged from a Blue Crane workshop, involving a broad range of representatives from the local community, that took place in July 1992. The goals of the program are to assess the status of the Blue Crane in the Overberg region, to address problems that cranes have caused for farmers, and to expand conservation measures for the Blue Crane in the region. To meet these goals, nine specific conservation projects were outlined, and coordinators assigned to monitor progress and provide feedback to the Overberg Crane Group. Officials of the Cape Nature Conservation contribute to the implementation of these projects as part of their assigned duties, while volunteers from the farming community, universities, and other institutions also participate. The Overberg Program has met with considerable success to date and provides a useful model for conservationists in other portions of the species' range (Jones 1994, Scott and Scott in press).



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Grassland habitat of the Blue Crane in South Africa

Protected Areas

Siegfried (1992) reports that Blue Cranes have been recorded in at least 75 nature reserves in South Africa, though not necessarily as a breeding (or even regularly occurring) species. Allan (1994a) notes that only a small fraction of the total population—less than 200 pairs—breed in nature reserves. Johnson and Barnes (1986) stress the inadequacy of relying on reserves for conservation of the species since too few of the cranes occur in too few protected areas; moreover, those that do use protected areas are not residents, but frequently move onto adjacent farms where they are vulnerable to the threats present in agricultural lands. In some cases, however, protected areas may provide a last line of defense for threatened populations. Allan (1993) noted that the total remaining breeding population of 12 Blue Cranes in Swaziland was restricted to the Malalotja Nature Reserve. Similarly, the entire Namibian population is found within Etosha National Park (Brown 1992).

Habitat Protection and Management

Because only a relatively small proportion of the total population of Blue Cranes live within nature reserves or national parks, and even these areas are not large enough to meet all their habitat requirements, the long-term conservation of the species rests almost entirely with private landowners. In South Africa, this aspect of crane conservation has received increased attention in recent years (Johnson 1992c, A. Scott 1993, Allan 1994). Johnson (1992c) notes that the land-use practices that favor cranes are now fairly well understood (e.g., appropriate fallow periods, planting of lure crops, baiting roost sites with waste grain), and that landowners may easily be able to accommodate cranes without disruption of farming practices. Much of the emphasis until now has been on defining and communicating habitat management requirements. To encourage the implementation of these measures, attention is now shifting toward the development of demonstration areas, increased farmer participation, and adoption of economic and policy incentives.

Surveys/Censuses/Monitoring

Counts and surveys of Blue Cranes have been conducted in various portions of the species' range. Siegfried (1985) reported on an extensive series of road counts of Blue (and Grey Crowned) Cranes undertaken in Cape Province in 1965-66. Vernon et al. (1992) presented data from similar counts of the same two species in the eastern Cape Province from 1977 to 1987. Filmer and Holtshausen (1992) reported the results of a census of all three southern African crane species conducted in 1985-86. An aerial census of the Natal midlands was conducted in 1994 in a cooperative effort of Eskom, the Endangered Wildlife Trust, and the Natal Parks Board (see below) (McCann and Wilkins 1994). Blue Cranes have also been counted during the African Waterfowl Census conducted by the IWRB (Taylor and Rose 1994, Davies in press).

ICF

Afforestation of South Africa's grasslands is a leading threat to Blue Crane habitat

Allan (1995) reports the results of counts carried out by the Cape Bird Club in 1993 and 1994 in southern Cape Province. The Namibian population is counted during aerial surveys of Etosha National Park. Young birds in this population have also been banded (Brown 1992). Allan (1993) combined data from bird atlas reports, road counts, line transect counts, and aerial censuses to determine the abundance and distribution of Blue Cranes throughout its range. This study represents not only the most extensive work on the Blue Crane, but the first application of such techniques to the study of any species of crane throughout its entire range.

Research

Until relatively recently the Blue Crane was poorly studied (at least in part because it was presumed to be of little conservation concern). Walkinshaw (1963) studied its breeding habits in Natal, while Van Ee (1966) reported on its breeding behavior in captivity. Two avian handbooks covering the area of distribution (Urban et al. 1986, Maclean 1993) contain brief summaries of the biology of the Blue Crane.

In the last ten years, research has expanded significantly. Several assessments of the status of populations in various parts of the species' range have been published in recent years (Geldenhuys 1984, Siegfried 1985, Johnson and Barnes 1986, Tarboton et al. 1987b, Allan 1992, Brown 1992, Johnson 1992a, Vernon et al. 1992). Filmer and Holtshausen (1992) report on the distribution, abundance, habitat, breeding, and conservation status of the Blue Crane based on data derived from the Southern African crane census. Several regional bird atlases include distribution maps for the species in various parts of South Africa. Allan (1993) provides a comprehensive study of the species' biology, ecology, distribution, and conservation status.

Since 1994, Eskom and the Endangered Wildlife Trust have collaborated in a research program involving the Wattled, Blue, and Southern Crowned Crane in the Natal midlands. As part of this program, satellite tracking studies are to be undertaken to enhance understanding of the local and seasonal movements of Blue Cranes. These studies are expected to contribute to the development of a management plan for these three species (McGann and Wilkins 1994).

Non-governmental Organizations

Several non-governmental organizations have been instrumental in stimulating interest in Blue Cranes and promoting conservation measures in South Africa. The Southern African Crane Foundation (SACF) (P.O. Box 74, Mooi River 3300, Natal, RSA) was established in 1988, and works to conserve all three of southern Africa's crane species. SACF now serves as an umbrella organization for coordinating the activities of several working groups and other organizations devoted to crane conservation in the region: the Natal Crane Working Group (Natal Parks Board, P.O. Box 662, Pietermarlisburg, Natal, RSA); the Overberg Crane Group (P.O. Box 1, Voelklip 7203, RSA); the Highlands Crane Group of the Endangered Wildlife Trust (Private Bag X11, Parkview 2122, RSA); and the Wakkerstroom Natural Heritage Association (P.O. Box 223, Wakkerstrom 2480, RSA). The Southern African Ornithological Society (P.O. Box 87234, Houghton 2041, Johannesburg, RSA) is dedicated to the conservation of all the indigenous birds of the region, and supported the formation of the SACF. The Endangered Wildlife Trust is concerned with the conservation of biodiversity in general in southern and central Africa. EWT has devoted special attention to working with farmers to provide stronger protection for cranes and their habitats (Rodwell 1994). Allan (1994a) provides further information on these organizations and their activities.

Education and Training

Educational programs involving Blue Cranes and their habitat have been carried out mainly through the NGOs. An interpretation and education center is being developed at Hlatikulu, Natal under the auspices of the SACF. Two of the projects outlined in the Blue Crane conservation program of the Overberg Crane Group involve education and the dissemination of information among students, landowners, farm workers, decision-makers, and the general public (A. Scott 1993). In particular, the Overberg Crane Group has begun to work closely with farmers to expand awareness of crane behavior and appropriate adaptation of farming operations. A Crane Education Forum was established in 1993 to develop and distribute community-based educational materials on crane conservation (for information contact Christine Lambrechts, 97 Westcliff Dr., Hermanus 7200, RSA). The Forum grew out of the 1993 African Crane and Wetlands Training Workshop and will focus on promoting the responsible use of agricultural chemicals among farm workers (A. Scott pers. comm.). In 1994, the Endangered Wildlife Trust published a informational booklet, *Cranes and Farmers* (Allan 1994), that is now being widely distributed.

Captive Propagation and Reintroduction

The GCAR for cranes identified 976 Blue Cranes in captivity worldwide as of 1993 (Mirande et al. in press a). This figure does not include an additional, unknown number of birds held in the private sector (see Allan 1985, Schoeman 1994). An African regional studbook for the species has been prepared in South Africa (Schoeman 1994), and regional studbooks are being developed in North America and the United Kingdom. The species breeds reasonably well in captivity. It is represented in adequate numbers within South Africa, and so a global breeding program is not required.

At present, no reintroduction program has been undertaken, and other conservation needs are of higher priority. Reintroduction has been discussed as a conservation strategy for portions of the species' historic range where it no longer occurs. However, if the species is protected and its habitat restored, the population can be expected to expand rapidly in the wild. This may already be occurring, for example, in portions of Natal. The Blue Crane conservation program of the Overberg Crane Group has recommended that injured and permanently disabled birds be used in captive breeding programs

(A. Scott 1993). Given the high level of interest in the species for educational purposes, such programs may provide conservation benefits while minimizing impacts on wild populations.

2.4.10 Priority Conservation Measures

Legal and Cultural Protection

1) Strengthen existing laws prohibiting the capture, keeping in captivity, shooting, intentional poisoning, hunting, injuring, or disturbing of Blue Cranes without a permit from the relevant conservation agency.

2) Enhance awareness of legal restrictions through expanded educational efforts.

International Agreements and Cooperation

1) Transfer the species from CITES Appendix II to Appendix I.

Implementing the Overberg Conservation Program

1) Carry out the projects outlined in the *Conservation Programme for the Blue Crane in the Overberg* (A. Scott 1993). The program represents a significant effort to coordinate Blue Crane conservation activities in a region where more than half of the Blue Crane population occurs.

2) Monitor and report on progress toward program goals.

3) Take advantage of the demonstration opportunities of the Overberg program to communicate conservation concepts to crane conservationists throughout southern Africa.

4) Review and analyze the program on a regular basis for useful lessons that can be applied beyond Overberg.

Protected Areas

1) Identify and designate for protected status critical Blue Crane habitat not yet included in reserves. Traditional wintering grounds are especially important. Specific areas that should be considered for protected status include: the Blood River Vlei in Natal; grasslands in and near Wakkerstrom and Dullstroom; and additional areas in the grassland biome.

2) Integrate conservation plans for Blue Cranes so that management needs within and outside of protected areas are addressed in concert. In particular, conservation planning should take into account local and seasonal movements, and should involve private landowners near protected areas.

Habitat Protection and Management

1) Implement existing habitat protection and management programs. The programs outlined by Johnson (1992c), Maclean (1991), Scott (1993), and Allan (1994a) provide guidelines for immediate actions, especially those that involve farmers and other private landowners.

2) Enact incentive programs to reward farmers and other landowners who undertake conservation measures for Blue Cranes on their lands, in particular for setting aside suitable nesting habitat and restoring afforested grasslands.

3) Continue research and development of techniques that promote the coexistence of cranes and agriculture.

4) Require impact assessments on all lands in South Africa that are to be purchased for, or otherwise devoted to, timber plantations.

5) Require greater communication and coordination of activities among local and national conservation agencies, Eskom, and the South African Departments of Forestry, Agriculture, and Water Affairs. This is especially important with regard to the planning of afforestation programs and the granting of afforestation permits. The marking of utility lines is also a high priority in problem areas.

Surveys/Censuses/Monitoring

1) Conduct accurate censuses of the Blue Crane population in all habitats.

2) Undertake summer breeding censuses throughout South Africa to confirm and/or revise estimates of the total population.

3) Monitor on an annual basis a selected number of established flocking and nesting sites in the main species' range.

4) Repeat roadside transect surveys of Blue Crane populations at 5-year intervals.

5) Continue annual censuses of the Namibian population at Etosha Pan.

6) Initiate monitoring programs for the small and/or vagrant populations of Blue Cranes in Botswana, Swaziland, and Lesotho.

Research

1) Expand research into the population dynamics, demographics, and seasonal movements of Blue Cranes through more extensive color banding, radiotelemetry, and satellite tracking studies.

2) Determine the breeding habitat requirements of the species.

3) Conduct systematic research into crane poisoning, including: the extent and location of poisoning incidents; types of poisons employed; methods of use; persistence of poisons; effects on species other than cranes; and economic aspects of crop damage and poisoning.

4) Conduct studies of the extent and impact of commercial afforestation on grassland ecosystems in South Africa.

5) Conduct feeding studies to quantify the extent and timing of crop damage (see related recommendations below under "Responding to Poisoning").

6) Conduct studies of the population dynamics and genetic variability of the Namibian population, and its relationship to the main population. In particular, determine the degree to which birds from the Southern population supplement the Namibia population.

7) Establish a long-term research program to determine the viability of the small populations in Botswana, Swaziland, and Lesotho.

Responding to Poisoning

The threat posed by the poisoning of Blue Cranes is serious and demands a coordinated program of response. As such a program is developed, the following measures should receive high priority.

1) Pass stronger legislation to restrict the use of poisons and to penalize those who intentionally poison cranes.

2) Establish a reporting system through which the incidence of crop damage can be assessed and monitored.

3) Undertake educational campaigns, using mass media, to discourage farmers from using poisons on their lands, to promote responsible use of pesticides, and to disseminate information on alternative means of controlling pest damage.

4) Direct conservation officers to work with private landowners on crane protection measures, to monitor local crane populations, to report incidents of crane persecution, and to provide feedback to improve conservation projects.

5) Conduct research on the extent, nature, and timing of crop damage, and on alternative farming practices and damage control methods. Feeding studies are needed to quantify the extent of damage caused by cranes.

6) Where necessary, establish compensation programs for farmers suffering crop damage.

7) Address the issue of crop damage caused by associated "problem" species (such as the Egyptian goose, *Alopochen aegyptiacus*), in order to prevent indirect persecution/poisoning of cranes.

Education and Training

1) Support development of the Crane Education Forum's education programs.

2) Develop educational materials and programs specifically directed toward farmers and other private landowners, farm workers, and students. In particular, the booklet *Cranes and Farmers* should be distributed to all farmers whose lands are important to Blue Cranes. As a further part of this effort, workshops should be developed to assist local community leaders in the use and dissemination of these materials.

3) Address the poisoning problem specifically through a broad-based information campaign in the mass media.

4) Encourage existing environmental education programs to include Blue Crane and grassland conservation as components in their curricula.

5) Promote the Blue Crane as the national bird and as an indicator species for the endangered grassland ecosystem in southern Africa. In part, this can involve taking advantage of the Blue Crane's potential for promoting responsible ecotourism.

Captive Propagation and Reintroduction

1) Implement the recommendations outlined in the Crane GCAR and CAMP (Mirande et al. in press a). These are to:
   - Manage the captive population of Blue Cranes at the Intensive-1 (B priority) level, with an initial population target of 200 well managed birds of known genealogy.
   - Strengthen and coordinate on a regional basis the captive management program in South Africa.
   - Maintain and update the international studbook for the Blue Crane in South Africa. The studbook is maintained by Dr. Ferdi Schoeman of the National Zoological Gardens (Box 754, Pretoria 0001, RSA).
   - Improve the genetic management of the European and North America captive populations by interpreting and applying studbook data.
   - Improve coordination among captive managers, field researchers, and habitat managers in the development and implementation of conservation strategies for the species, including decisions regarding possible releases into portions of the species' historic range.

W. TARBOTON

Colour-banded pair of Wattled Cranes *(Bugeranus carunculatus)* at Wakkerstrom Wetland Reserve and Crane Sanctuary in South Africa

2.5 WATTLED CRANE (*Bugeranus carunculatus*)

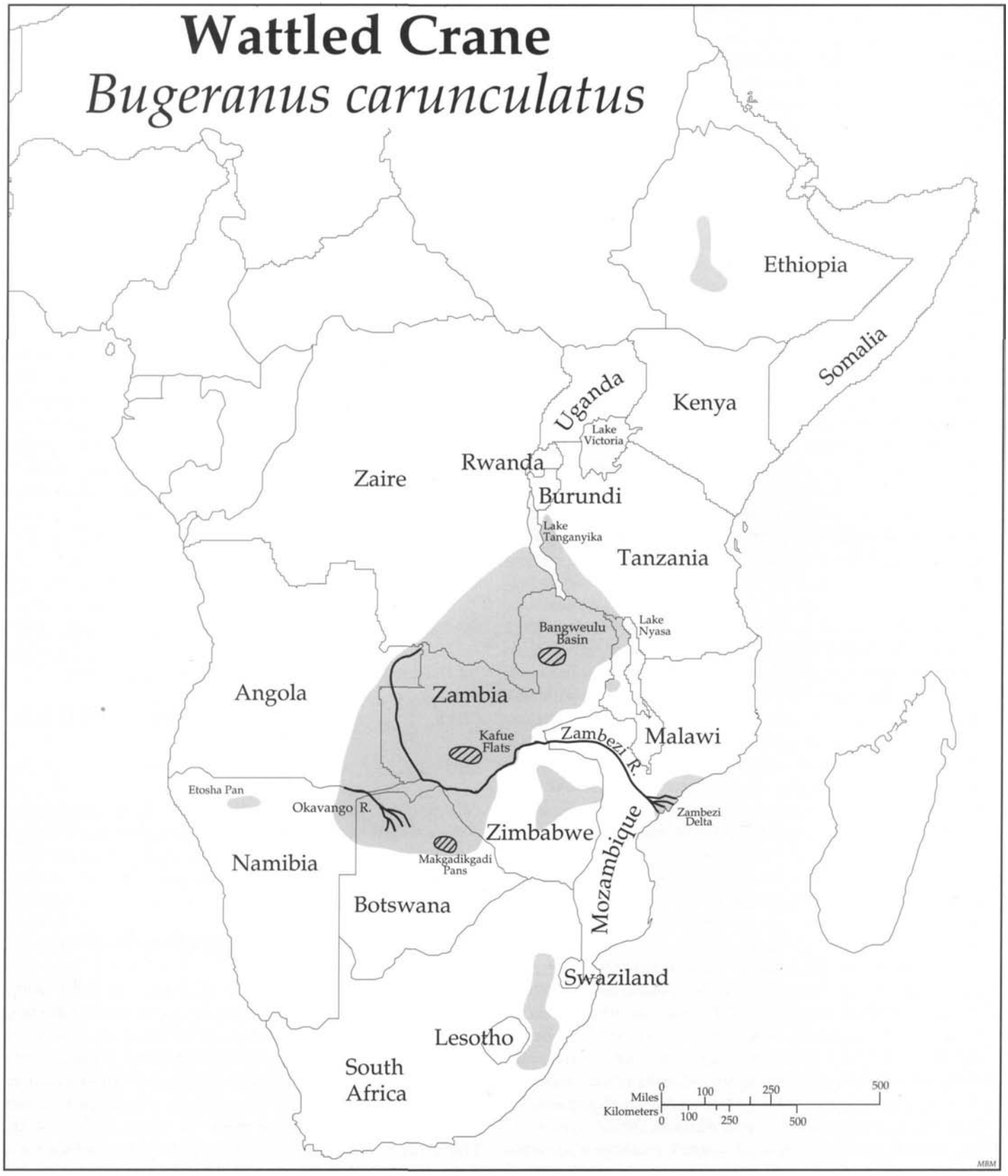
Ann Burke

2.5.1 Summary

The Wattled Crane is the largest and rarest of the six crane species that occur in Africa. There are no subspecies. Three main populations are recognized. Most are found in south-central Africa. Smaller populations are found in Ethiopia and South Africa. Over the last several decades, the species has been declining over much of its range. The total population estimate of 13,000-15,000 has remained constant over the last decade, but this is due largely to the discovery of some 2500 birds in Mozambique in the early 1990s. Historically, the species was more abundant and more widely distributed across southern Africa than at present, with the greatest losses occurring in South Africa. The species is classified as Endangered under the revised IUCN Red List Categories. The South Africa population is Critically Endangered.

The Wattled Crane is the most wetland-dependent of Africa's cranes. The extensive riparian wetlands of southern Africa's large river basins (especially the Zambezi and Okavango) are their preferred habitat, but they also use smaller upland wetlands throughout their range. The Ethiopian birds may make greater use of drier habitats during the non-breeding season. Nesting pairs establish large (often >1 km^2) territories, generally in shallow wetlands with minimal human disturbance. Their diet consists primarily of aquatic vegetation, but also includes seeds, insects, and waste grain in drier habitats. Wattled Cranes are non-migratory, but do undertake irregular local movements in response to water availability.

Loss and degradation of wetland habitats constitute the most important threats to the species. The decline of the species in South Africa is due mainly to the loss of wetlands to intensified agriculture, dam construction, industrialization, and other pressures. In other portions of the range, dams and other water development schemes have caused fundamental


Wattled Crane
Bugeranus carunculatus
Ethiopia
Somalia
Uganda
Kenya
Lake Victoria
Rwanda
Zaire
Burundi
Lake Tanganyika
Tanzania
Bangweulu Basin
Lake Nyasa
Angola
Zambia
Kafue Flats
Zambezi R.
Malawi
Etosha Pan
Okavango R.
Zimbabwe
Zambezi Delta
Mozambique
Namibia
Makgadikgadi Pans
Botswana
Swaziland
Lesotho
South Africa
Miles 0 100 250 500
Kilometers 0 100 250 500
MBM

changes in the species' floodplain habitats. Human disturbance at or near breeding sites is also a major threat. Breeding success can be hindered by the establishment of human settlements too close to wetlands and by indiscriminate resource use within the wetlands. Because Wattled Cranes occasionally forage on agricultural fields alongside Blue and Grey Crowned Cranes, they are also vulnerable to poisoning.

Conservation measures have been undertaken most extensively in South Africa, but are increasing in other range countries. These measures include: strict legal protection in South Africa and other range countries; establishment of protected areas in several of the key wetlands used by the species, especially in Zambia, Namibia, and Botswana; identification and communication of appropriate habitat conservation practices for farmers and other private landholders; marking and relocation of utility lines; expanded counts and surveys (especially since the early 1980s); expanded research, especially in South Africa, Zambia, and Namibia; establishment, in 1982, of a Wattled Crane Steering Group in South Africa; and development (mainly by non-governmental organizations) of education and public awareness programs. A limited release program for the species has been initiated in South Africa.

Priority conservation measures for the species include: transfer of the species to CITES Appendix I; enforcement of existing legislation protecting cranes; strengthening of key protected areas, especially in the Bangweulu Swamps and Kafue Flats in Zambia; surveys to identify additional areas of critical habitat for designation as protected areas; assessment of large-scale habitat threats (mainly from water development schemes) in the Kafue Flats, Okavango Delta, Makgadikgadi Pans, and Zambezi Delta; development of a coordinated protection program for the protection of breeding habitat on privately owned farmland; organization of a range-wide census; expanded field research outside of the South African portion of the range; organization of local Wattled Crane counts; and development of education programs aimed at farmers and other private landowners, farm laborers, and students.

2.5.2 Subspecies/populations

No subspecies. Three main populations are recognized. All but a few hundred birds occur in south-central Africa (Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zaire, Zambia, and Zimbabwe). A small isolated northern population is found in the highlands of Ethiopia. South Africa's population of several hundred birds is isolated from those further north. At present no genetic analysis has been undertaken to determine the degrees of divergence among these populations. The Ethiopian population may be distinct. The more southern populations include both cold upland residents and seminomadic lowland birds, but further research is needed to ascertain whether these differences are taxonomically significant (D. Johnson pers. comm.).

2.5.3 Population Numbers and Trends

Population	Number	Trend	Source
Ethiopia	several hundred	Unknown	Y. Dellelegn pers. comm., Yohannes in press
South-central Africa	13,000-15,000	Declining	Urban in press
South Africa	~250	Declining	McCann and Wilkins 1995, D. Johnson pers. comm., Urban in press
Total	13,000-15,000	Declining	

The population of Wattled Cranes has declined over the last decade, although more thorough field surveys have allowed estimates of the total population to remain constant. In Mozambique, population estimates have increased considerably due to the discovery of some 2500 birds in the Zambezi Delta in the early 1990s (Goodman 1992). In Zambia, the population has fallen from an estimated 11,000 in 1985 to 7,000-8,000 in 1994 (T. Dodman pers. comm., Urban in press).

2.5.4 Conservation Status

Species	
IUCN category	Endangered, under criteria A1b,c,d,e A2c,d,e
CITES	Appendix II

Population	IUCN Category
Ethiopia	Endangered, under criterion D
South-central Africa	Endangered, under criteria A2c
South Africa	Critically Endangered, under criterion D

2.5.5 Historic and Present Distribution

The Wattled Crane is found in Ethiopia and south-central Africa. More than 1000 km separate those in the Ethiopian population from those further south. The species is most abundant in southern Zambia, Mozambique, and Botswana. The largest recorded concentration—more than 2500—was reported in the Zambezi Delta in Mozambique (Goodman 1992; see also McCann and Wilkins 1995). A recent survey of the Marromeu Complex in the delta suggested that substantially fewer birds are breeding in the area (Beilfuss 1995). Smaller (<500) scattered populations occur in southern Zaire, western and southwestern Tanzania, Mozambique, Malawi, Zimbabwe, South Africa, northern Namibia, and southern Angola (Urban and Gichuki 1988, Urban in press). Wattled

Cranes are non-migratory, but exhibit irregular nomadism in response to water availability.

Historically, the Wattled Crane was more numerous than at present and distributed more widely across southern Africa. In southern Africa the species formerly ranged from southern Tanzania to the southwestern Cape Province[1] (West 1976, 1977; Vernon and Boshoff 1986, 1987; Brooke and Vernon 1988). The greatest changes in the historic range have occurred in South Africa. The species formerly occurred in all four former South African provinces, and was widespread from the Eastern Cape to as far south as Somerset West and Caledon in the Western Cape. Prior to European settlement, disturbance by cattle herders and food gatherers may have contributed to the local extirpation of the species from apparently suitable habitat in what is now Cape Province (Brooke and Vernon 1988). Brooke and Vernon (1988) conclude that before 1800 the Wattled Crane occurred throughout Orange Free State and Lesotho, and that these birds were connected to populations in northeastern Cape Province, Transkei, Natal, and eastern Transvaal.

After European settlement, accelerated habitat destruction and human disturbance led to the species' demise in western Cape Province, eastern Cape Province and Transkei, and northern Cape Province and Orange Free State. In South Africa, Wattled Cranes now occur only in Natal and Transvaal, although occasional breeding pairs have been reported in Cape Province (Vernon and Boshoff 1986) and Transkei (Allan 1994). The Wattled Crane has also been extirpated from Swaziland (West 1976, Konrad 1981).

2.5.6 Distribution by Country

Angola	r
Botswana	R
Ethiopia	r
Malawi	r
Mozambique	R
Namibia	r
South Africa	r
Swaziland	X
Tanzania	r
Zaire	r
Zambia	R
Zimbabwe	r

R = Resident (populations >1000)
r = Resident (populations <1000)
X = Extirpated

2.5.7 Habitat and Ecology

The Wattled Crane is the most aquatic of Africa's cranes. Extensive sedge/grass wetlands in riparian floodplains are their preferred feeding and nesting habitat, but they also rely on smaller wetlands throughout their range (Konrad 1981). Large wetlands along major river systems that are extremely important to the Wattled Crane include: the Kafue Flats, Bangweulu Swamp, Busanga Flats, Liuwa Flats, Lukanga Swamp, and Sioma-ngwezi Plain in the Zambezi basin in Zambia; the Mweru Wantipa area, upper Chambeshi basin, Luangwa Valley, and Nyika Plateau, also in Zambia; the Okavango Delta and Makgadikgadi Pans in Botswana; and the Marromeu Complex in Mozambique's Zambezi Delta.

In South Africa, Malawi, and parts of Zimbabwe, Wattled Cranes are year-round residents of small permanent highland marshes. Ephemeral and seasonal wetlands may be used opportunistically by breeding pairs or serve as important post-breeding dispersal areas. The Ethiopian population is somewhat less dependent on wetlands (except during the breeding season), using montane grasslands, wet meadows, savannahs, small lakes, streams, and marshes, as well as riparian areas in the Rift valley (Yohannes in press, Newton et al. in press). During the dry (non-breeding) season, the Ethiopian birds may migrate locally to drier, lower elevation habitats, including plowed fields (J. Hillman pers. comm.).

The majority of Wattled Cranes nests in the floodplains of Zambia, Botswana, and Mozambique at the peak of the floods (August and September), when the risk of nest drowning is lowest. Chicks are reared in the shallows as the water recedes. Wattled Cranes that nest in smaller and more widely scattered wetlands in southern Africa usually breed in July and August, when conditions are drier and colder. Chicks are fledged in the rainy season (November-February), during which time the Grey Crowned Cranes nest in the same areas (Walkinshaw 1964). The Ethiopian population's breeding season begins in May or June, as the high altitude wet season begins (Hillman 1993). Changes in photoperiod may also influence the timing of breeding in the species (G. Archibald pers. obs.).

The Wattled Crane's diet is composed primarily of aquatic vegetation, including the tubers and rhizomes of submerged sedges (*Cyperus* and *Eleocharis* spp.) and water lilies (*Nymphaea* spp.) (Douthwaite 1974). Wattled Cranes also forage for grain, grass seeds, and insects in drier upland habitats and utilize agricultural fields when convenient. In Ethiopia's Bale Mountains, the population's main breeding area, Wattled Cranes take advantage of beetle larvae and other invertebrates that occur in the spoil heaps created by the giant molerat (J. Hillman pers. comm.).

Nesting pairs generally require wetlands with minimal human disturbance. Pairs are strongly territorial and may defend territories >1 km^2 in size (Konrad 1981). These territories are highly specialized, comprising shallow wetlands with predominantly sedge-based vegetation. Nests are typically built in

[1] See note 1 in the Grey Crowned Crane species account regarding the political realignment of the South African provinces.

S. TRANEVING

Wattled Crane pair at nest, Steenskampsburg, South Africa

open grass and sedge marshes bordered by drier flat to sloping grassland meadows, with medium-height vegetation, and water up to 1 meter in depth (Johnsgard 1983). There have been several accounts of Wattled Crane using artificially constructed impoundments (usually dams built across vleis) in South Africa (Filmer and Holtshausen 1992). West (1976) notes that the Wattled Crane population is limited by the availability of suitable habitat, the scarcity of acceptable nest sites in shallow water, and the territorial requirements of breeding pairs.

The Wattled Crane's reproductive rate is low. The average clutch size is lowest of any of the cranes (Johnsgard 1983). Pairs usually produce just one egg per clutch. Occasionally two eggs are laid, but only one chick is reared. The incubation period (usually 33-36 days) is the longest of any crane. Chicks do not fledge until at least 90-130 days of age. This is the longest fledging period of any crane, and render the young particularly vulnerable to predation by people and animals.

In many parts of the range, Wattled Cranes exhibit irregular nomadism, apparently in response to water availability. Birds using perennial rivers and associated seasonal wetlands tend to be more nomadic than those inhabiting permanent wetlands. The degree of movement between countries is unknown. At certain times of the year, Wattled Cranes leave the Kafue Flats for unknown destinations. They are believed to join the resident Wattled Cranes of the Okavango Delta and Makgadikgadi Pans in Botswana (Urban and Gichuki 1991). Wattled Cranes are also thought to move between Bangweulu Swamp, the Kafue flats, and other wetlands in the Zambezi basin during unusually high water levels, and to move downstream into the Morremou wetland complex in Mozambique as the waters recede (R. Douthwaite pers. comm., R. Beilfuss pers. comm.).

A distinctly seasonal population of Wattled Cranes occurs in northern Namibia during the wet season (October-April). The origins of these birds are not known, but it is surmised that the birds from Bushmanland and Grootfontein are part of the Okavango Delta (and possibly the Zambian) subpopulation, while the birds of the Oshana Region are thought to be part of the southern Angolan subpopulation (Hines in press).

The movements of the Ethiopian population appear to be migratory rather than nomadic. The departure of the birds from the Bale Mountain breeding area in November/December coincides with seasonal reductions in water levels, when the high altitude wetlands may dry com-

pletely. The birds reappear in May/June, as the rains return to fill in the wetlands (J. Hillman pers. comm.).

2.5.8 Principal Threats

The destruction, alteration, and degradation of wetland habitats constitute the most significant threats to the Wattled Crane (Konrad 1981, Johnson 1984, Allan 1994, McCann and Wilkins 1994). Hydroelectric power projects and other water development schemes have caused fundamental changes in the species' expansive floodplain habitats. Hydroelectric dams alter natural flooding regimes, reducing streamflow during the rainy season and increasing it during the dry season. This not only diminishes the extent of the floodplain habitat, but alters vegetation and facilitates burning of grasslands, thus reducing suitable breeding and feeding areas.

Douthwaite (1974) noted that the number of pairs attempting to nest on the Kafue Flats depended upon the degree of flooding. After an average flood (6.4 m), 40% of all pairs attempted to breed. After negligible flooding (5.0 m), only 3% of all pairs bred. The Kariba and Cahura-Bassa dam projects on the Zambezi River have altered the hydrological and ecological processes of the Zambezi Delta, with unknown impacts on Wattled Crane habitat. In Botswana, proposals for alternative uses of the waters of the Okavango Delta may, if carried forward, have serious impacts on that important stronghold for the species.

Loss of smaller wetlands has also been detrimental. The present breeding range of the Wattled Crane in South Africa falls wholly within the grassland biome, a region that has undergone (and remains subject to) massive changes as a result of intensified agricultural practices, mining, exploitation, afforestation, damming for water storage, industrialization, and urbanization (Macdonald 1989). In portions of South Africa and Zimbabwe, widespread irrigation has caused ground water levels to drop, altering the hydrology of wetlands to such an extent that cranes are no longer able to breed within them (Rockingham-Gill in press). Increased cattle grazing in Ethiopia's higher altitude grasslands may be having direct and indirect impacts on the region's Wattled Cranes (J. Hillman pers. comm.).

Disturbance due to human activity at or near breeding sites is a second major threat to the Wattled Crane (West 1977, Konrad 1981, Tarboton 1984, Eksteen in press). Establishment of human settlements close to wetlands and the activities of hunters, fisherman, cultivators, and pastoralists can hinder successful breeding. Accidental or intentional setting of grass fires during the dry season (i.e., the winter months) frequently kills pre-fledged chicks, while non-seasonal fires set in wetlands and floodplains are also a threat to successful breeding (Namibia Crane Action Plan in press).

As Wattled Cranes occasionally forage on agricultural fields alongside Blue and Grey Crowned Cranes, they are also vulnerable to accidental and purposeful poisoning (Allan 1994). Additional anthropogenic threats include: collision with utility lines; illegal collection of eggs, chicks, and adults for food; and disturbance from livestock and domestic dogs (Douthwaite 1974, Johnson 1984, Allan 1994). In South Africa, important crane habitat in the Natal midlands is threatened by plans for construction of a large new utility line (D. Johnson pers. comm.). Mass aerial spraying associated with the tsetse-fly control program is also suspected to have had negative effects on Wattled Cranes, particularly in the Okavango region (Mangubuli in press). Among natural threats, fires, hail, flooding, desiccation of floodplains, and extended droughts are probably the most significant throughout the species' range.

2.5.9 Current Conservation Measures

Note: many of the current and priority conservation measures described below for the Wattled Crane also apply to the Grey Crowned Crane and Blue Crane in areas where their ranges overlap.

Legal and Cultural Protection

The Wattled Crane is legally protected by the Provincial Nature Conservation Ordinances in all four provinces of South Africa. It is a statutory and punishable offence to interfere with crane nests, eggs, or chicks; to keep cranes in captivity; or to shoot, trap, poison or in any other way kill or injure them without a permit from the local conservation authority (Allan 1994). In Malawi, cranes are protected under the National Parks and Wildlife Act. In Zambia, the National Parks and Wildlife Act restricts the hunting of wild animals and forbids disturbance or removal of any bird's nest within national park boundaries. Designated Game Management Areas afford some protection, although human settlement and other activities are permitted within these areas.

Protected Areas

Few protected areas have been established primarily to protect Wattled Cranes and their habitats. In many range countries, however, establishment of national parks and game management areas has coincidentally provided protection for Wattled Cranes.

- Johnson and Barnes (1985) note that in South Africa it is difficult to protect Wattled Cranes in reserves because most of their breeding habitat is thinly scattered and found on valuable, privately owned farmland. Prior to 1984, only four Wattled Crane pairs lived in formally established protected areas in South Africa, all in Natal Province. In 1985 the Verloren Vlei Nature Reserve in the Transvaal was established in large part to protect grasslands and Wattled Crane habitat (Eksteen in press). In 1988 the Natal Parks Board acquired Umgeni Vlei specifically to protect the ten pairs of Wattled Cranes breeding there. At the same time, an additional farm was acquired and added to the existing Karkloof Reserve to protect two pairs of Wattled Cranes (Johnson 1990).

- At present, the Swamp, Coleford, Himeville, Highmoor, and Stillerand (Kamberg) Nature Reserves in Natal also support nesting pairs, while the Ntsikeni Nature Reserve in Transkei supports a single pair (Johnson 1990, Allan 1994). It is unlikely that a nature reserve or national park sufficiently large to encompass a viable Wattled Crane population will be created in South Africa's grassland biome. At the same time, the existing network of small and isolated protected areas cannot ensure viability. The fate of this population thus lies largely in the hands of private landowners (McCann and Wilkins 1994). More specifically, it depends primarily on the actions of fewer than 100 farmers on whose properties they breed (Allan 1994).
- In Zambia, important wetland areas are protected under the jurisdiction of several game management areas and in the Kafue Flats, Kasunga, Nyika, Isangano, Lochinvar, Liuwa Plain, and Blue Lagoon National Parks (Kampamba and Pope in press). Although birds and their nests are afforded protection under national park legislation, enforcement is generally lacking and these areas are subject to non-seasonal flooding, human disturbance, and intensifying resource use.
- In northern Namibia, resident Wattled Cranes are found within the Mahango Game Reserve/West Caprivi Reserve section of the Okavango River and in the Mamili National Park along the Linyanti River (Hines in press). The Mahango Game Reserve is the only reserve with formal conservation status along the Okavango River. Two conservation areas—the Mamili and Madumo National Parks—protect the southern floodplains of the Kwando and the Linyanti Rivers. The northern floodplains of the Kwando are protected by the East Caprivi Game Reserve.
- In Botswana, Wattled Cranes occur at the Moremi Wildlife Reserve and (more sporadically) at the Makgadikgadi Pans Game Reserve. The Chobe Game Reserve (part of the Okavango system) also harbors Wattled Cranes.
- In Malawi, Wattled Cranes occur in the Kasungu and Nyika National Parks and the Vwaza Wildlife Reserve.
- In Mozambique, the Marromeu Complex Game Management Area provides protection for about 2500 birds. It is the only protected area in the Zambezi Delta.

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Wattled Cranes and lechwe in the Okavango delta, Botswana

- In Ethiopia, Wattled Cranes are protected in Abijatta-Shala Lakes and Bale Mountain National Parks, but management of the parks and their resources needs strengthening (Yohannes in press, Hillman 1986).

Habitat Protection and Management

Community-based habitat conservation programs have been developed in some portions of the Wattled Crane's range. In northern Namibia, the Ministry of Wildlife is developing a Communal Resource Management initiative that seeks to address the conservation needs of Wattled Crane populations outside of formal conservation areas (specifically, in the Nyae-Nyae Pans region) (Hines in press). At the 1993 African Crane and Wetland Training Workshop, several assessments of habitat protection and management needs were presented (Banda in press, Kamweneshe in press b, Mangubuli in press), and eight of the twelve range countries produced national crane and crane habitat action plans.

Habitat conservation efforts have been intensively pursued in South Africa, where (as noted above) the long-term viability of the Wattled Crane population will depend almost entirely on the actions of private landowners. Johnson (1992c) notes that the land-use practices that favor cranes (e.g., appropriate fallow periods, planting of lure crops, baiting of roost sites with waste grain) are now generally well understood, and that landowners may easily be able to accommodate cranes without disruption of farming practices (see also the "Habitat Management and Protection" discussion in the Blue Crane species account in this volume). At present, however, no incentive or extension programs exist to encourage farmers to adopt such conservation measures. Allan (1994a) provides an overview of these required measures.

In an effort to reduce the incidence of crane mortality due to collisions with utility lines, Eskom (South Africa's main energy producer) has added markers to transmission lines to make them more visible. In one area, Eskom has re-routed the utility line responsible for killing adult Wattled Cranes. Eskom has also created a Wildlife Advisory Committee, which is collaborating in studies of the impact of utility lines on crane injury and mortality rates (McCann and Wilkins 1994, 1995). Eskom has postponed plans for a controversial new utility line in Natal pending a study of its potential impacts. If built, this utility line would cross through the heart of Natal's crane habitat (D. Johnson pers. comm).

Surveys/Censuses/Monitoring

Counts and surveys of the Wattled Crane have been undertaken in various portions of the species range. Mundy et al. (1984) reported 83 birds in a 1983 survey of Zimbabwe. In 1986 and 1987, the Wildlife Trust of Zimbabwe conducted aerial censuses of Wattled Cranes, finding a maximum total of 94 birds within Zimbabwe (Mundy et al. 1988). Bousfield (1986) studied the distribution and breeding status of the Wattled Crane in the Okavango Delta and found approximately 200 pairs. Aerial surveys of the Okavango Delta have recently been undertaken by Mangubuli and Motaloate (in press) and Archibald and Garba (pers. comm.).

From 1971-1973, aerial surveys of Wattled Cranes were conducted on the Kafue Flats, Busanaga Plain, and Lukanga Swamp (Douthwaite 1974). In 1987, 369 Wattled Cranes were counted in an aerial survey of the Kafue Flats, allowing an estimate of more than 2500 birds for the entire area (Anon. 1988). Banda (in press) reports the results of surveys conducted in 1985-1987, 1990-1991, and 1992 in Nyika National Park, Malawi. Dodman (in press) reports results of surveys conducted in the Kafue Flats, Zambia, from 1982-1993. Kamweneshe (in press a) reports results of ground and aerial surveys in the Bangweulu region of Zambia in 1984, 1991, and 1993.

Goodman reported an estimated 2570 Wattled cranes in the Marromeu Complex of the Zambezi Delta during a wet season (23-30 September) survey conducted in 1990. A recent (March 1995) aerial survey of the same area during the dry season resulted in a total count of 156 birds, and at least 58 pairs (Beilfuss 1995).

From 1978-1982, Wattled Crane breeding sites in South Africa were surveyed by the Natal and Transvaal Provincial Administrations (Tarboton et al. 1987a). In November and December 1985, and in January and July 1986, a census of cranes was conducted in South Africa; this included casual sightings, road censusing, detailed weekend crane counts, and aerial surveys (Filmer and Holtshausen 1992). In Natal, an annual aerial census of breeding sites is conducted in July (D. Johnson pers. comm). Wattled Cranes have also been counted during the African Waterfowl Census conducted by the IWRB (Taylor and Rose 1994, Davies in press).

Research

West (1963), studying a pair of Wattled Cranes in Zimbabwe (Rhodesia), was the first field researcher to provide detailed information on the biology of the species in the wild. Walkinshaw (1965) studied the crane in northern and southern Rhodesia and in Natal, South Africa. In 1967, Urban and Walkinshaw described the distribution of Wattled Cranes in Ethiopia. Walkinshaw (1973) and Johnsgard (1983) provided general accounts of the species in their monographs of the family.

Douthwaite (1974) described the distribution and biology of the large population of Wattled Cranes in the Kafue Flats of Zambia. In order to verify information on the biology of the species, define conservation problems, and propose solutions, Konrad (1981) investigated the status of the species and their wetland habitats in Zambia, Botswana, and South Africa. Additional publications have assessed the overall status of the species (Urban 1988, Urban in press).

Most of the research on Wattled Crane habitat and biology has been conducted in South Africa (Johnson and Barnes 1985, 1991; Tarboton et al. 1987a), Malawi (Banda in press), Zambia (Dodman in press, Kamweneshe in press a), and Namibia (Hines in press). Eskom and the Endangered Wildlife Trust are now collaborating in a research program involving the Wattled, Blue, and Southern Crowned Crane in the Natal midlands. In particular, researchers are focusing on studies of

the movements of cranes (McCann and Wilkins 1995). These studies are expected to contribute to the development of a management plan for these three species (McCann and Wilkins 1994, 1995). The status and ecology of Wattled Cranes in the other range countries are not well documented. An ethogram for the species has been prepared by Davenport and Urban (in press).

Working Groups and Management Plans

In 1982 a Wattled Crane Steering Group, composed of members of the Natal Parks Board, Transvaal Nature Conservation Division, Endangered Wildlife Trust, Southern African Ornithological Society, and the Council for Scientific and Industrial Research, was established in South Africa. In addition to educational projects, it developed a Management Plan for the Conservation of the Wattled Crane in South Africa (Tarboton and Johnson 1992). This blueprint for Wattled Crane survival set a goal of maintaining a population of 300 Wattled Cranes in natural areas in South Africa. The plan called for establishment of a breeding site register, additional protected reserves, improved legislation and law enforcement, research, public education, and captive propagation. The Southern African Crane Foundation has since taken over the functions of the steering group (D. Johnson pers. comm).

In 1992 preliminary modeling was undertaken in South Africa in preparation for a full PHVA for the species. This step involved gathering existing information on the status of the species, but did not entail a full workshop or widespread communication and review of findings. A full PHVA has been planned but not yet undertaken (C. Mirande pers. comm.).

At the 1993 African Crane and Wetland Training Workshop in Maun, Botswana, 9 of the 11 range countries prepared national crane and wetland action plans. These are to be published in the workshop proceedings (Beilfuss et al. in press).

Non-governmental Organizations

See Allan (1994a) and the Blue and Grey Crowned Crane species accounts in this volume for discussion of NGOs active in the preservation of South Africa's cranes. The Wakkerstroom Natural Heritage Association has been especially active in the conservation of this species and its habitats. Farmers in South Africa who support breeding pairs on their land are now being urged to have their farms registered as Natural Heritage Sites under the South African Natural Heritage Program. Registration allows for crane management plans to be incorporated into the title deeds (Johnson 1992c). The Highlands Crane Group of the Endangered Wildlife Trust has sponsored special "farmers' days" to stimulate cooperative conservation activities among farmers (Rodwell 1994).

Dodman (in press) describes the WWF-Zambia Wetlands Project, which has operated in the Kafue Flats since 1986 at Lochinvar and Blue Lagoon National Parks. The main aim of the project is to establish a fair system by which local communities and governments may share the costs and benefits of sustainable conservation and the management of wetlands (World Wide Fund for Nature 1992). Training courses are offered to community leaders and members, project and governmental employees, and school groups. A conservation component is included in all programs in the hope that participants will link their training to the value and benefits of wetlands and wildlife, and will seek out alternatives to poaching and other illegal activities in the area. Courses in bird identification, conservation, and study are also offered, allowing community members to understand better the population status of the Wattled Crane and other wetland species. The Ethiopian Wildlife and Natural History Society has developed conservation and education programs pertinent to the cranes in Ethiopia.

Education and Training

Educational programs and public awareness efforts involving Wattled Cranes and their habitats have been carried out most extensively by NGOs in South Africa. SACF is currently developing an interpretation and education center at Hlatikulu, Natal. An Environmental Education Center and Community Development Program were established in 1992 under the auspices of the Wakkerstroom Natural Heritage Association. The development program focuses on grassland and wetland ecology and sustainable community development projects. In 1994, the Endangered Wildlife Trust published a booklet entitled *Cranes and Farmers* (Allan 1994) that is now being widely distributed. This booklet also addresses the needs of Blue Cranes and Grey Crowned Cranes.

Professional training related to the conservation of Wattled Cranes and their wetland habitats has been most readily available in South Africa. However, training opportunities involving this and the other African crane species have expanded in recent years, particularly in connection with the 1993 African Crane and Wetland Training Workshop in Botswana.

Captive Propagation and Reintroduction

Beall (in press) provides an overview of the status and management of captive Wattled Cranes for conservation. The first record of Wattled Cranes being held in captivity dates to 1873. The first successful breeding in captivity was recorded in 1944. Captive propagation, however, became more widespread only recently, as birds exported from Africa to Europe and the United States began to reproduce. The GCAR identified 172 Wattled Cranes in captivity worldwide as of 1993 (Mirande et al. in press a). This total includes sixteen breeding pairs in thirteen institutions (Beall in press). The species is relatively difficult to breed in captivity, and fertility rates (especially among wild-caught birds) are low compared to other crane species.

In 1989, the Wattled Crane was included among the crane species to be covered in a Species Survival Plan of the American Zoo and Aquarium Association (Beall in press). A SSP Master Plan for Wattled Cranes in North America has also been developed and implemented. Europe, North America, and Asia all have (or are currently preparing) regional management plans (Beall in press). A Global Animal Survival Plan was strongly recommended in the GCAR and is being

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Scientists and conservationists at the 1993 African Crane and Wetland Training Workshop, Maun, Botswana

organized by Fred Beall, the International Studbook Keeper. The GASP effort will be co-chaired by Lindy Rodwell of SACF.

There is strong interest in coordinating captive management and *in situ* conservation of this species in South Africa and Zimbabwe. Since 1988, the Umgeni River Bird Park in Durban, South Africa has received permission from the Natal Parks Board to collect second eggs from wild nests. These eggs have been successfully hatched and reared (Abrey 1992). Some of these birds will be used to establish a release program. SACF has begun to develop this program and is coordinating training in release techniques and research on potential release sites. The first experimental releases will take place in 1996 at Verloren Vlei, where Wattled Cranes occurred historically and where the original factors behind the species' decline have been addressed (L. Rodwell pers. comm.).

2.5.10 Priority Conservation Measures

Legal and Cultural Protection

1) Enforce existing legislation protecting Wattled Cranes from hunting, poisoning, and capture.

2) Enforce existing measures regulating resource use and settlement within protected areas.

3) Introduce specific legislation to encourage conservation and to prevent further development of Wattled Crane breeding habitat outside of protected areas.

4) Develop and enforce requirements for environmental impact assessments in the process of issuing permits for changes in land-use (especially afforestation permits).

International Agreements and Cooperation

1) Transfer the species from CITES Appendix II to Appendix I.

Protected Areas

1) Provide greater protection for the following key habitats by expanding existing protected areas, upgrading their protective status, and/or strengthening management capabilities:
   - Bangweulu Swamps (Zambia). A critical part of the Bangweulu wetlands requires immediate protection under the jurisdiction of a national park. Currently, this area is classified as a game management area, with no form of hunting permitted. A small portion falls within

Isangano National Park. The game management area in the Bangweulu Swamps should be greatly expanded and upgraded to a national park to provide full protection to the area.

- Kafue Flats (Zambia). Important breeding grounds to the north of Namalio and between Chawembe and Luwato Lagoons require protection within Lochinvar National Park. Laws regulating the activities of fishermen, pastoralists, and settlers within the national park boundaries need to be communicated and enforced.
- Morremou Complex (Mozambique). Special needs here include: training for reserve personnel, stronger safegaurds against poaching, and studies of local land use practices.
- Abijatta-Shala Lakes and Bale Mountain National Parks (Ethiopia). See Hillman (1986, 1993). Community-based conservation and development programs are of high priority in these areas.

2) Conduct national-level surveys to identify additional areas of critical habitat for designation as protected areas.

3) Provide improved habitat conditions within existing reserves. Required measures include: restoration of native plant species and communities (in part through the removal of plantation trees and other alien plant species); timing of burning schedules to avoid destruction of eggs or pre-fledged chicks; controlled livestock grazing; and establishment of lure crops and feeding areas.

Habitat Protection and Management

1) Develop community-based wetland conservation and management programs in several key sites where Wattled Cranes occur. Such demonstration sites are especially needed in the central portion of the species' range (Mozambique, Botswana, Zambia). The experience of the WWF-Zambia Wetlands Project should be examined for useful and more widely applicable lessons.

2) Assess and ameliorate to the extent possible large-scale threats in the following critical habitats:
   - Kafue Flats. The hydrologic regime of the Kafue Flats has been altered as a result of hydroelectric development. This has reduced the availability of feeding areas and nesting sites for the Wattled Crane. Proper regulation and timing of water discharge at the Iteshiteshi Dam is of paramount importance to the future of the Kafue Flats as suitable habitat. The Wattled Crane population is also threatened by gypsum mining near Gwisho in Lochinvar National Park, and by completion of a hydroelectric power project in the lower Kafue Basin.
   - Zambezi Delta. Hydroelectric development has also altered the dynamics of the Zambezi Delta. In addition, years of warfare have had profound impacts on habitat conditions, wildlife populations, and management functions in the delta.
   - Okavango Delta. The Okavango Delta faces development pressures due to planned water diversions, reservoir construction, and tsetse fly control programs (see Urban 1988).
   - Makgadikgadi Pans. This area is under pressure from soda ash mining and associated human development (see Urban 1988).

3) Protect breeding habitat on privately owned farmland. This should be accomplished in part through the following steps:
   - Inventory and register wetlands used by Wattled Cranes.
   - Determine the means whereby breeding sites can be preserved. This may be accomplished by providing compensation to landowners to prevent wetland development or by establishing a "rent-a-wetland" scheme. The number and activities of dogs on farms where cranes breed should be carefully controlled.
   - Work with farmers to ensure that eggs and chicks of breeding cranes are not interfered with on their properties.
   - Monitor and assess planned or possible land use changes that threaten particular breeding sites.
   - Disseminate information to landholders on habitat protection and management measures. For example, wetlands supporting pairs of Wattled Cranes should not be burned when eggs or chicks are present. Controlled livestock grazing may be beneficial in nesting habitat, and land managers may want to include grazing in their management plans (D. Johnson pers. comm).
   - Develop incentive programs to encourage farmers to adopt crane conservation practices and to participate in conservation programs.

Surveys/Censuses/Monitoring

The following actions should be coordinated with one another, and with priority measures under this category for the Grey Crowned and Blue Cranes.

1) Organize and conduct a range-wide Wattled Crane census. This effort should entail:
   - formation of a coordinating body to determine count dates and to collate and distribute all census information;
   - simultaneous counts throughout the species range, preferably at the same time as the IWRB counts;
   - collection of data, where possible, on the social structure of each population, mated pairs, non-breeding flocks, and successful pairs with juvenile chicks.

2) Establish long-term crane monitoring programs in the major wetland complexes throughout the range of the Wattled Crane (including the Kafue Flats, Bangweulu

Swamp, Busanga Flats, Liuwa Flats, Lukanga Swamp, and the Sioma-ngwezi Plain in the Zambezi basin; the Okavango Delta; the Makgadikgadi Pans; the Luangwa Valley; the Nyika Plateau; the Zambezi Delta; and known habitats in the highlands and Rift valley of Ethiopia).

3) Develop a standard method of conducting aerial surveys of Wattled Cranes that will allow for future duplication and reliable comparisons of data.

Research

1) Study the feasibility of simulating bi-annual flooding in floodplain habitats that have had their natural flooding regimes altered by artificial impoundments. Natural flooding may be simulated through short duration maximum volume releases and other changes in water management policies.

2) Expand research on Wattled Crane habitat and biology outside of the South African portion of its range. Studies should focus on the distribution, population status, habitat requirements and availability, wetland ecology, and the life history of resident, breeding, and non-breeding cranes. These studies in turn should contribute to improved range maps and facilitate the protection and management of critical habitats.

3) Describe and study the populations of Wattled Cranes in Angola, Tanzania, and Ethiopia. The status and movements of these populations are poorly known.

4) Initiate a coordinated program of ringing (banding) pre-fledged chicks to collect information on habitat requirements, population dynamics, seasonal movements, and movements of non-breeding adults and juveniles. This program should involve all range countries. Details of the program (e.g., color banding scheme per country, timing, etc.) need to established, most likely by the same body responsible for the coordination of censuses.

5) Conduct radio and/or satellite telemetry studies needed to provide data on seasonal movements, territory size, home range, and life history.

6) Study the connection between hydrological change (as a result of water development projects) and nesting success in floodplain habitats. This data can be used to guide comprehensive water management policies to avoid loss of critical habitat.

7) Study the role that non-breeding habitat plays in the breeding success and population dynamics of the species. For example, large ephemeral wetlands in Namibia are used on a seasonal basis by large numbers of Wattled Cranes when the availability of habitat in permanent wetlands is limited. The role such dispersal areas play in the breeding success and population dynamics of the Okavango, Zambian, and Angolan population requires further study (see Hines in press).

8) Determine whether the Ethiopia population is genetically distinct from the rest of the species. If the populations are taxonomically divergent, this may affect future conservation and captive propagation programs, as the majority of captive birds are from the South-central and South Africa populations.

Education and Training

1) Stimulate local interest in resident crane populations through Wattled Crane counts and other educational programs involving cranes and their habitats. Support should be given to NGOs (such as wildlife clubs and ornithological societies) to sponsor these projects. In some areas (primarily in South Africa), counts of Wattled, Blue, and/or Grey Crowned Cranes can be organized simultaneously.

2) Develop educational programs aimed at farmers and other private landowners, farm laborers, and students. The recently published booklet *Cranes and Farmers* should be distributed to all farmers in South Africa whose lands are important to cranes.

3) Address the poisoning problem specifically through a broad-based information campaign in the mass media.

4) Enhance awareness of the legal protection of Wattled Cranes through educational efforts throughout its range.

5) Provide funding agencies, authorities, and local residents with information about the management policies of national parks and game management areas.

Captive Propagation and Reintroduction

1) Implement the following recommendations outlined in the Crane GCAR and CAMP (Mirande et al. in press a):
   - Manage the captive population of Wattled Cranes at the Intensive-1 (A priority) level, with a target population of 250 well managed birds of known genealogy (this will require the population to be increased by some 73 birds). There are adequate numbers of genetic founders in the worldwide captive population, so that additional birds or eggs from the wild are not needed if regions cooperate in the exchange of bloodlines.
   - Base decisions for future release programs on overall conservation priorities developed by a multidisciplinary management team. Among other questions, the team should consider whether captive birds are needed to support release efforts, and whether more captive pairs should be established in southern Africa or birds and

eggs from existing captive programs in Europe and the United States should be utilized.

- In view of the number of crane taxa requiring management and the limited availability of resources, the Ethiopian population should not at this point be managed separately.
- Conduct additional research on egg-laying, fertility rates, and egg breakage among captive Wattled Cranes (especially among wild-caught birds).

2) Increase the rate of parent-rearing within the captive population.

3) Identify and assess the suitability of potential release sites in southern Africa.

4) Move forward with efforts to develop a Global Animal Survival Plan for the species. A full PHVA should be undertaken as part of this process.

2.6 SIBERIAN CRANE (*Grus leucogeranus*)

2.6.1 Summary

The Siberian Crane is the third rarest species after the Whooping and Red-crowned Cranes. The total population was believed to number only a few hundred until 1981, when Chinese biologists discovered a wintering flock of 830-850 cranes at Poyang Lake along the middle Yangtze River in China. Subsequent field surveys have allowed scientists to revise the total population estimate upward to 2900-3000. These numbers, although encouraging, do not ease the conservation challenges the Siberian Crane faces. Archibald (1992b) notes that "from the tundra to the subtropics, few endangered species involve so many complex problems in so many countries

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Siberian Crane *(Grus leucogeranus)* pair at Keoladeo National Park, Bharatpur, India

as does the Siberian Crane." The species is classified as Endangered under the revised IUCN Red List Categories. The Central and Western populations, because of their extremely limited numbers, are Critically Endangered.

The species is divided into three populations. All but a few belong to the Eastern population. These birds breed in northeastern Siberia and winter along the middle Yangtze River in China. The Central population winters in the Indian state of Rajasthan, most regularly at Keoladeo National Park. Banding studies indicate that the population's breeding grounds lie in the lower basin of the Kunovat River in western Siberia. After a two-year absence, four birds, representing the entire known population, were observed on their wintering grounds in February. The Western population, which according to recent counts has only nine birds, winters at a single site along the south coast of the Caspian Sea in Iran. The exact location of the breeding grounds in northwestern Russia is being actively investigated through satellite-tracking, aerial surveys, and field interviews. Although the number of birds in the population has apparently held at 8-14 birds over the last 8-10 years, the population remains extremely vulnerable.

The Siberian Crane is the most highly specialized member of the crane family in terms of habitat requirements, morphology, vocalizations, and behavior. It is the most aquatic of the cranes, exclusively using wetlands for nesting, feeding, and roosting. It nests in bogs, marshes, and other wetland types of the lowland tundra, taiga/tundra transition zone, and taiga, preferring wide expanses of shallow fresh water with good visibility. Although its migration and wintering habitats are somewhat more varied, feeding and roosting sites are still found only in shallow wetlands, including artificial water impoundments in India and Iran. It is most frequently observed probing in wetlands for its preferred foods—the roots, tubers, sprouts, and stems of sedges and other aquatic plants.

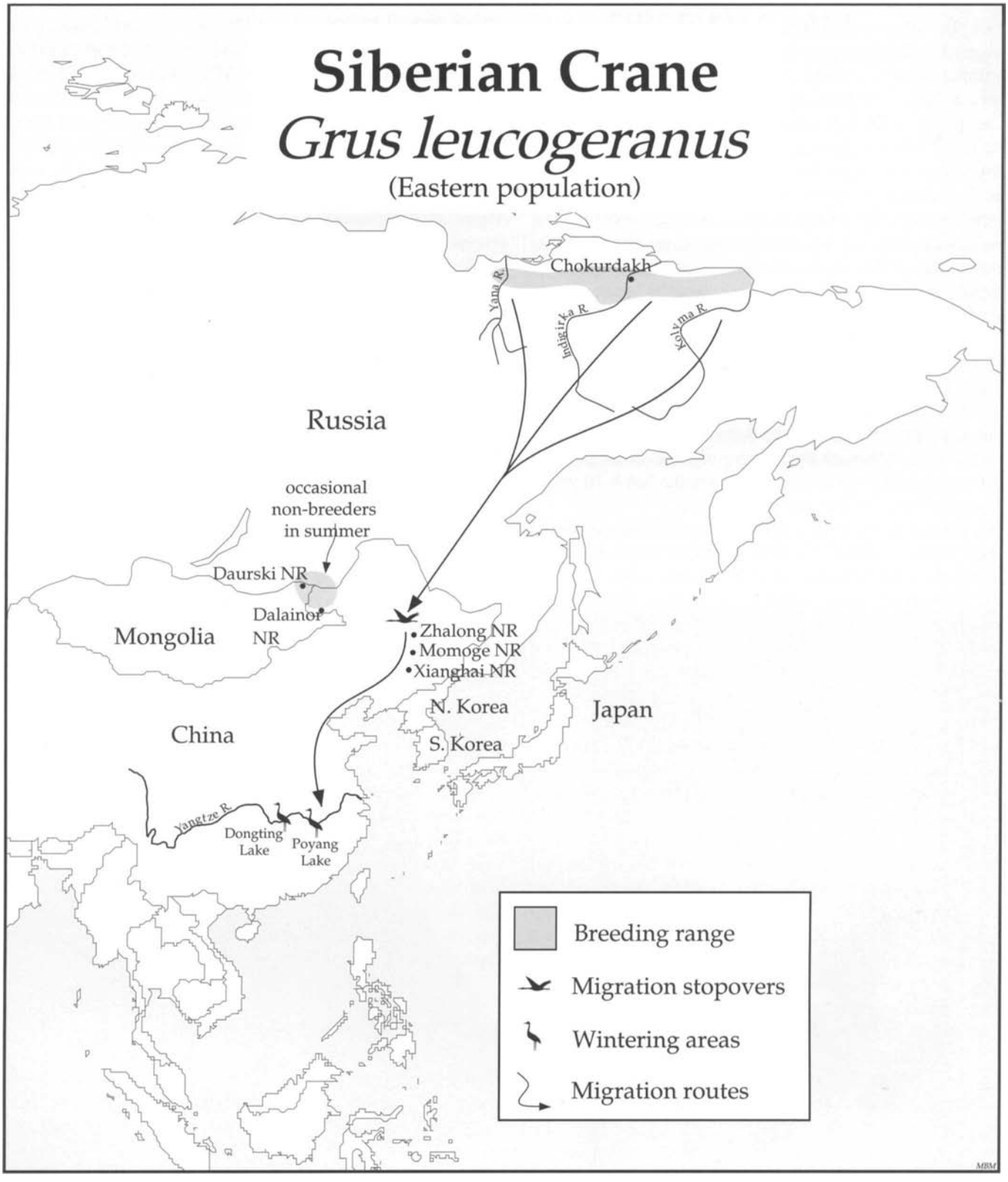
The three populations of Siberian Cranes face an array of threats. The traditional migratory and wintering habitats of the species (especially in China) are under constant pressure from the demands of the growing human population on wetland systems and resources. Large portions of the Eastern population's wintering grounds in China have been lost to drainage, reclamation, and agricultural development. These areas are also threatened by oil exploration and by construction of the Three Gorges Dam on the Yangtze River. Oil exploration and development pose a broad scale threat to the known breeding grounds of the species. Hunting is believed to be the major cause behind the rapid decline of the Central population, and is of continuing concern in Pakistan, Afghanistan, and other portions of the species' range. The Central and Western populations are especially vulnerable to these and other threats because of their extremely low numbers.

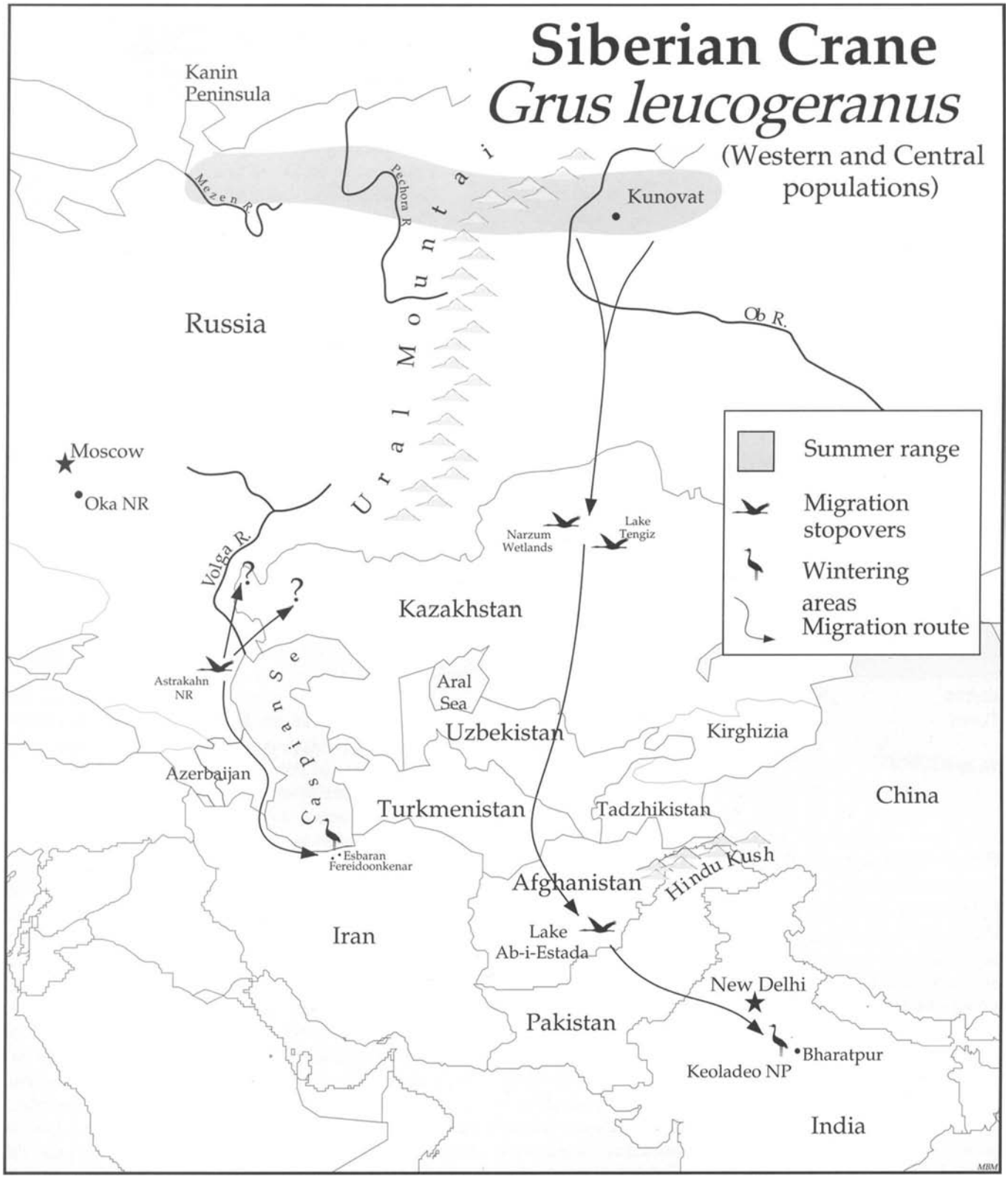
Concerted conservation efforts on behalf of the species began in the early 1970s. Since then, extensive research has been conducted on the ecology, ethology, breeding and wintering grounds, and migration routes of the species. Annual censuses are carried out in all three known wintering areas, and regular counts in several known breeding areas of the Eastern and Central populations. Based on this data, a PHVA was prepared for the species in 1992. Protected areas have been established at migration stopover points in Russia, Pakistan, and China, and at the wintering grounds in China and India. Since the early 1980s, educational programs have played a significant role in efforts to protect the Central population in its non-breeding habitats in India, Pakistan, and Afghanistan. Information about the species has been shared at several international conferences and through expanded communications among biologists. Efforts are now underway to establish an international Siberian Crane Recovery Team and to develop a Recovery Plan. A Memorandum of Understanding Concerning Conservation Measures for the Siberian Crane has been developed (though not yet signed by all the range countries). An intensive captive propagation program, involving three separate facilities, was initiated in the mid-1970s. Captive-raised birds are now being released in an effort to maintain the Central population, and releases are also planned for the Western population.

Priority conservation measures for the species include: active participation of all range countries in the Memorandum of Understanding; full development of the Recovery Team and Recovery Plan; creation of protected areas on breeding grounds and at key staging areas and stopover points; upgrading of habitat protection and management efforts at the wintering grounds in Iran and China; continuation of annual winter counts; identification of the breeding grounds in the Kunovat basin and possibly other areas in northwest Russia; identification of migration routes, important staging areas, stopover points, and alternative wintering grounds; studies of breeding, migration, and wintering grounds and other crucial aspects of Siberian Crane biology and ecology; and development of special educational programs involving hunters along the migration route of the Central population and communities near the wintering areas in Iran, India, and China. Captive propagation and reintroduction efforts should focus on bolstering the Western and Central populations, maintaining a genetically diverse captive population, and perfecting rearing and release techniques.

2.6.2 Subspecies/populations

There are no subspecies. The species is currently divided into three separate populations. Studies are underway to determine the intraspecific taxonomic status of these populations.


Siberian Crane
Grus leucogeranus
(Eastern population)
Chokurdakh
Yana R.
Indigirka R.
Kolyma R.
Russia
occasional
non-breeders
in summer
Daurski NR
Dalainor
NR
Mongolia
Zhalong NR
Momoge NR
Xianghai NR
N. Korea
S. Korea
Japan
China
Yangtze R.
Dongting
Lake
Poyang
Lake
Breeding range
Migration stopovers
Wintering areas
Migration routes
MBM


Siberian Crane
Grus leucogeranus
(Western and Central populations)
Kanin Peninsula
Mezen R.
Pechora R.
Ural Mountains
Kunovat
Ob R.
Russia
Moscow
Oka NR
Volga R.
Narzum Wetlands
Lake Tengiz
Kazakhstan
Summer range
Migration stopovers
Wintering areas
Migration route
Astrakahn NR
Caspian Sea
Aral Sea
Uzbekistan
Kirghizia
Azerbaijan
Turkmenistan
Tadzhikistan
China
Esbaran Fereidoonkenar
Afghanistan
Hindu Kush
Iran
Lake Ab-i-Estada
New Delhi
Pakistan
Bharatpur
Keoladeo NP
India

2.6.3 Population Numbers and Trends

Population	Number	Trend	Source
Eastern	2900-3000	Unknown.	Song et al. 1995, Gui 1995, Harris et al. 1995, J. Harris pers. comm.
Central	4	Steadily declining. Observed on the traditional wintering grounds in February 1996 after a two-year absence.	A. Sorokin pers. comm.
Western	9	Holding at 9-11 birds on the wintering grounds since the mid 1980s. Highly vulnerable.	A. Sorokin pers. comm.

2.6.4 Conservation Status

Species	
IUCN category	Endangered, under criteria A1c C1 C2b
CITES	Appendix I

Population	IUCN Category
Eastern	Endangered, under criteria A1c, C1 C2b
Central	Critically Endangered, under criteria A1a,c,d A2b,d B1c,e C1 C2b D E
Western	Critically Endangered, under criteria A1a,c A2b,c B1 B2e C1 C2b D E

2.6.5 Historic and Present Distribution

Evidence regarding the Siberian Crane's former range and abundance is unclear. Sauey (1985) attributes the disparities in the historical record to several factors: the species' rarity; the remoteness of its breeding grounds; its extended use of traditional stopover areas during migration; the extremely localized wintering grounds; and the tendency of non-breeding individuals to wander extensively (often far from the breeding grounds) in the summer. Evidently, the species was never very abundant in historical times, and by the 19th century was declining due to human impacts. Sauey (1985) concludes that "while it is not possible to assess numerically the extent of the... decline over the last century, there can be little doubt that this species suffered great losses in range and numbers."

The species probably had a broader breeding and wintering range than at present. There are records of the Siberian Crane breeding from Scandinavia to northern Kazakhstan, northern Mongolia, and eastern Siberia. Some of these records may be questionable due to the remoteness of the breeding areas and assumptions based on occasional occurrences. The historical evidence for a more extensive winter distribution is stronger (see Sauey 1985, Sauey et al. 1987). The species may have wintered more widely along the southern Caspian Sea region in Iran, in the Gangetic Basin in India, and in the Yangtze River basin in China. There are also historical records of the species wintering in the Balkan Peninsula and in Turkey and other portions of the Black Sea region (Nankinov 1995).

The species now exists as three localized, disjunct wintering populations.

1) *Eastern population*

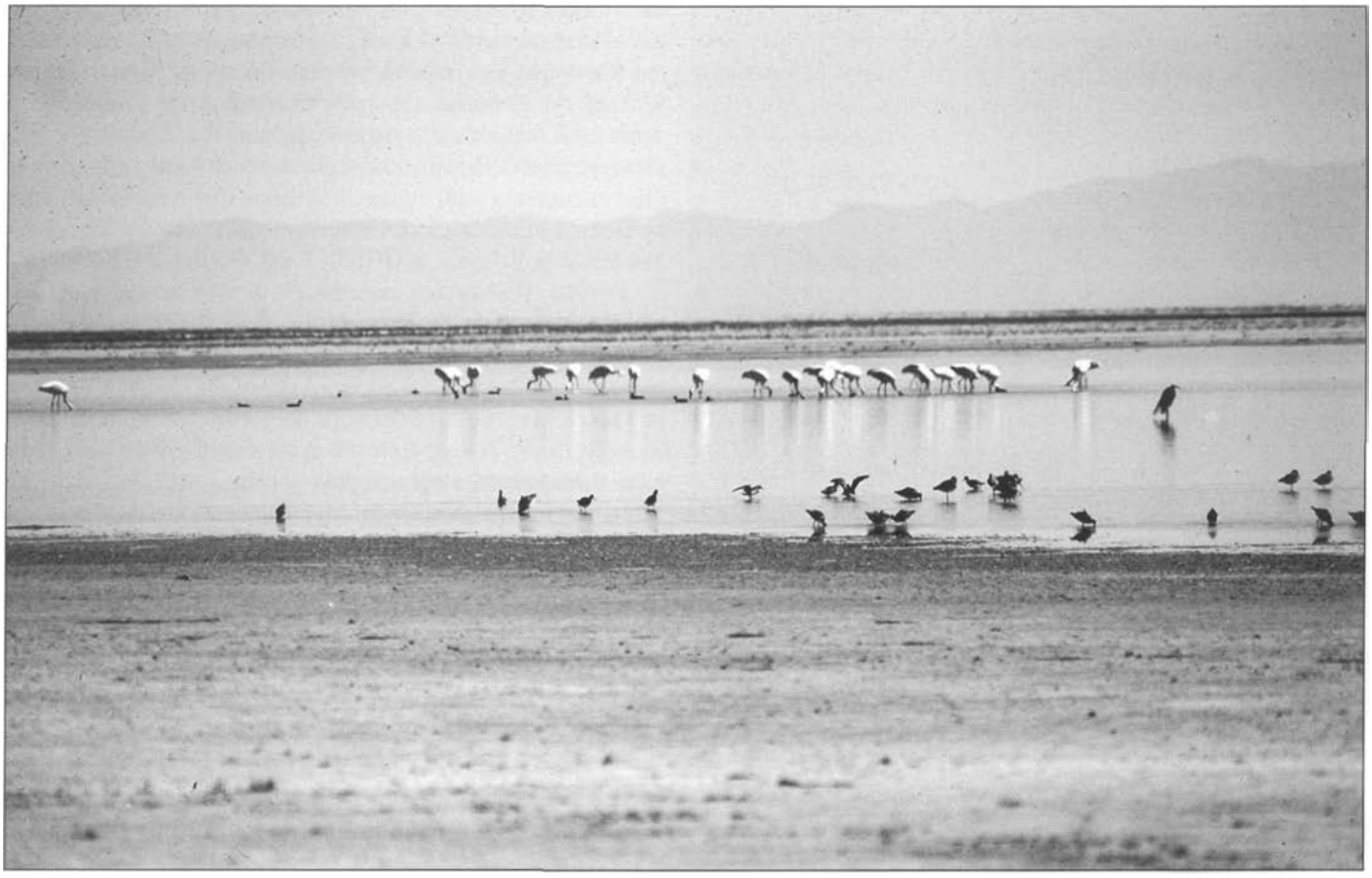
The Eastern population contains 2900-3000, more than 99% of the world's total population. The main breeding grounds cover 82,000 km^2 in the Yakutia region of northeastern Siberia, south of the East Siberian Sea between the Yana and Kolyma Rivers (Flint and Sorokin 1982, Labutin et al. 1982, Degtyaryev and Labutin 1991). Non-breeding individuals range widely, and have occasionally been observed during the breeding season in the Russia-Mongolia-China border region. The population migrates along a 5100 km migration route following the Yana, Indigirka, and Kolyma River valleys, and then into eastern China, with several resting areas and longer-term stopover points (Degtyaryev and Labutin 1991, Harris 1992a). Although some of these important traditional stopover points are now protected by the Xianghai, Momoge, and Zhalong Nature Reserves, others remain unprotected. Vagrant individuals are occasionally reported in Japan, usually in the autumn.

The population winters in a limited number of wetlands along the middle Yangtze River in south-central China (Ding and Zhou 1991). Approximately 98% of the population winters in one area—at Poyang Lake in northern Jiangxi Province. The Poyang Lake Nature Reserve protects some of the most important wintering sites in this area, but the birds also use adjacent sites outside the reserve. The remainder of the known population, perhaps a hundred or more birds, winters at Dongting Lake in the city of Yueyang in Hunan Province (Gui 1991, Harris 1991a). The population may use other as yet unknown wintering sites in China (J. Harris pers. comm.).

The existence of this population had been noted in historical records, but there were no modern reports until ornithologists in China discovered the wintering birds at Poyang Lake in 1980 (Zhou et al. 1981). The population was thought to number only a few hundred until a larger flock of over 800 birds was reported in 1984. Subsequent surveys, using improved techniques, have allowed estimates of the total number to be revised upward (Liu et al. 1987a). The population is now believed to number approximately 3000 (Song et al. 1995, Gui 1995, J. Harris pers. obs.).

2) *Central population*

The Central population, as observed on its traditional wintering grounds at India's Keoladeo National Park in February 1996, included only four individuals; it is possible that other members of the population have continued to winter elsewhere in India. The breeding grounds in western Siberia have been



R. SAUEY

Siberian Cranes (central population) at Lake Ab-i-Estada, Afghanistan in the early 1980's

tentatively identified through satellite telemetry studies. In 1981, a breeding population of Siberian Cranes was located in the lower basin of the Kunovat River (a tributary of the Ob River), about 60 km east of Gorki (Sorokin and Kotyukov 1987). A juvenile from this area, satellite-tracked in 1992, followed a route toward India until its signal was lost near the Turkmenistan-Afghanistan border. This indicates that the Kunovat cranes are probably the same birds that spend the winter at Keoladeo NP, near Bharatpur in the Indian state of Rajasthan (Archibald 1994). This was confirmed in February 1996 when a wild chick, color-banded at Kunovat in 1995, was observed at Keoladeo NP. This migration route is among the longest of any crane population. The presumed route passes through Kazakhstan, Uzbekistan, Turkmenistan, Afghanistan, and Pakistan, with possible traditional stopover points at Lake Tengiz and the Naurzum wetlands in Kazakhstan, and at Ab-i-Estada in Afghanistan (Jamil 1994). The final leg of the migration route brings these birds across the Indus basin and northwest India.

Wintering Siberian Cranes were reported with regularity in the Gangetic basin through the 1800s (Sauey et al. 1987). Since at least 1937, however, the only known wintering site of the population has been among the artificially improved wetlands at Keoladeo NP. In extremely dry years, however, the lack of water in the park can prompt the population to avoid this area, or to disperse from Keoladeo to other sites. Only a few of these alternative wintering grounds have been identified (Singh et al. 1987).

The population has been counted annually at Keoladeo NP since 1965. Since then, the population has declined steadily from around 200 in 1965 to just four individuals—a pair with a chick and a lone adult—in 1996. None were observed at the park in the winter of 1993-94, and 1994-1995. The alternative wintering site has not been identified. In the summer of 1994, not less than 9-10 Siberian Cranes were reported on the presumed breeding grounds of the population in the Kunovat basin (S. Sorokin pers. obs.). In February 1995, two Siberian Cranes were reported in northeast Iran along the Afghanistan border among a flock of Eurasian Cranes (F. Mostofi pers. comm.). Data from radio-tracking studies show that the Eurasian Cranes wintering in this area nest in the Kunovat basin, and it is probable that Siberian Cranes seen in this area also nest in the Kunovat region.

The loss of adult and young birds during migrations through Pakistan and Afghanistan is thought to be the leading factor behind the decline. Attempts to supplement the population with captive-reared birds were initiated in 1991, and have continued each year up to the present. Results have so far been

inconclusive. As of Autumn 1995, none of the seven birds released in the north are known to have migrated south successfully, and none of the six birds released in the south are known to have migrated north successfully. (See "Captive Propagation and Reintroduction" section below).

3) *Western population*

The Western population, which currently includes nine individuals, is known only from its occurrence at a single wintering site in Iran. The exact location of the breeding grounds has been long sought. At the time of publication, new information on the possible breeding grounds was beginning to emerge. In spring 1996, ornithologists working under the auspices of the Wild Bird Society of Japan were able to satellite-track a paired male in the population on its northern migration. The bird moved north from the wintering grounds along the western and northern coasts of the Caspian Sea, across western Kazakhstan, and east of the Ural Mountains to a site on the Kunda River, about 630 km due south of the Central populations's breeding grounds at Kunovat (Wild Bird Society of Japan pers. comm.). As of June 1996, this bird had remained at this site.

Other recent information indicates that the population may also breed in scattered locations west of the Ural mountains. In the summer of 1994, a pair of Siberian Cranes was reported on the tundra southeast of the Kanin Peninsula, 1000 km west of the Kunovat basin, midway between the Ural Mountains and Finland (V. Kalzakin pers. comm., Archibald 1994). Aerial surveys of this region have not yet been able to confirm their presence there. However, interviews with local people about their encounters with cranes offer hope that nesting sites may be located in the bogs and other wetlands between the Mezen and Pechora Rivers.

Further studies are needed to determine the complete migration route(s) of the population. Only the southern portion of the route(s) has been substantiated. This portion stretches along the northern and western coasts of the Caspian Sea from the Volga River delta in the north to northern Iran in the south. The Astrakahn Nature Reserve at the mouth of the Volga protects a traditional stopover point in the spring and fall. The migration route continues through Dagestan and Azerbaijan to the population's traditional wintering grounds—flooded fields at Fereidoonkenar and Esbaran along the southeast coast of the Caspian Sea in northern Iran.

Historical information on the Western population is scarce (Vuasalo-Tavakoli 1991, 1995). Wintering Siberian Cranes were first recorded in Iran in 1773, but subsequent observations were scattered. The species may have been more widely

E. NAZAROV

Siberian Cranes unison calling at nest in Kunovat basin, Russia

distributed across the Caspian lowlands during the winter. The population was thought to have been extirpated until 1978, when a remnant band of 12 birds was reported at Fereidoonkenar (Sauey 1985). Since then, annual winter counts have been conducted, and the population has fluctuated between 8-14 birds (Vuasalo-Tavakoli 1991, 1995).

2.6.6 Distribution by Country

Afghanistan	M
Azerbaijan	M
China	NB, M, W
India	W
Iran	W
Japan	V
Kazakhstan	M
Mongolia	NB, M
North Korea	V
Pakistan	M
Russia	B, M
South Korea	V
Turkmenistan	M
Uzbekistan	M

B = Present during breeding season
M = Present during migration
NB = Present during breeding season as non-breeder
W = Present during winter
V = Vagrant

2.6.7 Habitat and Ecology

The Siberian Crane's distinctive morphology, vocalizations, and feeding and courtship behavior distinguish it from the other *Grus* species (Johnsgard 1983, Sauey 1985). Its clear, high-pitched voice is unique among cranes. It is also the most specialized in terms of its habitat requirements, exclusively using wetlands for nesting, feeding, and roosting. Siberian Cranes are most frequently observed wading and probing for food in shallow (up to 30 cm) water. Fledged juveniles emit piercing calls to solicit feeding by their parents, suggesting that Siberian Crane chicks are more dependent on parental care than are post-fledged chicks of other species.

Siberian Cranes nest in scattered breeding territories, preferring wide expanses of fresh water with good visibility. The Eastern population's breeding grounds in Yakutia are in lowland tundra (moss-lichen tundra and grass- and sedge-dominated wetlands), more rarely in forest-tundra transitional areas, and sometimes in the northernmost taiga between the Arctic Ocean and uplands to the south. The Central population breeds in the northern taiga in sphagnum bogs and marshes. These marshes tend to be large, open wetlands surrounded by forests and divided by long, low inconspicuous ridges, the cranes nesting in the shallow waters between them (Sorokin and Kotyukov

ICF

Siberian Crane breeding habitat near Kunovat, Russia

1987). The nests consist of flat mounds of grass and sedge elevated 12-15 cm above the surrounding water. Eggs are generally laid from late May to mid-June, with peak production occurring in the first week of June. In most cases two eggs are laid, with only one chick surviving to fledging. The incubation period is about 29 days, and chicks fledge at 70-75 days.

In general, Siberian Cranes consume a wider variety of food items, both aquatic and terrestrial, on their breeding grounds than on their wintering grounds. The diet on the breeding grounds consists of plants, including roots, rhizomes, sprouts of sedges, seeds, horsetails, and berries and cranberries, as well as insects, fish, frogs, small mammals (e.g., voles and lemmings), and other small aquatic animals (including, on occasion, waterfowl). Animal foods are especially important at the beginning of the breeding season, when plant foods are unavailable, and during the chick-rearing period (Sauey 1985, A. Sorokin pers. comm., M. Nagendran pers. comm.).

During migration, the cranes roost and feed in large, isolated wetlands. The feeding and roosting areas at Zhalong, China, for example, are 3-5 km away from the nearest villages (J. Harris pers. comm.). Water depths of 30-60 cm are preferred. Occasionally Siberian Cranes will use dry mounds within or on the borders of wetlands, and even upland wet meadows. However, they virtually never use drier upland areas, even those close to roosting or feeding sites. This holds true even in drought years.

Because Siberian Cranes in India and Iran use artificially maintained wetlands, the wintering areas in China are probably more representative of the species' preferred winter habitat under natural conditions. In China, they forage in the shallows and vast mudflats created by the lowering of the water level in seasonal lakes during the winter dry season. The borders of the winter lakes shift with the changing winds, and the cranes follow the edges where the water-saturated soils create ideal conditions for extracting sedge tubers. The Central population's

wintering grounds in Keoladeo National Park consist of a series of artificial water impoundments that retain waters collected during the monsoon season (a dam also feeds water into the impoundments through a system of canals) (Vijayan 1990). The Western population winters within local "abbandans"—shallow (5-20 cm) artificial wetlands that are used to flood adjacent fields for rice paddy cultivation. In the winter months these areas attract waterfowl and have been modified with corral-like traps for capturing waterfowl. These areas are licensed and used by local farmer-trappers (Vuasalo-Tavakoli 1991, D. Ferguson pers. comm.).

Along migration routes and in the wintering grounds, Siberian Cranes eat primarily the roots, bulbs, tubers, rhizomes, sprouts, and stems of aquatic plants (and especially sedge tubers), but also take advantage of clams, fish, snails, and other aquatic animals if they are available. In China, the cranes of the Eastern population feed primarily on pondweed (*Potamogeton malainus*), stems and tubers of wild celery (*Vallisneria spiralis*), and small freshwater clams (Liu and Chen 1991). At Keoladeo, the birds of the Central population feed almost exclusively on tubers, corms, and roots of aquatic plants (especially the sedge *Cyperus rotundus*), supplemented by occasional animal foods (Sauey 1985). The cranes in the Iran population subsist on sedge tubers, other aquatic plants, and (possibly) rice gleanings (Vuasalo-Tavakoli 1991).

2.6.8 Principal Threats

The breeding grounds of the Siberian Cranes are remote and relatively undisturbed. However, several problems have been identified in these areas. Oil exploration and development pose a significant threat. Oil has been discovered in and near the breeding grounds of the Eastern population in Yakutia. Drilling rights have been granted on the Yamal Peninsula near the Kunovat Nature Reserve, where the Central population breeds (Archibald 1990).

In the Kunovat basin, common crows pose a definite threat to cranes, destroying eggs when the cranes are disturbed by the approach of elk, reindeer, and other large animals. Logging practices in the Kunovat region also have negative impacts on cranes. In many areas, trees that are cut during the winter are hauled out by water after the spring break-up of the rivers. On these occasions, cranes that nest close to the rivers may abandon their nests (A. Sorokin pers. comm.). Flint and Kishchinski (1981) note that the herding of reindeer in portions of Yakutia can result in the trampling of crane nesting territories.

The most immediate threats to the Siberian Crane affect the species outside of its breeding grounds. These threats fall into several categories.

Habitat Loss and Degradation

Loss and degradation of habitat is of greatest concern at critical staging areas, migration stopover, and wintering grounds. Although several of the Eastern population's major staging areas in eastern China are protected by nature reserves (principally the Zhalong, Momoge, and Xianghai reserves), many others in the flyway remain unprotected. At the same time, there is limited information about the migration route on which to base future protection efforts. Moreover, Siberian Cranes may use different migration routes in the spring and fall. The threat to migration habitats is greatest in China's eastern provinces. Further research is needed to define better the most critical areas.

Many of the species' key habitats, both within and beyond existing protected areas, are subject to increasing human population pressures, and are situated in areas conducive to intensive agricultural development. High human density, especially in eastern China, may be leading to unsustainable levels of exploitation of the water, fish, reeds, and other resources in many of the nature reserves (such as Xianghai) and in other non-protected wetlands along the migration routes (Harris 1986, 1992a). Drainage, reclamation, and agricultural development have claimed major portions of the wintering grounds at Poyang and Dongting Lakes. Oil exploration and development pose a threat to crane habitat at Dalainor Nature Reserve in Inner Mongolia, Momoge Nature Reserve in Jilin Province, Shuangtaizi Nature Reserve in Liaoning Province, at the mouth of the Yellow River, and at Poyang Lake. The development of oil fields in these areas involves not only the potential for direct damage from accidents, but also increasing levels of human disturbance and habitat degradation through the building of roads.

If construction of the proposed Three Gorges Dam on the Yangtze River proceeds, the impact on the Eastern population of Siberian Cranes (as well as wintering populations of White-naped, Hooded, and Eurasian Cranes) will be profound. The dam will disrupt the hydrology of the floodplain wetlands along the middle Yangtze, including those at Poyang Lake, by artificially maintaining low water levels during the summer flood season and raising water levels in the winter (when the cranes are present). These changes in the river basin's hydrological processes will in turn result in changes in the wetland plant communities upon which cranes depend. The dam will also have detrimental social and environmental impacts on the regional landscape (Topping 1995). The disruption of upstream human communities, emigration, agricultural expansion, deforestation, and other land use changes will not only directly affect currently protected areas such as Poyang Lake, but also areas outside the reserves. While water control structures have the potential to mitigate some of the more direct and short-term impacts on the wetlands associated with the Yangtze, basic ecological studies of these areas have not been conducted, and the longer-term impacts have not been assessed.

Habitats of the Central population are also at risk. In Afghanistan, political tensions have made it difficult to observe, monitor, or protect effectively the staging area at Ab-i-Estada and other important sites (Jamil 1994). At Keoladeo NP, maintenance of adequate water levels can be an acute problem, especially during dry years. However, measures undertaken since the early 1980s have reduced pressures to

drain and utilize the wetlands, and management strategies have been adopted that maintain water supplies in a portion of the reserve for the benefit of the resident Sarus Cranes (K. Rao pers. comm.). The grass *Paspalum distichum* is encroaching upon some of the park's wetlands. Air- and water-borne pollutants and pesticide use in adjacent areas also present problems within the park (D. Ferguson pers. comm.). Pesticides are also a problem in the flooded rice fields that the Western population uses on its wintering grounds in Iran (A. Sorokin pers. comm.).

Disturbance

Human disturbance affects all three populations. Disturbance due to late winter waterfowl hunting is a serious problem for the Western population in Iran. The Central population's wintering grounds at Keoladeo National Park are situated in one of India's most populated regions, and pressure on the park from people and livestock has risen in recent decades. Sauey (1985, 1987) concluded that human activities at Keoladeo NP—fishing, burning, cutting of firewood, and other activities—affected Siberian Crane foraging behavior and forced them to alter their roosting sites. Since Sauey's studies, significant progress has been made in controlling and even eliminating these types of disturbance (A. Brar pers. comm., K. Rao pers. comm.). Disturbance is also a factor for the Eastern population at migration stopovers (e.g., Zhalong, Momoge, and Xianghai Nature Reserves) and at the wintering grounds. The cranes at Poyang Lake in China are regularly disturbed by fishing, burning, grazing, illegal hunting, and other activities that take place within the reserve (Harris 1986, 1992a; Harris et al. 1995).

Inadequate protected area management

Ineffective administration and inadequate management of protected areas is an important threat to the species. Protected areas often suffer from a lack of political support for their goals, limited training opportunities for their personnel, and inadequate financial backing for their programs (Harris 1992a). This holds true in the Chinese system of nature reserves (which has expanded rapidly over the last two decades) as well as in Russia and Mongolia. A lack of integrated resource management skills also makes it difficult for managers and administrators to cope with resource-related problems arising from surrounding land-uses. The owner of the wintering area of the Western population in Iran protects the site, though not specifically for the cranes.

Hunting

Hunting pressure is of concern in some portions of the species' range. Hunting has been documented on the Eastern population's wintering grounds in China, although this practice has declined in recent years as a result of local and national restrictions and international agreements (J. Harris pers. comm.). Nevertheless, poaching of cranes and other birds remains a concern at Poyang Lake Nature Reserve (Harris et al. 1995)

Hunting pressure during migration has likely been a significant factor behind the steady decline of the Central population. Crane hunting is a traditional sport in areas of Afghanistan and Pakistan where the population passes during migration (see the Demoiselle Crane species account in this volume). Demoiselle and Eurasian Cranes are the main object of hunting activity, but Siberian Cranes are occasionally taken (Roberts and Landfried 1987, Jan and Ahmad 1995, Landfried et al. 1995). Sauey (1985) concluded that the losses in the Central population are "almost certainly" attributable to hunting, while Archibald (1992b) noted that uncontrolled hunting in this region is "the weakest link in the chain of... survival" for the Central population. Jan and Ahmad (1995) and Landfried et al. (1995) summarize the legislative, educational, and research efforts that have been undertaken in response to the hunting situation in this region.

The Western population is also vulnerable to hunting on the wintering grounds in Iran, which are used by waterfowl trappers. The potential threat comes not from waterfowl trapping itself (as a rule trappers in the area do not attempt to capture cranes), but from late winter "shoot outs" that are held in the trapping areas just before the waterfowl migrate. During these hunts, hunters attempt to shoot waterfowl that have not yet been trapped. The cranes are extremely vulnerable at this time.

Genetic and demographic factors

The threats to the Central and Western populations are compounded by the low numbers within these populations. Both flocks are now susceptible to problems associated with inbreeding, skewed sex or age structure, and increased risk of losses due to catastrophic events.

2.6.9 Current Conservation Measures

Legal and Cultural Protection

Under the hunting laws of Russia (and the former Soviet Union), cranes have never been considered a game species and the hunting of cranes has been prohibited. On the breeding grounds in Western Siberia and Yakutia, the shooting of cranes is exceptionally rare. Among local inhabitants—the Hahnty and Mahntsy in Western Siberia, and Yakutians in Yakutia—Siberian Cranes are considered sacred birds, and have historically been protected. In these areas, and in Russia generally, there have never been traditions of crane hunting. Legal statutes provide a substantial fine (the maximum possible for a bird species) for shooting cranes or for harming them in any other way. Prison terms of up to three years may be imposed for violations (A. Sorokin pers. comm.). The new independent states of Uzbekistan, Turkmenistan, and Azerbaijan have maintained protections developed under the former regime. Siberian Cranes are legally protected in Iran, but *de facto* protection has largely been due to the attention of local landowners (D. Ferguson pers. comm.).

In China, all cranes have been listed as nationally protected

animals since 1990 (Fan et al. 1994). In addition, hunting of Siberian Cranes has recently been prohibited through a national law and through local regulations (adopted mainly in the mid-1980s). Hunting is also prohibited under the 1982 China-Japan Agreement on Migratory Birds. Since 1983, three of Pakistan's four provinces have enacted crane hunting and possession legislation (Ahmad and Shah 1991, Landfried et al. 1995). These measures have been modestly enforced. In India, Siberian Cranes are held in high regard and are not hunted. India's Wildlife Protection Act of 1972 provides legal protection for the species (D. Ferguson pers. comm.).

International Agreements and Cooperation

Of the eleven countries where Siberian Cranes occur regularly, five (China, India, Iran, Pakistan, and Russia) have signed the Ramsar Convention (see Table 3.2). While awaiting confirmation of the Convention, the new independent states of Azerbaijan, Kazakhstan, Turkmenistan, and Uzbekistan have guaranteed fulfillment of obligations under its provisions.

International conservation efforts involving the Siberian Crane have expanded greatly since the early 1970s (Ferguson 1993). Scientists within the former Soviet Union had collaborated on research and conservation projects prior to the first regular contacts with non-Soviet crane conservationists in the 1970s. Ornithologists from the USSR and USA began cooperative conservation projects in 1974 (Flint 1995). The Soviet Working Group on Cranes, established in 1978, provided a focus for research and conservation involving all the cranes of the former Soviet Union. Until it dissolved in 1989, the SWGC organized biennial meetings, published scientific information and research reports, and promoted the designation and establishment of protected areas. Efforts are now underway to a reestablish a crane working group in Russia.

Since the early 1980s, information about Siberian Cranes has been exchanged at the international level through crane workshops and meetings. Siberian Crane biologists and conservationists from Russia, India, China, Iran, Japan, Germany, the United States, and other countries met in India (1983), China (1987), Estonia (1989), Pakistan (1991), and Russia (1992). Since Russia opened to foreign travel, Russian and non-Russian crane biologists have been able to work much more closely together. Cooperative efforts have expanded significantly in recent years. For example:

- During the winters of 1992-93 and 1993-94, Russian specialists from the Daurski Nature Reserve studied the Siberian Cranes at Poyang Lake in China.
- During the summers of 1992 and 1993, Indian and U.S. crane specialists worked with Russian colleagues at the Kunovat breeding grounds in western Siberia.
- In 1993, a Russian specialist studied the Western population at its wintering grounds in Iran.
- During the winters of 1992-1993 and 1993-1994, Russian specialists together with colleagues from the U.S. carried out work on the release of captive-raised Siberian Cranes at Keoladeo NP (Kumar 1994).

Cooperative activities have also expanded to address other critical conservation needs. The U.S. Fish and Wildlife Service supported a 10-year (1980-1990) study of Keoladeo NP. Part of this study, which was undertaken in cooperation with the Bombay Natural History Society, focused on the winter ecology of the Siberian Crane (Vijayan 1990, D. Ferguson pers. comm.). Since 1980, the USFWS has worked with the government of Pakistan on a bilateral conservation program focusing on Siberian Crane research, education, and training activities (Roberts and Landfried 1987, Landfried et al. 1995).

A Memorandum of Understanding (MOU) Concerning Conservation Measures for the Siberian Crane was signed in 1993 under the auspices of the Convention on the Conservation of Migratory Species (CMS) of Wild Animals (the "Bonn Convention"). As of June 1995, the MOU had been signed by Iran, Pakistan, Russia, and Kazakhstan, while the governments of India, Turkmenistan, and Uzbekistan had also expressed strong support. ICF, the UNEP/CMS Secretariat, and the Wild Bird Society of Japan are also signatories to the agreement (D. Hykle pers. comm.). The MOU now provides a framework through which conservation efforts for the species can be formulated, coordinated, and implemented (see Box 2).

BOX 2
Coordinating Efforts to Protect and Restore the Siberian Crane

In May 1995, the first meeting of the range countries of the Siberian Crane took place in Moscow under the auspices of the Secretariat of the Bonn Convention, in collaboration with the All-Russian Institute of Nature Conservation and ICF (Archibald 1995, UNEP/CMS 1995). Twenty-five representatives from eight range countries attended the meeting, which focused on the critically endangered Central and Western populations. At the meeting, delegates shared the latest information on the status of and threats to the populations, and agreed to a series of recommended actions to improve their chances of survival (UNEP/CMS 1995). The strategy agreed upon in Moscow contains five elements: (1) identifying unknown breeding, staging, and wintering areas; (2) enhancing the existing wild population; (3) establishment of additional protected areas; (4) education and awareness; and (5) research (including surveys to identify breeding, stopover, and wintering areas). The eight countries attending the meeting, as well as the UNEP/CMS Secretariat and ICF, committed themselves to specific actions within these five categories (UNEP/CMS 1995). The recommended actions and those presented in this action plan have been formulated in tandem, and provide the foundation for eventual development of a species-wide recovery plan.

Development of a Siberian Crane Recovery Team

Efforts to establish a Siberian Crane Recovery Team have been underway since 1992. Modeled after the Whooping Crane Recovery Team, the Siberian Crane Recovery Team will include representatives from various range countries. It will develop and periodically update a comprehensive Siberian Crane Recovery Plan. Since 1992, several meetings have been held to lay the groundwork for permanent establishment of the recovery team, and to outline immediate conservation needs and priorities for the species (see above). The team is currently led by Alexander Sorokin of the Russian Institute of Nature Conservation and Reserves. Further development of the team, however, has been slow due to a lack of funding and inherent logistical and communication difficulties.

Protected Areas

Protected areas have been established to safeguard many critical Siberian Crane habitats. The breeding grounds in Russia have been largely unaffected by intensive development due to their remote location. Three refuges (zakazniks)—Elon, Khroma, and Tchaigurgina—have been established in the breeding range of the Eastern population in Yakutia. Efforts are now underway to protect the breeding areas of both the Eastern and Western populations in special protected areas (see Krever et al. 1994). Game refuges currently exist in these areas, but they provide insufficient protection (A. Sorokin pers. comm.).

Resident non-breeding Siberian Cranes sometimes use the Dalainor Nature Reserve (China) and the Daurski Nature Reserve (Russia). Seven protected areas are found along the migration route of the Eastern population in Russia. In China, key migration stopover points of the population are protected in the Zhalong, Momoge, Xianghai, Keerqin, Shuangtaizi, Huang He Delta, and Shengjin Lake Nature Reserves (Wu Zhigang et al. 1991, Harris 1992). The Central population uses the Naurzum and Kurgaldzhin Nature Reserves in Kazakhstan during migration. The government of Pakistan has established the Indus Reserve (in 1990) and the Lakki Refuge (in 1992) to provide greater protection to cranes during migration and to provide education and training opportunities (Landfried et al. 1995). The Astrakhan Nature Reserve in Russia protects the Western population's traditional stopover point in the delta of the Volga River on the Caspian Sea.

Since 1983, greater protection for the Chinese wintering grounds has been secured through the establishment of Poyang Lake Nature Reserve and three reserves at Dongting Lake in Hunan Province, China (Gui 1991, 1993, 1995; Harris 1992a;

S. TRANEVING

Wintering Siberian Cranes (eastern population) at Poyang Lake Nature Reserve, China

Ma and Li 1994). Keoladeo National Park was established in India in 1981.

Habitat Protection and Management

Habitat management to benefit the Siberian Crane has been pursued primarily in and around the protected areas listed above, especially at Poyang Lake in China and Keoladeo in India. This has involved mainly improvements in reserve administration and law enforcement, management of water levels and protection of water quality, more effective regulation of resource extraction activities, and encouragement of conservation practices on adjacent lands.

Surveys/Censuses/Monitoring

All three populations are counted on an annual basis on their wintering grounds. Regular counts are also conducted on the breeding grounds of the Eastern and Central populations, although these counts do not cover all of the known or potential nesting areas within the breeding range (A. Sorokin pers. comm.).

Research

Over the last 20 years, extensive research has been undertaken on all three populations. Scientists have conducted ecological and behavioral studies on both breeding and wintering grounds (e.g., Flint and Kishchinski 1981, Zhou and Ding 1982, Sauey 1985, Ashtiani 1987, Zhao et al. 1986, Liu and Chen 1991, Vuasalo-Tavakoli 1991, Harris et al. 1995). The breeding grounds of the Eastern population have been identified and defined (Flint and Kishchinski 1981), while aerial surveys of the Kunovat River breeding area have been conducted since 1981 (Sorokin and Kotyukov 1987). Through migration studies of the Eastern population, significant staging areas, stopover points (especially along the southern China flyway), and wintering grounds have been identified (Xu et al. 1986a, Li and Li 1991, Wu Zhigang et al. 1991, Williams et al. 1991). In the autumn of 1993, the Central population's migration stopover at Ab-i-Estada was the subject of a preliminary survey and conservation needs assessment (Jamil 1994). Satellite radio tracking studies of the migration routes of the Western and Eastern populations have been undertaken through a collaborative project of the USFWS, the U.S. National Aeronautics and Space Administration (NASA), and the Wild Bird Society of Japan (Archibald 1994, H. Higuchi pers. comm.). The USFWS has also supported long-term ecological studies at Keoladeo NP and basic field assessments in Pakistan (Vijayan 1990, Landfried et al. 1995).

Population and Habitat Viability Assessment

A preliminary PHVA was conducted for the Siberian Crane at a Crane Conservation Workshop held in Calgary, Canada in August 1992 (Mirande et al. in prep. d). The critical findings of the PHVA were that: (1) the Eastern population has a high probability for stabilizing *if* current trends continue, and if winter and migratory habitat can be adequately protected; and (2) the Central and Western populations have a high probability of extinction within the next decade unless the high mortality rates are greatly reduced, and significant numbers of captive-raised birds are successfully released and survive to breed. The international Siberian Crane Recovery Team that is now being established will incorporate these findings into a species recovery plan (see above).

Education and Training

The imperiled status of the Siberian Crane has stimulated intensive educational efforts. In particular, educational programs have since the early 1980s played a significant role in efforts to protect the Central population in its non-breeding habitats in India, Pakistan, and Afghanistan. Landfried et al. (1995) review the history, development, and accomplishments of these programs. The effort in this region has entailed broad public awareness programs, programs targeted specifically at hunters, and training sessions for conservation officials. A variety of methods has been employed, including audio-visual programs, television documentaries, leaflets, brochures, workshops, and public meetings and presentations. Educational centers are also being planned at the Lakki Refuge in Pakistan and at Esbaran in Iran. A concerted effort has been made to integrate these educational activities with research and planning projects (Landfried et al. 1995). Captive-raised birds are being provided for educational programs in India, Iran, and Pakistan (C. Mirande pers. comm.).

Conservation education projects are less developed in other portions of the species' range. Programs involving several species of cranes, including the Siberian, have been initiated in China as new reserves have been established. Up until now, these programs have emphasized dissemination of information through facilities and displays rather than through interpersonal communication between local people and reserve staff. Captive-bred birds have often been used in these programs, but with no guarantee that they complement and support information on habitat conservation. Only recently have several of the reserves begun to stress the conservation of wetland resources as part of their education mission (Harris 1992a).

Captive Propagation and Reintroduction

Because two of the three wild populations are on the brink of extinction, and the third population remains highly endangered, sound management of all captive Siberian Crane and coordinated support of propagation and reintroduction efforts are considered critical to the survival of the species (Mirande et al. in press a).

Efforts to organize a conservation-oriented captive propagation program for the species began in the mid-1970s (Putnam and Archibald 1987). Concerns about the continued decline of the wintering population in India and the lack of information about the status of the species on its wintering grounds in Iran and China prompted efforts to establish a "species bank" of captive birds. Under the auspices of the US-USSR Agreement on Environmental Exchange, ICF and ornithologists in the former Soviet Union cooperated in establishing captive flocks at ICF (1976), at Vogelpark-Walsrode in Germany (1979), and at the Oka State Nature Reserve in Russia (1979). The first successful

breeding of Siberian Cranes in captivity occurred at ICF in 1981. As of the 1994 breeding season, 84 Siberian cranes were in the captive program, and 111 chicks had been hatched.

The international studbook for the Siberian Crane is maintained in Russia by Vladimir Panchenko. The studbook does not include a complete listing of the birds in China (a Chinese studbook developed in 1992 needs to be revised). Most members of the captive population are derived from the Eastern population; a small number of breeding birds are from the Central population. Twenty-four of 33 wild-caught birds have produced young. The captive population is being managed to support both a viable, self-sustaining captive population and experimental release efforts in Russia, India, and Iran.

In 1993, the IUCN/SSC Conservation Breeding Specialist Group sponsored a meeting to develop a Global Animal Survival Plan (GASP) for the Siberian Crane as part of the broader definition of Global Captive Action Recommendations for the species. Among other measures, the GCAR recommended that the species be managed at the highest (Intensive-1, A priority) level, that the total captive population be expanded from 200 individuals, and that efforts be made to bring Chinese institutions into active participation in the global breeding program. The Siberian Crane was also selected as a model for cooperative global strategies for endangered species (Mirande et al. in press a, Mirande and Panchenko in prep.).

Since 1990, crane specialists in Russia have collaborated closely with colleagues from other countries to manage the captive population of Siberian Cranes and to release captive-raised cranes into the wild (Kumar 1994). Thus far, these efforts have involved the following:

- Beginning in 1991, "gentle release" techniques were used to rear and release chicks from captive-laid eggs on the territories of the last two known breeding pairs in the Central population.
- In 1992, one captive-reared juvenile Siberian Crane joined wild Eurasian Cranes on the breeding grounds at Kunovat. In 1993, two captive-reared juvenile Siberian Cranes joined a family of three wild Siberian Cranes at Kunovat. None of the released birds have been observed subsequent to the initiation of migration.
- During the winters of 1992-93 and 1993-94, efforts were made to induce captive-reared Siberian Cranes to join the wild cranes at Keoladeo NP in India. These attempts have so far been unsuccessful, in part because the wild birds failed to return to Keoladeo during the second season.
- In 1994, three captive-reared juveniles were released in the Kunovat basin, joined wild Siberian and Eurasian Cranes, and initiated migration in the fall.
- In 1995, one juvenile and one yearling were released at Kunovat, and joined wild Eurasian Cranes.

Nagendran (1995) has studied the behavioral development of captive-reared Siberian Cranes in conjunction with the release program.

2.6.10 Priority Conservation Measures

The Eastern population of the Siberian Crane shares many conservation priorities with the other migratory cranes of East Asia that migrate through northern China and winter in the middle Yangtze River valley. The Central population shares many conservation priorities with the Central Asia and Eastern populations of the Demoiselle Crane and the Western Siberia population of Eurasian Cranes.

International Agreements and Cooperation

1) Fully implement the Recommended Actions for the Conservation of the Western and Central Populations of the Siberian Crane developed under the Memorandum of Understanding Concerning Conservation Measures for the Siberian Crane (see UNEP/CMS 1995).
2) Secure the endorsement of, and active participation in, the Memorandum of Understanding by all range countries.
3) Support establishment of the Siberian Crane Recovery Team and its efforts to develop (and update on a regular basis) a detailed Siberian Crane Recovery Plan. Although several preliminary meetings have been held in recent years to determine conservation priorities for the species, the planning process should be formalized and should involve additional participants from throughout the species' range.
4) Address the conservation needs of the Siberian Crane within an umbrella international agreement on the conservation of the migratory cranes of East Asia (Japan, Russia, China, Mongolia, and North and South Korea).
5) Strengthen international efforts to monitor Siberian Cranes along their migration routes and to protect important vulnerable habitats (this may be undertaken simultaneously with similar efforts for other crane species).
6) Improve the dissemination of research results on population sizes, migratory routes, mortality, and other aspects of Siberian Crane biology and ecology through preparation, translation, and distribution of regular summary reports.

Protected Areas/Habitat Protection and Management

1) Preserve the known breeding habitats of the Siberian Crane by creating and/or upgrading protected areas in the Kunovat River basin and near Chokurdakh in Yakutia. As surveys identify more precisely the breeding grounds of the Western and Central populations, immediate steps should be taken to protect additional areas.

2) Protect additional staging areas and stopover points along migration routes. Key areas that currently lack effective protection include:
   - Ab-i-Estada (Afghanistan);
   - the Naurzum wetlands and additional wetlands in the

Turgaiski region of northwest Kazakhstan;
- wetland complexes in Heilongjiang Province, China;
- wetland complexes near Baoli, Sanmenwangjia, and Longzhao in Jilin Province, China; and
- important stopover points in south China between Bohai Bay and Poyang Lake.

3) Strengthen management of the wintering grounds in China. Priorities at the Poyang Lake Nature Reserve in China are:
   - protection of additional wetlands in the region through expansion of the existing reserve or through the establishment of new reserves;
   - elimination of poaching, waterfowl poisoning, and netting of birds;
   - establishment of additional stations on the reserve to supplement the existing reserve headquarters;
   - development of an effective patrol and reporting system;
   - improvement of the reserve's communications system (through, among other steps, provision of new radios);
   - adoption of performance incentives for reserve personnel;
   - development of the reserve's research capacity, including collaborative international research projects;
   - additional aerial surveys (at least twice per winter) within and beyond the reserve;
   - development of a research base and mitigation plan for water management that takes into account the environmental impacts of the Three Gorges Dam on the Yangtze River; and
   - development and implementation of sustainable economic development strategies in the communities near the reserve.

Most of these needs pertain as well to the Dongting Lake reserves. In addition, efforts should be undertaken at Dongting Lake to:
- develop a management plan that links the conservation goals and methods at the three reserves;
- reduce illegal hunting in areas adjacent to the Dongting reserves, particularly at Hubei.

4) Strengthen protection efforts on the wintering grounds in Iran, including:
   - establishment of a Siberian Crane Nature Reserve or Conservation Zone, overseen and operated by local farmers and waterfowl hunters;
   - greater cooperation with the farmer-trappers and development, if necessary, of a compensation program;
   - development of an education center at Esbaran; and
   - use of captive-bred birds for education, for attracting wild cranes to new wintering sites, and possibly for genetic diversification of the population.

5) Maintain strong protections at the wintering grounds at Keoladeo National Park in India through:
   - continued efforts to minimize the effects of disturbance and drought;
   - maintenance of consistent supplies of water from the rivers feeding the park;
   - continued efforts to protect park resources against negative impacts from human use; and
   - continued controls on grazing by feral cattle and intensified efforts to reduce the spread of the grass *Paspalum distichum* and provide areas of open water.

Surveys/Censuses/Monitoring

1) Continue annual counts of the three populations on their wintering grounds.

2) Conduct comprehensive land surveys in India to identify alternative existing and potential wintering sites of the Central population outside of Keoladeo National Park.

3) Continue aerial surveys of breeding areas in the Kunovat basin and other parts of northwest Siberia, especially between the Mezen and Pechora Rivers in the northern portion of the Arkhangelsk region.

4) Distribute throughout the Kunovat region Siberian Crane identification cards to provide the public with information and to encourage the reporting of sightings.

5) Support continued development and deployment of more reliable satellite telemetry equipment.

6) Place standard radio transmitters with mortality censors on released birds.

Research

1) Continue efforts to locate the breeding grounds of the Western population through satellite tracking studies and aerial surveys; identify possible breeding grounds by correlating information on water depth, vegetation type, and other habitat characteristics using geographic information system (GIS) technology.

2) Identify more precisely the migration corridors, important staging areas, stopover points, and wintering grounds of all three populations through satellite tracking studies, banding studies, aerial surveys, and other monitoring techniques. In particular, additional research is needed:
   - to confirm whether the Central population is still using staging grounds at Lake Ab-i-Estada in Afghanistan;
   - to determine the Central population's migration route and stopover points in Pakistan;
   - to determine alternative wintering sites of the Central population in India;
   - to provide information on the use of staging areas and

stopover points in eastern China; and

- to determine flock sizes and movements of the Eastern population.

3) Determine the migration routes of major populations of Eurasian Cranes migrating south from Kunovat and Tumen or north from the wetlands east of Rajasthan. Identify a population that migrates through areas where cranes are not hunted. (Such a population may be used to help establish a migratory flock of Siberian Cranes).

4) Monitor the status of habitat in crucial breeding, staging, and wintering areas through aerial surveys and remote sensing.

5) Conduct further research on other crucial aspects of Siberian Crane biology and ecology, including: distribution and numbers of breeding cranes; basic studies of the hydrology, vegetation, and ecological dynamics of traditional breeding grounds, migration stopovers, and wintering grounds; habitat use, status, and management; food habits and foraging behavior; local movements on wintering grounds in China; and the impact of human activities, including hunting.

6) Translate and publish existing research results. Most of the information on Siberian Cranes has been published originally in Chinese and Russian. While much of this information has been translated into English and is available through ICF, other research papers remain inaccessible for most scientists and conservationists.

Education and Training

1) Expand interactions between crane hunters and conservationists and develop a focused hunter education program along the migration route of the Central population, with special emphasis on Afghanistan and Pakistan (the education center at the Lakki Refuge should be developed as part of this effort).

2) Continue community education programs in Pakistan and India, and initiate such programs in Iran. Programs should emphasize the uniqueness of the local wintering populations and the need for effective conservation programs. Establish education centers, with several captive-bred Siberian Cranes on site, at Esbaran in Iran and at the Lakki Refuge in Pakistan.

3) Develop coordinated public education programs throughout the species' summer and winter ranges and along its migration corridors. Education programs should be undertaken as part of the Siberian Crane Recovery Plan.

4) Develop educational materials for use in other protected areas along the Siberian Crane migration routes and on the wintering grounds. These materials should be prepared in local languages and designed specifically for each area.

5) Develop in China special educational materials, involving both the general public and local people living near the critical wetlands, that emphasize the protection of cranes within the context of broader conservation goals.

Captive Propagation and Reintroduction

Priorities for captive propagation and reintroduction of the Siberian Crane are described in the GCAR for cranes and in the Siberian Crane GASP. Specific recommendations and plans for the captive propagation and release of Siberian Cranes into the wild are developed by members of the Siberian Crane Recovery Team and are available from ICF. Future efforts should focus on the implementation of these plans and further refinement of release techniques. In keeping with the recommendations developed through these programs, the general priorities for captive propagation and reintroduction are:

1) Bolster the Western and Central populations through the release of captive-raised birds in Russia, India, and Iran; annually review results and revise plans; expand efforts to monitor migration and mortality; and support transport of non-migrating birds to staging and wintering areas.

2) Maintain a genetically diverse captive population. Support participation of the captive centers in the global propagation plan and in *ex situ* conservation programs. Special emphasis should be placed on expanding the participation of Chinese breeding centers in the global captive propagation plan.

3) Improve techniques for rearing cranes in captivity for successful reintroduction. Further research is needed to improve poor reproduction among hand-reared, imprinted founders and to understand better the late age of sexual maturity within the species.

2.7 SANDHILL CRANE (*Grus canadensis*)

2.7.1 Summary

With a total estimated population of more than 500,000, the Sandhill Crane is the most abundant of the world's cranes. It is widely (though intermittently) distributed throughout North America, extending into Cuba and far northeastern Siberia. Six subspecies have been described. The three migratory subspecies—the Lesser, Greater, and Canadian Sandhill Cranes—are relatively abundant. They are distributed across a broad breeding range in northern North America and eastern

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Sandhill Crane *(Grus canadensis)*

Siberia, with wintering grounds in the southern United States and northern Mexico. The other three subspecies—the Mississippi, Florida, and Cuban Sandhill Cranes—exist as small, non-migratory populations with restricted ranges in the southern United States (Mississippi, Florida, and southern Georgia) and Cuba. The total population is increasing in numbers, although some local populations may be declining. The species is classified as Lower Risk under the revised IUCN Red List Categories. The Mississippi and Cuban subspecies are classified as Critically Endangered, and also listed on CITES Appendix I.

At the time of European settlement the species was probably more widely distributed than at present. The remote arctic and subarctic breeding grounds of the Lesser and Canadian Sandhill Cranes have been relatively free of human impact. However, the wintering grounds of these subspecies have been extensively altered. Hunting, agricultural expansion, drainage of wetlands, and other habitat changes in the 18th and 19th centuries led to the extirpation of the Greater Sandhill Crane from many parts of its breeding range in the United States and Canada. The population and range of the non-migratory Sandhill Cranes in the southern United States have also diminished due to hunting, loss of wetlands, and other changes in its habitat. The Cuban Sandhill Crane was probably more widely distributed in the Cuban archipelago than at present.

Sandhill Cranes are primarily birds of open freshwater wetlands and shallow marshes, but the different subspecies utilize a broad range of habitat types, from bogs, sedge meadows, and fens to open grasslands, pine savannahs, and cultivated lands. During the breeding season, the three migratory subspecies may be found in a wide variety of northern wetland communities. Habitats along migration routes tend to be large, open palustrine and riparian wetlands near agricultural areas, while wintering habitats include riparian wetlands, wet meadows, seasonal playa lakes, and pastures. The non-migratory subspecies use seasonally variable wetlands, grasslands, and palm and pine savannahs. Sandhill Cranes are omnivorous, feeding on a wide variety of plant materials (including waste grains) and small vertebrates and invertebrates, both on land and in shallow wetlands.

The leading threat to the species is the loss and degradation of wetland habitats, especially ecological and hydrological changes in important staging areas. Of special concern are the spring staging areas along the central Platte River, which have diminished due to changes in the river's flow, and which are further threatened by excessive water withdrawals and potential dam construction projects. Loss of suitable roosting habitat has increasingly concentrated the migrating cranes, increasing the risks associated with disease, disturbance, and other threats. Habitat loss continues to have a major impact on breeding grounds of the Greater Sandhill Crane and on the year-round habitats of the non-migratory subspecies. Overhunting poses a potential threat to certain segments of the mid-continental Sandhill Crane populations. Lead and mycotoxin poisoning, abnormal predation pressures, and collisions with fences, vehicles, and utility lines are of local concern for various populations.

Since the decline of the Sandhill Crane in the first half of the 1900s, extensive conservation measures have been undertaken on its behalf. These include: protection under the Migratory Bird Treaty of 1916; establishment of protected areas in key breeding, migration, and wintering habitats; stronger national wetland protection policies and programs; annual surveys and counts of many populations; wide-ranging research on many aspects of the species' biology and ecology; management guidelines and plans for mid-continental and Rocky Mountain populations; development of a recovery plan, PHVA, and captive propagation and release program for the Mississippi Sandhill Crane; initiation of a research and management program for the Cuban Sandhill Crane; and a wide variety of public education programs.

Priority conservation measures for the species include: protection, restoration, and management of critical breeding, migration, and wintering habitat for the migratory subspecies (especially along the Platte River) and of the permanent habitats

of the non-migratory subspecies; implementation of conservation programs and incentives that involve private landowners; research to improve understanding of the size, status, dynamics, distribution, and movements of populations; continued implementation and updating of the recovery plan for the Mississippi Sandhill Crane; development of a comprehensive Cuban Sandhill Crane conservation program; greater attention to problems associated with crop depredation; greater attention to the long-term effects of hunting on hunted populations; and clarification of intraspecific genetic structure and phylogenetic relationships.

2.7.2 Subspecies/populations

Six subspecies are currently recognized:

Lesser Sandhill Crane	*G. c. canadensis*
Canadian Sandhill Crane	*G. c. rowani*
Greater Sandhill Crane	*G. c. tabida*
Florida Sandhill Crane	*G. c. pratensis*
Mississippi Sandhill Crane	*G. c. pulla*
Cuban Sandhill Crane	*G. c. nesiotes*

The taxonomic status of, and relationships among, the Sandhill Crane subspecies have been discussed frequently in the literature (e.g., Walkinshaw 1973, Lewis 1977, Tacha et al. 1985). The *G. c. canadensis-rowani-tabida* group is probably clinal, with gradual changes in morphological characters and no positive means of distinguishing among them (except between *G. c. canadensis* and *G. c. tabida* at the extremes of their ranges). Random pairing among the three subspecies has been demonstrated, and intergrading occurs along the limits of their ranges (Tacha et al. 1985). *G. c.* pulla was described as a subspecies in 1972, based mainly on color differences between it and *G. c. pratensis* (Aldrich 1972). The existing population of *G. c. pulla* in Mississippi was probably more widespread in the past, and may have intergraded with *G. c. pratensis* and *G. c. nesiotes* to the east.

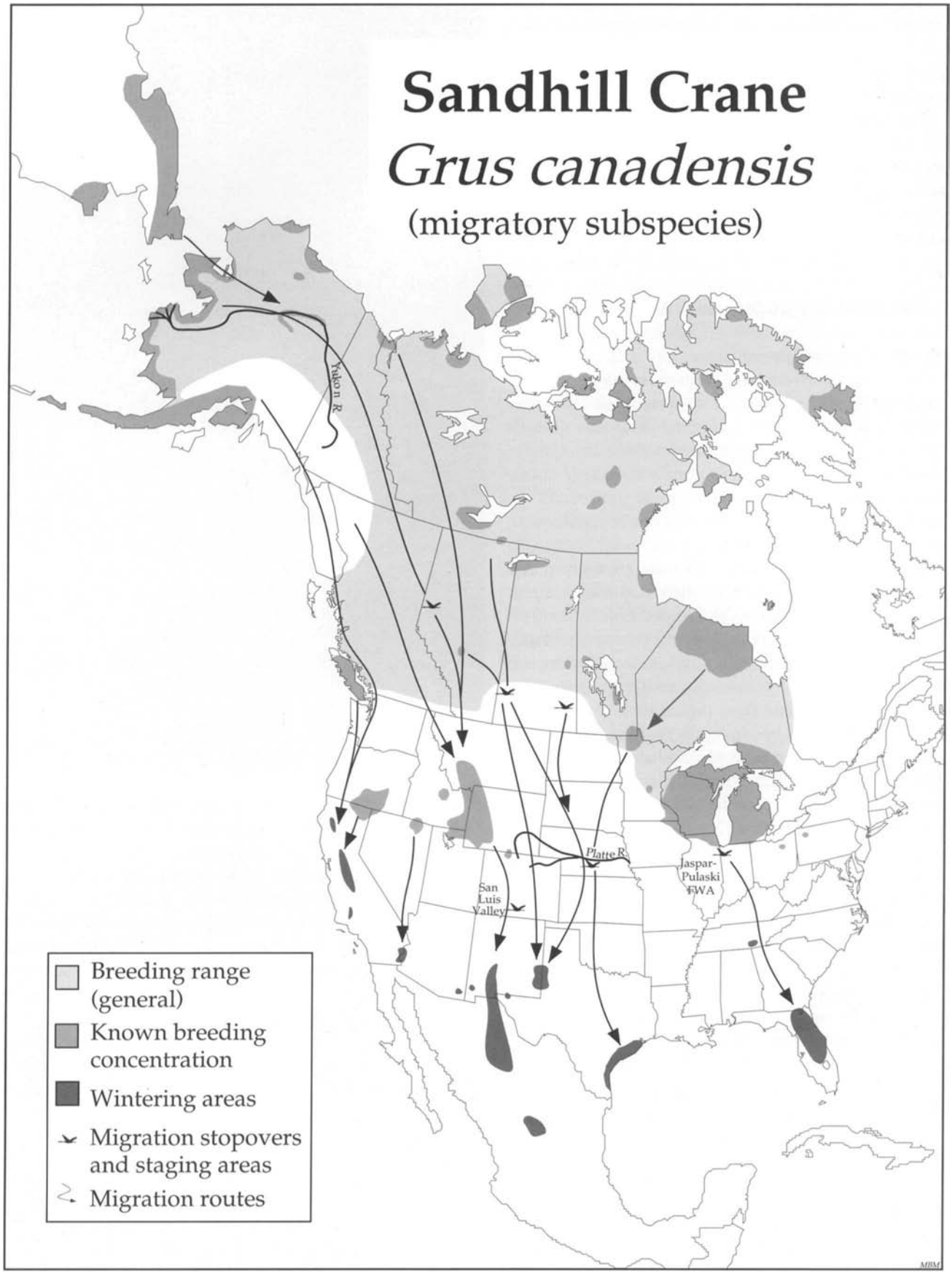
G. c. tabida is subdivided into five populations in this action plan. There are morphological differences among the populations, but they have not yet been analyzed in terms of their taxonomic significance. In many portions of the winter range, two or more subspecies occur together. Tacha et al. (1992) differentiate a total of nine geographic populations.

2.7.3 Population Numbers and Trends

Subspecies	Number	Trend	Source
G. c. canadensis and	~450,000[1]	Probably stable.	Walter 1995,R. Drewien pers. comm.
G. c. rowani		Unknown due to difficulty in distinguishing from Lesser Sandhills; probably stable.	
G. c. tabida	65-75,000	Increasing rapidly in the eastern portion of its range. Generally stable elsewhere. Some western populations may be declining.	Pogson and Lindstedt 1991, Urbanek 1994, Drewien et al. 1995
G. c. pratensis	4,000-6,000	Generally stable, with local increases and declines. Includes the Okefenokee portion of the population (about 400 individuals).	Tacha et al. 1994
G. c. pulla	120	Numbers in wild increasing through augmentation. Reproduction in the wild is below replacement level.	S. Hereford pers. comm.
G. c. nesiotes	300	Generally stable. New populations recently discovered.	X. Galvez and A. Perera,pers. comm.
Total	520,000	Stable to increasing.	

This should be considered a conservative estimate. Tacha et al. (1992, 1994), using a geographic breakdown of populations and subpopulations, arrive at a total estimate of at least 652,500. Especially for the migratory subspecies, it has been difficult to confirm population numbers and establish trends. Improved aerial census techniques have begun to provide more reliable survey data, but these techniques have not been in use long enough to allow meaningful analysis of trends.

[1] Population estimates of the mid-continental populations of Sandhill Cranes do not distinguish between Lesser and Canadian Sandhill Cranes (a relatively small number of Greater Sandhill Cranes are also included in the total). Estimates are based on 3-year running averages of spring counts conducted on the Platte River during migration. The figure given here represents the 1995 survey results for the midcontinental populations (420,866) plus about 25,000 Lesser Sandhill Cranes from California.


Sandhill Crane
Grus canadensis
(migratory subspecies)
Yukon R.
Platte R.
San Luis Valley
Jaspar-Pulaski FWA
Breeding range (general)
Known breeding concentration
Wintering areas
Migration stopovers and staging areas
Migration routes
MBM

2.7.4 Conservation Status

Species	
IUCN category	Lower Risk (Least Concern)
CITES	Appendix II

Subspecies	IUCN Category
Lesser (G. *c. canadensis*)	Lower Risk (Least Concern)
Canadian (G. *c. rowani*)	Lower Risk (Least Concern)
Greater (G. *c. tabida*)	Lower Risk (Least Concern)
Florida (*G. c. pratensis*)	Lower Risk (Near Threatened)
Mississippi (G. *c. pulla*)	Critically Endangered, under criterion C2b (also on CITES Appendix I)
Cuban (G. *c. nesiotes*)	Critically Endangered, under criterion C2a (also on CITES Appendix I)

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Sandhill Crane parents feeding newly fledged chick, Florida, USA

2.7.5 Historic and Present Distribution

The Sandhill Crane breeds primarily in northern North America and extreme northeastern Siberia, and winters in northern Mexico and the southern United States. Non-migratory populations are found in Mississippi, Florida, and Georgia in the southern U.S., and in Cuba. There are few reliable records regarding the distribution of the Sandhill Crane at the time of European settlement. The species was probably more widely distributed, especially in its southern breeding range (Tacha et al. 1992). At the species level, the Sandhill Crane reached its low point in terms of conservation status in the mid- to late-1930s, after hunting had extirpated or depleted many populations and European settlement (mainly through agricultural expansion and the conversion of wetlands) had deprived it of much of its original habitat in the southern portions of its range. The historic and present ranges of the subspecies and their constituent populations are as follows:

Lesser Sandhill Crane (*G. c. canadensis*)

The breeding grounds of the Lesser Sandhill Crane are scattered throughout the arctic and subarctic regions of northern Canada from Baffin Island to the Yukon Territory; in coastal and interior areas of Alaska; and in northeastern Siberia (including the lower Anadyr River watershed, coastal areas west to the Indigirka River, and the Kamchatka Peninsula) (Walkinshaw 1973, Krechmer et al. 1978, Kishchinski et al. 1982, Labutin and Degtyaryev 1988). The population inhabiting Banks Island and other arctic islands may be distinct (Reed 1988). The Lesser Sandhill Crane intergrades on the southern edge of its mid-continental summer range with the Canadian Sandhill Crane (Walkinshaw 1973, Johnsgard 1983, Tacha et al. 1985).

The large migratory flocks of Sandhill Cranes that congregate on the Platte River in the spring consist primarily of this subspecies, along with most of the Canadian Sandhill Crane population and smaller numbers of Greater Sandhill Cranes (see below). Stopover points for the mid-continental populations of these subspecies are scattered throughout the plains, but some 80-90% of them (between 350,000 and 450,000) stay for up to six weeks on the river flats of the Platte and North Platte Rivers (Walkinshaw 1949, 1973; Johnson and Stewart 1973; Lewis 1977; Tacha et al. 1992). Along the Platte, Greater Sandhill Cranes are generally found disproportionately around Grand Island, Nebraska (at the eastern edge of the staging area), Canadian Sandhill Cranes in the middle stretches of the staging area, and Lesser Sandhill Cranes in the western end around North Platte, Nebraska (Tacha et al. 1984.; J. Lewis pers. comm.).

The main part of the population (about 80%) winters in the seasonal playa lakes and riparian wetlands of eastern New Mexico, northwestern Texas, and northern Mexico (Iverson et al. 1985, Drewien et al. 1996). A smaller portion of the flock, mainly from southeastern Alaska, migrates through Washington and Oregon and winters in California's Central Valley and Carissa Plains (Littlefield and Thompson 1979, 1982; Mickelson 1987).

The breeding grounds of the Lesser and Canadian Sandhill Cranes have been relatively free of direct human impact. However, portions of the wintering grounds of these subspecies in the southwestern United States and northern Mexico have been extensively altered by agricultural development.

Canadian Sandhill Crane (*G. c. rowani*)

The Canadian Sandhill Crane is probably a transitional race between the arctic-dwelling Lesser Sandhill Crane and the more temperate Greater Sandhill Crane (Tacha et al. 1985). Thus it is difficult to define with any certainty its range limits. In general, its breeding grounds are scattered across subarctic

Canada between 50° and 60° N, from northern Ontario through northern Alberta, Saskatchewan, and Manitoba to west-central British Columbia. Birds from the eastern portion of this range winter mainly in coastal Texas with Greater Sandhill Cranes. The wintering grounds of the western populations of the Canadian Sandhill Crane are not well established. They likely share areas in California, New Mexico, Mexico, and Texas with the western populations of Lesser and Greater Sandhill Cranes.

Greater Sandhill Crane (*G. c. tabida*)

The breeding range of the Greater Sandhill Crane spans mid-continental North America from the Great Lakes to the Pacific Ocean. Scientists generally divide the Greater Sandhill Crane into four distinct regional populations. A fifth population, the Prairie population, is added here based on new information about migration routes and wintering grounds.

1) *Eastern population*

The breeding grounds of the Eastern (or Great Lakes) population are in southcentral Canada, the western Great Lakes, and the Upper Midwest (southern Ontario, Michigan, Wisconsin, northern Illinois and Iowa, and southeastern Minnesota). During the 1994 fall census (Urbanek 1994), 26,187 birds were tallied. The population likely exceeds 30,000. The main portion of the population migrates through the east-central United States (Illinois, Indiana, Ohio, Tennessee, Kentucky) to wintering grounds in southern Georgia and central Florida (Walkinshaw 1973, Lewis 1977). The Jaspar-Pulaski Fish and Wildlife Area in northwest Indiana is a critical migration stopover point. Birds from the western parts of the breeding range may migrate down the Mississippi Valley to wintering areas on the Texas Gulf Coast. The population breeding in the James Bay lowlands is probably contiguous with the more southern concentration of breeding birds; these breeding populations join during migration and on the wintering grounds (Urbanek 1988, R. Urbanek pers. comm.).

This population has recovered dramatically in recent decades, and continues to expand back into areas of its historic range. Hunting, agricultural expansion, drainage of wetlands, and other habitat changes in the 18th and 19th centuries led to its extirpation from both breeding and wintering grounds in the United States (Walkinshaw 1949, 1973; Leopold 1949). As the wetlands, prairies, and plains of the midwestern and western U.S. were transformed in the second half of the 19th century, breeding populations dwindled. Declines were most dramatic from about 1890 to the early 1930s. The Sandhill Crane disappeared as a breeding bird from Illinois (1890), Iowa (1905), South Dakota (1910), Ohio (1926), and Indiana (1929), and was almost extirpated from several others (Johnsgard 1983). In Wisconsin, the Sandhill Crane was reduced to about twenty-five breeding pairs in the 1930s (Henika 1936).

Since then, hunting prohibitions and the protection, restoration, and management of wetlands have allowed the population to increase significantly, especially in Wisconsin, Michigan, and other portions of the western Great Lakes (Walkinshaw 1973, Dietzman and Swengel 1994). From these core areas, breeding populations have returned to other portions of the historic range. In recent years, Sandhill Cranes have returned as breeding birds in Illinois (in 1979), southeastern Minnesota (in the mid-1980s), Ohio (in 1988), Iowa (in 1992), and Pennsylvania (in 1994). Vagrants are occasionally reported from further east. The subspecies remains extirpated from large portions of the historic former range, but the continuing recovery and dispersal of the breeding populations may allow it to continue reclaiming these areas.

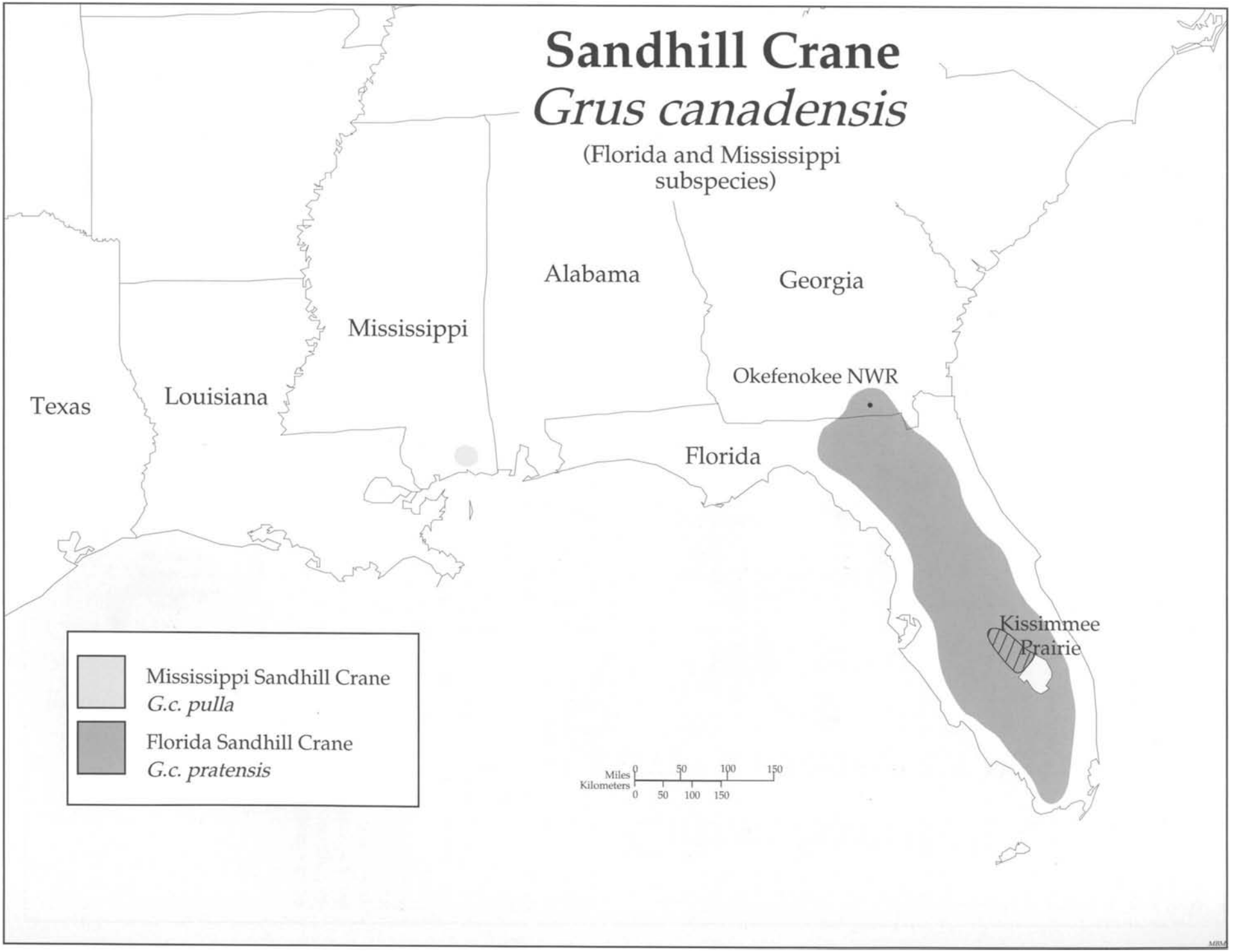
2) *Prairie population*

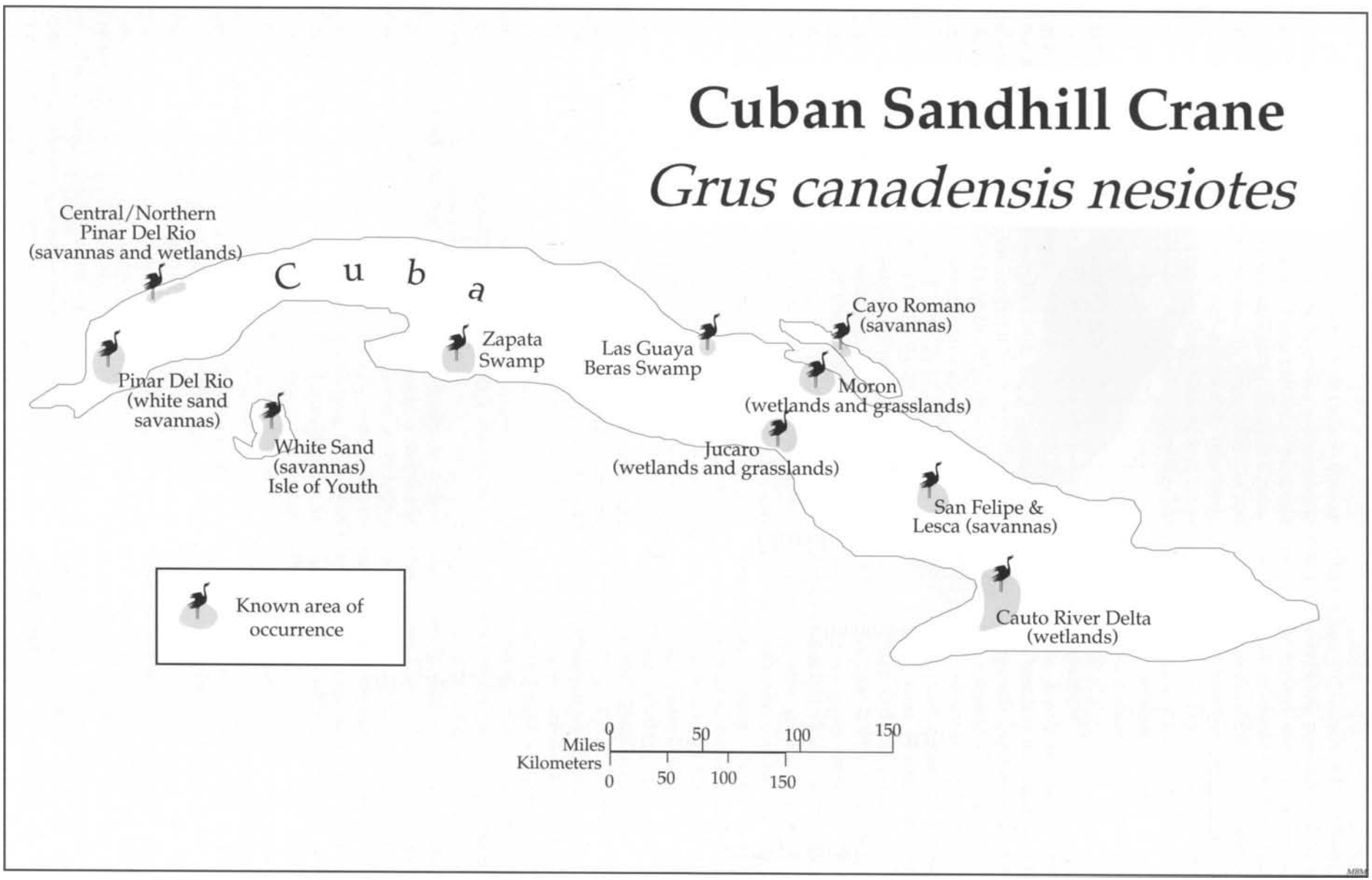
The prairie population, which includes perhaps 10,000-15,000 birds, breeds in the marshes and wet prairies of northwestern Minnesota, southwestern Ontario, and southern Manitoba. The population formerly extended into North and South Dakota, but last bred in these states in the late 1800s. In the last twenty years, occasional nesting has been reported in North Dakota, most recently at J. Clark Salyer National Wildlife Refuge (G. Krapu pers. comm.). It is unclear whether the Sandhill Cranes in the greater region represent a recovering remnant or reoccupying population. There are regular historic records of Sandhill Cranes in the region, suggesting that the species was able to persist through the main period of European settlement and has recently begun to expand (D. Hjertaas pers. comm.). These birds migrate through the Dakotas, Nebraska, Kansas, and Oklahoma to wintering grounds along the eastern Texas coast of the Gulf of Mexico west of Houston, which they share with wintering Canadian Sandhill Cranes (Guthery et al. 1979, Melvin 1982, Melvin and Temple 1982, Tacha et al. 1984).

3) *Rocky Mountain population*

In recent years, the Rocky Mountain population has been estimated at 18,000-21,500 (Benning 1991, Tacha et al. 1992, Drewien 1995, Drewien et al. 1995b). The breeding grounds of the population are in west-central and southwestern Montana, central and eastern Idaho, northeastern Utah, western Wyoming, and northwestern Colorado. The migration route crosses Utah, Colorado, and New Mexico, with a major spring and fall staging area in Colorado's San Luis Valley. The main wintering grounds are in the middle Rio Grande valley in New Mexico, with other scattered locations in southwestern New Mexico, southeastern Arizona, and north-central Mexico (Drewien and Bizeau 1974, Lewis 1977, Drewien et al. 1996).

All the western populations of Greater Sandhill Cranes are believed to have been more abundant prior to European settlement. The breeding range formerly extended south into Arizona and northern Mexico (Tacha et al. 1992). The more southern of these populations were likely non-migratory, or migrated only short distances on a seasonal basis. The Rocky Mountain population reached an historic low of 150-200 breeding pairs in the 1940s. Since then it has recovered dramatically, but may now be declining due to the effects of regional drought, poor survival of chicks, and increased hunting pressure. Drewien et al. (1995b) regard the population as stable to slightly declining.


Sandhill Crane
Grus canadensis
(Florida and Mississippi subspecies)
Alabama
Georgia
Mississippi
Okefenokee NWR
Texas
Louisiana
Florida
Kissimmee Prairie
Mississippi Sandhill Crane
G.c. pulla
Florida Sandhill Crane
G.c. pratensis
Miles 0 50 100 150
Kilometers 0 50 100 150


Cuban Sandhill Crane
Grus canadensis nesiotes
Central/Northern
Pinar Del Rio
(savannas and wetlands)
C u b a
Zapata
Swamp
Las Guaya
Beras Swamp
Cayo Romano
(savannas)
Moron
(wetlands and grasslands)
Pinar Del Rio
(white sand
savannas)
White Sand
(savannas)
Isle of Youth
Jucaro
(wetlands and grasslands)
San Felipe &
Lesca (savannas)
Cauto River Delta
(wetlands)
Known area of
occurrence
Miles
Kilometers
0
50
100
150
0
50
100
150

4) *Colorado River Valley population*

The population is estimated at 1400-2100 and is considered stable (Rawlings 1992, Tacha et al. 1992). However, no surveys have been undertaken recently (Tacha et al. 1992). The population breeds in northeastern Nevada and southwestern Idaho, migrates through Nevada (with a spring stopover near Lund), and winters along the lower Colorado River in Arizona, in California's Imperial Valley, and along the Gila River in southwestern Arizona (Lewis 1977, Drewien et al. 1987).

5) *Central Valley population*

The 6000-6800 cranes in the Central Valley population breed mainly in south-central and southeastern Oregon and northeastern California, with additional breeding areas up to southern British Columbia and Vancouver Island (Pogson 1990, Pogson and Lindstedt 1991). In the winter, these cranes migrate to the Central and Imperial Valleys of California (Lewis 1977, Littlefield and Thompson 1979). This population is believed to be increasing.

Florida Sandhill Crane (*G. c. pratensis*)

The non-migratory Florida Sandhill Crane occurs in peninsular Florida from the Everglades (where they have probably always been present, but never abundant) north to southern Georgia (Charlton and Ware counties) in and around the Okefenokee Swamp (Bennett 1989, Nesbitt and Williams 1990). The subspecies is most abundant in the region of Florida's Kissimmee and Desoto Prairies.

The range of Sandhill Cranes in the southeastern United States diminished steadily following European settlement (Walkinshaw 1949, 1973). Non-migratory Sandhill Cranes may have once formed a single extended population in the southeastern U.S. and Cuba. Over time, overhunting, loss of wetlands, conversion of habitat to agriculture, land development, deforestation, and afforestation are thought to have reduced and fragmented the population of resident Sandhill Cranes in the region. Sandhill Cranes are known to have nested in coastal Texas until 1900, in Alabama until 1911, and in southern Louisiana as late as 1919 (Walkinshaw 1949, 1973; Johnsgard 1983). Over the decades, nesting cranes have been reported intermittently in southwestern Alabama. The Mississippi Sandhill Crane (see below) may represent the western remnant of this formerly more extensive population.

Despite these historic losses, the Florida Sandhill Crane has proven to be adaptable. It has benefitted from the establishment of protected areas in key portions of its remaining range. As a result, its population and distribution have stabilized in recent decades.

Mississippi Sandhill Crane (*G. c. pulla*)

The original distribution and abundance of the subspecies is unknown, but may have been part of a more extensive resident population in the southeastern U. S. (see above). Its habitat had already been extensively altered and its numbers reduced by the time the cranes were first surveyed (Leopold 1929). The subspecies now occurs only in Jackson County, Mississippi in the United States, between the Pascagoula River and the Harrison-Jackson County line (Valentine and Noble 1970, USFWS 1991). Only since the late 1980s has the total number of birds in the wild risen above 100. The resident population is supplemented by annual releases of captive-bred birds, but reproduction in the wild has consistently fallen below replacement levels (Valentine and Logan 1991, Ellis et al. 1992). The entire wild and reintroduced population of approximately 120 birds (as of September 1994) occurs on and near the Mississippi Sandhill Crane National Wildlife Refuge. Of the refuge's 19,300 acres, about 12,500 can be used by cranes (S. Hereford pers. comm.). The subspecies is reproductively isolated from other populations of Sandhill Cranes. Over the past several decades, breeding cranes—most likely from this subspecies—have occasionally been reported in southern Louisiana and Alabama (USFWS 1991).

Cuban Sandhill Crane (*G. c. nesiotes*)

The Cuban Sandhill Crane is endemic to the island of Cuba and nearby islands and keys of the Cuban archipelago. It is the largest bird in Cuba and the West Indies, and the only crane that occurs in the Caribbean or Central and South America (Galvez and Perera 1995). Little is known about its historic distribution. It was likely distributed widely throughout Cuba. There are historic records of its occurrence at Pinar del Rio, Havana Province, Matanzas Province, and Santa Clara (in addition to areas in which it survives) (Johnsgard 1983). Since the early 1960s, however, its range and numbers have diminished (Galvez and Perera 1995).

The remnant population now occurs at ten known disjunct locations in Cuba: (1) savannas near the Pinar Del Rio near Guanes, at the western end of the Cuban mainland; (2) savannas and wetlands of the central and northern Pinar del Rio; (3) the Isle of Youth (also known as the Isle of Pines) near Los Indios; (4) Zapata Swamp, Mantanzas Province; (5) Las Guaya Beras Swamp north of Sancti Spiritus Province; (6) savannas and wetlands at Moron, north of Cielo de Avila Province; (7) Jucaro, south of Cielo de Avila Province; (8) Cayo Romano, north of Camaguey Province; (9) savannas of San Felipe and Lesca in Camaguey Province; and (10) the Cauto River Delta in Granma Province (A. Perera pers. comm.). Their status in these areas is poorly understood. The first comprehensive survey of their known and possible habitats was carried out in October 1994 (Galvez and Perera 1995).

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Savannah habitat of the Cuban Sandhill Crane

2.7.6 Distribution by Country

Canada	B,M
Cuba	R
Japan	V
Mexico	W
Russia	B
United States	B, M, R, W

B = Present during breeding season
M = Present during migration
R = Permanent resident
W = Present during winter
V = Vagrant

2.7.7 Habitat and Ecology

Sandhill Cranes are primarily birds of open freshwater wetlands, shallow marshes, wet meadows, and adjacent uplands. They utilize a broad range of habitat types, from bogs, sedge meadows, and fens to open grasslands, stubble fields, and savannahs. They are omnivorous, feeding on a wide variety of plant materials (including waste grains), invertebrates, and small vertebrates, both on land and in shallow wetlands. For reviews of the species' breeding, migration, and winter habitats, food habits, behavior, breeding biology, and demographics, see Walkinshaw (1949, 1973), Johnsgard (1983), and Tacha et al. (1992, 1994). During the breeding season, the three migratory subspecies utilize a wide variety of northern wetland types. Lesser Sandhill Cranes occur mostly in wetlands of the arctic lowland coasts, river deltas, and tundra, including bogs, shallow lakes, seasonal ponds, and riparian marshes. In some areas it nests on grassy hillsides and dunes and in shrubby wet meadows. The subarctic habitats of the Canadian Sandhill Crane consist of muskeg and other shallow wetland communities, open and forested bogs, and other boreal forest wetland types. Greater Sandhill Cranes are typically found in bogs, fens, cattail marshes, sedge meadows, shrub carrs, and other wetland types, as well as wetter open parklands, riparian areas, flooded meadows, and beaver ponds (Walkinshaw 1973, Drewien and Bizeau 1974, Johnsgard 1983). In the more arid parts of its western breeding range, it is found in shallow wetlands and along rivers. In agricultural areas, it prefers nesting sites close to cultivated fields. The size of nesting territories varies widely within the breeding range. Drewien (1973) found territories averaging 17 ha in Idaho; Walkinshaw (1973) reported an average of 85 ha in Michigan's Upper Peninsula.

Nests in wetland sites are built of the dominant vegetation in the nesting area; dry site nests are minimally prepared. The incubation period is 29-32 days, and chicks fledge at 67-75 days (Drewien 1973). Average fledging periods tend to be longer for southern populations.

Habitats along migration routes tend to be large, open marshes and riparian wetlands near agricultural areas, especially harvested grain fields, hay fields, and pastures (Soine 1982, Melvin and Temple 1982). Krapu et al. (1984), Currier et al. (1985), Iverson et al. (1987), and Folk and Tacha (1990)

describe habitats of the mid-continental populations on the Platte River and at other points along its spring migration route. The migratory subspecies are found in widely varying winter habitats, including pastures and wet meadows in Florida (often shared with resident Florida Sandhill Cranes); coastal and freshwater marshes, coastal prairies, and stubble fields along the Texas Gulf Coast; seasonal playa lakes and other shallow lakes and riparian wetlands in west Texas, New Mexico, and Arizona; and large marshes, irrigated pastures and croplands, grain fields, and dairy farms in southern California and other parts of the American Southwest and adjacent Mexico (Tacha et al. 1992, Drewein et al, 1996).

The non-migratory subspecies favor seasonally variable wetlands, grasslands, and pine and palm savannahs. Florida Sandhill Cranes use shallow freshwater wetlands, wet prairies, and savannahs. The birds at Okefenokee Swamp tend to prefer more open marshes, and make little use of drier upland habitats (Bennett 1989). Although this subspecies has lost much habitat to agricultural expansion and development, it has adapted to the pastures that now occupy large portions of its historic range. Preferred habitats include wetland/grassland and grassland/forest transitional zones and upland areas near water (such as hammocks and sloughs) (Nesbitt and Williams 1990). In recent years, however, increasing human population and development pressures have caused it to nest in ditches, near artificial pools, and in other improbable sites. Common food items include tubers, seeds, acorns, and berries, as well as crops (especially corn and peanuts) and invertebrate animals (Nesbitt in press).

The endangered Mississippi and Cuban Sandhill Cranes are now confined to drier or seasonally flooded habitats. The limited territory of the Mississippi Sandhill Crane consists of pine savannahs dominated by wiregrass and a rich herbaceaous community, with scattered longleaf pine, slash pine, and pond cypress. Marshes and pine plantations also are found within the area. The cranes nest in mesic to wet savanna as well as wetland edges, and roost in freshwater and slightly brackish marshes, artificial ponds, and savannahs (Valentine and Noble 1970, USFWS 1991). Much of this habitat has been altered since the 1940s by afforestation and urban and agricultural development (Smith and Valentine 1987). The Cuban Sandhill Crane occupies relatively dry upland grasslands, hammocks, and pine and palmetto savannahs, often associated with wetlands (Walkinshaw 1949, Faanes 1990, X. Galvez pers. comm.). Some pairs of the non-migratory cranes remain on their breeding territories throughout the year (this is particularly true of the Okefenokee population of Florida Sandhill Cranes). Others gather in flocks and forage on agricultural gleanings, in pastures, and (in the case of the Mississippi Sandhill Crane) food plots within refuges.

2.7.8 Principal Threats

Loss and degradation of wetlands and other habitats are the most important threats to Sandhill Crane populations. For the migratory subspecies, this is of greatest concern in staging and wintering areas, where changes in land use, hydrology, and vegetation have reduced available habitat and concentrated the flocks during the non-breeding season. The drier meadow, savannah, and other upland habitats to which the non-migratory subspecies are partially adapted have also been widely altered by agricultural conversion and development.

The spring staging areas along the Platte River are of special concern because of their importance to the mid-continental crane populations and other migratory birds (see Johnsgard 1984, Currier et al. 1985, VanDerwalker 1987, Faanes 1988). With about 80% of the total Sandhill Crane population using the Platte River during the spring, the long-term loss of habitat quality at this site constitutes the most critical threat to the species. Over the last century, construction of upstream dams and water withdrawals have reduced the flow of the Platte by some 70% and have altered the river's historic hydrologic regime (Currier et al. 1985). This in turn has allowed riparian vegetation to encroach upon the riverbanks, and altered the process of sand bar formation within the channel (Faanes 1988, Faanes and Bowman 1992, Farrar 1992). Flood control structures, agricultural conversion, and gravel mining have reduced by some 75% the total area of native grassland and wet meadow adjacent to the river (Currier et al. 1985). These meadows are critical habitat for pair formation activity and for foraging, providing food items high in nutrients (Frith 1974, Krapu 1981). As a result, the stretch of river providing the necessary mixture of feeding and roosting habitats has shrunk from about 200 miles to about 80 miles, with consequent increases in flock concentration in the remaining suitable roosting areas (P. Johnsgard pers. comm.). Fundamentally, the quality of habitat along the Platte River will depend on the maintenance of minimum flows rates from upstream dams (in particular the Kingsley Dam on the North Platte River north of Ogallala) and control of maximum usage rates downstream (Faanes 1988, Faanes and Bowman 1992).

Overhunting poses a potential risk to migratory populations in western and central North America. The three migratory subspecies are hunted in portions of their ranges in Russia, Canada, the United States, and Mexico (the Mississippi, Cuban, Florida, and Eastern and Central Valley populations of Greater Sandhill Cranes are not hunted). Canadian Sandhill Cranes and the Prairie population of Greater Sandhills, because of their more southern distribution, are exposed to disproportionately heavy hunting pressure. Since the mid-1980s the total estimated annual kill (including crippling losses) in the mid-continental populations has ranged between 25,000 and 31,700, or about 4-5.4% of the fall population (Sharp and Vogel 1992, Central Migratory Shore and Upland Game Bird Technical Committee 1993, Tacha et al. 1994).

The hunted populations are managed according to management plans (summarized under "Management and Recovery Plans" below). However, Tacha et al. (1994) note that "funds for research to improve management have been limited," even as "substantial additional information is required

to facilitate population, harvest, and/or habitat management." Drewien et al. (1995) note that the Sandhill Crane has the lowest recruitment rate of any bird now hunted in North America, and caution that "no long-term data on recruitment or survival have been collected" for the mid-continental populations. At present, few long-term studies of the effects of hunting on the different subspecies and populations are underway. Research on the racial composition of the mid-continental populations does provide important foundations for such studies (see Johnson and Stewart 1973, Johnson 1979). For the Lesser and Canadian Sandhill Cranes in particular, clear management objectives, reliable data on population sizes, disturbance, and recruitment rates, and a definitive understanding of intraspecific genetic relationships are lacking. Although these gaps in knowledge do not threaten the species as a whole in the short term, the effects on specific breeding populations are unknown.

Other threats to the species are more localized. Mycotoxins ingested through the consumption of waste peanuts have caused large-scale mortality (up to 5,000 individuals), while lead poisoning and collisions with fences and utility lines also cause injury and death (Brown et al. 1987, Windingstad 1988, Allen and Ramirez 1990, Ward and Anderson 1992). The concentrated migratory flocks along the Platte River are susceptible to outbreaks of avian cholera and other diseases. Increasing public interest in the cranes along the Platte may also result in increased disturbance of the birds at these sites. Although pesticide residues have sometimes been found in relatively high levels in Sandhill Cranes, this has not been shown to have detectable impacts, and pesticides are not considered a major threat.

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Sandhill Cranes at spring staging area on the Platte River, Nebraska, USA

The principal threats at the subspecific level are as follows:

Lesser and Canadian Sandhill Crane

The loss and alteration of riparian habitat at the migration stopover points along the Platte River constitute the most important threat to the Lesser and Canadian Sandhill Cranes. Other important threats include degradation of wintering grounds in Texas, New Mexico, and Mexico, and the susceptibility of the population to drought and resultant loss of roosting sites in these areas. About 80% of the mid-continental populations of these subspecies winter on fewer than 20 lakes in western Texas (Iverson et al. 1985). On one of these lakes, concentrations of as many as 300,000 cranes have been recorded; more than 100,000 commonly roost on several others (Tacha et al. 1994). The most important wintering area in Mexico, Laguna de Babicora in Chihuahua, is also threatened by proposed habitat alterations (Drewien et al. 1996). Expanding the effort to protect these habitats is a high conservation priority.

Greater Sandhill Crane

The destruction and degradation of habitats—especially wintering grounds in California and Florida, breeding grounds in the American upper midwest, and migration stopovers on the Platte River and other portions of the plains states—comprise the most important current threat to the Greater Sandhill Crane. The habitats of the Rocky Mountain population are increasingly affected by residential and commercial development, changing agricultural practices, drainage of wetlands, water diversions, oil and gas exploration and development, and other land use changes. Increased concentration of populations in the Rocky Mountains and other areas have led to increased risk of disease and crop depredation (Smith 1991).

Florida Sandhill Crane

Agricultural, residential, and commercial development in Florida has reduced and fragmented the habitat of the Florida Sandhill Crane population. This has affected shallow wetlands, wet savannahs, upland savannahs, and open upland feeding areas. The preferred wetland community type—pickerel weed and maidencane—is also highly susceptible to vegetation change, shifting to cattail (*Typha* spp.) and willow (*Salix* spp.) and other woody species as a result of alterations in the quantity and quality of instream flow. The cranes in Florida are also prone to accidental collision with fences, automobile colli-

sions, and disturbance from free-ranging domestic dogs and cats (Nesbitt in press).

Mississippi Sandhill Crane

The Mississippi Sandhill Crane has declined in large part due to long-term habitat loss and degradation. It is now subject to a broad range of interrelated threats, including: insufficient habitat (especially prime breeding grounds) as a result of the spread of pine plantations, fire suppression, road construction, and urban encroachment; high predation pressures (especially on nests, chicks, and recently released juveniles), primarily from coyotes; drier habitat conditions as a result of changes in the hydrologic regime of its remaining habitat; vulnerability to drought, hurricanes, and other catastrophic events; exposure to pesticides and toxic chemicals; loss of genetic diversity within the population; accidental shootings; collisions with vehicles and utility lines; and high rates of disease and tumor formation, possibly due to environmental toxins (USFWS 1991). These factors have contributed to low reproduction and survival rates, and a consequently low recruitment rate, within the population (S. Hereford pers. comm.).

Cuban Sandhill Crane

The Cuban Sandhill Crane is subject to many of the same threats facing the other non-migratory Sandhill Cranes: changes in the hydrology and fire regime of its savannah habitat; loss of habitat to deforestation, development, land reclamation, and agricultural expansion; vulnerability to catastrophic weather events; and genetic and demographic problems due to its small and fragmented population. Feral pigs and dogs may affect the breeding success of the cranes within the Las Salinas Wildlife Refuge in the Zapata Swamp. Habitat conversion (especially due to the development of citrus plantations) is the principal factor behind the significant decline of the cranes on the Isle of Youth (Galvez and Perera 1995). Hunting may also be a problem, especially given the economic pressures within Cuba. Cuba's political isolation has also limited the availability of information, funding, equipment, and scientific and management expertise, and hindered cooperative conservation measures to address these threats.

2.7.9 Current Conservation Measures

Since declining through the first half of the 1900s, the Sandhill Crane has benefitted from extensive conservation efforts. See Walkinshaw (1949, 1973), Johnsgard (1983, 1991), and Tacha et al. (1992, 1994) for overviews of these efforts.

Legal and Cultural Protection

In Canada and the United States, the hunting of Sandhill Cranes is regulated under the Migratory Bird Treaty of 1916. Hunting was prohibited until increased interest in Sandhill Cranes as game animals led to the opening of hunting seasons in Canada in 1959 and in the United States in 1961 (Central Migratory Shore and Upland Game Bird Technical Committee 1993). The species has been legally hunted in Mexico since at least 1940. In the U.S., Sandhill Cranes are now legally hunted in Alaska, Arizona, Colorado, Kansas, Montana, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, and Wyoming. In Canada, Sandhill Cranes are hunted in Saskatchewan and Manitoba. In Mexico, hunting is permitted in nine northern and central states (Tacha et al. 1994).

Both the Cuban and Mississippi Sandhill Crane are protected under the U.S. Endangered Species Act. The Florida Sandhill Crane is listed as a threatened species by the Florida Game and Freshwater Fish Commission. In Mississippi the Mississippi Sandhill Crane is listed as endangered and is protected under the state's Nongame and Endangered Species Act of 1974 (USFWS 1991). The Cuban Sandhill Crane is listed as Endangered in Cuba.

International Cooperation and Agreements

All of the main range countries of the Sandhill Crane are parties to the Ramsar Convention. In Canada and the United States the species falls under the protection of the Migratory Bird Treaty. The treaty allows for the prohibition or regulation of hunting and other forms of direct exploitation. In 1936, the U.S. and Mexico signed a similar Treaty for the Protection of Migratory Birds and Game Mammals. While hunting has been legalized in certain portions of the species' range, the provisions of these treaties remain in effect for the species as a whole.

Canadian and U.S. agencies collaborate in developing mid-continental Sandhill Crane management plans. Since 1994, crane conservationists in Cuba and the United States have worked more closely on Cuban Sandhill Crane conservation efforts (Galvez and Perera 1995).

Protected Areas

Sandhill Cranes use many national, provincial, and state protected areas as well as private conservation lands. A few areas, such as the Mississippi Sandhill Crane National Wildlife Refuge, are especially significant for cranes, and have been protected primarily for that reason. In most cases, however, cranes are only one of many species that benefit from the protected status of these areas. The breeding grounds of the mid-continental populations in Canada are found largely outside of protected areas. Nonetheless, many of Canada's national and provincial parks and refuges do protect breeding cranes and their habitats.

Protected areas have played a key role in the protection and recovery of Greater Sandhill Crane populations in the United States, especially in the Great Lakes and Rocky Mountain states. Among the many important protected areas used by breeding Greater Sandhill Cranes are: Seney National Wildlife Refuge (NWR) in Michigan; Necedah and Horicon NWRs in Wisconsin; Sherburne and Crane Meadows NWRs in Minnesota; Seedskadee and Cokeville Meadows NWRs and Yellowstone and Grand Teton National Parks in Wyoming; Bear Lake, Camas, and Grays Lake NWRs in Idaho; and

Malheur NWR in Oregon.

Among the refuges used by migrating cranes are: Jasper-Pulaski Fish and Wildlife Area in Indiana; Last Mountain Lake National Wildlife Area in Saskatchewan; Chase Lake and Long Lake NWRs and the Audubon Complex in North Dakota; Medicine Lake NWR in Montana; Bear Lake and Grays Lake NWRs in Idaho; Ouray, Bear River, and Fish Springs NWRs in Utah; Monte Vista/Alamosa NWR in Colorado; LaCreek NWR in South Dakota; North Platte NWR in Nebraska; Cheyenne Bottoms State Wildlife Area and Kirwin and Quivira NWRs in Kansas; and Salt Plains, Tishomingo, and Washita NWRs in Oklahoma.

Important wintering areas are protected in the Cibola NWR in Arizona; Bosque del Apache, Grulla, and Bitter Lake NWRs in New Mexico; and Muleshoe, Aransas, Brazoria, and Laguna Atascosa NWRs in Texas.

Protected areas have been especially important in efforts to protect the non-migratory subspecies. Large areas of Florida Sandhill Crane habitat are protected within a matrix of state parks, preserves, and wildlife management areas and private conservation lands (Nesbitt in press). These areas are also important for wintering Greater Sandhill Cranes from the Great Lakes population. In Georgia, the Okefenokee NWR protects critical Florida Sandhill Crane habitat. The Mississippi Sandhill Crane NWR was officially established in 1975 to protect the core habitat of the Mississippi Sandhill Crane. Four of the known sites where the Cuban Sandhill Crane occurs are within existing protected areas: Las Salinas Wildlife Refuge in Zapata Swamp; Los Indios Wildlife Refuge on the Isle of Youth; Romano Key Managed Resource Area in Camaguey Province; and Cauto River Delta Wildlife Refuge in Granma Province. Three other populations are adjacent or close to protected areas: the Guanes population in western Pinar del Rio is near the Peninsula de Guanahacabies Biosphere Reserve; the north Sancti Spiritus population is near the Caya Caguanes Nature Preserve and Jobo Rosado National Wildlife Refuge; and the north Cielo de Avila population is near the Cunagua Managed Resource Area (A. Perera pers. comm.).

Habitat Protection and Management

Sandhill Cranes have benefitted from many national, provincial, and state policies and programs to conserve wetlands, especially in parts of the United States where populations were depleted or extirpated. This pertains to habitat both within protected areas and on private lands. Restoration of hydrological regimes through reflooding and management of water levels has played a critical role in reestablishing the ecological functions and diversity of previously drained wetlands, especially in the upper midwestern United States. In some areas, habitat management programs have been undertaken specifically for cranes. The Platte River Whooping Crane Trust, which was established by a federal court ruling, is responsible for acquiring lands and restoring crane habitat (especially through the clearing of riparian vegetation) on the central Platte River (Strom 1987, Currier 1991). Prescribed burning has also been used to restore open meadows and savannahs in Mississippi, Texas, and other areas used by cranes (S. Hereford pers. comm.). In and near many of the important staging areas, food crops have been planted both to benefit cranes directly and to lure them away from commercial croplands (USFWS 1991). Behavioral studies have led to the development of new methods to reduce crane collisions with utility lines (Morkill and Anderson 1992, 1993).

Surveys/Censuses/Monitoring

The mid-continental populations of Sandhill Cranes are monitored through annual spring surveys. Annual aerial surveys along the Platte River in Nebraska date to 1957. Since 1974, annual surveys have been conducted in late March throughout the Central Flyway. The Rocky Mountain population of Greater Sandhill Cranes is monitored by the U.S. Fish and Wildlife Service in the San Luis Valley in Colorado during spring migration. Surveys are also conducted annually at Grays Lake NWR and at staging and wintering areas in Montana, New Mexico, and Utah (Smith 1991, Central Migratory Shore and Upland Game Bird Technical Committee 1993, Drewien et al. 1995). The wintering Colorado River Valley population has been counted on a semi-regular basis, most recently in November 1994 (Drewien 1995). Drewien et al. (1996) provide a summary of data on the distribution and abundance of wintering cranes in Mexico. Since 1974, an annual "crane count" has been held in Wisconsin and parts of adjacent Minnesota, Michigan, and Illinois, providing an index to the size the population of Greater Sandhill Cranes in the upper midwest (Dietzman and Swengel 1994). An annual fall census of the Eastern population is coordinated by the USFWS (Urbanek 1994). The Mississippi Sandhill Crane population is monitored year-round, and its size estimated semi-annually through censuses conducted in January and October (S. Hereford pers. comm.). The Cuban Sandhill Crane has been surveyed only intermittently since the mid-1940s. The first range-wide survey was undertaken in late 1994 and early 1995 (Walkinshaw 1973, Faanes 1990, Galvez and Perera 1995).

Research

The Sandhill Crane is among the most thoroughly studied crane species, and has long been among the most studied wildlife species in North America. Field research has been conducted in various parts of the species' range, and has focused on a wide array of topics involving life history, breeding biology, ecology, ethology, migration, and demography. Carey Krajewski of Southern Illinois University is conducting continuing studies of mitochondrial DNA to define more precisely the phylogenetic relationships and degree of genetic variance within the species (Krajewski and Fetzner 1994, Krajewski and Archibald in prep.). Results from many of the studies of Sandhill Cranes have been reported within the proceedings of the North American and international crane workshops. *The Unison Call*, the biannual newsletter of the North American Crane Working Group, provides regular sum-

maries of ongoing studies. Tacha et al. (1992, 1994) provide thorough syntheses of this information.

Much of the recent research on the species derives from its importance as a surrogate in efforts to reestablish Whooping Crane populations. The cross-fostering experiment at Grays Lake, Idaho, entailed extensive studies of the Rocky Mountain population of Greater Sandhill Cranes (e.g., Drewien and Bizeau 1974, Drewien et al. 1987). Since the mid-1980s, the Florida Sandhill Crane has been the subject of intensive monitoring, demographic studies, and ecological research related to efforts to establish a non-migratory flock of Whooping Cranes in Florida (e.g., Walkinshaw 1982, Bishop 1988, Nesbitt and Williams 1990). These ongoing studies have provided a strong basis as well for conservation of the Florida Sandhill Crane itself. The precarious state of the Mississippi Sandhill Crane has focused scientific attention on a wide range of topics relevant to crane conservation in general, including habitat management, dispersal patterns, effects of predators and pesticides, the role of disease, and loss of genetic diversity (USFWS 1991). Several recent studies (McIvor 1993, McIvor and Conover 1994, Bouffard in press) have examined the incidence and impact of crop depredation.

Drewien et al. (1995) provide a comprehensive review of recruitment data for the Rocky Mountain population of Greater Sandhill Cranes in comparison with other North American crane populations.

The Cuban Sandhill Crane represents the exception to the generally high level of scientific knowledge about the species. Cuban conservation biologists have had only limited funding, training, and personnel with which to work, and until recently only a few non-Cuban crane researchers have been able to gain access to areas where the cranes survive (Faanes 1990, Galvez and Perera 1995, E. Santana pers. comm., X. Galvez pers. comm.).

Population and Habitat Viability Assessment

A population and habitat viability assessment was conducted for the Mississippi Sandhill Crane in September 1992. Participants in the PHVA workshop offered a number of specific recommendations aimed at increasing the nesting success of the wild cranes, reducing the mortality rate of wild cranes, dividing the captive flock, and addressing health issues (Seal and Hereford 1992). A number of these recommendations have already been implemented. The CAMP for cranes has also recommended that PHVAs be conducted for the Cuban Sandhill Crane (pending the results of field surveys) and for the Okefenokee population of the Florida Sandhill Crane (Mirande et al. in press a).

Management and Recovery Plans

Management and recovery plans have been prepared for several Sandhill crane subspecies and populations. These plans are briefly summarized here.

Mississippi Sandhill Crane Recovery Plan

A recovery plan for the Mississippi Sandhill Crane was first developed in 1976, and has since been revised three times. The recovery objective, as stated in the most recent (1991) revision, is "to maintain a genetically viable, stable, self-sustaining, free-living Mississippi Sandhill Crane population." In working toward this goal, the recovery plan lays out detailed conservation actions under six main categories:

(1) Develop population dynamics and minimum viable population models for the Mississippi Sandhill Crane.

(2) Restore, improve, and maintain nesting, feeding, and roosting habitats within the Mississippi Sandhill Crane National Wildlife Refuge.

(3) Increase recruitment, reduce mortality, and enhance heterozygosity.

(4) Monitor the response of wild cranes to habitat management actions.

(5) Review the potential for establishing one or more breeding populations within the historic range.

(6) Plan, update, and implement a comprehensive research program to address: (1) reduced natural recruitment, (2) loss of genetic viability, (3) tumor rate, and (4) habitat enhancement (USFWS 1991).

Management Guidelines for Mid-continental Sandhill Cranes (1981, 1990, 1993)

Under the auspices of the Central Flyway Waterfowl Council, a statement of Management Guidelines for Mid-Continent Sandhill Cranes was first developed in 1981, and has since been revised twice. The management goal, as stated in the most recent (1993) revision, is "to provide optimum diverse recreational opportunities consistent with the welfare of Mid-Continent Sandhill Cranes, international treaties, and socioeconomic constraints." The guidelines describe actions to be taken in meeting three objectives:

(1) "A population index of Mid-Continent Sandhill Cranes within a range of 343,000-465,000 birds."

(2) "Maintain the geographic and temporal distribution of Mid-Continent cranes similar to the 1982-1992 period."

(3) "Maximize recreational use consistent with population and distribution objectives."

Management Plans for the Rocky Mountain population of Greater Sandhill Cranes (1982, 1987, 1991).

A Management Plan of the Pacific and Central Flyways for the Rocky Mountain Population of Greater Sandhill Cranes was

first developed in 1982, and has since been revised twice. The goals, as stated in the most recent (Smith 1991) revision, are to:

(1) "Maintain a stable population of 18,000-22,000... Greater Sandhill Cranes as determined by the most recent, accurate, spring census in the San Luis Valley, Colorado."

(2) "Allow for expansion of current distribution where desirable."

(3) "Maintain and protect sufficient habitats to support population and distribution objectives."

(4) "Provide for recreational uses of the crane population."

The plan recommends specific state-level management procedures involving habitat preservation, uses of cranes, depredation control, inventories, and research.

Cuban Sandhill Crane Research and Management Plan

As a result of recent contacts among Cuban, Mexican, and U. S. crane conservationists, efforts have begun to develop a comprehensive research and management plan for the Cuban Sandhill Crane. The initial objectives of the plan are to determine: (1) the status and distribution of the Cuban Sandhill crane; (2) the factors limiting its population; (3) daily and seasonal activity patterns; and (4) feeding and reproductive behavior (Galvez and Perera 1995). This information will provide the foundation upon which to base future conservation activities.

Non-governmental Organizations

The North American Crane Working Group has played a key role in focusing interest on the Sandhill Crane through regular workshops, publications, and other activities. The group hosted its seventh workshop in January 1996. Private conservation organizations, including The Nature Conservancy and the National Audubon Society, have also contributed to the protection of valuable Sandhill Crane habitat. For example, The Nature Conservancy played an instrumental role (beginning in 1974) in acquiring lands for the establishment and expansion of the Mississippi Sandhill Crane NWR (USFWS 1991). Important spring staging areas along the Platte River are held by TNC, the National Audubon Society, the Platte River Whooping Crane Habitat Maintenance Trust, and the State of Nebraska (Logan et al. 1976, Currier et al. 1985, VanDerwalker 1987, Strom 1993). ICF has focused on the Sandhill Crane in many of its education, research, training, and habitat protection and management programs.

Education and Training

As a wide-ranging, abundant, and easily identified species, the Sandhill Crane has been incorporated into many conservation education programs and projects, especially those focusing on wetland values, functions, and conservation. These include, for example, the annual midwestern crane count (see above), which not only provides data on the size of the population and status of habitat conditions, but allows participants to learn about crane and wetland conservation in the process (Dietzman and Swengel 1994). Annual crane festivals have been organized at several key staging and wintering grounds, including the Platte River staging grounds, the Buena Vista NWR, and the Bosque del Apache NWR.

In addition to the key role that Sandhill Cranes play in public education programs, they have also been used extensively for professional training in field research, captive propagation, and reintroduction methods. Practices that have been (or will be) applied mainly to other species have often been "tested" first on Sandhill Cranes. These include the development of techniques for isolation rearing and banding and migration studies. Sandhill Cranes are now being used in experiments to teach migration routes to captive-reared cranes (see the Whooping Crane species account).

Captive Propagation and Reintroduction

All five mainland subspecies are maintained in captivity, but only the Mississippi Sandhill Crane is being bred actively for reintroduction purposes. The others have been used in captivity in educational programs, as surrogate incubators for threatened species, and in research on captive rearing methods.

The GCAR for cranes inventoried the known captive populations of Sandhill Cranes (Mirande et al. in press a). Greater and Florida Sandhill Cranes are the most widely represented within the captive population. As of 1993, some 150 Greater Sandhill and 300 Florida Sandhill Cranes were known to be in captivity. They are generally easy to breed.

The Mississippi Sandhill Crane is the focus of an intensive captive propagation and release program. The U.S. Fish and Wildlife Service initiated the program at its Patuxent Wildlife Research Center (now the Patuxent Environmental Science Center) in 1966. The first fertile eggs were produced in 1973, and releases began in 1981. Since then, a total of 245 birds have been released. Approximately 75-80% of the birds at the Mississippi Sandhill Crane Wildlife Refuge are either captive-bred, or direct descendants of captive-bred, individuals (Valentine and Logan 1991, Ellis et al. 1992). As of 1994, Patuxent housed 17 breeding pairs. The captive flock at Patuxent is in the process of being split and transferred to two facilities, the White Oak Conservation Center in Tulee, Florida, and the Freeport-McMoran Audubon Species Survival Center in New Orleans.

Since 1993, wild-caught subadult Florida Sandhill Cranes have been translocated to the Grand Bay Wildlife Management Area in Georgia. This project aims to establish a non-migratory population in Georgia outside of the Okefenokee Swamp (Nesbitt 1994a).

There have been no systematic efforts to maintain and breed the Cuban Sandhill Crane in captivity.

2.7.10 Priority Conservation Measures

In general, the Sandhill Crane's conservation needs reflect the fact that the migratory populations are still abundant, and thus offer opportunities to prevent population declines, to bolster their recovery in areas where they have declined, and to anticipate potential conflicts between people and cranes. However, this will require an active, energetic program of population monitoring, habitat protection, policy incentives, and education.

For the *G. c. canadensis-rowani-tabida* complex, the most critical general conservation needs are (1) improved surveys of the breeding populations and (2) expanded habitat protection, management, and restoration of present and former spring staging areas along the Platte River, especially through education and watershed-wide habitat conservation programs.

For the non-migratory subspecies, the most important general needs are (1) effective management of remaining habitats, (2) restoration of degraded habitats and ecological processes (especially fire and hydrological cycles), and (3) effective reintroductions of the Mississippi (and potentially the Cuban) Sandhill Cranes.

The following specific conservation priorities relate to these general needs.

Legal and Cultural Protection

1) Secure legal protection for the Platte River instream flow, and provide for protection, restoration, and maintenance of habitat within areas traditionally used by migrating Sandhill Cranes.

2) Assess the need for separate listing of the Florida Sandhill Crane by the USFWS.

International Agreements and Cooperation

1) Support continued international efforts to develop a conservation program for the Cuban Sandhill Crane (see below).

2) Expand cooperation between biologists in Mexico's Sandhill Crane wintering grounds and those working in the breeding range of these populations.

Protected Areas

Priority needs in this area are noted within several other categories in this section.

Habitat Protection and Management

1) Protect instream flow in the Platte River.

2) Protect and restore essential wetland and upland habitats of the non-migratory subspecies. This should include: acquisition and protection of additional habitats of the Florida Sandhill Crane to ensure that the range of the species remains contiguous throughout the Florida peninsula; securing of existing and potential habitats for the Mississippi and Cuban Sandhill Crane; and management of these habitats to maintain appropriate vegetation type and ecosystem structure and function.

3) Protect and restore additional critical staging and wintering areas of the migratory subspecies, including: the seasonal playa lakes of western Texas; wet meadows and riparian roosting areas along the North Platte and Platte Rivers; wintering grounds of the Greater Sandhill Crane in Florida; wetlands of the intermountain west, California, and the American Southwest; and Laguna de Babicora and other wintering areas in northern Mexico (see Tacha et al. (1994) for specific needs in many of these areas).

4) Promote conservation of habitats on private lands in the key migration and wintering areas of the migratory subspecies. Since much of the non-breeding (and, in the case of the Greater Sandhill Crane, breeding) habitat of migratory Sandhill Cranes is on private land, it is important that conservationists and private landowners collaborate in efforts to protect, improve, and restore wetlands, to exchange information, and to monitor and respond to crop depredation problems. Greater attention to trends in agricultural policy and agricultural practices, and their impact on habitat conditions, is needed. Cooperative agreements, easements, and other methods of habitat protection should be explored (see Smith 1991, Bouffard in press).

Surveys/Censuses/Monitoring

Priority needs in this area are noted within several other categories in this section.

Research

Research related to the rarer Sandhill Crane taxa should focus on:

1) Population and habitat surveys and a conservation needs assessment for the Cuban Sandhill Crane.

2) Continued studies of the factors behind poor reproduction and recruitment rates in the Mississippi Sandhill Crane population.

3) Clarification of the intraspecific genetic structure and phylogenetic relationships among the Cuban, Florida, and Mississippi Sandhill Cranes.

4) Quantitative analysis of the genetic distinctiveness and long-term viability of the (Okefenokee) population of the Florida Sandhill Crane.

Research related to more abundant Sandhill Crane taxa should focus on:

1) Improved assessments of the size, status, and population

dynamics of the mid-continental populations. In particular, research should: assess the accuracy of current survey techniques; assess the suitability of survey results as indices for the entire population; identify factors affecting the accuracy of surveys; develop alternative and/or supplemental means of monitoring; and determine the stability of annual recruitment rates.

2) Clearer delineation of populations, migration routes, range expansions, and the relationships among subspecies along migration routes and in wintering grounds.

3) Clarification of the intraspecific genetic structure and phylogenetic relationships among the *G. c. canadensis-rowani-tabida* group.

4) Improved techniques for controlling and minimizing crop depredation.

Recovery of the Mississippi Sandhill Crane

1) Fully implement the Mississippi Sandhill Crane Recovery Plan.

2) Give special consideration, within the framework of the Recovery Plan, to the following:
   - expand habitat restoration efforts at the Mississippi Sandhill Crane NWR, with emphasis on removal of pines and restoration of the natural hydrologic regime;
   - conduct research on the effects of fire timing and intensity on savanna quality;
   - expand education outreach activities directed to refuge visitors and the local community;
   - develop release sites at 2-3 new areas on the Mississippi Sandhill Crane NWR to increase the colonization rate;
   - initiate a second population in suitable habitat in Mississippi, and possibly in southern Alabama (Grand Bay NWR and other areas) and southwestern Louisiana, based on studies of the potential for reintroduction in other areas of the subspecies' historic range and identification of specific release sites;
   - complete transfer of the captive flock to the two facilities in the southeastern U. S. (see "Captive Breeding and Reintroduction" priorities below);
   - expand the subspecies sperm bank;
   - devote greater attention to the incidence and prevention of tumor development in the population;
   - continue research on predator movements in relation to areas used by cranes and on the effects of predation (especially by coyotes) on chick survival; implement, if necessary, a balanced program of predator control;
   - expand research on: the taxonomic status of the subspecies; possible causes of low fertility and survival rates in the population, including loss of genetic viability and the incidence of tumors; techniques of screening for diseases prior to the release of captive-reared birds; and habitat conditions, restoration, and enhancement.

Developing a Cuban Sandhill Crane Conservation Program

In order to protect and restore the highly endangered population of the Cuban Sandhill Crane and its habitats, a comprehensive conservation program needs to be developed and implemented. This program should include the following components:

1) Development and implementation of an initial research and management plan.

2) Thorough field surveys and assessments of existing populations, habitats, and threats. These are needed to provide the basis for further conservation planning.

3) Establishment of a monitoring program to provide accurate assessments of trends in the populations and their habitats.

4) Ecological research on historic and current crane habitat to provide management guidelines (especially for fire management), and to weigh the potential for restoration in portions of the historic range.

5) Opportunities for collaboration and training involving Cuban and non-Cuban field ecologists, ornithologists, and conservationists.

6) Development of an education program to communicate the importance, status, and conservation needs of the subspecies.

7) Establishment, pending the results of thorough field surveys, of a captive propagation and reintroduction program.

Anticipating and Responding to Crop Depredation

Crop depredation by Sandhill Cranes is intermittent, and limited to certain geographic areas, crop types, and times of the year. This offers opportunities to conduct research, to anticipate future occurrences of damage, and to prepare effective responses. To do so, programs should focus on:

1) Research to determine the timing and extent of the problem in different parts of the species' range.

2) Habitat management techniques (e.g., development of lure crops) to minimize potential damage.

3) Extension and public education programs involving farmers.

4) Research into the actual impact of hunting as a method of reducing depredation.

5) Development of compensation programs and policy incentives to reward farmers whose management practices contribute to crane conservation.

Understanding the Impact of Hunting

The effect of hunting on Sandhill Crane populations has been a controversial topic. In order to provide a stronger scientific basis for understanding the impacts of hunting on crane populations (including the accidental taking of Whooping Cranes), for informing policy debates, and for making policy decisions, the following measures should be given high priority:

1) Improve regular surveys to monitor trends in the populations of migratory Sandhill Cranes. Especially important are surveys of the Western and Gulf Coast wintering subpopulations of mid-continental Sandhill Cranes (see Tacha et al. 1994).

2) Expand research on the effects of hunting on various populations and on the number and age structure of birds taken. Greater attention should be given to research on the long-term effects of disturbance from hunting on the distribution of the various migratory populations.

3) Continue close monitoring of the legal kill, crippling losses, and poaching in areas of the U.S. and Canada.

4) Improve documentation of the annual mortality from sport and subsistence hunting in Mexico and Russia, and from subsistence hunting in Alaska and Canada.

5) Expand basic research to support management objectives. Key areas (as indicated above under "Research") include more precise demographic studies of the mid-continental populations, delineation of subspecies/subpopulation distribution and migration routes, and clarification of intraspecific taxonomic relationships.

6) Improve communication among Canada, the United States, Mexico, and Russia on the impacts of hunting on Sandhill Crane populations, and on hunting practices, regulations, and prohibitions.

Education and Training

Because Sandhill Cranes are well studied, conspicuous, widespread, and migrate over great distances, they present many opportunities for innovative education programs. Specific educational priorities include:

1) Involving qualified students in crane counts and censuses, especially at important staging and wintering areas.

2) Involving students in long-term monitoring programs for the non-migratory subspecies.

3) Developing cooperative projects involving schools in Russia, Canada, the United States, and Mexico in the study of avian migration, using cranes as a model.

4) Developing primary and secondary school curriculum materials that use Sandhill Cranes to communicate information about the biology, status, and conservation of the species, other crane species, and wetlands. This should include field studies that stress the role of cranes as wetland "umbrella" species (i.e., species whose conservation can provide protection for a wide range of species and ecosystem processes).

5) Using present knowledge of crane social behavior to communicate lessons about the role of animal behavior in conservation.

Captive Propagation and Reintroduction

1) Implement the following recommendations outlined in the GCAR and CAMP for cranes (Mirande et al. in press a):
   - Discontinue captive propagation of Lesser Sandhill Cranes.
   - Manage the captive populations of Greater and Florida Sandhill Cranes at the Intensive-2 (C priority) level, based on interest in these subspecies for conservation education and as surrogates in conservation programs for endangered cranes. Allow the populations in captivity to reach no more than 200, and monitor them to ensure that they do not occupy space better utilized in programs for endangered cranes.
   - Manage the captive population of Mississippi Sandhill Crane at the Intensive-1 (A priority level). Implement the Mississippi Sandhill Crane PHVA recommendations to divide the captive flock by transferring breeding pairs from the USFWS Patuxent Environmental Science Center and the National Zoological Park's Conservation and Research Center to the Freeport-McMoran Audubon Species Survival Center and the White Oak Conservation Center. Allow the captive population to increase to no more than 100 individuals.
   - Increase contacts with Cuban conservation biologists, and base decisions involving the need for captive propagation and release of Cuban Sandhill Cranes on results from field surveys and communication of information on captive birds (if any) in Cuba.

2.8 SARUS CRANE (*Grus antigone*)

2.8.1 Summary

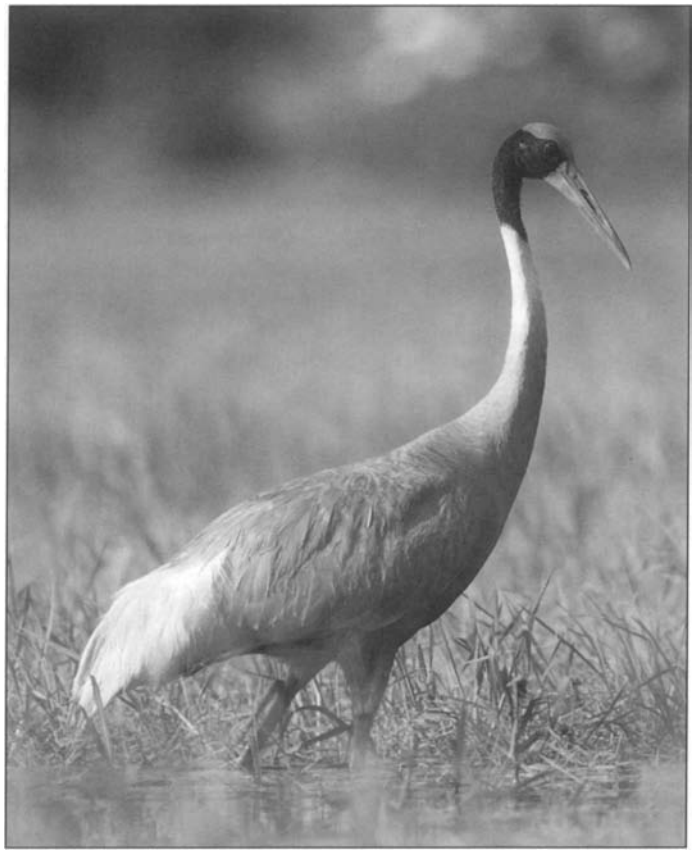
The Sarus Crane is the only resident breeding crane in India and southeast Asia, and is the world's tallest flying bird. Three subspecies are recognized, with a total estimated population of between 13,500 and 15,500. The Indian Sarus Crane (G. *a. antigone*) is still common in northern India, but has been extirpated from large portions of its historic range and continues to decline in areas where it still exists. The Eastern Sarus Crane (G. *a. sharpii*[1]) has been decimated throughout its historic range in southeast Asia. One known population, estimated at between 500 and 1500, survives in Cambodia, Vietnam, and Laos (and possibly elsewhere in the region). The Australian Sarus Crane (G. *a. gilli*) is limited to northeastern Australia, and probably numbers less than 5,000. Sarus Cranes, possibly of a distinct subspecies, formerly occurred in the Philippines. This population is now presumed extinct. The species is classified as Endangered under the revised IUCN Red List Categories. The Indian and Eastern subspecies are classified as Endangered. Too little is known about the Australian subspecies to classify it at this time.

The three subspecies use widely varying habitats. The Indian Sarus Crane has proven to be highly adaptable in the face of high human population pressures. The birds are able to use even small wetlands if they are not persecuted or heavily disturbed. Breeding pairs and families with pre-fledged chicks are typically dispersed among scattered natural and artificial wetlands. Adult pairs will use drier habitats such as cultivated and fallow fields. Eastern Sarus Cranes are less tolerant of people and are almost completely dependent on natural wetlands in both the wet and dry seasons. Australian Sarus Cranes nest in open wetlands during Australia's wet season and feed in upland agricultural fields and grasslands at other times of the year.

Loss and degradation of wetlands—due to agricultural expansion, industrial development, river basin development, pollution, warfare, heavy use of pesticides, and other factors—are the most significant threats to the species, especially in India and southeast Asia. In many areas, high human population pressures compound these threats by increasing the level of disturbance. Human population growth and planned development projects on the Mekong River are acute threats to the Eastern Sarus Crane. Hunting, egg stealing, and the capturing of chicks are also significant problems in some areas, and especially affect the Eastern Sarus Crane. Trading in adults and chicks has been reported in India, Cambodia, and Thailand.

Local traditions and religious beliefs have protected the species in many parts of its range, especially northern India, Nepal's western Tarai, and Vietnam. The species has been the focus of increased conservation activity in recent years, including: international agreements and collaborative conservation projects in southeast Asia; field studies of the species in India and Nepal; intensive surveys of the Eastern Sarus Crane during the dry season in Vietnam, and during the breeding season in Cambodia; establishment of the Tram Chim National Reserve in Vietnam and efforts to restore the reserve's wetlands; convening (in 1990) of an International Sarus Crane and Wetland Conservation Workshop; initial development of a PHVA for the Eastern Sarus Crane; and focused education programs in Nepal and Vietnam. Sarus Cranes are not now being reintroduced, but plans for reintroduction have been advanced in Thailand and discussed in other portions of the species' historic range.

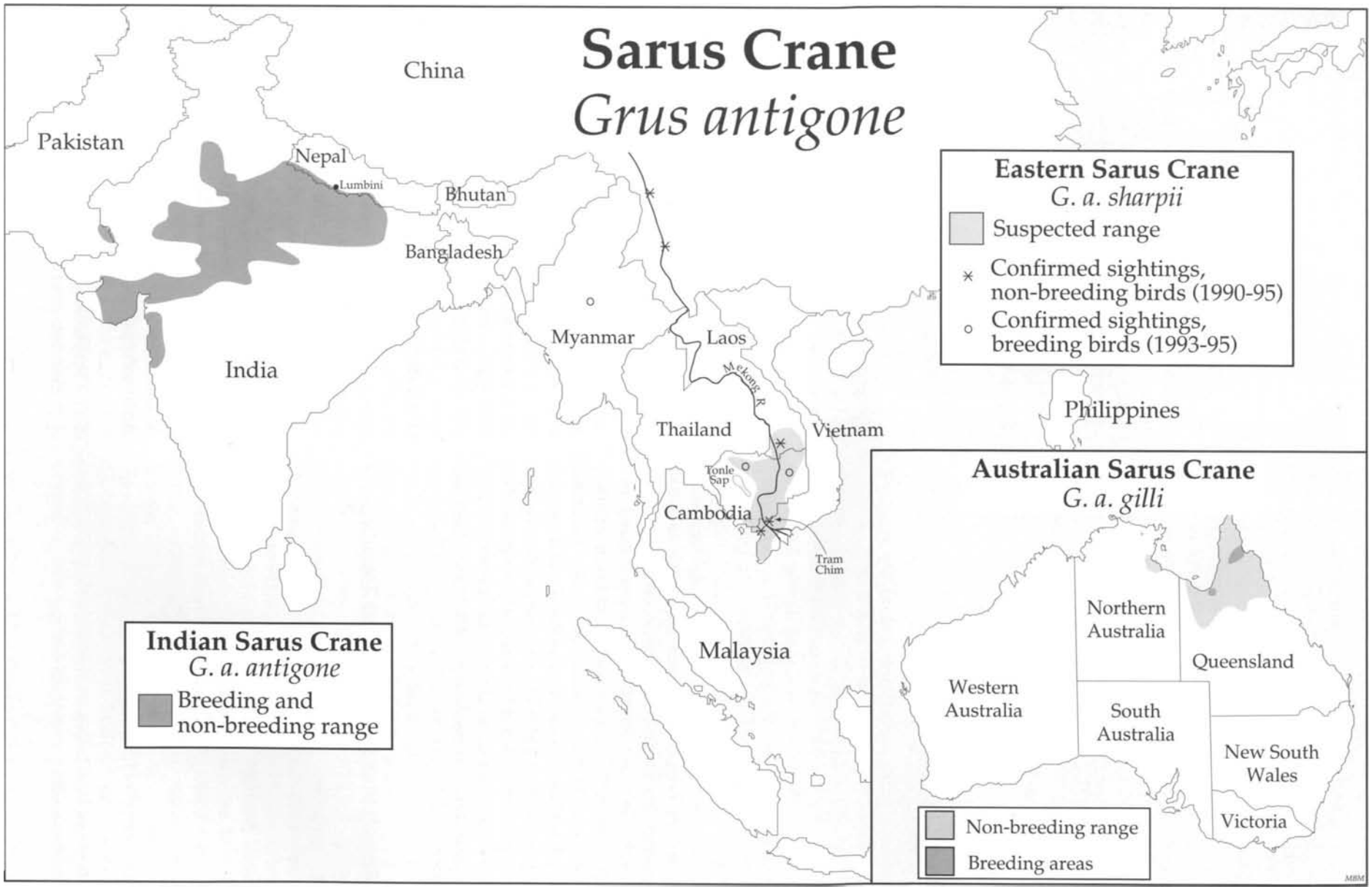
Priority conservation measures for the species include: transfer of the species to CITES Appendix I; identification and protection of breeding areas in India, Cambodia, Myanmar, and Laos, and of additional dry season habitat areas in Vietnam, Laos, and Cambodia; full implementation of the management plan for Vietnam's Tram Chim National Reserve;



M.P. KAHL

Sarus Crane *(Grus antigone),* Indian subspecies

[1]The spellings *G. a. sharpii* and *G. a. sharpei* have been used interchangeably in the literature. Similarly, *G. a. gilli* is the most commonly used spelling for the Australian Sarus Crane, although Schodde et al. (1988) introduced the subspecies as *G. a. gillae.*


Sarus Crane
Grus antigone
China
Pakistan
Nepal
Lumbini
Bhutan
Bangladesh
India
Myanmar
Laos
Mekong R
Thailand
Vietnam
Tonle Sap
Cambodia
Tram Chim
Malaysia
Philippines
Eastern Sarus Crane
G. a. sharpii
Suspected range
Confirmed sightings, non-breeding birds (1990-95)
Confirmed sightings, breeding birds (1993-95)
Indian Sarus Crane
G. a. antigone
Breeding and non-breeding range
Australian Sarus Crane
G. a. gilli
Northern Australia
Queensland
Western Australia
South Australia
New South Wales
Victoria
Non-breeding range
Breeding areas
MBM

protection, maintenance, and restoration of village ponds and other small wetlands in India; watershed-level conservation planning in the Mekong River basin; expanded efforts to survey and monitor Eastern Sarus Cranes; further research on distribution, ecology, movement, and habitat needs throughout the species range; expanded surveys and basic ecological studies of the Australian Sarus Crane; development and implementation of national-level wetland conservation plans in range countries; preparation of full PHVAs for both the Indian and Eastern Sarus Crane; and assessments of existing habitat and the potential for natural recolonization in areas where the species is now rare or extinct.

2.8.2 Subspecies/Populations

Indian Sarus Crane	*G. a. antigone*
Eastern Sarus Crane	*G. a. sharpii*
Australian Sarus Crane	*G. a. gilli*

The three subspecies are distinguished mainly by morphological differences. *G. a. antigone* is taller than *G. a. sharpii* and *G. a. gilli.* The plumage of all three is generally grey, but *G. a. antigone* has a white collar and white tertials. *G. a. sharpii* and *G. a. gilli* are a uniform (and slightly darker) grey. The dividing point between the ranges of *G. a. antigone* and *G. a. sharpii* falls in Eastern India and Myanmar. *G. a. sharpii* may exist in two separate populations: the known birds of the lower Mekong basin in Cambodia, Laos, and Vietnam; and (assuming it still exists) an isolated population in eastern India, Myanmar, and Yunnan.[2] *G. a. gilli* occurs exclusively in Australia. Schodde *et* al. (1988) differentiated it based on its smaller size, larger and darker ear patches, and more extensively feathered throat. Its status as a subspecies may be clarified through DNA analysis (Krajewski and Archibald in prep., C. Krajewski pers. comm.). The Sarus Cranes that occurred in the Philippines may have belonged to a distinct subspecies *Grus (Antigone) antigone luzonica,* although no taxonomic studies have been undertaken to confirm this status (see Hachisuka 1932, 1941).

2.8.3 Population Numbers and Trends

Subspecies	Number	Trend	Source
G. a. antigone	8,000-10,000	Declining	P. Gole pers. comm.
G. a. sharpii	500-1500	Unknown; likely declining	J. Barzen pers. comm.
G. a. gilli	<5,000	Unknown	A. Haffenden pers. comm.
Total	13,500-15,500	Declining	

The figures presented here are based on the best current estimates of members of the Crane Specialist Group. P. Gole (pers. comm.) notes that the estimate for the Indian Sarus Crane is lower than estimates published in recent years. The Eastern Sarus Crane has not been accurately surveyed due to the remoteness of its widely dispersed breeding grounds, and the possible existence of additional wintering areas. There have been no range-wide surveys of the Australian Sarus Crane and thus no basis for accurate estimates. A. Haffenden (pers. comm.) estimates that 750-1200 birds winter on the Atherton Tablelands and notes that "this may be the majority of the total population, as few are seen elsewhere in winter in any numbers."

2.8.4 Conservation Status

Species	
IUCN category	Endangered, under criteria A1b,c
CITES	Appendix II

Subspecies	**IUCN Category**
Indian Sarus (*G. a, antigone)*	Endangered, under criteria A1b,c,d,e
Eastern Sarus (*G. a. sharpii)*	Endangered, under criteria A1c,d,e A2c,d,e C1
Australia (*G. a. gilli*)	Data Deficient
Philippine	Extinct

2.8.5 Historic and Present Distribution

The Sarus Crane occurs in the northern Indian subcontinent, southeast Asia, and northeast Australia, and is the only crane species that breeds in Asia south of the Himalayas. Although Sarus Cranes are non-migratory, populations do move on a seasonal basis in response to monsoons and droughts. In general, Indian Sarus Cranes are more sedentary than Eastern and Australian Sarus Cranes, undertaking extended movement only during times of severe drought.

Indian Sarus Crane (*G. a. antigone*)

The current range of the Indian Sarus Crane includes the plains of northern, northwestern, and western India and the western half of Nepal's Tarai lowlands. The population has declined sharply over the last several decades. This decline is probably continuing, given the species' relatively low recruitment rate within India (Gole 1989b, P. Gole pers. comm.). Sarus Cranes are most common and densely distributed in the Indian states of Uttar Pradesh, Rajasthan, Gujarat, and Haryana; they are less common in Bihar and Madhya Pradesh (Gole 1989b). The population in Nepal is small (200-500) and apparently declining (R. Suwal pers. comm.). In Pakistan, India's Punjab, and western Bangladesh, the Sarus Crane now

[2]In the summer of 1996, as this action plan was going to press, the presence of Sarus Cranes in Myanmar was confirmed (J. Barzen pers. comm.). The subspecies status of theses birds is as yet unclear.

S. TRANEVING

Eastern Sarus Cranes, Tram Chim Reserve, Vietnam

occurs rarely (Gole 1989a, 1989b, 1991b; Iqubal 1992; M. Ahmad pers. comm.). Since 1993, a few have been observed along the Indus River in Pakistan not far from the border with India in Sindh/Rajasthan (A. Ahmad pers. comm., M. Ahmad pers. comm.).

The current distribution of the Indian Sarus Crane represents a substantial constriction of its historic range. Sarus Cranes formerly occurred across the subcontinent, from the province of Sindh in Pakistan in the west to Bangladesh in the east, throughout the Gangetic plain, and in the arid and semi-arid regions of the Deccan Plateau of south-central India. They were common in the dry season in Pakistan until the 1960s (Gole 1989a, 1989b). In Nepal, they have been extirpated from the eastern half of the Tarai lowlands (Suwal 1995). Although still common in India, where the association between people and Sarus Cranes is ancient and close, they are increasingly restricted to regions where traditional land and water management practices are maintained (P. Gole pers. comm.).

Eastern Sarus Crane (*G. a. sharpii*)

The Eastern Sarus Crane formerly occurred throughout Indochina. Over the last fifty years it has been decimated throughout this range. It has apparently been extirpated from Thailand and the Malay Peninsula; its status in Myanmar, Laos, and Cambodia is uncertain (but see n. 2 at bottom of previous page) In China, the Eastern Sarus Crane occurred historically in Yunnan Province, but has probably been in decline since the 1960s. Extensive surveys undertaken in Yunnan in the late 1980s failed to locate any birds (Yang 1987a, 1987b, 1991; Yang and Han 1987). The Philippine population of Sarus Cranes occurred on the island of Luzon (Hachisuka 1932, 1941; Delacour and Mayr 1946; Dickinson et al. 1991). The cranes were relatively common in some areas until the 1940s, but declined rapidly over the next two decades. Rare sightings were reported into the late 1970s, but surveys undertaken in the 1970s and 1980s failed to locate any birds (Madsen 1981, Dickinson et al. 1991).

The Eastern Sarus Crane survives in Vietnam, Laos, and Cambodia (Duc 1991). The subspecies formerly bred throughout the Mekong River delta, but large areas of the delta were devastated by war, and the Sarus Crane was presumed to have gone extinct in the area. In 1984, however, local officials in Vietnam reported that the species had reappeared. In 1986, ornithologists from the University of Hanoi confirmed that a flock had spent the dry season (December-April) on the Plain of Reeds, a 62,500 km^2 depression in the delta. The plain extends from Phnom Penh in Cambodia almost to the South China Sea (near My Tho, Vietnam). The flock was discovered in Vietnam at a 7500 ha impoundment, the Tram Chim wetland (Brehm Fund 1987, Duc 1987, Harris 1987, Duc et al. 1989). The exact location of this population's breeding grounds have yet to be determined, but Eastern Sarus Crane nests have recently been confirmed at three sites in northeastern Cambodia (Barzen 1994). Seasonal movements of the subspecies have not been well studied. They may entail distances of up to several hundred kilometers within the Mekong River

basin (R. Beilfuss pers. comm.).

Eastern Sarus Cranes have occasionally been reported during the breeding season in northern Myanmar, and the Rangoon Zoo is known to have had Eastern Sarus Cranes in captivity. A few individuals appear at the beginning of the monsoon season in the eastern Indian states of Tripura and Manipur (P. Gole pers. comm.). If wild Sarus Cranes still exist in this region, they may move into Yunnan Province, China, during the dry season (Yang and Han 1987, Yang 1991). Given the distance between these areas and the lower Mekong River basin where the other birds are found, these individuals may constitute a second, distinct population.

Australian Sarus Crane (*G. a. gilli*)

The Australian Sarus Crane occurs in northeastern Australia, almost exclusively on the Cape York Peninsula in northern Queensland (Blakers et al. 1984, Marchant and Higgins 1993). Over the last twenty years it has been reported at several additional sites in north central Australia (Marchant and Higgins 1993), but further surveys are required to verify their current status in these areas (Tanner and Jaensch 1988). The birds in Queensland undertake limited migrations between wet season breeding areas near the coast and inland dry season wintering areas (Archibald and Swengel 1987, A. Haffenden pers. comm.).

Reports of Sarus Cranes in Australia date to 1953 (Archibald and Swengel 1987). Ornithologists first positively observed the species in Normanton in 1966 and in the Atherton Tablelands the following year (Gill 1969). It is probable, however, that Sarus Cranes have long been present in Australia (see Schodde et al. 1988, Krajewski and Archibald in prep.). Native Australians differentiated between Sarus Cranes and Brolgas, calling the former "the crane that dips its head in blood" (G. Blackman pers. comm.). The Australian Sarus Crane has occasionally hybridized with the Brolga, and may be outcompeting the smaller Brolga in areas where they are found together (Archibald 1981a, Archibald and Swengel 1987). A. Haffenden (pers. comm.) notes that differences in diet, nest site selection, and other ecological and behavioral differences are likely to minimize interbreeding between the two species.

Over the last several decades, environmental changes—especially the introduction of cattle into Australian Sarus Crane habitat—may have indirectly allowed the population to increase and expand across the Cape York Peninsula toward the east. Cattle grazing has reduced the relative proportion of shrub cover in this area while promoting the growth of grasses used by Sarus Cranes in and around temporary wetland depressions. This may have allowed the population to expand and disperse eastward until it reached the grain fields of the Atherton Tablelands, which now serve as a large and dependable source of winter food. This "discovery" allowed the population to increase further. This explanation is supported by the fact that in the winter Sarus Cranes do not occur elsewhere in the region in concentrated or significant numbers (A. Haffenden pers. comm.).

J. BARZEN

Breeding habitat of the Eastern Sarus Crane, Cambodia

2.8.6 Distribution by Country

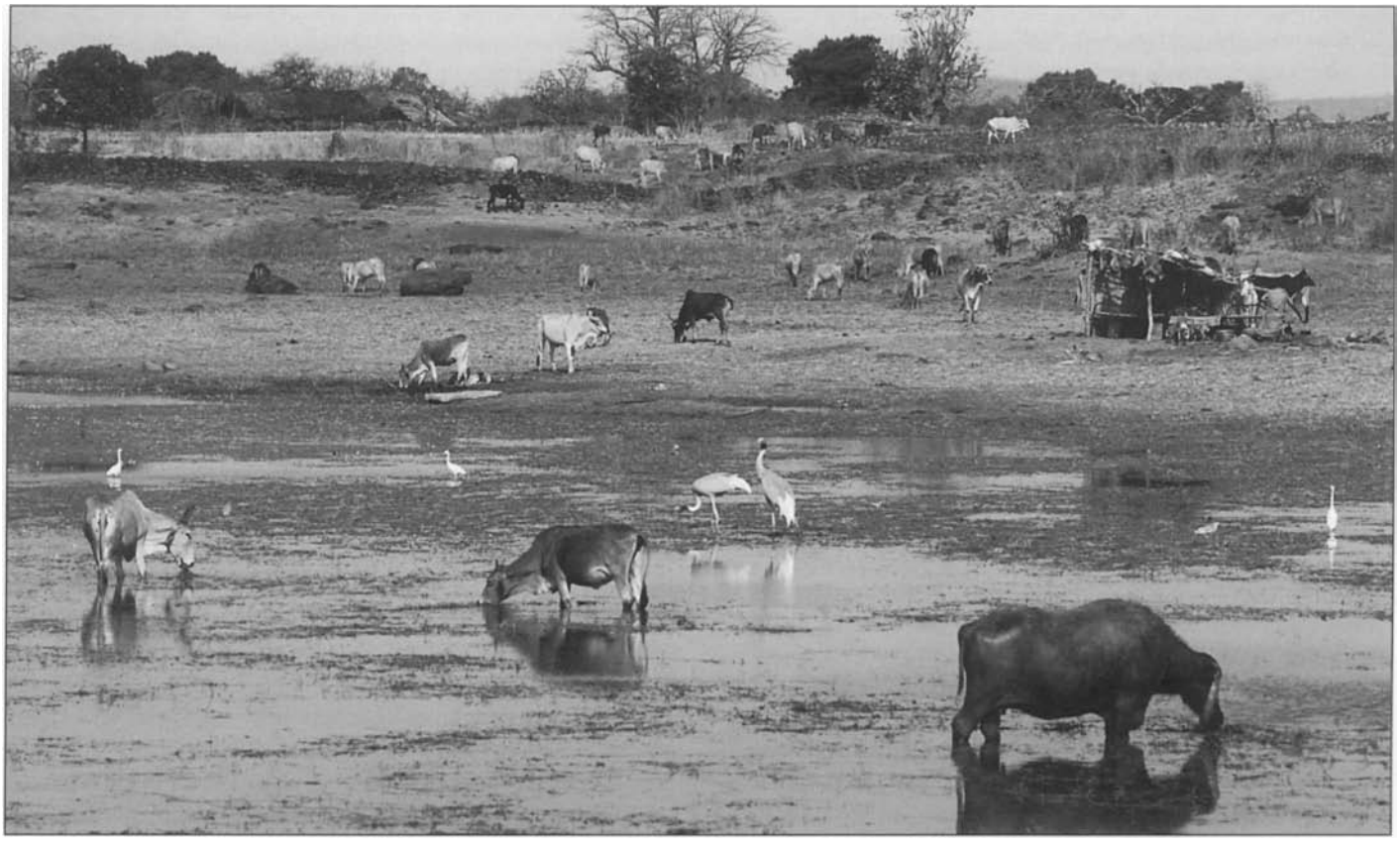
Australia	R
Bangladesh	r
Cambodia	r(b),r(d?)
China	X(b)?
India	R
Laos	r(b)?, r(d)?
Malaysia	X
Myanmar	r(b)?, r(d)?
Nepal	r
Pakistan	r
Philippines	X
Thailand	X
Vietnam	X(b), r(d)

R = Resident (populations >1500)
r = Resident (populations <1500)
(b) = Breeding season only
(d) = Dry season only
X = Extirpated
? = Unconfirmed

2.8.7 Habitat and Ecology

Indian Sarus Crane (*G. a. antigone*)

Indian Sarus Cranes have adapted to the dense human population in India and interact closely with people in areas where traditions of tolerance prevail. They breed throughout the year (except in May and June, with a peak from July-September), moving locally and utilizing a wide variety of habitat types



B. WRIGHT

The fate of the Sarus Crane in India is dependent on the maintainance of the quality of water and small wetlands

depending on food availability, cropping patterns, and other seasonal factors. Their optimal habitat includes a combination of marshes, ponds, fallow lands, and cultivated lands (Gole 1989b, 1991b). The diet includes aquatic plants, invertebrates, and grains.

Adult pairs use cultivated fields, fallow land, and other drier habitats, as well as flooded fields, rice paddies, and degraded (saline and water-logged) lands. Families with pre-fledged chicks, however, use wetlands almost exclusively (Gole 1993a). Breeding pairs use larger wetlands where they are available, but are typically scattered across the landscape, nesting in fields, along canals and irrigation ditches, beside village ponds, and in shallow marshes, rice paddies, jheels, and reed beds (Gole 1989b, Suwal 1995). The size of nesting territories ranges from 1 ha in populated areas to 27 ha within protected areas (Gole 1989b). Nests of all the subspecies consist of wetland vegetation and other available materials. Usually two eggs are laid. Incubation takes 31-34 days and chicks fledge at 85-100 days. Increasing human demands on India's wetlands may be contributing to the decline of the Sarus Crane by reducing the recruitment rate within the population.

Eastern Sarus Crane (*G. a. sharpii*)

In contrast with the Indian Sarus Crane, Eastern Sarus Cranes are intolerant of people and depend almost completely on natural wetlands. They breed during the monsoon season (May-October), during which time they are isolated and territorial. Their breeding areas are largely unknown, hence their breeding habitat requirements are poorly understood. Of three nests recently found in northeastern Cambodia, all were located in isolated wetlands less than 150 ha in size and surrounded by dry, open dipterocarp forests (Barzen 1994). As the dry season progresses, the birds gradually concentrate, form flocks, and move to their dry season habitats in the Mekong River delta. In the delta they use shallow wetlands, dried-out sedge meadows, rice fields, and burned-over wet grasslands. They feed primarily on the tubers of sedges *(Eleocharis ochrostachys)* and small vertebrates and invertebrates (Duc et al. 1989).

Australian Sarus Crane (*G. a. gilli*)

See Marchant and Higgins (1993) for a review of habitat, movements, diet, social organization and behavior, and breeding characteristics. During northern Australia's dry season (April-November), Australian Sarus Cranes forage in a variety of habitats (including shallow marshes, upland agricultural fields, and tussock grasslands), as long as water is available. In areas where both Brolgas and Sarus Cranes occur, Brolgas tend to restrict themselves to lowland sedge marshes, while Sarus Cranes use drier habitats (Archibald 1981a, Archibald and Swengel 1987). Although the wetland habitats of the two species overlap to a greater degree during the wet (breeding) season, the two species appear to differ in nest site prefer-

ences, with Brolgas preferring more open nest sites than the Sarus (Archibald and Swengel 1987, A. Haffenden pers. comm.). The diet includes seeds, bulbs, and other plant materials as well as insects and small vertebrates. Within Australia, Sarus Cranes are partly migratory (Marchant and Higgins 1993). Some birds migrate on a regular annual basis between summer breeding grounds on western Cape York Peninsula and winter feeding grounds in the eastern part of the peninsula, a distance of about 400 km (A. Haffenden pers. comm.). As noted above, human land use impacts may be benefitting the Sarus Crane by expanding the extent of grasslands and disturbed areas at the expense of native forests and wetlands.

2.8.8 Principal Threats

Wetland loss and degradation are the most significant threats to the Sarus Crane throughout its range. These result mainly from agricultural expansion (especially for rice production), the adoption of highly intensive agricultural methods, and accelerated industrial development. These, in turn, reflect increasing human population pressures, especially in India, Pakistan, Nepal, Yunnan, the Philippines, and Vietnam (Gole 1991b, Suwal 1995).

In many parts of India and Nepal, large-scale agricultural development projects undertaken since the 1960s have resulted in extensive loss of wetlands used by the Sarus Crane. Many wetlands in these countries have also been drained in efforts to control mosquito populations. In Nepal, emigration from the mountains to the lowlands has played a key role in the Sarus Crane's extirpation from the eastern Tarai (R. Suwal pers. comm.). In Vietnam, Sarus Cranes disappeared when the Plain of Reeds in the Mekong delta was devastated by draining and burning during the Vietnam War. In addition, large birds of many species were (and in some areas of Cambodia still are) shot for food or target practice. Although cranes have returned to the Plain of Reeds, the high rate of human population growth in the area has led to rapid and extensive conversion of the wetlands to intensive rice production. At the regional scale, population growth and the restoration of peace in the region have increased pressures to pursue large development projects within the Mekong River system, with profound implications for the wetlands associated with the river (Lohmann 1990, Tran 1994).

Human population growth and intensified agricultural production also have indirect impacts on wetland habitat, including hydrological changes, high rates of sewage inflow, extensive agricultural runoff, and high levels of pesticide residues. These have significantly affected water and wetland quality in India, Nepal, Vietnam, Philippines, and other areas. In areas where the human population is particularly high, extreme levels of contact with people—in particular, disturbance of cranes on their nesting territories—may be contributing to low recruitment rates (Gole 1989b). All of these factors are of special concern in India, where the future of the Sarus Crane is closely tied to the quality of small wetlands that experience heavy human use (e.g., borders of canals and village ponds, shallow marshes, jheels). Cranes have also died due to pesticide poisoning in India (Muralidharan 1992).

Sarus Cranes have been hunted in portions of their historic and present range (mainly the Philippines, Yunnan, Vietnam, and some portions of India). Although hunting is no longer a critical threat in most countries, eggs and chicks are still stolen for food or for pets in Nepal, Cambodia, and possibly Laos (Tran 1994, Suwal 1995, J. Barzen pers. comm.). The impact of these activities is unknown, but it may be a critical factor affecting the Eastern Sarus Crane's recovery. Trade may also be a threat in some areas. Significant numbers of birds have reportedly been used for trade in India, and chicks have also been smuggled from Cambodia and Thailand (Mirande et al. in press a).

In contrast to the many threats to the species in India and Southeast Asia, the Australian subspecies faces few acute hazards. However, the species should not be considered secure in Australia. The population's actual size and distribution is insufficiently known. Few basic ecological studies have been undertaken, and none are now underway or proposed. Little research has been done to assess existing or potential threats to the population. At present, none of the subspecies' breeding grounds or winter feeding areas are protected, and important breeding and wintering areas are highly vulnerable to changes in the agricultural economy and in land management practices (A. Haffenden pers. comm.).

2.8.9 Current Conservation Measures

Legal and Cultural Protection

Sarus Cranes are fully protected by law in most of the countries where they are found (the exceptions are Cambodia, Laos, and Myanmar). However, the effectiveness of law enforcement varies widely. For example, although the Thai government has recently taken action to halt the Cambodia-Thailand trade in Sarus Crane chicks, trade continues.

Local traditions and religious beliefs have played a significant role in protecting the species (Gole 1989a, 1993a; Suwal 1995). Especially in northern India, the western Tarai in Nepal, and Vietnam, they are regarded as sacred birds. However, in some of these areas—especially where development and population pressures have recently stimulated emigration—these traditions of veneration have been eroding (R. Suwal pers. comm.). Gole (pers. comm.) notes that the lack of strong cultural protections in eastern and east-central India (i.e., Assam, eastern Uttar Pradesh, Bihar) has been a significant contributing factor in the disappearance of the species from these areas.

International Agreements and Cooperation

Of the ten countries where Sarus Cranes are known or suspected to occur, seven are signatories to the Ramsar Convention (the exceptions are Cambodia, Laos, and Myanmar).

Since the rediscovery of Eastern Sarus Cranes in the

Mekong River delta, several international initiatives have been undertaken to protect the population and its habitats (Harris 1987, Duc et al. 1989). In 1986, Vietnam and Cambodia began planning cooperative research on the status of the subspecies as a foundation for establishing new protected areas. To date, progress in this effort has been limited. Through a series of agreements with Vietnamese officials, ICF has assisted in research, education, and habitat management programs at the Tram Chim National Reserve. In 1990, an International Sarus Crane and Wetland Conservation Workshop in Vietnam brought together many of the crane and wetland conservationists who have worked with the Sarus Crane. In 1992, representatives from Cambodia, Thailand, and ICF prepared and signed a Memorandum of Agreement that outlined plans for Thai and Cambodian researchers to study the breeding grounds in Cambodia; for collaborative field studies in the Plain of Reeds; and for Cambodian crane biologists to receive training in Thailand and the United States (ICF 1992, Archibald 1992c). In 1994, a team of wetland managers from Vietnam visited natural floodplain wetlands in northern Australia to study and compare wetland management techniques (Beilfuss 1994). In 1995, representatives from Thailand, Cambodia, Laos, Vietnam, and ICF met in Bangkok to lay plans for a coordinated conservation program for the Eastern Sarus Crane.

Protected Areas

In general, little Sarus Crane habitat is protected within reserves. In India, most Sarus Cranes are found scattered throughout private and village lands, but they do occur in many protected areas, including Keoladeo and Madhav National Parks, the National Chambal Sanctuary, and the Karera Bustard Sanctuary. At the end of 1994, ICF signed an agreement with the Lumbini Development Trust in Nepal to lease 120 ha of land at Lumbini, the birthplace of the Buddha, to establish the Lumbini Crane Sanctuary and to protect the habitat of Nepal's remnant population of Sarus Cranes (Harris 1992b, R. Suwal pers. comm.).

The rediscovery, of the Eastern Sarus Cranes' dry season habitat in Vietnam's Tram Chim wetlands played a critical role in the designation of this area, first (in 1986) as a district-level reserve, and later (in 1994) as a national reserve. The conservation, management, and education programs at the Tram Chim Reserve continue to place heavy emphasis on the fate of the cranes. Plans to identify and protect 3-4 additional areas used by cranes during the dry season in the Plain of Reeds are progressing under the direction of the Institute of Forest Management and Planning in Vietnam's Ministry of Forestry (R. Beilfuss pers. comm.).

Australia's Sarus Cranes are found mainly outside of protected areas. They occur as breeding and wintering birds in Lakefield National Park, and have occasionally been reported at Kakadu National Park (A. Haffenden pers. comm.).

Habitat Protection and Management

Habitat management for the Sarus Crane reflects the diverse conditions in which the three subspecies are found. In India and Nepal, only limited habitat management has been undertaken, although the studies of Gole (1989, 1991a, 1991b) and Suwal (1995) provide the foundation for more concerted efforts in the future. Proposed designs for the Lumbini Crane Sanctuary include plans to create wetlands to support breeding cranes (J. Harris pers. comm.). The Eastern Sarus Crane has benefitted from intensive efforts to restore and manage the Tram Chim wetlands in Vietnam (Barzen 1991, Kiet 1993, Beilfuss and Barzen 1994). In addition, broader concerns over the habitat of the Eastern Sarus Crane have stimulated efforts to strengthen buffer zone management at Tram Chim, to develop a national wetland management plan for Cambodia, and to coordinate development and conservation plans at the watershed scale in the Mekong basin (J. Barzen and R. Beilfuss pers. comm.). In partnership with international conservation organizations, Vietnam and Laos have also begun to develop national wetland conservation plans (J. Barzen pers. comm.).

Surveys/Censuses/Monitoring

Sarus Crane populations have been most closely surveyed and monitored in India (Gole 1989b, 1991a, 1991b) and Nepal (Harris 1992b, Suwal 1995). Counts of the population at Keoladeo National Park have been carried out by K. Kumar since 1983 (D. Ferguson, pers. comm.). The Eastern Sarus Crane population has been counted at the Tram Chim National Reserve in Vietnam at least once each year since 1986. Comprehensive surveys of the flock on its breeding grounds have not been possible, but limited surveys have recently been conducted in Cambodia: at Tonle Sap and in the Plain of Reeds in 1992; in wetlands throughout the country in 1993; and in the northeast portion of the country in 1994 (Archibald 1992c, T. Mundkur pers. comm., Barzen 1994). The former range of the Sarus Crane in the Philippines was last surveyed for possible remnants of the population in the late 1970s and 1980s (Madsen 1981, Dickinson et al. 1991). No comprehensive survey of the Australian Sarus Crane has been undertaken. Marchant and Higgins (1993) summarize recent observations. Sarus Crane numbers have been monitored intermittently at Bromfield Swamp, a major winter night roost in the Atherton Tablelands, since 1989 (A. Haffenden pers. comm.)

Research

Little sustained research on the Sarus Crane was carried out until the 1980s. Desai (1980) reported on the biology of the Indian Sarus Crane, and Gole (1987) on studies of the subspecies at Keoladeo National Park in India. Gole's studies (1989, 1991a, 1991b) of the status and ecological requirements of the Sarus Crane in India are the most extensive yet undertaken on the species. Iqubal (1992) studied breeding behavior in the India population. In Nepal, a three-year-long Sarus Crane Survey Project (Suwal 1995) has provided detailed information on population size, home ranges, habitat use, and nest site selection in that country's Tarai region. The rediscovery of the Eastern Sarus Crane in Vietnam has stimulated studies of that population's status, ecology, habitat requirements, and management (Duc et al. 1989, Barzen 1991, Kiet 1993,

Beilfuss and Barzen 1994). The Eastern Saras Crane has also been the subject of population modeling efforts preliminary to the preparation of a complete PHVA (Tran 1994). Studies of the Sarus Crane in Australia have focused mainly on their habitat use and their relationship with the Brolga (Archibald 1981a, Archibald and Swengel 1987). The taxonomic relationship among the three subspecies is the subject of ongoing research by C. Krajewski of the University of Illinois at Carbondale (Krajewski 1989, Krajewski and Fetzner 1994, Krajewski and Archibald in prep.).

Non-governmental Organizations

Non-governmental organizations have played a key role in supporting Saras Crane conservation work. The India Crane Working Group and Bombay Natural History Society have collected information on the Saras Crane's status in India, and the Ecological Society (based in Pune, India) has provided a base for field research (Gole 1989b, 1991b). In Nepal, the King Mahendra Trust for Nature Conservation has supported the Sarus Crane Survey Project (Suwal 1995). Wetland restoration and education projects are being developed at Lumbini through the Lumbini Development Trust. Projects involving conservation of the Eastern Saras Crane have been coordinated and implemented with the assistance of (among others) the Asian Wetland Bureau, the Brehm Fund for Bird Conservation, the Christopher Reynolds Foundation, Earthwatch, ICF, the MacArthur Foundation, the Pew Charitable Trusts, and the National Wildlife Federation (Harris 1987, Barzen 1991).

Education and Training

Public education programs involving the Saras Crane have special opportunities to emphasize the uniqueness of the Sarus Crane as the world's tallest flying bird; the importance of wetland conservation and sustainable use of wetland resources (especially in areas where reintroduction is under discussion); and watershed-level approaches to river systems and the costs and benefits of development plans. Similarly, professional training programs are able to stress techniques in wetland management (especially the need to coordinate surveys, research, wetland restoration, water management, and watershed-level planning) and the relationship between sustainable land use practices and the quality of wetlands and crane habitat.

In several parts of the species range, these opportunities have already been incorporated within conservation education programs. In Nepal, Bird Conservation Nepal, the IUCN Environmental Camp for Conservation Education, and the Gaida Wildlife Camp at Royal Chitwan National Park have all focused on the Saras Crane in their programs (R. Suwal pers. comm.). At the Lumbini Crane Sanctuary, an environmental education center is being developed that will explore the connections between conservation and the teachings of the Buddha (Harris 1992b, Suwal 1995). Vietnam's Tram Chim National Reserve includes a public education center and serves as a focal point for local crane and conservation education projects (R. Beilfuss pers. comm.). An environmental education video that features the Eastern Saras Crane and wetland restoration work at Tram Chim has been produced in Vietnam. In Australia, several ecotourism operators have included Sarus Cranes within their tour itineraries. A viewing platform with interpretive materials has been constructed at one roost site. School groups also use this site for field trips (A. Haffenden pers. comm.).

Since the mid-1980s, biologists and wetland managers from Vietnam, Cambodia, Australia, and the United States have participated in several national and international-level training programs focusing on issues related to the species. These programs have taken place within the Eastern Sarus Crane's range in Vietnam and Cambodia, at sites with similar wetlands in Australia, and at ICF in the United States (Beilfuss 1994).

Captive Propagation and Reintroduction

The Saras Crane as a species is well represented in captivity. The GCAR for cranes identified a total of 403 Sarus Cranes in captivity as of 1993 (Mirande et al. in press a). Of these, an estimated 41-50 were identified as Eastern Saras Cranes, 28 as Australian Sarus Cranes, and the remainder as Indian Saras Cranes. A large but unknown number are also thought to be held in private collections (Mirande et al. in press a, M. Wellington pers. comm.).

Many of the captive Eastern Sarus Cranes are birds from northern Cambodia that were confiscated by the Thai government after being brought into captivity illegally by dealers. These birds are now being managed to support a possible reintroduction program. When the Eastern Saras Crane was believed extinct, more than 20 Australian Saras Cranes were brought into captivity as the first step in establishing a reintroduction program. After the native southeastern Asian population was rediscovered, the captive population of Australian Saras Cranes was maintained (it currently numbers 28) to support a planned reintroduction program. However, no Australian Sarus Cranes will themselves be released in southeast Asia.

Although Saras Cranes are not being released or introduced at present, such plans have been discussed and proposed for Thailand; Yunnan, China; Assam and the Punjab region of India; and the Sindh wetlands in Pakistan (Harris 1987, Yang and Han 1987, Gole 1991b). The program in Thailand has progressed the furthest. In 1984, the Thai Royal Forest Department established a Crane Propagation Center at the Bangphra Wildlife Research Center. Captive cranes are also maintained at the Phuhkieo Sanctuary, Khao Kheow Open Zoo, Nakorn Ratchasima Zoo, and Chiang Mai Zoo. In 1995, representatives from Thailand, Cambodia, Laos, Vietnam, and ICF met in Bangkok to discuss the coordination of captive management and reintroduction efforts (M. Wellington pers. comm.).

2.8.10 Priority Conservation Measures

The priority measures described below reflect the general status of the three subspecies. Although declining, the Indian

Sarus Crane is still found in much of its historic range, and opportunities exist to prevent further losses by maintaining traditional habitats and to promote the return of the species to areas from which it has been extirpated. The Eastern Sarus Crane has been decimated over much of its range and requires immediate efforts to gain information about its status, to protect and manage key remaining habitats, and to stimulate international conservation projects. The status of the Australian Sarus Crane is poorly understood, and the emphasis here is on actions to expand and strengthen the knowledge base for conservation.

Legal and Cultural Protection

1) Enact strong laws at the national level to protect Sarus Cranes (this pertains primarily to Laos, Myanmar, and Cambodia).

2) Strengthen enforcement of existing laws prohibiting the hunting of Sarus Cranes and protecting their wetland habitats (this pertains primarily to India, Pakistan, Nepal, Thailand, and China).

3) Enact trade restrictions and adopt penalties to discourage dealers who capture wild Eastern Sarus Cranes in Cambodia (this pertains primarily to Thailand and Cambodia).

4) Strengthen the legal foundation for protected areas used by Sarus Cranes by instituting bans on hunting and other disturbances, prohibiting further conversion of habitat, and carefully regulating human use of resources in the reserves.

International Agreements and Cooperation

1) Transfer the species from CITES Appendix II to Appendix I.

2) Continue international-level watershed planning for conservation and sustainable development in the Mekong River basin.

3) Support the signing and ratification of the Ramsar Convention in range countries where this has not yet occurred, and implementation of its provisions in signatory countries.

Protected Areas

1) Identify and secure protection for important Sarus Crane breeding areas in India, Cambodia, Myanmar, and Laos.

2) Identify and secure protection for Eastern Sarus Crane dry season habitats in Vietnam, Laos, Cambodia, and China. In Vietnam, a second reserve is needed to protect early dry season habitat.

3) Provide continued support for the Tram Chim National Reserve management plan. The plan outlines measures to improve water management by restoring the natural hydrological regime; to restore native flora and fauna; to integrate resource conservation and income-generating activities in buffer zone areas; to provide training opportunities for reserve personnel; to expand education programs to include local schools as well as national audiences; and to develop ecotourism opportunities.

4) Complete the planned Lumbini Crane Sanctuary in Nepal, including the creation of wetlands within the sanctuary as well as at satellite sites in the area.

Habitat Protection and Management

1) Support efforts to develop and implement national-level wetland conservation plans. This is important in all range countries, but especially in India, Nepal, Vietnam, Laos, and Cambodia.

2) Protect, maintain, and restore small wetlands in Nepal and India. Wetland conservation should be integrated into village-based farmer education and development programs and should aim to ensure the availability of water, maintain and enhance water quality, and protect breeding cranes from disturbance. As part of this effort, rehabilitation programs for injured Sarus Cranes should be established at the village level. Conservation of wetlands in the Brahmaputra Valley is especially important, since this region contains important habitat to which Sarus Cranes may return.

3) Define dry season habitat needs for Eastern Sarus Cranes outside of existing protected areas in the Plain of Reeds in Vietnam and Cambodia.

4) Conduct a thorough assessment of the status of Sarus Crane habitat in northeastern Australia.

Surveys/Censuses/Monitoring

1) Expand efforts to survey and monitor Eastern Sarus Cranes in Cambodia, especially at Tonle Sap and in northern Cambodia (during the breeding season); and in the Mekong River delta between Phnom Penh and the Vietnam border (during the dry season).

2) Conduct a comprehensive survey to determine the status of the Eastern Sarus Crane in eastern India, Myanmar, southern Laos, and the extreme southern and western portions of China's Yunnan Province. This information should be used to clarify whether one or two populations exist in southeast Asia.

3) Establish a program to monitor on an annual basis the Indian Sarus Crane population in India and Nepal, and to use this data to track long-term trends.

4) Initiate a program to survey on a regular basis the Sarus Crane population in Australia.

Research

Research priorities for the Indian Sarus Crane:

1) Continue studies of Sarus Crane habitat needs, threats, local and seasonal movements, and wetland ecology.

2) Study the impact on cranes and crane habitats of the increased use of machinery, fertilizers, and pesticides in agricultural production. Especially important are studies of the extent of pesticide use and its impact on cranes.

3) Support research on traditional practices of land and water management and alternative means of sustaining and improving agricultural production that protect wetlands and water quality.

Research priorities for the Eastern Sarus Crane:

1) Expand collaborative studies of the location, habitat needs, and behavior of breeding cranes in Cambodia and of the dry season flocks in the wetlands of the Vietnam/Cambodia border region.

2) Determine the distribution of Eastern Sarus Cranes in Myanmar and Laos to clarify whether the subspecies exists as one or two populations.

3) Expand hydrological studies of the wetlands associated with the Plain of Reeds.

4) Undertake banding studies of the Tram Chim flock to determine local and seasonal movements.

5) Confirm the extinction of the Sarus Crane in the Philippines and assess the potential for reintroduction of the species.

6) Conduct research to support education and possible reintroduction efforts in eastern India.

Research priorities for the Australian Saras Crane:

1) Determine with greater accuracy the size and distribution of the subspecies.

2) Initiate basic ecological studies of the subspecies.

3) Define critical habitat, especially optimal breeding habitat, for the subspecies.

4) Assess potential threats to the long-term viability of the population.

5) Conduct studies of the interspecific relationship between Brolgas and Sarus Cranes during the dry season to understand better potential changes in the distribution of the two species.

Population and Habitat Viability Assessment

1) Complete the PHVA that has been initiated for the Eastern Sarus Crane.

2) Prepare a PHVA for the Indian Sarus Crane.

Education and Training

1) Develop local school programs that focus on the biology of cranes, threats to cranes, minimizing of human impacts, and prevention of egg-stealing and chick-capturing. Such programs are needed in India, Nepal, and the countries of southeast Asia.

2) Complete the planned environmental education centers at Tram Chim National Reserve in Vietnam and the Lumbini Crane Sanctuary in Nepal.

3) Provide expanded training opportunities for wildlife conservation officials in Cambodia and Laos.

4) Support increased exchanges among officials, researchers, and reserve managers from all range countries.

5) Support farmer education and extension programs to improve farm practices and to provide information about sustainable agriculture practices and the importance of wetlands. Such programs are needed especially in India, Nepal, and the countries of southeast Asia.

Captive Propagation and Reintroduction

1) Implement the following recommendations outlined in the GCAR and CAMP for cranes (Mirande et al. in press a).
   - Manage the captive population of Indian Sarus Cranes at the Intensive-2 (C priority) level; clarify the International Species Information System (ISIS) data for the taxon; and manage a subset of the captive population with known genealogy.
   - Manage the captive population of Eastern Sarus Cranes at the Intensive-1 (A Priority) level. Focus on establishing strong pair bonds in appropriate breeding situations and ensuring that an adequate number of birds are breeding to support genetically viable populations in captivity and for release. Only Eastern Sarus Cranes should be used in any future reintroduction efforts in Southeast Asia. The captive propagation program should be coordinated with additional efforts to discourage and prevent the capturing of wild birds.
   - Manage the captive population of Australian Sarus

Cranes at the Intensive-2 (C Priority) level. A propagation program may be considered pending revised estimates of the size of the population in the wild. This subspecies may also be used in public education efforts and as incubators and surrogate parents for Eastern Sarus Crane eggs and chicks.

2) Evaluate reintroduction programs for the Eastern Sarus Crane as part of the PHVA workshop to be held in Thailand in 1996.

3) Develop a studbook summarizing the subspecies and reproductive status and history of Sarus Cranes in Thailand's captive breeding centers.

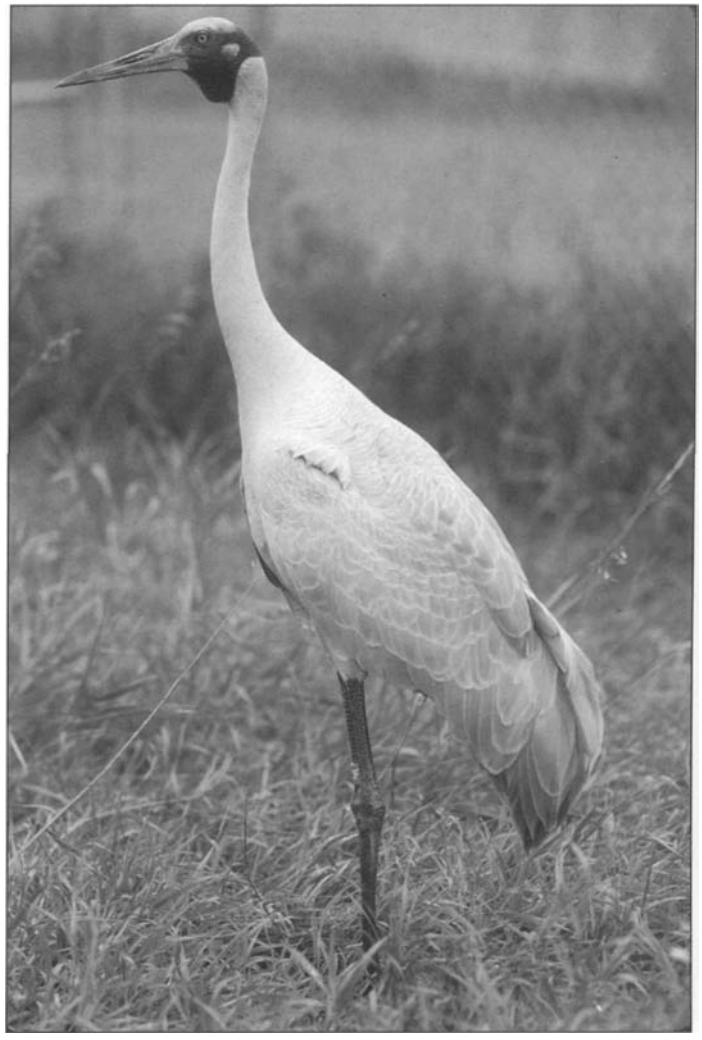
4) Assess the status of existing habitat and the potential for natural recolonization in portions of the historic range where the species is now rare or extinct (i.e., Pakistan, eastern India, Thailand, Cambodia, China, the Philippines).

2.9 BROLGA (*Grus rubicundus*)

2.9.1 Summary

The Brolga occurs throughout northern and eastern Australia and in limited areas of New Guinea. The Brolgas in northern and southern Australia can be regarded as discrete populations, but are no longer recognized as distinct subspecies. No systematic, range-wide surveys of the species have been undertaken, and so populations estimates and trends are poorly understood. The total population may range from 20,000-100,000 and is probably stable overall. The species still occupies much of its historic range. In recent decades, the Brolga has declined in southeastern Australia, while apparently expanding (due to increasing used of croplands) in the Northern Territory, the Kimberleys, and other portions of western Australia. Little is known about the status of or trends in the New Guinea populations. The species is classified as Lower Risk under the revised IUCN Red List criteria.

Brolgas are non-migratory, but do move in response to seasonal rains. Ecologically, they are perhaps the most opportunistic of the cranes, having evolved to cope with Australia's extreme climatic variations. Northern populations are concentrated during the dry season in coastal freshwater wetlands, where they subsist on the tubers of the bulkuru sedge (*Eleocharis dulcis*). In the wet season, they disperse to breeding territories in freshwater and brackish marshes, wet meadows, and other seasonal wetlands. Although the wet and dry seasons in southern Australia are less marked, southern Brolga populations also move between wet season breeding territories and traditional dry season flocking areas. They use a similarly wide range of available wetland types, but generally use salt marshes far less than the northern Brolgas.

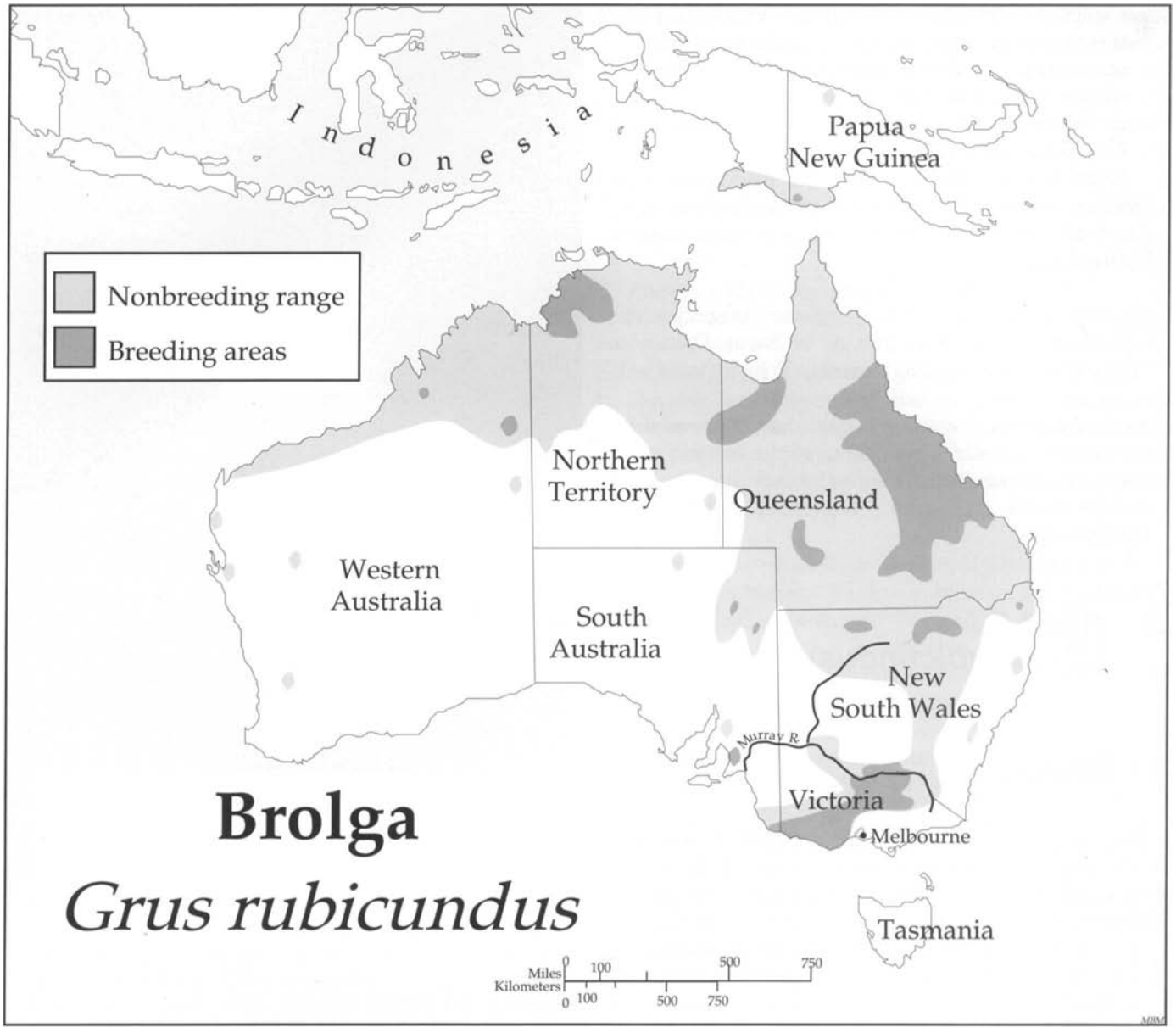


ICF

Brolga *(Grus rubicundus)*

The most significant threat to the Brolga across its range is the loss and degradation of wetland habitats. In northern Australia (especially along the eastern coast), wetlands used by Brolgas are extensively degraded as a result of heavy livestock grazing, disruption of hydrological processes, and changes in vegetation. In the south, loss of wetlands to drainage and reclamation for agriculture is probably the main factor behind the dramatic decline in the number of Brolgas occurring there. Other threats include the subdivision (and subsequent fencing) of large private landholdings, predation by the introduced red fox, incidental poisoning, and collisions with utility lines.

Most research and conservation activity involving the Brolga has taken place in the southeast, where the species is no longer as common as in the north. Conservation measures undertaken for the species include: legal protection throughout Australia; local surveys in South Australia, Victoria, and New



Brolga

Grus rubicundus

South Wales; preparation of an Action Statement for Brolgas under the Victorian Flora and Fauna Guarantee Act; programs to protect and restore privately owned wetlands in Victoria; and establishment of a private conservation organization, Friends of the Brolga. A captive propagation program was instituted in Victoria in 1964. Surplus birds from this program are to be released on a one-time-basis in 1995 and 1996.

Priority conservation needs include: adoption of stronger watershed-level approaches to wetland protection and restoration; assessment of the status and conservation needs of the species in New Guinea; enactment of stronger national wetland protection laws and policies; development of incentive and extension programs to encourage and reward private landowners who conserve Brolga habitat; development of a systematic censusing and monitoring program for the species, and inclusion of the species in routine aerial waterfowl counts; expanded research on flocking sites, breeding biology, size and trends in the total population, and the occurrence of isolated populations; and expanded education and extension programs.

2.9.2 Subspecies/populations

There are no subspecies. The species was formerly divided into two subspecies: the Northern Australian Crane (G. *r. argentea*) and the Southern Australian Crane (G. *r. rubicundus*). This division is no longer accepted by most crane biologists. However, several factors do justify regarding the northern and southern Brolgas as separate populations. They are adapted to different breeding (wet) seasons. They are separated by an extensive area of unsuitable habitat, and because seasonal movements are limited, the northern and southern birds interact minimally. There may be some morphological differences between the birds of the north and the south. These factors may be significant, and should be taken into account in planning conservation measures (A. Haffenden pers. comm.). DNA analysis may confirm these distinctions between northern and southern birds.

ICF

Brolga pair with chick, Queensland, Australia

2.9.3 Population Numbers and Trends

Population	Number	Trend	Source
Northern Australia	20,000-100,000	Generally stable	P. DuGuesclin pers. comm., R. Jaensch pers comm., A. Haffenden, pers. comm.
Southern Australia	~1000	Stable to declining	White 1987, 1992
New Guinea	Unknown	Unknown	
Total	20-100,000	Generally stable possibly declining in SE Australia	

A lack of systematic surveys, especially in northern Australia, makes population estimates for the Brolga highly uncertain. Several northern sites are known to hold seasonal concentrations of thousands of Brolgas, and 20,000 is presumed to be the minimum for the species. The total is likely to be much higher, although even reasonable estimates should be regarded essentially as guesswork at this point (R. Jaensch pers. comm., A. Haffenden pers. comm.).

The population in southern Australia has not been surveyed. White (1987) provided a "conservative estimate" of 600-650 Brolgas in Victoria. A total of 635 birds were recorded during a 1992 census of Victoria (White 1992). The present estimate assumes additional birds in the region, but should be regarded as a general figure.

2.9.4 Conservation Status

Species	
IUCN category	Lower Risk (least concern)
CITES	Appendix II

Population	IUCN Category
Northern Australia	Lower Risk (least concern)
Southern Australia	Vulnerable, under criteria Clb,c D
New Guinea	Data Deficient

2.9.5 Historic and Present Distribution

The Brolga occurs only in Australia (not including Tasmania) and limited areas of New Guinea (Lavery and Blackman 1969, Blakers et al. 1984, Coates 1985, Marchant and Higgins 1993). It has been reported as an occasional or accidental visitor in New Zealand (Walkinshaw 1973). They are non-migratory, but do move in response to seasonal rains.

The species continues to occupy most of its historic range. Since the 1800s, however, the population has retracted from former strongholds in southeast Australia, while apparently expanding into cultivated areas in the Northern Territory, the Kimberleys, and other areas of western Australia (Pizzey 1980, Johnsgard 1983, Blakers et al. 1984). The range of the Brolga overlaps that of the Sarus Crane in northern Queensland and in the extreme northern portions of the Northern Territory and Western Australia (Blakers et al. 1984, Archibald and Swengel 1985, R. Jaensch pers. comm.).

Within Australia, Brolgas are found in both the wet-dry tropics of the north (Western Australia, Northern Territory, and Queensland) and the southern temperate regions (eastern South Australia, Victoria, and portions of New South Wales) (Marchant and Higgins 1993). Through most of this range, Brolgas are relatively uncommon and widely dispersed. They are most abundant in northeastern Australia, where they are relatively free of competition from magpie geese *(Anseranas semipalmata*) for their preferred food, the tubers of bulkuru sedge *(Eleocharis dulcis)* (Lavery and Blackman 1969, Blakers et al. 1984, H. Lavery pers. comm.). During the dry season and droughts, northern Brolgas gather into flocks at freshwater coastal and inland marshes. Concentrations of several hundred birds can occur at the most favorable sites (Storr 1977, 1980). When rains return in the north (November-April), the Brolgas disperse widely to breeding territories (Pizzey 1980). The northern populations of the Brolga apparently began to expand into Western Australia in the 1920s, and have continued to increase there, especially since the early 1950s (Serventy and Whittell 1967).

The Southern population of the Brolga has declined significantly since European settlement. In Victoria, at the southernmost extent of its range, the greatest range reductions occurred from the 1890s to the late 1940s (White 1987). Brolgas were found in the plains and wetlands around Melbourne until the early 1900s; on French Island in Western Port Bay until 1919; on the coastal plains of east Gippsland until the 1920s; in the Rutherglen district of northeast Victoria until the early 1960s; and in the Corryong District of northeast Victoria until the mid-1970s (White 1987, Hill 1992, P. Du Guesclin pers. comm.).

As a result of these range reductions, the Southern population of the Brolga is now small and fragmented, and relies on smaller (often protected) wetlands. These losses were significant in that they separated, and perhaps isolated, the southern flocks from the large flocks of northern Australia (White 1987). In Victoria, the Brolga has been listed as rare by Ahern (1982) and Baker-Gabb (1991), and in 1991 was classified as threatened under the state's Flora and Fauna Guarantee Act. Brolgas continue to breed in southwestern Victoria, southeastern South Australia, and to a lesser extent in west Wimmera in central and northeast Victoria. Breeding also occurs in isolated and restricted areas with suitable habitat in New South Wales (e.g., Macquarie Marshes and the Denilquin area) (P. Du Guesclin pers. comm., D. White pers. comm.).

In New Guinea, the Brolga occurs in the southern lowlands, with a smaller population possibly resident along the north-central coast in the Sepik River Basin (Mayr 1941, Coates 1985). The extensive wetlands in the south have apparently supported healthy crane populations in the past, but little is known about the historical trends or current size and distribution of this population (Johnsgard 1983, Coates 1985). The population probably occurs mainly in the coastal floodplains (e.g., of the Bensbach River area), although recent observations have been purely anecdotal (R. Jaensch pers. comm.). It is possible that Brolgas from northeastern Australia retreat to New Guinea for refuge during periods of extended drought. Such movements have been noted among several other species of Australian waterbirds (H. Lavery pers. comm.).

ICF

Tubers of the bulkuru sedge (*Eleocharis dulcis*), the principal dry season food item of Brolgas in northern Australia, and Brolga droppings

2.9.6 Distribution by Country

Australia	R
Indonesia (New Guinea)	R
New Zealand	V
Papua New Guinea	R

R = Permanent resident
V = Vagrant

2.9.7 Habitat and Ecology

Marchant and Higgins (1993) provide a comprehensive review of information on the habitat, ecology, diet, movement,

and behavior of the Brolga. Of the fifteen species of cranes, the Brolga is perhaps the most opportunistic and variable in terms of habitat selection. Brolgas have developed physiological and behavioral adaptations to Australia's diverse climatic conditions, especially its rainfall patterns. Because the northern and southern birds respond to different environmental conditions, they are discussed here separately.

Northern Australia/New Guinea

During the northern dry season (usually June to November), Brolgas are concentrated in coastal freshwater marshes dominated by the bulkuru sedge. These marshes are situated in a narrow zone between the coastal hills and the salt-pans and mangrove forests of the coast edge. The Brolgas gather in large flocks and dig holes in the drying mud to extract bulkuru tubers, the main item in their dry season diet. Other wetland types (freshwater lagoons, tidal and riparian pools, inland marshes, lake edges, irrigated pastures and fields) as well as grasslands and croplands are also used (Lavery and Blackman 1969; Walkinshaw 1973; Storr 1977, 1980). In addition to tubers, the Brolga diet includes other wetland plants, upland plants (including cereal grains), insects, freshwater and saltwater mollusks, crustaceans, and frogs (Lavery and Blackman 1969, Marchant and Higgins 1993).

Breeding season in northern Australia begins in November or December during the "pre-wet." At this time the Brolgas disperse to breeding areas and select nest sites. Brolgas may nest wherever suitable wetlands exist. Some remain in the large coastal wetlands; a substantial portion of the population in Queensland nests in coastal wetlands around the Gulf of Carpentaria (which extend as far as 50 km inland). Others disperse to inland nesting sites, including both upstream sections of coastal floodplains and wetlands up to several hundred kilometers inland. As the rainy season advances, many small, isolated, ephemeral wetlands become available to them (Blackman 1978). They may also nest at small artificial livestock watering ponds (Lavery and Blackman 1969).

Brolgas begin to nest as water levels rise with the arrival of the "wet" in January. Heavy rains are frequent during this period, and can result in the drowning of the nests of early nesting pairs (Blackman 1978, A. Haffenden pers. comm.). Nests are large (up to 1.5 m in diameter) mounds of grass and sedge stems, built in densely vegetated wetlands. Egg-laying peaks in February-March. Usually two eggs are laid. Among both northern and southern birds, incubation takes 28-31 days and chicks fledge at about 100 days. By June or July the breeding wetlands are drying, and families begin to move back toward coastal areas to re-form flocks. Timing and distance of these movements can vary, depending on annual rainfall amounts. Loss of habitat has also had an impact on movement patterns, especially along Australia's east coast, where wetlands have been widely converted to agricultural production (mainly for corn, rice, sorghum, and pasture grasses).

In Queensland, the ranges of the Brolgas and Sarus Crane overlap (Archibald and Swengel 1987). However, competition between the two species appears to be insignificant at both breeding sites and dry season feeding areas. In the breeding season, Sarus Cranes tend to prefer smaller wetlands in more forested settings, while Brolgas prefer larger, more open wetlands (A. Haffenden pers. comm.). Tubers comprise the main part of the Brolga's dry season diet, while Sarus Cranes feed primarily on seeds and other surface foods. Sarus Cranes thus tend to avoid the Brolga's primary habitat, utilizing croplands and other disturbed habitats that Brolgas only use when their preferred habitats are unavailable. It is probable that the two species have always used these habitats in this way, but the phenomenon may now be more obvious due to the spread of cereal crop agriculture in northern Australia (A. Haffenden pers. comm., H. Lavery pers. comm.).

Although information on the habitat and ecological circumstances of the Brolgas in New Guinea is scarce, the habitat characteristics are likely similar to those of the Australian birds (R. Jaensch pers. comm.).

Southern Australia

The Brolga's habitat in southern Australia is characterized by less extreme patterns of rainfall than in the monsoon-dominated habitats of the north. Wet winters alternate with drier summers, although rain can and does occur at anytime during the summer. The normal breeding season extends from July to December. During this period, Brolgas nest and forage in shallow (<50 cm) freshwater marshes and wet meadows, preferring the former. They also use deeper marshes, shallow lakes, flooded grasslands, brackish wetlands, and other wetland types, but generally use salt marshes far less than the northern Brolgas (Blakers et al. 1984, Arnol et al. 1984).

From December to May, as the dry season advances and wetlands dry out, parents and chicks gather at traditional flocking areas, which include permanent freshwater wetlands and upland foraging areas. During the dry season, Brolgas also use the edges of small reservoirs and lakes, and disperse into a wide range of other habitat types, including not only wetlands but upland pastures, croplands, and other drier habitats (White 1987). They remain in these areas until the rains return again. In May and June, the flocks disperse again to return to their breeding areas.

Bulkuru sedge is not available to the Brolgas south of Brisbane. The diet of the birds in the south is thus more varied, consisting of a wide range of plant, invertebrate, and small vertebrate food items (see Marchant and Higgins 1993).

2.9.8 Principal Threats

In both north and southern Australia, the most significant threat to the Brolga is loss and degradation of wetland habitats. The hydrological processes of many wetlands within the Brolga's range have been disrupted by intensive livestock grazing and other factors, with both direct and indirect effects on Brolga habitat. Sedimentation due to accelerated soil erosion in upper watersheds affects many wetlands (especially

large coastal wetlands in Queensland and other areas of northeastern Australia). At the same time, upstream dams, drainage projects, and water diversions have reduced stream inflow in many wetland systems. These changes have allowed non-wetland grasses and shrubs to invade wetlands, reducing the supply of sedge tubers available to Brolgas. Changes in vegetation may also allow increased predation by providing cover for goannas, foxes, and other predators close to crane nests and chicks (A. Haffenden pers. comm.). The coastal wetlands of northern Australia are also subject to increased saltwater intrusion and invasion by *Mimosa pigra*, rendering them unsuitable for cranes (R. Jaensch pers. comm).

More directly, many wetlands have been actively drained and managed to expand the area available for grazing and to make these areas more accessible during the wet season. The physical impact of heavy grazing results in earlier and harder drying of wetlands, preventing the cranes from reaching the subsurface tubers. Grazing also promotes invasion of wetlands by non-wetland plants. In many areas (especially northern Australia), feral pigs not only contribute to these changes in habitat, but also seek out the sedge tubers themselves for food. Although the extent of these alterations is not known, it is likely that many smaller wetlands have been severely affected by them (A. Haffenden pers. comm.).

In general, the Northern population has in the past been relatively secure due to the remoteness of the breeding habitat, and the unsuitability of these lands for disruptive farming practices. Moreover, protected areas have included relatively extensive areas of breeding and foraging habitat. Although protected areas continue to be important for the species (especially in the Northern Territory), higher agricultural demand and changing husbandry techniques have led to an increase in disturbance and alteration of prime breeding habitat in Queensland, and a reduction in suitable foraging habitat. This trend is continuing. Although little quantitative work has been undertaken, observational and anecdotal information indicates that fewer Brolgas are being seen in traditional dry season areas on the eastern coast. In some areas, these reductions exceed 50% (A. Haffenden pers. comm.).

In southeastern Australia, reclamation of wetlands for agriculture (along with poisoning, hunting, and egg collecting) are believed to have been the main historical factors contributing to the dramatic decline in Brolga numbers (D. White pers. comm.). In southern Australia, continued loss or modification of freshwater wetlands threatens traditional crane breeding and flocking areas (Arnol et al. 1984). In the 1980s, a 500 kv utility line was built directly through the highest quality breeding habitat remaining in Victoria, resulting not only in direct loss of habitat, but increased risk of collision (White 1987, Goldstraw and Du Guesclin 1991).

In some breeding areas (mainly in southern Australia), the subdivision of large private landholdings with wire fencing has also been a detrimental factor. Cranes can become tangled in fences. In addition, as the size of paddocks has decreased, the effective foraging range of Brolgas with dependent flightless young has been reduced. Chicks in these "enclosed" areas are more vulnerable to predation, starvation, and dehydration. When the nesting areas dry out, unfledged chicks may be unable to follow their parents to nearby wetlands (Arnol et al. 1984). The increasing density of human settlements has also disrupted foraging behavior and seasonal movements of Brolgas throughout coastal Australia (H. Lavery pers. comm.).

S. TRANEVING

Dancing Brolgas near Townsville, Australia

Other threats to the Brolga include: disturbance and fragmentation of flocks during the waterfowl hunting season; hunting and poisoning of cranes in response to crop depredation (this was more common in the past than at present); incidental poisoning as a result of pest control campaigns; predation by the introduced red fox (*Vulpes vulpes*); and collisions with utility lines (Arnol et al. 1984).

There is no information available on existing or potential threats to the Brolga in New Guinea.

2.9.9 Current Conservation Measures

International Agreements and Cooperation

Australia and Papua New Guinea are signatories to the Ramsar Convention. Recently, Australian crane and wetland biologists have worked jointly with counterparts from Vietnam to understand the ecological similarities and differences underlying wetland conservation efforts in their respective countries (Beilfuss 1994). This training effort was carried out with the support of the Asian Wetland Bureau, ICF, and the MacArthur Foundation.

Legal and Cultural Protection

The species is protected throughout Australia, although the degree of protection varies from state to state. Cranes cannot be hunted in Queensland, Western Australia, or the Northern Territory. In Queensland and the Northern Territory, a Permit to Take can be issued to farmers if they can demonstrate that Brolgas are causing crop damage. In practice, permits are very rarely (if ever) issued (A. Haffenden pers. comm.). In Victoria, the species is fully protected under the state's 1975 Wildlife Act. The 1988 Flora and Fauna Guarantee Act requires that a statement of actions for managing the species and its habitat be prepared (this statement has not yet been issued). Brolgas are fully protected in all National Parks where they occur. Aboriginal hunting is allowed in some park lands, as well as on aboriginal lands. Export and translocation of captive Brolgas is strictly regulated by the Australian government.

Protected Areas

Most of the highly significant Brolga habitat (e.g., important breeding areas of the western Cape York Peninsula) occurs on private lands. No protected areas have been dedicated to, or established specifically to protect, Brolgas. However, the species does use many protected areas throughout its range. The Staaten River, Mitchell & Alice Rivers, and Lakefield National Parks (all in Queensland) protect both wet and dry season habitat and have resident breeding populations. Several national parks near Townsville protect important wetland areas, although much of the significant Brolga habitat in the area is held by private landowners. Brolgas occur (although in smaller numbers than in the past) at the Town Common Environmental Park, administered by the Queensland Department of Environment and Heritage. Other protected areas used by Brolgas include: Kakadu National Park (Northern Territory); Parry Lagoons Nature Reserve (Western Australia); Bool Lagoon Conservation Park (South Australia); Lake Ayrey and Lake Cuerang Wildlife Reserves (Victoria); and Tonda Wildlife Management Area (Papua New Guinea) (P. DuGuesclin pers. comm, A. Haffenden pers. comm., R. Jaensch pers. comm.).

Habitat Protection and Management

In general, little habitat protection or management has been undertaken specifically to benefit the Brolga. Some habitat alterations have had incidental positive impacts. For example, the construction of water impoundments has in some cases increased the availability of breeding habitat in the drier portions of the species' range (e.g., at Lake Argyle in the Kimberley Division of Western Australia).

In southeast Australia, where a significant percentage of wetland breeding habitat has been lost to development, interest in habitat management and restoration is growing. Recent research on nesting habitat requirements provides a basis on which to build management programs, especially programs that involve private landowners (Hill 1992). In the early 1990s, the Victoria Department of Conservation and Environment provided support for conservation projects on private wetlands (e.g., fencing, tree and shrub planting, water level restoration) through a program of Wetland Improvement Grants. Since 1987, the Victorian Conservation Trust (an independent body established by Act of Parliament) has worked with landowners to develop "conservation covenants" that provide long-term protection for conservation values on private land (Forge 1990). Also in Victoria, the Department of Conservation and Environment and Bird Observers Club of Australia have jointly organized a "Land for Wildlife" program. The program encourages the voluntary conservation of wetlands and other wildlife habitats on private lands.

Surveys/Censuses/Monitoring

There are at present no programs to survey or monitor the Brolga population across its entire range. Few surveys have been undertaken in the past, in part because of the presumption that the population is healthy. H. Lavery (pers. comm.) notes that undertaking an accurate census would be "a monumental and impracticable task," and that the difficulties of such an effort are compounded by crane movements in response to drought and other factors. In the north, there are no regular counts, but some local surveys have been conducted (e.g., Lavery and Blackman 1969, Archibald and Swengel 1987). In Victoria and New South Wales, the nesting areas and numbers of Brolgas have been documented since 1991 by the Friends of the Brolga (see below). The population in New Guinea has never been surveyed.

Research

Recent research on Brolgas has been conducted primarily in South Australia, Victoria, New South Wales, and Queensland. These studies have examined the status and distribution of the

Brolga (White 1987); ecology and habitat management requirements (Arnol et al. 1984, Haffenden in prep.); aerial survey methods and population estimates (Blackman 1977); and the breeding population in southeastern South Australia (Bransbury 1991). Banding studies have been carried out on a limited basis in Victoria (Anon. 1992). Hill (1992) collected and analyzed information on Brolga nesting and breeding sites in Victoria, and offered recommendations on how to use this information to establish a database, model breeding habitat, enhance habitat management, and improve census procedures. Archibald and Swengel (1987) studied the interactions and comparative ecology of Brolgas and Sarus Cranes in the shared portions of their ranges. Virtually no field research has been undertaken in the New Guinea portion of the Brolga's range.

Management and Recovery Plans

In Victoria, where the Brolga has experienced significant declines, the Department of Conservation, Forests, and Lands prepared in 1984 a comprehensive plan, "Management of the Brolga (*Grus rubicundus*) in Victoria" (Arnol et al. 1984). This document recommended conservation actions in five areas: policy development, extension and advisory services, research, captive propagation, and protection of breeding sites. This management plan has been implemented only partially, and many of the recommendations remain relevant and applicable not only in Victoria, but throughout the species' range (P. Du Guesclin pers. comm., D. White pers. comm.). An Action Statement for the species is currently being prepared under Victoria's Flora and Fauna Guarantee Act (P. Du Guesclin pers. comm.).

Non-governmental Organizations

A citizens' organization, Friends of the Brolga, was established in 1991. At present it has more than 500 members, mainly landowners in Western Victoria. The group's efforts have resulted in relocation of utility lines, protection of breeding areas, and the involvement of volunteers in Brolga counts, field days, and education and extension programs (D. White pers. comm.). Since 1991, the group has published a newsletter, *Brolga News.* The Australian Bird Environment Fund, established by the Bird Observers Club of Australia, may provide support for information-gathering activities carried out by the Friends of the Brolga. In addition, the Victorian Wetland Trust has brought together farmers, wildlife biologists, botanists, planners, and others interested in the conservation of wetlands.

Education and Training

Few education programs have focused specifically on the Brolga. Special educational programs have been developed at the Serendip Wildlife Center. At Kakadu National Park, a "Window on the Wetland" visitor center (designed to symbolize a dancing Brolga) opened in 1994. The center provides visitors with opportunities to learn about the natural history of Kakadu, wildlife ecology, and aboriginal traditions and culture (Beilfuss 1994). A permanent crane and wetland interpretive center is being considered as part of a private/public conservation effort at Cromarty (H. Lavery pers. comm.). The "Land for Wildlife" project, noted above, provides landowners with information on wildlife, including Brolgas, in Victoria and Southern Australia.

Captive Propagation and Reintroduction

As of 1993, an estimated 34 Brolgas were maintained in captivity—19 in Australia and 14 in facilities in other countries (Mirande et al. in press a). This estimate did not include birds at the Serendip Wildlife Center. The captive flock at Serendip was initiated in 1964 using eggs collected from the nests of wild birds as well as two adults brought in from the wild (White 1987). All the birds in the captive flock are derived from the wild population of Brolgas in western Victoria. From 1978-80, eggs were once again collected to supplement the captive population. Artificial insemination was successfully used at Serendip for the first time in 1986. As of 1994, a total of 53 birds were maintained at Serendip: 14 pairs and 25 young (<4 years) birds (P. Du Guesclin pers. comm.).

The Australian Species Management Program has established a target of 55 Brolgas for management, while the GCAR sets a global target of 75 birds (Mirande et al. in press a). In the GCAR, the Brolga was identified as one of the few crane taxa whose captive population may require an influx of wild birds or eggs in order to maintain desirable levels of genetic diversity (C. Mirande pers. comm.). At present, no studbook for the captive population has been developed.

In recent years, the release of captive-bred Brolgas from the Serendip facility has been intermittently recommended and discussed (e.g., Arnol et al. 1984, White 1987, Bransbury 1991). These proposals have dealt exclusively with the potential for release and/or reintroduction of Brolgas in southern Australia. In December 1994, approval was given for a one-time-only release (to take place in 1995 and 1996) of birds currently at Serendip; thereafter, no further breeding of Brolgas for release to the wild is to take place (D. White pers. comm.). Future captive propagation at Serendip will be undertaken only to support maintenance of the captive population and education programs (P. Du Guesclin pers. comm.).

2.9.10 Priority Conservation Measures

International Agreements and Cooperation

1) Support international exchanges of conservation biologists, ornithologists, and officials from New Guinea, Australia, and Southeast Asia.

Legal and Cultural Protection

1) Enact stronger wetland conservation policies and legislation at all levels of government in Australia. In particular, measures to encourage the protection and restoration of prime breeding habitat on private lands in Southern Australia and Victoria are needed.

Initiating a Brolga Conservation Program in New Guinea

In order to gain information and plan effectively for the conservation of the Brolga in New Guinea, the following initial actions should be undertaken:

1) Conduct surveys to assess the past and present status of the Brolga populations and their habitats, and the degree to which Brolgas may retreat from Australia to New Guinea during periods of drought.

2) Define the conservation needs of the Brolga populations and their habitats.

3) Assess the need for stronger legal protection for wetlands in New Guinea.

Protected Areas

1) Review the extent to which Brolgas use existing protected areas, and the adequacy of current areas in protecting key dry season and breeding habitats.

Habitat Protection and Management

1) Strengthen watershed-level approaches to wetland conservation and management, especially in the coastal wetlands of northeastern Australia, the Burdekin River basin, and the Murray-Darling river system.

2) Define critical habitat for Brolgas, both breeding and non-breeding dry season habitat.

3) Identify critical dry season Brolga congregation areas and provide protection for them and the associated watersheds.

4) Develop programs (or expand existing programs) to encourage the maintenance, protection, and restoration of Brolga habitat on private lands. These programs may involve a combination of tax benefits, other financial incentives, voluntary management agreements, extension programs, and supporting legislation.

Surveys/Censuses/Monitoring

1) Establish a systematic, coordinated program to survey and monitor the population in Australia.

2) Apply habitat predictor models (in conjunction with climate records) to calculate past and present suitable habitat, and use this information to assess trends in the population. (Such techniques are important given the degree of fluctuation in available habitat and Brolga populations in response to Australia's variable climate patterns)

3) Establish a program to monitor important nesting areas.

4) Monitor movements of populations in Australia through an expanded color banding and radio-tracking program.

Research

Research on the Brolga should focus on:

1) Studies to determine the size and trends in the total population. Various studies (local censuses, breeding success, survival and recruitment rates, flocking behavior, etc.) should be conducted throughout the species range, and this information used to better assess the species' status.

2) Studies of breeding habitat and biology throughout the species' range. In the south, priority should be given to identification of key nesting areas and factors affecting breeding success at different sites to define critical factors and suggest strategies for habitat management restoration. (See Hill (1992) for specific recommendations regarding monitoring of breeding habitat). In the north, priority should be placed on determining the trends in the Brolga populations and their habitats.

3) Studies of traditional and potential flocking sites used in the course of seasonal movements. These studies are needed to provide a foundation for improved protection and management of these areas. They can be coordinated with broader efforts to understand seasonal movements through expanded banding and radio-tracking studies.

4) Identification and analysis of isolated and potentially threatened populations (this pertains primarily to southern Australia).

5) Studies to promote the restoration of degraded wetlands and other habitats used by Brolgas.

6) Further studies of the interaction and comparative ecology of Brolgas and Australian Sarus Cranes.

Education

1) Develop public education programs throughout the species' range, stressing the importance of wetlands for cranes and other waterbirds.

2) Expand extension and advisory services to encourage the involvement of farmers and other private landowners in crane conservation activities.

3) Support development of the permanent wetland/Brolga interpretive center at Cromarty.

Captive Propagation and Reintroduction

1) Implement the recommendations outlined in the Crane

GCAR and CAMP (Mirande et al. in press a). These are to:

- Manage the captive population of Brolgas to maintain a nucleus of approximately 75 well managed birds (C priority).
- Develop a regional management plan Tor the species.
- Determine the need to develop a studbook and/or to review and update International Species Information System (ISIS) data on the species.

2.10 WHITE-NAPED CRANE (*Grus vipio*)

2.10.1 Summary

The total population of White-naped Cranes is estimated at 4,900-5,300. The species breeds in northeastern Mongolia, northeastern China, and adjacent areas of southeastern Russia. Birds in the western portion of the breeding range (about 3,000 individuals) migrate south through China, resting at areas on the Yellow River delta, and wintering at wetlands in the middle Yangtze River valley. Approximately 2,000 birds in the eastern portion of the breeding range migrate south through the Korean peninsula. Several hundred remain on wintering grounds in the Demilitarized Zone between North and South Korea; the remainder continue on to the Japanese island of Kyushu. In the past, the White-naped Crane was more numerous and more extensively distributed than at present. The population reached its historic low in the years following World War II and the Korean War. Since then, it has increased in many portions of its range, although it may again be declining in portions of Russia and China. The species is classified as Vulnerable under the revised IUCN Red List Categories.

The species' typical breeding habitat includes shallow wetlands and wet meadows in broad river valleys, along lake edges, and in lowland steppes or mixed forest-steppe areas. White-naped Cranes nest and feed in shallow wetlands and along wetland edges, foraging in adjacent grasslands or farmlands. During migration and on their wintering grounds, they use rice paddies, mudflats, other wetlands, and agricultural fields, where they feed on waste grains, seeds, and tubers.

The loss of wetlands to agricultural expansion, especially in the breeding grounds of the Amur River basin and other parts of northern China, is the most significant threat to the species. Its preferred habitats—wetland edges and adjacent grasslands—are especially prone to drainage and conversion. The Korean Demilitarized Zone, which has served as a critical refuge for White-naped and Red-crowned Cranes, is highly vulnerable to armed conflict or to development should political tensions between the North and South be resolved. Other threats include overexploitation of wetland resources, ineffective management of key protected areas, indiscriminate pesticide use, and the proposed dams on the Amur River and on the Yangtze River at Three Gorges. The dense concentrations of wintering Hooded and White-naped Cranes at Izumi in Japan are highly susceptible to disease outbreaks.

Conservation measures to protect the White-naped Crane and its habitats have included: legal protection in all range countries; international cooperation to protect the species and to manage key protected areas in the China-Russia-Mongolia border region; establishment of protected areas in important breeding and wintering habitats; regular surveys of the population at migration stopover points and on the main wintering grounds; expanded research on the species throughout its range; and the involvement of non-governmental organizations in research, habitat protection, and captive propagation programs. Limited releases of captive-reared birds have been carried out at the Zhalong Nature Reserve in China and the Khinganski Nature Reserve in Russia.

Priority conservation measures include: expanded international cooperation in managing protected areas and in research on migration patterns and timing; expansion of existing reserves and establishment of new protected areas (especially in Mongolia, northeastern China, and the Korean Peninsula);

N. YUSHIO

Bugling White-naped Cranes (*Grus vipio*), Izumi, Kyushu Island, Japan


White-naped Crane
Grus vipio
Russia
Lake Baikal
Daurski NR
Uldz R.
Khinganski NR
Amur R.
Zhalong NR
Sanjiang Plain
Ussuri R.
Mongolia
Xianghai NR
Dalinor NR
L. Khanka
Yellow R.
Shuangtaizi NR
N. Korea
Demilitarized Zone
S. Korea
Japan
China
Izumi
Yangtze R.
Dongting Lake
Poyang Lake
Shengjin Lake
Taiwan
Breeding range
Migration stopovers
Wintering areas
Migration route
MRM

ICF

White-naped (front) and Red-crowned (rear) Cranes in Korean Demilitarized Zone

dispersion of the wintering crane populations at Izumi; development of integrated land use and conservation programs in key watersheds; assessment of the environmental impacts of large-scale dam and development projects; continuing surveys of the population; more complete identification of the species' breeding grounds, especially in northeastern China; professional training opportunities for reserve managers and conservation officials; improved agricultural information services for farmers; and community-based conservation education programs involving cranes and wetlands.

2.10.2 Subspecies/Populations

There are no subspecies. There are two main wintering populations, in China and Japan, and a smaller wintering population in South Korea.

2.10.3 Population Numbers and Trends

Wintering Subpopulation	Number	Trend	Source
Japan (Izumi)	1800-2100	Increasing	Ohsako 1994
Korean Peninsula	100-200	Unknown	F. Kaliher pers. comm.
China (Poyang Lake)	~3,000	Unknown	Song et al. 1995
Total	4900-5300	Stable to declining (based on loss of breeding area wetlands)	

2.10.4 Conservation Status

IUCN category	Vulnerable, under criteria A1c,d A2c C1
CITES	Appendix I

2.10.5 Historic and Present Distribution

Information on historical changes in the range of the White-naped Crane is limited. According to Flint (1978), the breeding range was apparently more extensive in the past. Wintering areas were probably widespread across the Korean peninsula (Won 1981). Austin (1948) reported that the White-naped Crane, "in common with the other species [of cranes in Korea], has suffered considerable decimation in the last few decades with the encroachment of civilization, particularly from firearms, on its wintering grounds." World War II and the Korean War damaged many of the species' stopover points and wintering areas (Flint 1978, Won 1981). These impacts, together with other habitat-related changes (including changes in agricultural practices), apparently contributed to its decline in these years.

The present breeding range has not been fully determined. Known breeding grounds are in northeastern Mongolia, northeastern China, and adjacent areas of southeastern Russia (Smirenski 1980, Ma 1991, Su 1993). A minimum of 1,000 White-naped Cranes breed in northeastern Mongolia and adjacent Russia, primarily in riparian wetlands along the Uldz and other rivers (J. Harris pers. comm.). Further east, breeding pairs are scattered along the middle Amur and Ussuri Rivers and their tributaries, and in wetlands bordering Lake Khanka. Many likely breed in remote northern areas of Heilongjiang and Inner Mongolia in China. The number and distribution of breeding White-naped Cranes in these provinces are still being investigated (some 8-10 pairs have been observed in Jilin Province). Several wetland reserves established in this region to protect breeding populations of Red-Crowned Cranes also provide protection for lesser numbers of White-naped Cranes.

White-naped Cranes from the eastern portion of the breeding range migrate to and through the Korean peninsula (Ozaki 1991; Higuchi 1993; Higuchi et al. 1992, 1994b, 1995; Chong et **al.** 1994). In the autumn and spring, about 2,000 White-naped Cranes stop at several sites in or near the Demilitarized Zone (DMZ) between North and South Korea. The most important sites are the Choelwon basin, the Han River estuary, and the lower Imjin River (Higuchi et al. 1994b, Kaliher 1993c, F. Kaliher pers. comm.). Most of the other important resting sites are in North Korea. These include the Baekchon wetlands (North Korea Natural Monument No. 164), the Eunyool fields (NKNM No. 133), and wetlands near Mundok, Kumya, Orang, and Sonbong (Chong et al. 1994). The estuary of the Nakton River in South Korea also serves as an important resting area (Higuchi 1993, S. Kim pers. comm.). Several hundred White-naped Cranes remain through the winter at sites on the DMZ. The others continue south to the island of Kyushu in Japan. They remain at Izumi, in western Kyushu, from early

November to late February, where they are sustained by an artificial feeding program. This program began in 1952 and is thought to be the main factor behind the population's dramatic increase from only 20 birds at that time to as many as 2,100 in recent counts (Chong 1987, Ohsako 1994, Matano 1995; see also the Hooded Crane species account in this volume).

About 3,000 White-naped Cranes from the western portion of the breeding range migrate across central and eastern China to wintering grounds in Hunan, Jiangxi, Anhui, and Jiangsu Provinces (Yang et al. 1991, Harris et al. 1995). Migration studies indicate that several hundred birds migrate along the China coast from Liaoning Province to the Yellow River delta, and then to Poyang Lake in the middle Yangtze lowlands of Jiangxi (Williams et al. 1991, Higuchi et al. 1994b, 1995). Other birds in the population migrate southeast from northern China and eastern Mongolia, rest at the delta of the Yellow River in Shandong Province, and then move on to Poyang Lake. A few birds winter at Dongting Lake in Hunan Province.

It is not known if the two main wintering populations meet in their breeding range. The populations may mix in an intermediate zone. As yet, migration studies have not determined if any birds from the west migrate eastward or vice versa (J. Harris pers. comm.).

2.10.6 Distribution by Country

China	B,M,W
Japan	W
Mongolia	B
North Korea	M, W
Russia	B
South Korea	M, W

B = Present during breeding season
M = Present during migration
W = Present during winter

2.10.7 Habitat and Ecology

The breeding grounds of the White-naped Crane in Russia, Mongolia, and China typically include wetlands and wet meadows in broad river valleys, along lake edges, and in lowland steppes or mixed forest-steppe areas (Li et al. 1991, Su et al. 1991, Fujita et al. 1994). They nest and feed in shallower sedge-dominated wetlands and along wetland edges, foraging in adjacent grasslands and croplands. On their breeding grounds they feed predominantly on insects, small vertebrates, seeds, and the roots and tubers of sedges and other wetland plants. Nests are mounds of dried sedges and grasses in open wetlands. Eggs, usually two per clutch, are laid from April to late-May. Incubation lasts 28-32 days and chicks fledge at 70-75 days.

During migration and on their wintering grounds, they use both wetlands and agricultural fields, feeding on waste grains, seeds, and tubers. At the feeding stations in Japan, they are provided with rice and other cereal grains, while also using nearby cultivated fields (Ohsako 1994). In the Korean peninsula, they use rice paddies, fallow fields, and

S. TRANEVING

White-naped Crane at nest, Zhalong Nature Reserve, China

the edges of reservoirs in the Panmunjom and Choelwon valleys, as well as mudflats in the Han, Naktong, and Imjin River estuaries (Kaliher 1994, Pae and Won 1994, Halvorson and Kaliher 1995). White-naped Cranes are proficient diggers. In the Han River estuary and at Poyang Lake they excavate the tubers of several species of sedges, in particular *Scirpus maritimus, S. fluvialis, Vallisneria spiralis, Suaeda japonica,* and *Salsola komarovi* (Cha 1986, Won 1986, Koo 1986, Chen et al. 1987).

In many portions of its breeding and winter range, the White-naped Crane is regularly found in the company of other cranes. The White-naped is among the four species of cranes that occur simultaneously during the winter at China's Poyang and Dongting Lakes. The White-naped is intermediate in its ecological niche—somewhat less aquatic than the Siberian Crane, somewhat more aquatic than the Hooded and Eurasian Cranes. In breeding areas that are shared with the Red-crowned Crane, White-naped Cranes prefer to feed in drier reed-sedge and sedge marshes, often remaining at one site and digging there for food items (Red-crown Cranes tend to forage more extensively). White-naped Cranes also feed regularly in nearby crop fields (Su et al. 1991, Li P. et al. 1991, S. Smirenski pers. comm.). In breeding areas in Mongolia and Russia (Transbaikalia) that are shared with the Demoiselle Crane, the White-naped prefers wetter areas with relatively high vegetation, such as the shores of shallow lakes (Fujita et al. 1994).

2.10.8 Principal Threats

Habitat loss and degradation are critical problems throughout the species' range. Destruction of wetlands due to agricultural expansion in the breeding range (especially in the Amur River basin, the Sanjiang Plain, and other parts of northeastern China) poses the most significant threat. In some areas of China and Mongolia, White-naped Cranes benefit from the presence of upland agricultural lands nearby. Because of its breeding habitat requirements, however, the species occurs in areas that are especially prone to large-scale agricultural conversion. Extensive wetland reserves have been established in northern China to protect the sympatric Red-crowned Crane, but these generally protect only the shallow waters where Red-crowned Cranes spend their entire breeding period. By contrast, wetland edges and adjacent grasslands, which White-naped Cranes prefer, are rapidly being drained and converted to cropland. This results not only in direct loss of habitat, but increased incidence of human disturbance of breeding birds (Su 1992, 1993). Meanwhile, smaller (and thus usually unprotected) wetlands in the breeding range remain subject to heavy development pressure.

The species faces other habitat problems in its breeding range. A series of dams have been proposed in the Amur River basin. If constructed, they would have a critical impact on the breeding grounds through flooding and increased agricultural development of natural areas (Archibald 1992d). In the Amur

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White-naped Cranes are artifically fed at winter feeding stations in southern Japan

basin, grass fires, livestock grazing, and indiscriminate use of pesticides may also affect breeding success (Smirenski 1990). Agricultural and industrial pollution present a serious threat at several breeding areas, including Muraviovka Nature Park, the Zhuravlini and Amurski Game Refuges, and Daurski and Lake Khanka Nature Reserves. At Zhalong Nature Reserve in China, economic activities (including reservoir construction, reed cutting, and overfishing) have altered the composition of habitat types in the reserve while reducing the output of marsh resources used by local communities (Harris 1992a, Su 1993). Hydrological changes due to drainage activities beyond the reserve boundaries have affected wetlands within protected areas, especially in the Chinese reserves.

Stopover points and other migratory habitats are also at risk, especially in the Korean peninsula. In the south, many agricultural fields can no longer support cranes due to the intensification of farming practices. Lack of suitable resting areas has forced small flocks to wander among scattered remnants of habitat, rendering them vulnerable to poaching (S. Kim pers. comm.). Human disturbance of cranes is also a factor (Pae and Won 1994).

Pressures on the Korean DMZ are the most significant long-term threat to the wintering and migrating cranes. Should military conflict occur in Korea, the impact on crane habitats would be devastating. Conversely, should political unification of the Korean peninsula occur, development pressures on the remaining habitats would quickly increase, especially in and along the current DMZ (Higuchi et al. 1995). The Han River and its estuary would likely be reopened to navigation and the bordering wetlands diked and converted to cropfields. The Choelwon Basin and Panmunjom Valley are likely candidates for industrial development zones. Preparations for such industrial expansion (e.g., surveying of road and railroad routes) are already proceeding in anticipation of reunification (Kaliher 1993b, 1994). These threats are compounded by a lack of conservation education and training opportunities and by practical difficulties in studying cranes in military-secured areas (Halvorson and Kaliher 1995).

White-naped Cranes face additional threats on their wintering grounds. The wintering populations of White-naped and Hooded Cranes at Izumi in Japan are highly concentrated, increasing the risk of a disease outbreak. In China, the proposed dam on the Yangtze River at Three Gorges would alter the hydrological processes at Poyang and Dongting Lakes. Loss of these China wintering areas would threaten about 60% of the total species population. Poor interagency communication, a lack of clear authority, and a shortage of qualified and motivated personnel hinder effective management of the reserves at Poyang Lake and elsewhere in China (Bouffard 1993).

2.10.9 Current Conservation Measures

Note: many of the measures noted in this section have also benefitted the other migratory crane species of East Asia.

Legal and Cultural Protection

Laws to protect the White-naped Cranes have been passed in all of the range countries, but enforcement of these laws is often weak.

International Agreements and Cooperation

In recent years, international agreements have played an important role in protecting White-naped Cranes and their habitats. Migratory bird agreements have been reached between Russia and Japan, Japan and China, Russia and North Korea, and Russia and South Korea. South Korea and Japan are currently discussing such an agreement. China, Japan, and Russia are parties to the Ramsar Convention. South Korea may soon sign the Convention.

In July 1992, an International Workshop on Cranes and Storks of the Amur Basin brought together conservation scientists, officials, and NGO representatives from China, Japan, South Korea, Hong Kong, Ukraine, Russia, and the United States. Scientists from these nations were able to pool their knowledge and produce a series of resolutions calling for protection of the Amur River ecosystem, joint studies of its ecological status and economic potential, and support for environmentally sound development alternatives for the basin (Archibald 1992d). Four sites—Muraviovka National Park, Khinganski Nature Reserve, Daurski Nature Reserve, and the Tumen River—were recommended for protection as Wetlands of International Importance under the Ramsar Convention. These sites were subsequently included in the official Russian proposal to the Ramsar committee in 1994. The workshop also produced resolutions involving other key crane habitats in the Far East and laid the foundation for further agreements on crane and wetland conservation. The proceedings of the meeting were published in 1995 as *Cranes and Storks of the Amur River* (Halvorson et al. 1995).

The 1992 workshop has stimulated further international activity on behalf of the species and its habitats. In 1993, crane and wetland conservationists gathered at an international symposium in Tokyo and Sapporo, Japan, to exchange information on migration, satellite tracking, habitat analysis, distribution, ecology, behavior and wetland conservation. The proceedings, published in 1994 as *The Future of Cranes and Wetlands,* included a proposal for an international network of wetland protected areas in the region (Ichida 1994).

Since 1993, workshops and delegation exchanges have brought together agency officials, crane biologists, and reserve managers from the breeding and wintering portions of the species' range. Agreements are currently being negotiated to manage on a cooperative basis the protected areas on the China-Russia border at Lake Khanka and in the China-Russia-Mongolia border region (see "Protected Areas" below). Key habitats along the Tumen River on the Russia-China-North Korea border were recommended for protection in the Appeal of the International North Asia Wetland Symposium held in Nagasaki in 1994. Friends of the Earth (Japan) and other non-governmental organizations have provided financial support for the establishment of a protected area in this region (S. Smirenski pers. comm.).

Protected Areas

White-naped Cranes use many protected areas throughout their range, although many lack effective enforcement and management. All three countries in the White-naped Crane's breeding range have protected breeding habitat within designated protected areas. In Russia, the species breeds in Muraviovka Nature Park; Khinganski, Lake Khanka, and Daurski Nature Reserves; and the Amurski, Ganukan, and Zhuravlini Game Refuges. In Mongolia, they are found in the Degee Numrug and Daguurun Nature Reserves. In China, they breed in the Hong He, Changlindao, Xingkai Hu, Zhalong, Momoge, Xianghai, Keerqin, and Dalinor Nature Reserves (Harris 1991b, 1992a, 1994c, Ma. and Li 1994). In 1992, Russia and China agreed to collaborate in protecting the wetlands around Lake Khanka (Xingkai Hu). In 1994, China, Mongolia, and Russia established a trilateral protected area for cranes that breed in the wetlands and grasslands of the Daurian Steppes where the three nations meet (see Harris 1991b).

Important resting areas along the migration routes of the White-naped Crane are protected by circumstance (in the Korean DMZ) and in several designated protected areas: the Shuangtaizi and Shengjin Lake Nature Reserves in China; the Kangryong, Kumya, Panmun, and Anbyon Natural Monuments in North Korea; and the Han River Estuary Natural Monument and the small (0.397 km^2) Choelwon Bird Reserve in South Korea. Again, lack of management or enforcement limits the effectiveness of these areas. Due to ecological changes, for example, fewer cranes are wintering in the Han River and Choelwon areas, and now use them only as stopovers (F. Kaliher pers. comm.).

Portions of the wintering grounds in China are protected in the Poyang and East Dongting Lake Nature Reserves. Although not a true protected area in the sense of protecting critical natural habitat, the Izumi Crane Park in Kyushu does serve as a sanctuary for the wintering populations in Japan.

Habitat Protection and Management

Little habitat management has been undertaken specifically for the species. Directed management activities have occurred within some protected areas. At East Dongting Lake and Poyang Lake Nature Reserves in China, restoration and maintenance of habitat for the White-naped and other crane species has been pursued through improved management of water levels and resource extraction, and through efforts to better coordinate land use on adjacent lands. The long-standing artificial feeding program at the Izumi wintering grounds in Japan has been noted above.

Surveys/Monitoring/Censuses

The White-naped Crane population has been surveyed at migration stopover points in Korea and on the main wintering grounds in Korea, Japan, and China. The migratory and wintering populations in Korea were first surveyed in 1973, and have been intermittently surveyed since (Won 1984; Kaliher 1993c, 1994). Accurate winter counts at Izumi have been conducted annually since the early 1950s. Annual winter counts have been carried out at Poyang Lake in China since the early 1980s (Song et al. 1995). These counts tend to be less accurate than those at Izumi due to the larger area requiring coverage and the extensive movements of the cranes within this area. (In general, winter surveys of the White-naped Cranes in China are not as accurate as surveys of Siberian Cranes, as the latter are more conspicuous). In December 1993, over 3,000 White-naped Cranes were counted at Poyang Lake, the most ever recorded for the species in China (Harris et al. 1995).

Research

Until the mid-1970s, very little research had been carried out on the biology, ecology, and conservation needs of the White-naped Crane. Since then, its endangered status has stimulated extensive studies by Chinese, Mongolian, and Russian scientists. Much of this information is available in collections published by the USSR Working Group on Cranes, and in the recent *Proceedings of the 1987 International Crane Workshop* (1991), *The Future of Cranes and Wetlands* (1994), and *Cranes and Storks of the Amur Basin* (1995).

Field studies of the White-naped Crane have been carried out in the species' breeding range (e.g., Smirenski 1980, Su et al. 1991, Bold et al. 1995); along the migration routes (e.g., Archibald 1981b, Williams et al. 1991, Xu X. et al. 1991, Kaliher 1994, Shibaev and Surmach 1994); and on their wintering grounds (e.g., Won 1986, Abe et al. 1987, Chen et al. 1987, Kaliher 1993c, Pae and Won 1994, Harris et al. 1995). Interactions of White-naped and Red-crowned Cranes on their shared breeding grounds have been studied by Su (1993). Fujita et al. (1994) compared breeding habitats of White-naped and Demoiselle Cranes in Mongolia. Color banding and satellite telemetry studies have provided critical information on the species' migration route, stopovers, and behavior (Dombrowski 1988; Ozaki 1991, 1995; Higuchi 1993; Higuchi et al. 1992, 1994b, 1995; Kaliher 1993a; Chong et al. 1994; Xu et al. 1995).

The *Proceedings of the 1987 International Crane Workshop* contain several reports on the breeding behavior and ecology of the species in China (Li P. et al. 1991, Su et al. 1991, Yuan and Li 1991). Additional breeding behavior studies have appeared in the Chinese literature (Yang et al. 1986, Zhu 1986, Li et al. 1987, Li F. et al. 1991). Studies relevant to the captive propagation of cranes for conservation purposes have been conducted by Tian et al. (1990, 1992).

Non-governmental Organizations

Non-governmental organizations have been especially important in efforts to protect this species in the Amur River basin. The Soviet Working Group on Cranes carried out projects in this region from 1980 to 1991. Since 1992, conservation activities in the basin have been conducted by the Socio-Ecological Union of Russia, with technical and financial support from ICF, the Wild Bird Society of Japan, the National Audubon Society, and The Nature Conservancy (Archibald 1992d). Biologists working at the Khinganski Nature Reserve in Russia have recently established the Amur Crane

Foundation with the goal of raising funds for the support of regional crane conservation activities. An Amur Program has been developed that stresses the need to integrate conservation goals and development needs (Smirenski 1995, Smirenski et al. 1995). NGOs have played an important role in other portions of the species' range. For example, the Wild Bird Society of Japan and ICF, in partnership with Korean ornithologists, have sponsored on-going research on the migration route and stopover areas of the species in Korea (Chong et al. 1994).

Education and Training

Crane and wetland education programs are prominently featured at many of the protected areas within the species' range, especially at Zhalong Nature Reserve near Qiqihar, Xianghai Nature Reserve in Jilin, and Muraviovka Nature Park in Russia. At the Izumi Crane Park in Japan, an education center provides visitors with information on the wintering flocks of White-naped and Hooded Cranes.

Captive Propagation and Reintroduction

The GCAR for cranes estimates that 409 White-naped Cranes were in captivity worldwide as of 1993 (Mirande et al. in press a). An international studbook for the species is maintained in North America and regional studbooks are kept in Japan, Europe, and the United Kingdom. Regional management programs have been developed for captive White-naped Crane populations in North America, Europe, and Japan. The GCAR determined that an adequate number of founders is currently breeding in captivity. Many pairs have produced their targeted number of offspring. Reproduction of these pairs has been curtailed, and future reproduction by their offspring will be limited. At this point, additional institutions are needed to maintain non-breeding individuals.

Reintroduction of White-naped Cranes has taken place on a limited basis at the Zhalong and Khinganski Nature Reserves, where birds have been released near research and education facilities. These birds have been raised in captivity, and thus have a greater tolerance for human beings. At least one pair, raised in captivity and released at Khinganski, has successfully migrated and bred.

2.10.10 Priority Conservation Measures

Note: many of the conservation priorities for the White-naped Crane described here also apply to the other migratory crane species of East Asia.

Legal and Cultural Protection

1) Improve enforcement of existing laws protecting White-naped Cranes and nature reserves, especially through increased patrolling to curtail poaching both within and outside protected areas.

2) Adopt increased fines for poaching of cranes and other protected wetland species. It is important that educational efforts be undertaken beforehand to fully inform the public of these measures.

International Agreements and Cooperation

1) Address the conservation needs of the White-naped Crane within an umbrella international agreement on the conservation of the migratory cranes of East Asia (Japan, Russia, China, Mongolia, and North and South Korea).

2) Secure full adoption of the Ramsar Convention in all range countries and register critical wetlands as Wetlands of International Importance.

3) Provide support for cooperative management of the international protected areas at Lake Khanka and in the China-Russia-Mongolia border region. Critical activities include: development of more systematic means of sharing information; joint efforts to control and mitigate pollution (this applies mainly to Lake Khanka); and expanded joint training programs for managers of protected areas.

4) Implement the Amur Program and support further international efforts to integrate conservation and development goals in the Amur River basin.

5) Continue and expand cooperative research on the White-naped Crane to help develop integrated conservation plans for the species and its habitats across its entire range. Highest priority should be given to migration studies using satellite tracking, and the application of this information in collaborative conservation projects. Other international research projects that should be undertaken include historical studies of the distribution of the species, comparative studies of habitat use and behavior, and studies of the impact of agriculture and land use practices.

Protecting the White-naped Crane on the Korean Peninsula

1) Secure protected area status for the key stopover points and wintering grounds of the White-naped Crane now protected by the Korean DMZ (the Han and Imjin Rivers and the Choelwon basin). This is an extremely high priority. Steps should immediately be taken toward this goal and should not await further developments in the relationship between North and South Korea. The high potential value of this area as a historical/ecological reserve, as an educational resource, and as a peace memorial and wildlife sanctuary merits support beyond its value as critical crane habitat.

2) Identify and assess key remaining and potential crane habitats throughout the Korean peninsula. Research should be undertaken to define the restoration and management needs of these areas, and to identify additional areas for designa-

tion as (or inclusion within) protected areas.

3) Strengthen management of existing protected areas in the Korean Peninsula.

4) Pursue increased interaction between North Korean, South Korean, and Japanese ornithologists, wetland experts, and other biologists in order to:
   - ascertain the status of knowledge of White-naped Cranes in the north;
   - exchange information on all migrating and wintering crane populations; and
   - pursue agreements for the protection and management of crane wintering areas.

5) Expand research on the White-naped Crane in the Korean peninsula through: annual monitoring of population numbers along migration corridors and in wintering areas; comprehensive studies of the cranes wintering along the Sachon River; continued surveys of the Han and Imjin River wintering sites, the Han River estuary stopover site, and other known and potential migration and stopover sites; investigations of the impact of different agricultural practices on crane habitat; and studies of the use of the Choelwon site in response to varying winter conditions.

Protected Areas

Because White-naped Cranes often share protected areas with several other crane species, the following priorities should be pursued in conceit with those defined in the other species accounts.

1) Strengthen the management of existing protected areas used by the species. In particular, support is needed to provide equipment and training; to guard against poaching; to compensate for crop losses; to mitigate other potential conflicts between cranes (and other wildlife) and agriculture; and to develop long-term management plans for protected areas. Priority areas are:
   - the Daguurun and Daurski Nature Reserves in the China-Mongolia-Russia border region;
   - the Lake Khanka and Xianghai Nature Reserves on the China-Russia border;
   - Muraviovka Nature Park and Khinganksi Nature Reserve in Russia; and
   - Poyang and Dongting Lake Nature Reserves in China.

2) Establish new protected areas. Priority areas are:
   - the Zhuravlini wetlands and grasslands in Russia;
   - areas along the Bijan River and Ganukan River in Russia;
   - wetlands (especially smaller wetlands) in the breeding range in northeastern Mongolia and in the Sanjiang Plain of northeastern China;
   - important areas along migration routes, especially at Beidaihe in China and at key sites in the Korean peninsula (see above);
   - vulnerable roosting areas on wintering grounds in Japan.

3) Expand existing protected areas to include additional wetlands and adjacent vulnerable grassland areas used by White-naped Cranes and to provide effective buffer zones. Priority areas are:
   - in China: Changlindao, Hong He, Poyang Lake, and East Dongting Lake Nature Reserves;
   - in Russia: Daurski and Khinganksi Nature Reserves, Muraviovka Nature Park, and Amurski and Zhuravlini Game Refuges;
   - in Mongolia: Daguurun Nature Reserve;
   - in North and South Korea: the Han River Natural Monument. The National Monument should be expanded to include mudflats along the estuary of the Imjin River between the mouth of the Han and Sachon Rivers and along the Imjin River to at least Chopyong-do Island (about 8 km upstream from Freedom Bridge).

Habitat Protection and Management

1) Undertake studies to assess the impact of the Three Gorges dam on the wetlands of the Yangtze River basin and to develop possible mitigation strategies.

2) Assess and disseminate information on the social and environmental impacts of the proposed dams in the Amur River basin.

3) Develop a plan to disperse the wintering flocks at Izumi. Although an even more critical need for the Hooded Crane, this is also an important consideration for the White-naped Crane (see the Hooded Crane species account in this volume).

4) Improve habitat management within protected wetlands used by White-naped Cranes. In particular, efforts should be made to: maintain appropriate water levels and flows; address pollution problems; relocate hazardous utility lines; institute sustainable agriculture and other resource use practices; and provide training opportunities for managers.

5) Develop integrated land use and conservation programs to coordinate economic and environmental goals, especially through watershed-level planning. This is needed both in key breeding areas (especially the Amur River basin, the Daguurun Reserve and nearby lands in the Uldz River watershed in Mongolia, and lands in and around Hong He and Changlindao Nature Reserves in China) and wintering areas (especially Poyang and Dongting Nature Reserves in China).

6) Develop a program to protect the scattered wetlands in the Sanjiang Plain and other areas of northeastern China.

These smaller wetlands, which are important for cranes and other wildlife, are situated within farmlands. They need to be identified, and simple management guidelines for them be developed and disseminated.

Surveys/Censuses/Monitoring

1) Conduct aerial surveys of wintering cranes at least once each winter (preferably more often) on Poyang Lake Nature Reserve and in surrounding lands.

2) Continue winter surveys and counts of the wintering populations in Korea and Japan.

3) Monitor the breeding population of the species through periodic simultaneous surveys (both aerial and field surveys) of the known breeding grounds in Russia, Mongolia, and China, and through continuous observations of selected control sites.

4) Conduct counts at key points along the migration routes in the Korea Peninsula and in China.

Research

1) Conduct basic ecological studies of known stopover sites and wintering grounds. It is especially important that ecological studies of protected areas be undertaken as a basis for more effective management.

2) Identify with greater precision the known and potential breeding areas of the species in the Amur River basin, northeastern China, and eastern Mongolia using satellite images and field surveys.

3) Conduct studies of habitat requirements and nesting success in the breeding range, especially by comparing breeding grounds in developed and non-developed areas. This effort should entail classification of crane habitats and comparison (through habitat sampling, time budgets, and foraging behavior studies) of their use by different crane species.

4) Determine through radio tracking the daily and seasonal movements of the species on the wintering grounds in China and Korea.

5) Expand satellite-tracking studies to determine the species' migration routes and important stopover and resting sites.

6) Conduct research on human resource use and its impact on White-naped Crane habitat (both within and beyond protected areas) to help develop sustainable alternatives. This is especially critical in the Amur River basin; at Zhalong, Changlindao, and Hong He Nature Reserves in China; and in the Yangtze River lowlands.

Non-governmental Organizations

1) Secure support for the Socio-Ecological Union of Russia and other NGOs whose activities involving sustainable agriculture, ecotourism, and environmental education have benefitted White-naped Crane, their habitats, and local communities

2) Support existing and emerging conservation NGOs in the Korea Peninsula that are working to protect habitat for cranes and other wildlife and to provide opportunities for conservation education.

3) Provide continued support for satellite tracking studies coordinated through the Wild Bird Society of Japan.

Education and Training

Both professional training and public education are critical to the future of the species. For professional training, the following measures are of highest priority:

1) Develop and maintain in all range countries strong professional research and training programs involving crane and wetland conservation and the management of protected areas.

2) Secure funding for increased international training and travel, and for international teams to participate in cooperative field work and conservation planning for the species.

3) At Poyang Lake Nature Reserve and other key protected areas for cranes, disseminate information on reserve management and conservation planning to administrators, policymakers, and reserve officials through conferences, field inspections, and various media.

For public education, the following measures are of highest priority:

1) Provide farmers (especially in Russia and China) with information on more efficient and sustainable methods of agricultural production and processing.

2) Develop community-based education programs focusing on crane and wetland conservation and stressing the connections between agriculture, wetlands, and wildlife protection.

3) Develop and disseminate improved educational materials that incorporate basic biological information about cranes (this is especially important in northern and eastern China, eastern mongolia, and the Russian Far East).

4) Provide Korean farmers and the general public with information about cranes through television programs, publications and other media. Special attention should be devoted to development of educational facilities and

programs in conjunction with protection of crane habitat in the DMZ.

Captive Propagation and Reintroduction

1) Implement the following recommendations outlined in the GCAR and CAMP for cranes (Mirande et al. in press a):
   - Manage the captive population of White-naped Cranes at the Intensive-1 (A priority) level, with a target population of 250 well managed birds. At present, the population exceeds that target, but not all the birds are within well managed programs.
   - Integrate existing regional management plans by developing a Global Animal Survival Plan (GASP) for the species.

2.11 HOODED CRANE (*Grus monachus*)

2.11.1 Summary

The total population of Hooded Cranes is estimated at 9,400-9,600. The breeding grounds of the species are in southeastern Russia and northern China, while non-breeding flocks occur in the Russia-Mongolia-China border region. There are no subspecies. The species is divided into several wintering subpopulations. More than 80% of the world's Hooded Cranes—about 8,000 birds—spend the winter at Izumi on the Japanese island of Kyushu, where they are sustained by artificial feeding. Small subpopulations are found at Yashiro in southern Japan, near Taegu in South Korea, and at several sites along the middle Yangtze River in China. Although little is known about historical changes in the distribution of the species, its numbers are known to have risen and fallen dramatically since the 1920s. At present, the population is probably as large as at any point this century. The species is classified as Vulnerable under the revised IUCN Red List Categories.

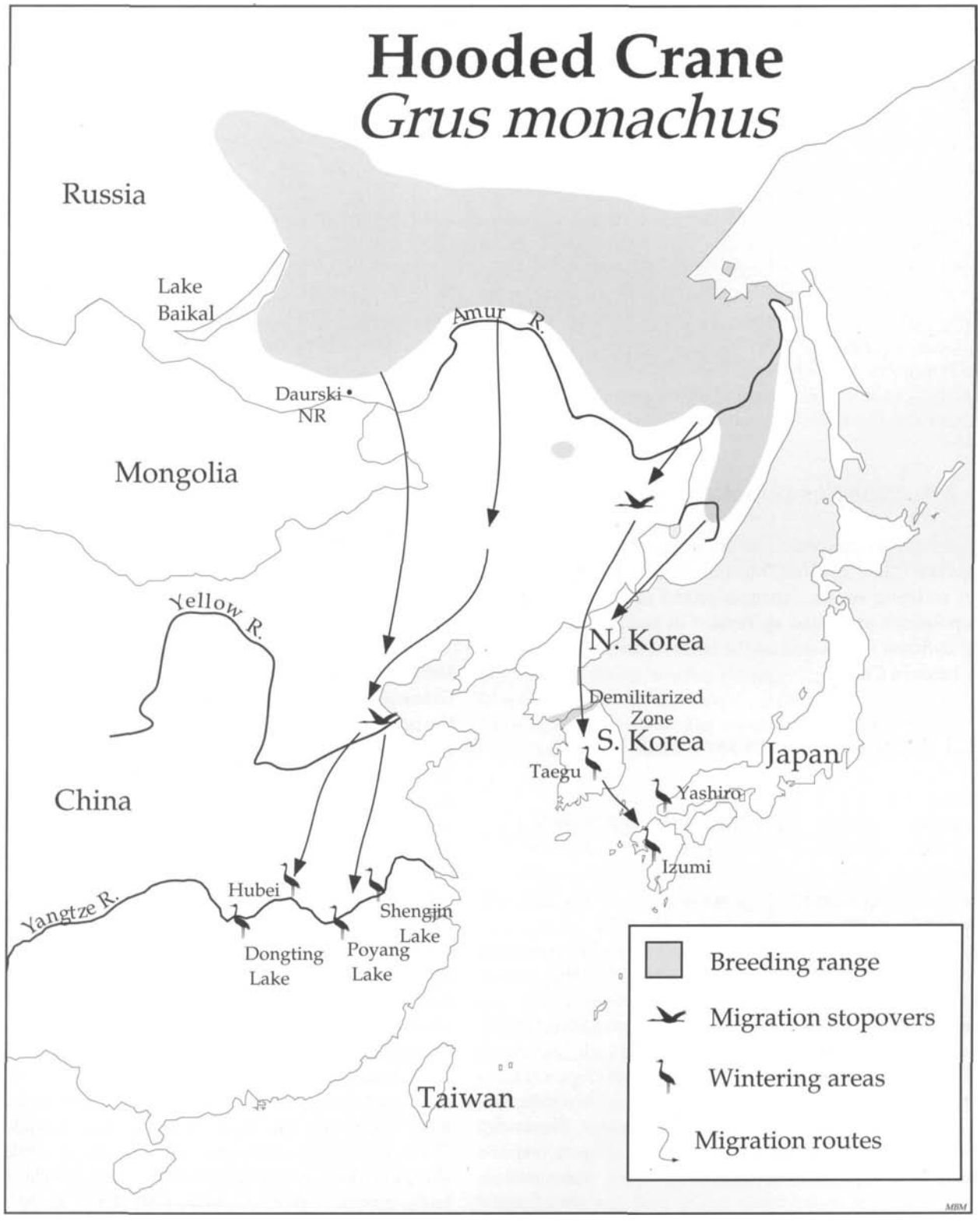
Hooded Cranes nest in isolated, widely scattered bogs in the taiga and in other forested wetlands, preferring mossy areas with widely scattered larch trees, and avoiding areas that are either too open or too densely forested. Non-breeding cranes are found in shallow open wetlands, natural grasslands, and agricultural fields in southern Siberia, northeastern Mongolia, and northern China. Wintering Hooded Cranes utilize a wide variety of habitats. In China, they tend to roost along the shores of rivers and shallow lakes, and to forage in the muddy edges of lakes and in nearby grasslands, grassy marshes, rice paddies, and agricultural fields. In Korea and Japan they feed almost exclusively at feeding stations and in agricultural fields.

Although the Hooded Crane is a threatened species, it is more secure than the other threatened cranes of East Asia. This is due mainly to the relative absence of intensive human economic activity in their breeding grounds. Moreover, the species (unlike the other East Asian cranes) winters mainly in Japan rather than China and the Korean Peninsula, where threats are somewhat greater. However, the species does face several critical threats, including: drainage of wetlands and intensified logging pressures in Russia's taiga forests; reclamation of wintering grounds in China for agriculture and alterations in the hydrology of these areas; the Three Gorges dam on the Yangtze River; rapid development of the key wintering grounds in Korea, especially through the construction of greenhouses; and high risk of disease outbreak in the concentrated flocks at the winter feeding stations in Japan.

Conservation measures that have been undertaken on behalf of the Hooded Crane include: legal protection throughout the species range; international agreements to protect the species and key habitats throughout its range; recently expanded research on its breeding habitats, winter ecology, and migration routes; annual surveys of the population on its wintering grounds; establishment of protected areas, especial-

Y. SHIBNEEY

Hooded Crane *(Grus monachus)* at nest, southeast Russia


Hooded Crane
Grus monachus
Russia
Lake Baikal
Amur R.
Daurski NR
Mongolia
Yellow R.
N. Korea
Demilitarized Zone
S. Korea
Japan
Taegu
Yashiro
Izumi
China
Hubei
Yangtze R.
Shengjin Lake
Dongting Lake
Poyang Lake
Taiwan
Breeding range
Migration stopovers
Wintering areas
Migration routes
MBM

ly in its winter range; and intensive management (including the artificial feeding programs) in its main wintering area in Japan.

The Hooded Crane has many of the same priority conservation needs as the White-naped, Red-crowned, and Siberian Cranes, including stronger enforcement of existing laws, adoption of an umbrella agreement on the migratory cranes of East Asia, adoption of the Ramsar Convention in all range countries, expanded international conservation programs, continued research on migration routes, and protection of key habitats in China and the Korean Peninsula. Additional priorities specific to the species include: protection of potential alternative feeding and roosting sites for the wintering populations in southern Japan and Korea; studies of the West Taegu population in Korea and application of this information in creating an adequate protected area for the flock; agreements to bring greenhouse development under control in and near the Hooded Crane Protection Area in Korea; continued winter surveys of all Hooded Crane populations; and development of a program to monitor the status of the breeding grounds in Russia.

2.11.2 Subspecies/populations

There are no subspecies. In the winter, the species breaks into several subpopulations. Most of the population spends the winter at Izumi on the Japanese island of Kyushu. Smaller subpopulations are found at Yashiro in southern Japan, near Taegu in South Korea, and on the lakes of the middle Yangtze River basin in China.

2.11.3 Population Numbers and Trends

Wintering subpopulation	Number	Trend	Source
Hubei (China)	up to 425	Unknown	Hu 1995
Dongting Lake (China)	up to 200	Unknown	Gui 1995
Poyang Lake (China)	up to 360	Unknown	Song et al. 1995
Shengjin Lake (China)	300	Stable, but habitat declining	Wang Q. 1991
West Taegu (South Korea)	<200	Declining	F. Kaliher and C. Halvorson pers. comm.
Yashiro (Japan)	<50	Declining	Kawamura 1991, Eguchi et al. 1993
Izumi (Japan)	~8,000	Stable	Ohsako 1994, Matano 1995
Total	9400-9600	Stable	

Note: numbers at the wintering sites in China (excepting Shengjin Lake) are highly variable due to the irregular movement of birds between existing protected areas in these areas.

2.11.4 Conservation Status

IUCN category	Vulnerable, under criteria A2c, C1
CITES	Appendix I

2.11.5 Historic and Present Distribution

The first nest of the Hooded Crane was not discovered until 1974 (Pukinski 1977, Pukinski and Ilyinski 1977). Consequently, little is known about the former distribution of the species on its breeding grounds. Since the mid-1970s, research has shown that it breeds in remote, widely scattered bogs and wooded marshes in eastern Siberia, from Lake Baikal and southern Yakutia to the lower Amur River basin and Primorye (Neufeldt 1977, 1981; Fujimaki 1989). The first nesting reports from northeastern China were published in the early 1990s (Liu and Sun 1992, Li 1993). During the summer, Hooded Cranes also occur in non-breeding flocks in Transbaikalia (including Daurski Nature Reserve), Mongolia's Uldz River valley, and portions of Inner Mongolia and Heilongjiang Province in China (Golovushkin and Goroshko 1995, Bold et al. 1995).

Hooded Cranes migrate through eastern Inner Mongolia, Heilongjiang, Jilin, and Liaoning Provinces in northeastern China (Qiu 1991, Harris 1992a, Wu and Han 1992). Most of the population crosses the Korean peninsula, resting for short periods at scattered sites, mainly in North Korea. The main wintering population—a total of more than 8,000 birds in recent counts (more than 80% of the total world population)—continues on to Izumi in Kagoshima Prefecture on Japan's Kyushu Island, where the cranes have become habituated to artificial feeding stations (Abe 1989, Chiba and Abe 1990, Higuchi 1991, Ohsako 1994). Since 1985, between 180 and 250 Hooded Cranes have remained through the winter in South Korea along the Naktong River near Taegu, although rapid development in the area has placed this population at risk (Cho and Won 1990, Kaliher 1994, Cho 1995, Halvorson and Kaliher 1995). Another small group winters near Yashiro, Yamaguchi Prefecture, on Honshu Island in Japan (Kawamura 1991, Eguchi et al. 1993).

Lesser numbers of Hooded Cranes follow a second migratory route along the coast of Bohai Bay through Beidaihe, China, continuing south from there to several wintering areas along the Yangtze River lowlands in Anhui, Jiangxi, Hunan, and Hubei provinces (Williams et al. 1991, 1992; Xu X. et al. 1991, Zhao 1991). The largest regular concentration of wintering Hooded Cranes in China—about 300 birds—is found at Shengjin Lake (Wang Q. 1991), although counts at nearby Longgan Lake in Hubei have sometimes been higher (Hu 1995).

As noted above, little is known about historical changes in the distribution of the species. Available data indicate that the

Y. AKEO

Hooded Crane in mid-takeoff

population has risen and fallen dramatically since the 1920s (Ohsako 1987, 1994). Winter crane counts at Izumi show that the population there increased rapidly in the late 1920s and 1930s, up to a pre-war high of more than 3,400 birds. During World War II, the numbers at Izumi fell to less than one-tenth of this total. In 1945, an airport was built in Izumi adjacent to the main roosting area. The cranes were intensively harassed in an effort to prevent collisions with planes, a factor that likely contributed to the species' rapid decline (S. Smirenski pers. comm.). The population hovered between 200 and 300 through the 1950s, although it is uncertain whether this reflected an actual population decline or the movement of birds to other areas. After the artificial feeding program at Izumi began in 1963, the population began to increase steadily to its current level (Ohsako 1987, Higuchi et al. 1992). The population at Yashiro has declined from more than 250 to less than 50 birds over the last fifty years (Ohsako 1987, Kawamura 1991, Eguchi et al. 1993).

2.11.6 Distribution by Country

China	B, M,W
Japan	M,W
Mongolia	NB, M
North Korea	M
Russia	B, M
South Korea	M.W

B = Present during breeding season
M = Present during migration
NB = Present during breeding season as non-breeder
W = Present during winter

2.11.7 Habitat and Ecology

Information on the breeding habitat of the Hooded Crane was first published in the late 1970s (Pukinski 1977, Pukinski and Ilyinski 1977, Flint and Smirenski 1978). The species' breeding grounds are in the central and southern taiga of eastern Russia, generally to the north of the main breeding grounds of the White-naped and Red-crowned Cranes in eastern Mongolia, northeastern China, and adjacent Russia. Within this region, they nest and feed in isolated sphagnum bogs scattered through the taiga and (in China) in forested wetlands in mountain valleys (Su L. pers. comm.). The dark plumage of the cranes renders them extremely difficult to locate and observe in these settings. Non-breeding birds are found in shallow open wetlands, natural grasslands, and agricultural fields in southern Siberia and northeastern Mongolia.

Hooded Cranes prefer to nest in mossy areas with widely scattered larch *(Larix siberica* and *L. dahurica)* trees, avoiding areas that are either too open or too densely forested (Pukinski 1977, Flint 1978). The nests are constructed of damp moss, peat, sedge stalks and leaves, and branches of larch and birch. Eggs are laid in late April and early May. Usually two eggs are

TS. HAYASHIDA

Hooded Cranes during migration, Japan

laid. Incubation takes from 27-30 days. The chicks fledge at about 75 days.

Wintering Hooded Cranes utilize a wide variety of habitats. In China, they are found near the shallow lakes of the middle Yangtze lowlands, but use drier habitats than the Siberian and White-naped Cranes that also occur at these sites. They tend to roost in the upper reaches of dried out mudflats along the shores of rivers and shallow lakes, and forage for rhizomes, seeds, and grains in grasslands, grassy marshes, agricultural fields (including fallow rice fields), mudflats, and lakeside beaches (Wang and Hu 1987, Chen and Wang 1991, Zhao 1991). In Korea and Japan they use agricultural (wheat, bean, and grass) fields and harvested rice paddies covered with grass or shallow water (Ohsako 1994). This is a direct consequence of the loss of natural habitats and adaptation of the subpopulation to the artificial feeding stations that have been established in the area.

Hooded Cranes are diggers and foragers in both their breeding and natural wintering grounds. Their natural diet includes aquatic plants, berries, insects, frogs, and salamanders in the breeding areas, and roots, rhizomes, seeds, blades of grass, and small aquatic animals in winter. Artificial foods, mainly rice, wheat, and waste cereal grains, are the principal food items in Korea and Japan (Cho and Won 1990, Ohsako 1987).

2.11.8 Principal Threats

Because of the Hooded Crane's particular habitat characteristics, it is relatively secure compared to the other endangered cranes of East Asia. The wooded bogs and marshes where it breeds have been largely unaffected by human activity due to their remoteness and inaccessibility. They are less desirable for agriculture than open marshes, and the logging that takes place in and near these areas is generally conducted during the winter, when the cranes are absent (Flint 1978). In addition, the main wintering grounds of the species are in Japan, where human population and development pressures, though intense, are less acute than in China's Yangtze River basin (the Three Gorges dam, in particular, would have less impact on the Hooded Crane than on East Asia's other cranes).

Despite these advantages, the Hooded Crane faces many critical threats.

- In Russia, bogs and other wetlands where Hooded Cranes breed are being lost to drainage, while logging pressures on the surrounding taiga forests are intensifying. Intentionally set fires can sometimes spread into Hooded Crane habitat. There are also potential conflicts with farmers at several stopover points within Russia (S. Smirenski pers. comm.).
- In China, Hooded Cranes have been hunted, poisoned (usually by eating poisoned grain), and disturbed on their wintering grounds by farmers and fishermen. Wintering habitats are threatened by reclamation of wetlands (especially along the borders of shallow lakes) for agriculture, changes in hydrology (including those resulting from construction of the Three Gorges dam), and other impacts associated with China's increasing human population (Wang and Hu 1987, Wang Q. 1991). As natural wetland habitats continue to be lost, Hooded Cranes must increasingly turn to rice paddies and crop fields, and the potential for crane-farmer conflicts increases (this may also hold for the wintering populations in South Korea and Japan).
- In South Korea, natural winter habitat has long since been altered by development. Harvested and fallow fields now serve as important Hooded Crane feeding and resting sites. These sites are now being rapidly developed, mainly through highway construction and widespread—and, since the mid-1980s, accelerating—construction of plastic greenhouses (Cho and Won

ICF

Hooded Cranes at artifical feeding area in Izumi, Japan

1990, Kaliher 1994, Halvorson and Kaliher 1995).

- In Japan, as in the Korean peninsula, winter habitat has largely been altered by agricultural development. Wintering Hooded Cranes are now highly concentrated at the Izumi feeding station. The risk of a disease outbreak in these areas, combined with the disappearance of possible alternative sites in the Korean Peninsula, poses a major potential threat to the main portion of the population. At the same time, the status of the existing wintering grounds in Japan (especially the roosting areas) is unstable, despite attempts to provide more permanent protection through conservation easements, land leases, and land purchases. Winter greenhouses are now being built in some of the feeding areas, making them unsuitable for the cranes. Human disturbance has contributed to the decline of the Yashiro population (Eguchi et al. 1993). Several dozen birds are also injured or killed annually as a result of collisions with utility lines in the Izumi area (S. Smirenski pers. comm.).

2.11.9 Current Conservation Measures

Legal and Cultural Protection

Hooded Cranes are legally protected throughout the species' range. The land in Japan where most of the population feeds in winter is privately owned, and the cranes are strictly protected there.

International Agreements and Cooperation

See the White-naped and Siberian Crane species account in this volume.

Protected Areas

No protected areas have been established specifically to protect the Hooded Crane and its habitat within the species' breeding range. During the breeding season, Hooded Cranes occur in the Zhuravlini Game Refuge, while non-breeders are often found at the Daurski Nature Reserve. In 1994, important breeding habitat along the Nora River was included within a proposal developed under Russia's federal planning program for protected areas. With support from the World Wide Fund for Nature (WWF), the Norski Nature Reserve has now been established in this area.

During migration, Hooded Cranes have been observed at the Zhalong, Honghe, Keerqin, Momoge, Xianghai, and Shuangtaizi Nature Reserves in China. Important wintering grounds are protected in the Shengjin Lake, Poyang Lake, and Dongting Lake Nature Reserves in China, and at Izumi Crane Park in Japan (Harris 1992a, Ma and Li 1994, Chiba and Abe 1990). In South Korea, the provincial government has designated a Hooded Crane Protection Area near West Taegu, but management of this area has been ineffective. Crane protection areas have also been designated locally at Hwasung Resort and Dalsung-Gun (S. Kim pers. comm.).

Habitat Protection and Management

In the species' remote breeding territories, deliberate management of habitat has not been necessary. Habitat management is of greater importance on the wintering grounds. At Izumi, natural habitats and food sources no longer exist, and the cranes depend completely on intensive habitat management and artificial feeding. Fresh water is pumped over the agricultural fields where the cranes are fed to aid in cleansing the area. At Yashiro, brushy vegetation has been removed from former rice fields in order to create optimal roosting habitat and steps have been taken to reduce human disturbance of the cranes (Eguchi et al. 1993). In the Poyang, Dongting, and Shengjin Nature Reserves in China, the regulation of wetland resource use is an increasingly important component of reserve management for the Hooded and other crane species.

Surveys/Censuses/Monitoring

As yet, no comprehensive surveys of the Hooded Crane have been undertaken in the species' breeding range. Counts of the main wintering population at Izumi have been conducted annually since 1947 (survey figures are also available from 1927-29 and 1936-39) (Ohsako 1994). In recent years, the wintering subpopulations in China and Korea have been surveyed on an irregular basis (e.g., Wang and Hu 1987, Cho and Won 1990, Halvorson and Kaliher 1995).

Research

Little studied until two decades ago, the Hooded Crane has since benefitted from field research on many aspects of its biology and ecology. Since Pukinski and Ilyinski (1977) reported the first location of an active nest, further studies have defined the breeding distribution and habitat needs of the species (e.g., Neufeldt 1981, Soviet Working Group on Cranes 1981, Fujimaki et al. 1989, Roslyakov 1995). The winter ecology of the species has been studied in Japan (Ohsako 1987, Eguchi et al. 1991); in China (Wang and Hu 1987, Chen and Wang 1991, Zhao 1991); and in Korea (Cho and Won 1990, Kaliher 1994, Cho 1995, Halvorson and Kaliher 1995).

International studies of migration have expanded significantly in recent years. Ozaki (1995) reports the results of more than ten years of banding studies of the species. Through an international effort involving Japan, Russia, and China, and coordinated by H. Higuchi of the Wild Bird Society of Japan, satellite telemetry has been used to track the migratory routes of the East Asian cranes since 1991 (Higuchi 1991, 1993; Higuchi et al. 1992, 1994b, 1995). In the spring of 1992, two Hooded Cranes were successfully tracked during their spring migration from Izumi, Japan, to their breeding grounds in Russia. In the fall of 1992, a Hooded Crane was successfully tracked over a 32-day migration from Daurski Nature Reserve in Russia to Poyang Lake in China. Two more Hooded Cranes were tracked from Daurski to Poyang in the fall of 1993. Through these efforts, important sites for migrating cranes—

especially wetlands on northeast China's Three Rivers (Sanjiang) Plain and in the Korea peninsula—have been identified (Kaliher 1993a, Chong et al. 1994, Ichida 1994, Higuchi et al. 1995).

Education and Training

Along with other crane species, the Hooded Crane benefits from education programs conducted at protected areas in China and at the feeding stations in Japan. Thousands of visitors come to observe cranes at Izumi and Yashiro in Japan. At the professional level, international exchange programs have recently allowed managers of protected areas, administrators, and scientists to engage in joint planning and training programs. One such program has brought together conservation officials and scientists from the Izumi Crane Park in Japan and Muraviovka Nature Park in Russia. Exchanges between Russian and Chinese crane conservationists have also increased significantly in recent years.

Captive Propagation and Reintroduction

The international studbook for the Hooded Crane is maintained in North America and as of 1994 included 106 individuals (Mirande et al. in press a). Regional studbooks are kept in Japan and the United Kingdom. Regional management programs have been developed in North America, Japan, and the United Kingdom. The species does not breed consistently in captivity. The first successful reproduction of the species in captivity occurred at ICF in 1976, and thereafter at the Guangzhou Zoo and Longsha Zoo in Qiqihar, China. The species has not been the subject of reintroduction projects, and at present no reintroduction efforts are envisioned.

2.11.10 Priority Conservation Measures

Priority conservation measures for the Hooded Crane include those enumerated in the White-naped Crane species account under the following categories: legal protection, international agreements, international cooperative conservation measures, the protection of critical habitats on the Korean Peninsula, and non-governmental organizations. Many of the priorities in other categories will also benefit both crane species (and others as well). The priorities noted here pertain more specifically to the Hooded Crane.

International Agreements and Cooperation

1) Address the conservation needs of the Hooded Crane within an umbrella international agreement on the conservation of the migratory cranes of East Asia (Japan, Russia, China, Mongolia, and North and South Korea).

Legal and Cultural Protection

1) Develop in Russia a national policy for the protection of the bogs and other wetlands where Hooded Cranes currently, or potentially may, breed.

Protected Areas

1) Identify and protect significant breeding areas in Russia and in China's Heilongjiang Province.

2) Identify and protect important migration resting areas in northeast China's Three Rivers Plain.

3) Secure protection through purchase, lease, or easement of farmlands in Japan used by wintering Hooded Cranes.

4) Strengthen the Hooded Crane Protection Area at West Taegu in South Korea through:
   - national-level legal protection for the area;
   - further research on the wintering crane subpopulation, including its size, location, and movements;
   - expansion, if necessary, of the area under protection;
   - professional training of protected area managers;
   - development of public education programs;
   - intensified habitat protection; and
   - development of a management plan that integrates agricultural practices and land use with the protection of the cranes and their habitat.

5) Identify and protect potential alternative feeding and roosting sites in southern Japan and the Korean Peninsula, including:
   - the large area of reclaimed rice paddies on the west coast of South Korea in the Sosan region;
   - sites of known historic occurrence, such as Mundok (Pyongyangnam-do) and Eunyool (Hwanghae-do) in South Korea;
   - sites near the existing Hooded Crane Protection Area near Taegu;
   - other coastal salt marshes in southern Japan.

Habitat Protection and Management

1) Undertake studies to assess the environmental impacts of the Three Gorges dam on the wetlands of the Yangtze River basin and to develop possible mitigation strategies.

2) Assess and disseminate information on the social and environmental impacts of the dams proposed for the Amur River.

3) Develop a plan to disperse the concentrated wintering flocks at Izumi, with special attention given to: identification, protection, and restoration of alternative wintering sites; increased research on local movements and feeding habits of the cranes; preparation of educational materials explaining the need for management changes; development of a provisional farmer compensation program; and implementation of gradual changes in the number, location, and management of artificial feeding stations.

4) Work with people living in and near the Taegu Hooded Crane Protection Area to restrict further greenhouse development (with special attention given to protection of the areas that as yet have no greenhouses).

5) Undertake basic measures to protect the aquatic ecosystems of the Chinese nature reserves used by the species (especially through more effective control of grazing, the cutting of grasses and reeds, and the inflow of sewage and pollution).

Surveys/Censuses/Monitoring

1) Conduct (and at Izumi, continue) annual surveys of the subpopulations at all wintering areas.

2) Establish a program to identify and monitor the status of the breeding grounds of the species in Russia and China.

Research

1) Expand efforts to assess the risk of a disease outbreak and to monitor risk factors on the wintering grounds at Izumi.

2) Continue satellite tracking studies of the species' migration routes.

3) Identify and assess the status of all present and potential sites used by wintering Hooded Cranes in South Korea in order to protect areas that could provide alternatives to the crowded sites in Japan.

4) Conduct radio tracking and field studies of the local movements of wintering Hooded Cranes in Japan and China.

5) Expand basic field research on the breeding grounds in Russia and China and at migration stopovers in the Korean peninsula and China.

6) Undertake research to improve captive husbandry techniques for the species.

Education and Training

1) Develop special public education programs focused on the West Taegu population. The proximity of the city of Taegu offers important opportunities for education, although these opportunities are contingent upon the continued use of the traditional feeding areas by this highly vulnerable population. Programs should emphasize the international significance of this wintering population and the need to protect their habitat.

2) Develop education programs involving farmers near important stopover points in Russia, and near the wintering grounds in Japan, Korea, and China, in order to minimize the potential for farmer-crane conflicts.

Captive Propagation and Reintroduction

1) Implement the following recommendations of the GCAR and CAMP for cranes (Mirande et al. in press a).
   - Manage the captive population of Hooded Cranes at the Intensive-2 (A priority) level, with a tentative target population of 200 birds worldwide.
   - Develop a Global Animal Survival Plan (GASP) for the species (required because the number of founders within any region is not adequate to support viable captive populations of the species).
   - Encourage Japanese representatives to assume responsibility for maintaining the international studbook and to take the lead in coordinating the GASP.
   - Undertake further husbandry research in order to breed the species more consistently and to ensure adequate founder representation.

2.12 EURASIAN CRANE (*Grus grus*)

2.12.1 Summary

The Eurasian Crane is the third most abundant species of crane after the Sandhill and Demoiselle Crane. The total population, estimated at between 220,000 and 250,000, is probably increasing, although some populations are declining. As no coordinated survey has been carried out throughout the entire species' range, this assessment should be considered tentative. The species is not globally threatened, but does have special protected status in many countries. The species is classified Lower Risk (Least Concern) under the revised IUCN Red List Categories. Breeding populations in European Russia and central Siberia are classified Vulnerable, while small populations in Turkey and the Tibetan Plateau are classified Data Deficient.

The species' breeding range extends from northern and western Europe across Eurasia to northern Mongolia, northern China, and eastern Siberia, with isolated breeding populations in eastern Turkey and Tibet. The winter range includes portions of France and the Iberian Peninsula, north and east Africa, the Middle East, India, and southern and eastern China. The species continues to occupy most of its historic range, but over the last 200-400 years it has been extirpated as a breeding species in southern and western Europe, the Balkan Peninsula, and southern Ukraine.

The Eurasian Crane nests primarily in bogs, sedge meadows, and other wetland types within Eurasia's boreal and temperate forest zones. Under natural conditions, they prefer large,

isolated nesting territories. However, in intensively cultivated areas they have adapted to using smaller and less wild wetlands. During migration, they forage in agricultural fields, pastures, and meadows, and roost in shallow lakes, bogs, rivers, along the edges of reservoirs, and in other wetlands. The widely scattered wintering grounds include a wide spectrum of upland and wetland habitats, from open oak woodlands in the Iberian Peninsula to shallow lakes, agricultural fields, and deltaic wetlands in China. They are omnivorous, foraging in wetlands, on dry land, and in agricultural fields for a wide variety of plant and animal foods.

Habitat loss and degradation are the principal threats to the species. Wetlands have been lost to drainage, dams, and other forms of development throughout the breeding range (particularly in Europe, European Russia, and central Asia) as well as along migration routes and in wintering areas. Although they have adapted to human settlement in many areas, continuing changes in land use and agricultural production methods (such as expanded irrigation and conversion of traditional pastures) also have negative impacts. Human disturbance and collision with utility lines are problems in Europe and other heavily developed portions of the species' range. Hunting is a significant concern for the populations that migrate through Afghanistan and Pakistan.

ICF

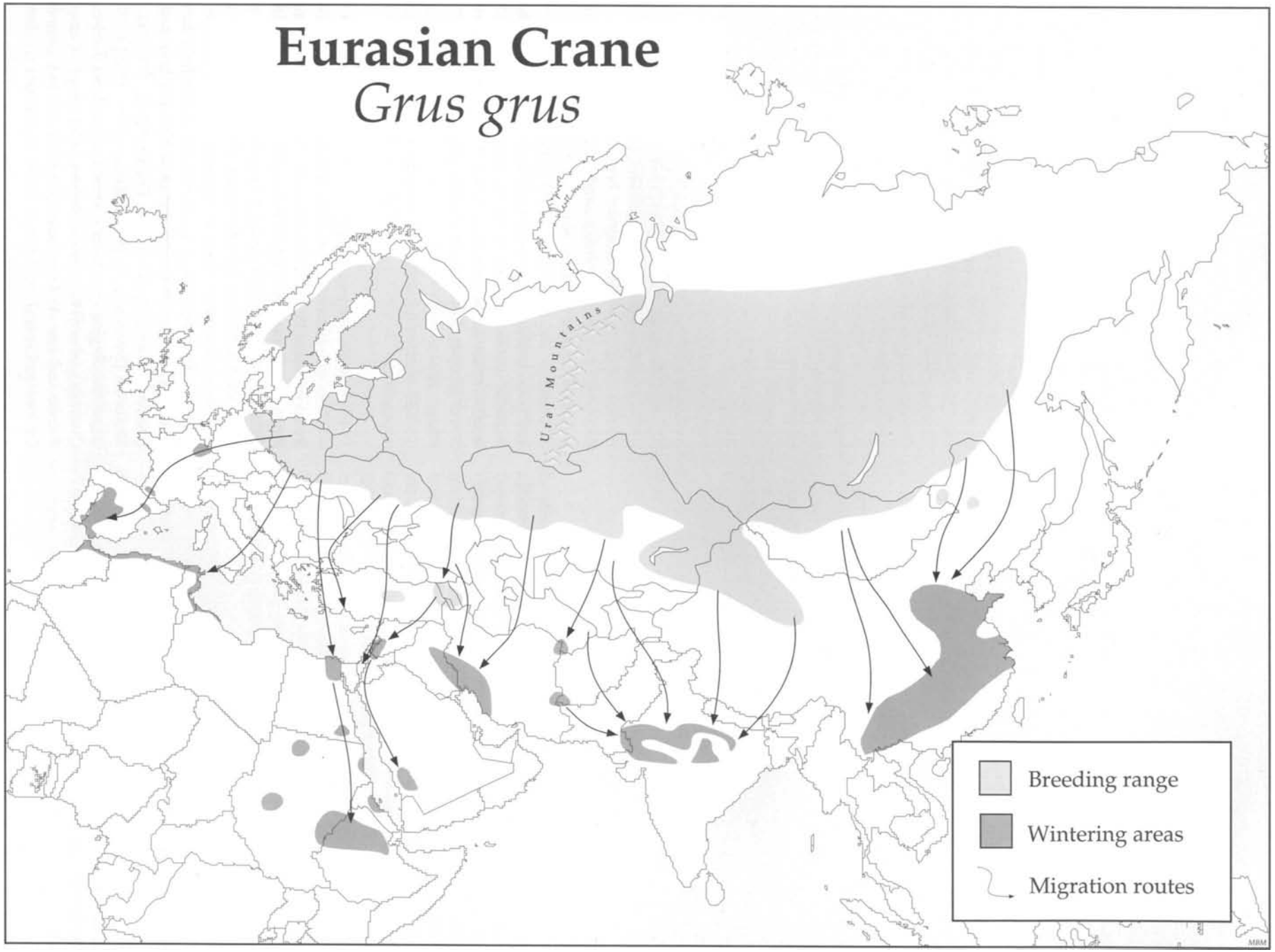
Eurasian Crane (*Grus grus*), Germany

Conservation measures have been undertaken most intensively in the western portions of the species' range. In western and central Europe, the species has benefitted from legal protection, systematic research and monitoring programs, creation and restoration of wetlands, and protection of important staging areas, roosting sites, and wintering grounds. Information about migration patterns is available due to color banding programs and regular observations along the migration routes. International cooperation has played an important role in promoting these measures. In the last decade, such cooperation has expanded into Eastern Europe, where the species has been under greater threat due to recent economic changes. Conservation efforts have been less focused in eastern Russia, Africa, the Middle East, and Asia. In these areas, however, the Eurasian Crane often shares habitats with other crane species and in many cases has benefitted from conservation actions undertaken on their behalf.

Priority conservation measures for the species include: adoption of the Ramsar Convention in all range countries; stronger legal protection for cranes and crane habitats; expanded international research, monitoring, and conservation programs; establishment of protected areas at key breeding, staging, and wintering areas; broad-scale wetland protection and restoration programs (especially in Europe); expanded efforts to survey and census populations; research on the number, status, distribution, migration routes, and breeding and wintering areas of the main populations; field studies of the isolated populations in the Tibetan Plateau and Turkey; establishment of a central database to maintain information on the species; coordinated efforts to address crop depredation problems; training programs for volunteers working in protected areas established for cranes; and expanded education programs for students and the general public.

2.12.2 Subspecies/populations

In the past the Eurasian Crane was split into two subspecies, *G. g. grus* (the western Eurasian Crane) and *G. g. lilfordi* (the eastern Eurasian Crane). This classification, however, is no longer generally accepted. The species was originally divided on the basis of variations in plumage color. It has since been determined that these variations were due in part to differences in feather-painting behavior. Seven main breeding populations have been identified (see below).


Eurasian Crane
Grus grus
Ural Mountains
Breeding range
Wintering areas
Migration routes

2.12.3 Population Numbers and Trends

Population	Number	Trend	Source
Western Europe	60-70,000	Stable to increasing	Muñoz-Pulido 1995, Alonso et al. 1995, Prange 1995
Eastern Europe	>60,000	Stable to increasing	Prange 1994, 1995, H. Prange pers. comm.
European Russia	~35,000	Declining	Markin and Sotnikova 1995, Y. Markin pers. comm.
Turkey	200-500	Declining	van der Ven 1981, J. van der Ven pers. comm.
Western Siberia	~55,000	Declining	Markin and Sotnikova 1995, Y. Markin pers. comm., J. van der Ven pers. comm.
C Siberia/ N China	5,000	Declining	Wang F. 1991, Ma 1995, Degtyaryev and Labutin 1995
Tibetan Plateau	1000?	Probably stable	J. Harris Pers. comm.
Total	220-250,000	Increasing overall, but with local declines	

The population numbers presented here should be considered tentative. Only in Europe and the central part of European Russia have populations been reliably surveyed and monitored on a regular basis. Trends in the populations are poorly understood. The total population is probably stable to increasing, with declines in some local populations (especially in the central and eastern portions of the range). In northeastern China, the Eurasian Crane was once a common breeding resident; it now occurs only rarely. Other populations, such as the West European, have increased steadily in recent years (but see note[1] below).

2.12.4 Conservation Status

Species	
IUCN category	Lower Risk (Least Concern)
CITES	Appendix II

The species is also included in Appendix I of Birds Directive 79/409/EEC, Appendix II of the Bonn Convention, and Appendix II of the Bern Convention.

Population	IUCN Category
Western Europe	Lower Risk (Least Concern)
Eastern Europe	Lower Risk (Least Concern)
European Russia	Vulnerable, under criteria A1a,c,d
Turkey	Data Deficient
Western Siberia	Lower Risk (Near Threatened)
C Siberia/N China	Vulnerable, under criteria Al C1
Tibetan Plateau	Data Deficient

2.12.5 Historic and Present Distribution

The Eurasian Crane is the most widely distributed of the fifteen crane species. The breeding range extends across Eurasia from Scandinavia, Western and Central Europe, Ukraine, Belorus, and Russia to western and northeastern China, northern Mongolia, and eastern Russia. The species' wintering grounds include portions of France, the Iberian Peninsula, north Africa, Sudan, Israel, Jordan, Saudi Arabia, Iran, Iraq, India, southeastern China, and perhaps Indochina. Isolated breeding populations occur in eastern Turkey and the Tibet Plateau. The Eurasian Crane has also been recorded as an occasional migrant or wintering bird in Japan, the Korean peninsula, and western North America.

The species continues to occupy most of its historic breeding range. Over the last 200-400 years, however, it has disappeared as a breeding bird in western and southern Europe, the Balkan Peninsula, and southern Ukraine, due mainly to the loss of breeding habitat (van der Ven 1981, Prange 1994). The species disappeared as a regular breeder in the British Isles about 1650; in France, Greece, and Italy in the 1700s; and in Austria, Bulgaria, Hungary, Romania, Yugoslavia, and portions of Germany and Poland in the 1800s (Prange 1989, J. van der Ven pers. comm.). Scattered breeding pairs continued to be recorded in many of these countries until the mid-1900s. Since the 1960s, the species has been able to return to some portions of its Central European breeding range (Johnsgard 1983, Prange 1994).

The species is divided here into seven main breeding populations:

1) *Western Europe population*

The population's breeding grounds are in Norway, Sweden, Finland, the Baltic states, northeastern Germany, Poland, and possibly western Russia (Prange 1989, Swanberg and Bylin 1993, Prange 1994). A few pairs have recently nested in the Czech Republic, Denmark, France, and the United Kingdom (Moreau 1990, Prange 1994). The population migrates southwest along and across the Baltic Sea, through Germany, the Netherlands, Belgium, and eastern and southern France to wintering grounds in France, Spain, Portugal, and Morocco (Swanberg 1986-87, Rinne 1995, Prange 1995). Important staging and resting areas include Lake Hornborga (Sweden), the Rügen-Bock region (Germany), Camp du Poteau and Lac du Der-Chantecoq (France), and Laguna de Gallocanta (Spain). In the mid-1970s, significant numbers of

S. TRANEBING

Eurasian Crane pair with chicks, Sweden

cranes began to winter in France (during mild winters, cranes may also remain at several important resting places in Germany). Since the 1960s, habitat has diminished throughout this population's range, but surveys at the staging areas and wintering grounds show an apparent increase in the population[1] (Alonso and Alonso 1990; Alonso et al. 1995; Mufioz-Pulido 1995; Prange 1989, 1995).

2) *Eastern Europe population*

The main breeding grounds are in Finland and the Baltic states (where mixing between the Western and Eastern Europe populations occurs), eastern Poland, western Russia, and Belarus. Birds from the westernmost portion of this breeding range migrate via Estonia to the Iberian wintering grounds of the West European population. Some birds follow a loop migration around the Baltic Sea to and from Iberia, flying over Finland in the autumn and over Sweden in the spring (Rinne 1995, J. Rinne pers. comm.). The majority of the population, however, migrates south into Slovakia and Hungary. Hungary's Hortobagy National Park protects a major staging area (more than 65,000 birds) (Fintha 1993, 1995). About one-third of the birds that rest in Hungary continue southwest across the southern tip of Italy and over the Mediterranean Sea to wintering grounds in Tunisia, Algeria, and possibly Libya (el-Hili 1995, Rinne 1995, Newton in press a, H. Prange pers. comm., J. Rinne pers. comm.). The migration route(s) of the remainder of the population have not yet been identified. However, in March 1995 a crane banded in Finland was recovered in Ethiopia, providing the first positive evidence that birds from this population winter in east Africa (J. Rinne pers. comm.).

More than 9,000 wintering Eurasian Cranes were counted in Ethiopia during the 1994 African Waterfowl Census (Taylor and Rose 1994).

[1] J. Alonso and J. Alonso (pers. comm.) note that increases in the West European population are "probably due to a reduction in adult mortality as a consequence of protection measures," but that "annual recruitment rates within the population apparently show a decreasing trend through the last 15 years." It is also possible that improved census procedures, as well as the current higher concentration of cranes at stopover and wintering areas, have contributed to an apparent "increase" in the population. Definitive identification of the trend in the population will require a longer series of accurate censuses.

3) *European Russia population*

The breeding grounds are in Russia west of the Ural Mountains, and Belarus and Ukraine (mostly east of the Dnieper River). The birds of this population migrate around the Black Sea through Ukraine, Romania, Bulgaria, and Turkey, or through Sivash Bay and Crimea and across the Black Sea and Turkey to wintering grounds in Turkey, Israel, Jordan, Saudi Arabia, Sudan, and Ethiopia (van der Berk et al. 1986, Grinchenko 1988a, Newton in press a). Some birds from this population may also follow the loop migration around the Baltic Sea (J. Rinne pers. comm.). Several thousand migrate east of the Black Sea to wintering grounds in Iran and Iraq (Newton in press a).

4) *Turkey population*

Information on the size, distribution, status, and movements of this population is extremely limited. Occasional pairs from the population have bred in neighboring Georgia (Abuladze 1995). These birds likely migrate with those of the European Russia population (see van der Berk et al. 1986).

5) *Western Siberia population*

The breeding grounds are east of the Ural Mountains in Russia and northern Kazakhstan. According to many reports, the population is declining in many regions (J. van der Ven pers. comm.). The majority of birds in the population follow a migration corridor southwest toward Afghanistan, and then southeast across Pakistan to wintering grounds in western and central India (Ahmad and Shah 1991, Khachar et al. 1991, Gole 1993a, Higuchi et al. 1994a). A smaller portion of the population migrates through Uzbekistan and Turkmenistan to wintering grounds along the Iran-Afghanistan border, especially in the valley of the Hamluth River and the Seistan Basin. Some may migrate across the Tibetan Plateau and through Nepal to wintering areas in east India (the Brahmaputra Basin).

6) *Central Siberia and Northern China population*

The breeding grounds are in south-central and eastern Siberia, Yakutia, and northern China. The population migrates across China to widely scattered wintering areas in southeastern China (Wang F. 1991; Ma 1991, 1995).

7) *Tibetan Plateau population*

The size and distribution of this population are poorly known. The breeding grounds are in Xinjiang and Qinghai Provinces of the northwestern Tibetan Plateau (Zhang 1994). The population presumably migrates to India.

2.12.6 Distribution by Country

Afghanistan*	M, W
Albania	M
Algeria	W
Armenia	M
Azerbaijan	M
Austria	M, X(b)
Bangladesh	W(?)
Belgium	M
Bhutan	M(?), W (occasional)
Bosnia-Herzegovina	M
Bulgaria	M, X(b)
Belgium	M
Belarus	B, M
Cambodia	X(w?)
Canada	V
Chad	W(?)
China*	B,W
Croatia*	M
Cyprus	M
Czech Republic	B (occasional), M
Denmark	B (rare), M
Egypt*	M, X(w?)
Eritrea	M
Estonia*	B, M
Ethiopia*	W
Finland*	B
France*	B (rare), M, W
Georgia	B (rare), M
Germany*	B, M, W (rare)
Greece	M, X(b)
Hungary*	M, X(b)
India*	W
Iraq*	W
Iran*	**W**
Israel*	M,W
Italy	M, W (occasional), X(b),
Japan	V
Jordan	M,W
Kazakhstan*	B, M
Kirghizia	M
Korea, North	V
Korea, South	V
Kuwait	M(?)
Laos	X(w?)
Latvia*	B,M
Lebanon	M
Libya	W?
Lithuania*	B,M
Luxembourg*	M
Macedonia	M
Malta	M
Moldova	B(?), M
Mongolia*	B, M
Morocco*	W
Myanmar	W
Nepal	M
Netherlands	M
Niger	V
Nigeria	V
Norway	B

Oman	V
Pakistan*	M,W
Poland*	B, M
Portugal*	W
Qatar	W(?)
Romania	B (rare), M
Russia*	B, M
Saudi Arabia	W
Slovakia	M, X(b)
Slovenia	M
Spain*	M, W, X(r)
Sudan*	W
Sweden*	B
Switzerland	M (occasional)
Syria	M,W
Tadzhikistan	M
Thailand	X(w?)
Tunisia*	W
Turkey*	B, M,W
Turkmenistan	M
Ukraine*	B,M
United Arab Emirates	V
United Kingdom	B (rare)
United States	V
Uzbekistan	M
Vietnam	X(w)
Western Sahara	V
Yugoslavia	M

* = indicates countries where the birds occur in significant numbers at some point in the year
B = Present during breeding season
M = Present during migration (breeding and wintering in other countries)
W = Present during winter
V = Vagrant
X = Extirpated: (b) as a breeding species; (m) as a migrant; (w) as a wintering species; (r) as a permanent resident
? = Unconfirmed

2.12.7 Habitat and Ecology

The Eurasian Crane breeds in wetlands of the Eurasian boreal and temperate forest zones, from lowlands up to 2200 m, often foraging in nearby upland areas (Walkinshaw 1973, Johnsgard 1983, Prange 1989). Across this extensive breeding range, the species nests in a variety of shallow (20-40 cm) freshwater wetland types, including open marshes, forested swamps (especially birch and alder swamps), sedge meadows, lake edges, and bogs. In central Asia, drier habitats (even semidesert areas) may be used if water is available. Former breeding habitats in southern Europe were primarily permanent, densely vegetated marshes. Eurasian Cranes are omnivorous, probing and picking for a wide range of plant and animal foods both on dry land and in wetlands. Even during the chick-rearing period, however, they prefer to forage in upland areas (including agricultural fields) with short vegetation. During this period, animal foods—worms, snails, insects, arthropods, frogs, lizards, snakes, rodents—are very important (especially for the chicks) and tend to be more frequently consumed.

ICF

Territorial dispute between Eurasian and Black-necked Cranes, Cao Hai Nature Reserve, China

In most areas, Eurasian Cranes prefer large, isolated nesting territories with nesting sites that are well protected from disturbance. However, they have proven adaptable to even heavy human interference under some circumstances. Over the last three decades, breeding cranes in Scandinavia and central Europe have begun to use smaller and less wild wetlands within intensively cultivated landscapes. In northeast Germany they now breed in small (<1000 m^2) wet depressions in the midst of agricultural fields (Mewes 1994, Prange 1995). These birds are more tolerant of the presence of humans than those that breed in larger, more natural forested swamps. Breeding cranes have also returned to artificial and restored wetlands in areas (especially in Germany) from which they had been extirpated.

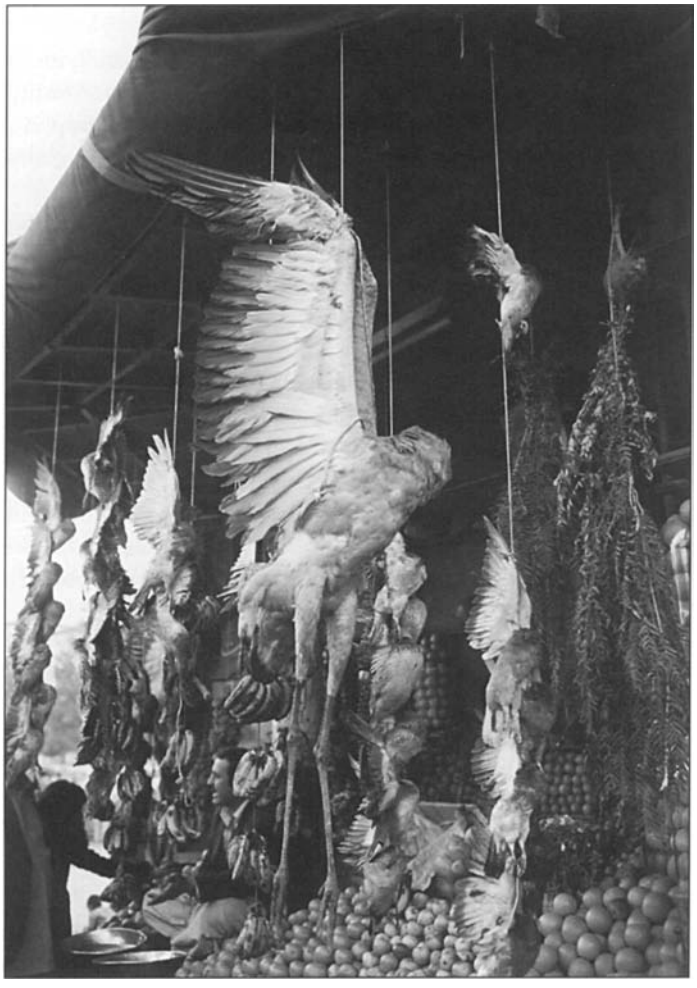
Nests consist of mounds of wetland vegetation. Eggs are laid primarily in May, usually two per clutch. The incubation period is 28-31 days, and chicks fledge at around 65-70 days. After the chicks fledge, Eurasian Cranes gather in large flocks prior to migration. In some areas these flocks assemble in agricultural fields, where they can cause crop damage. Flocks increase in size as the cranes gather at traditional staging areas before and during migration. Along their migration routes, they often forage in agricultural fields and roost in shallow lakes, large riparian wetlands, wet meadows, and other wetlands.

On their wintering grounds, Eurasian Cranes roost in wetlands and other shallow waters and forage for waste and sown grain, acorns, insects, and other foods in agricultural

fields, pastures, and other upland habitats. In general, plant items are much more important in the winter diet. Feeding and roosting habitats are highly varied throughout the species' widely scattered wintering grounds: open holm oak woodlands (*dehesas* and *montados*), cereal fields, and shallow wetlands in the Iberian Peninsula; lakebeds, large river valleys, and upland grasslands in North and East Africa; shallow lakes, reservoir edges, and coastal marshes in the Middle East and North Africa; agricultural fields, grasslands, reservoir margins, and other shallow water bodies in India; and shallow lakes, agricultural fields, and deltaic wetlands in China (Alonso et al. 1987b, Alonso and Alonso 1990, Almeida and Pinto 1995, Sanchez Guzman et al. 1993, el-Hili 1995, Farhadpour 1987, Newton in press a, Gole 1993, Wu and Wang 1986, Ji and Yu 1991, Xu X. et al. 1991).

2.12.8 Principal Threats

The leading threat to Eurasian Crane populations over the last several decades has been the loss and degradation of breeding habitat. Loss of wetlands and associated uplands to drainage, dams, agricultural expansion, urbanization, and other forms of development has been widespread throughout Europe, European Russia, and central Asia. For example, between 1958 and 1978 wetlands in the central portion of European Russia decreased by an estimated 37%, from 478,300 ha to 301,200 ha, and the crane population declined from about 3000 breeding pairs to 2500 pairs (Priklonski and Markin 1982). The same pattern has been observed in many other portions of the breeding range (e.g., Bulakhov et al. 1995, Kuchin 1995, Prokofiev 1995, Krivitski et al. 1995). Although destruction of wetlands has slowed in some areas in recent years, many additional breeding wetlands may be lost as political constraints on travel and development ease and economic growth intensifies.



R. SAUEY

Eurasian Crane in Kabul marketplace, Afghanistan

Wetlands have also been lost or degraded along the species' migration routes and on wintering grounds in China, India, the Middle East, northeastern Africa, and Europe (Harris 1992a, Farhadpour 1987, Newton in press a, Prange 1995). Many areas are subject to pressures related to increasing human population density. Human activities have a severe impact on wintering areas in China (many of which are shared with Siberian, White-naped, Hooded, Black-necked, and Red-crowned Cranes) (Harris 1992a). Destruction of wetlands in the Tigris-Euphrates basin along the Iran-Iraq border, and the continuing threat of warfare, constitute significant threats to the wintering population in this region. However, expansion of irrigated agriculture and associated artificial wetlands has created wintering habitat in Israel, Saudi Arabia, and several other arid countries (S. Newton pers. comm.).

Changes in land use, especially changes in agricultural production methods, are also of concern. This is of greatest consequence in Europe and India (Gole 1993, Prange 1995). The advent of mechanized farming in the present century has resulted in larger agricultural fields with reduced human activity on a day-to-day basis. This may actually have improved habitat conditions for cranes and allowed some populations to increase. Such adaptations, however, leave them vulnerable to further changes in cropping methods and land uses. In Germany, for example, reunification has resulted in dramatic changes in forestry and farming practices. These changes, in turn, have increased the pressure to drain wetlands used by breeding cranes, and have decreased food availability for migrating cranes in the Rügen-Bock region (von Treuenfels 1995).

At the same time, the West European population is increasingly concentrated in large flocks at feeding and roosting sites during migration due to the elimination of smaller traditional wetland roosting areas (Prange 1995). This population's wintering grounds in southwestern Spain and Portugal are threatened by the conversion of the traditional agricultural land use system—the open holm oak pastoral woodlands and extensive cereal cropfields—to irrigation agriculture, and by afforestation with eucalyptus trees (Alonso et al. 1987b, Alonso and Alonso 1990, Sanchez Guzman et al. 1993, Almeida 1995).

In areas where the population of Eurasian Cranes has stabi-

lized, increased, or become more concentrated, farmers have reported incidents of crop damage, particularly at staging and stopover points along migration routes, and on wintering grounds in eastern France, northern Spain (Laguna de Gallocanto), and India. This is likely to continue as a source of concern, especially as crane populations recover in areas in which they have been depressed, but where suitable habitat has declined (Alonso et al. 1991, Sanchez Guzman et al. 1993).

Historically, hunting probably contributed to the extirpation of breeding populations in England and southern Europe. Hunting continues to have a significant impact on the flocks that migrate through Afghanistan and Pakistan (see the Demoiselle Crane species account in this volume) (Roberts and Landfried 1987, Hamad and Shah 1991, Jan and Ahmad 1995, Landfried et al. 1995). Illegal shooting has been identified as a problem in other areas, including Portugal, southeast Europe, Egypt, and Sudan (Almeida 1995, Prange 1994, Newton in press a). Egg collecting is apparently a threat to the breeding population in Turkey (S. Newton pers. comm.). In other areas, such as the Rügen-Bock region of Germany, waterfowl hunting is a source of disturbance to cranes in nearby feeding areas (G. Nowald pers. comm.). Pesticides may be affecting cranes in some wintering areas, especially where they depend primarily on gleanings from agricultural fields (Newton in press a).

In heavily developed portions of the breeding range, nest disturbance by humans can reduce productivity indirectly by increasing the incidence of successful nest predation, primarily by crows, ravens, wild boars, and foxes. Predation may also be exacerbated during times of drought. Increased human disturbance is also a problem at many staging and winter roosting sites (Prange and Mewes 1991). Poisoning has been reported in several areas, normally along migration routes and in wintering areas (e.g., Zhmud 1988). Collisions with utility lines are frequent in highly developed areas of the breeding and winter ranges and along migration routes (e.g., Grinchenko 1988a). Collisions are probably the leading cause of adult mortality at wintering areas in Spain (Alonso et al. 1992, 1994a).

2.12.9 Current Conservation Measures

Conservation measures have been undertaken most extensively in the western portion of the Eurasian Crane's range. Outside of Europe, however, the Eurasian Crane often benefits from conservation actions undertaken on behalf of sympatric crane species.

Legal and Cultural Protection

The Eurasian Crane is legally protected in most range countries, including all European countries, Russia, Ukraine, China, India, and Iran. In many countries, however, stronger enforcement is needed. Wetland protection laws and policies, including compensation and incentive policies for wetland restoration, have played an important role in the species' recovery in parts of Europe. Although still hunted in Pakistan, legal restrictions on hunting were imposed beginning in 1984.

International Agreements and Cooperation

Because Eurasian Cranes are found in so many countries (more than any other crane species), international cooperation plays a key role in their conservation. The Ramsar Convention has drawn attention to important wetland habitats within signatory countries. In East Asia, the species has benefitted from international conferences, agreements, and conservation measures focused on the other, more endangered crane species of the region (see the White-naped, Siberian, Hooded, Red-crowned, Demoiselle, and Black-necked Crane accounts in this volume). In Europe, the European Crane Working Group (ECWG) has coordinated conservation activities—including research, monitoring, color banding, habitat protection, education, and recommended changes in agricultural policy—since the mid-1980s. This multilateral cooperation has been strengthened through meetings of the ECWG in Hungary (1985), Estonia (with members of the USSR Crane Working Group in 1989), Spain (1994), and Germany (1996). Although no range-wide conservation strategy for the species has been developed, scientists studying the species in Eastern and Western Europe, Russia, and North Africa have begun to work more closely together in recent years (see the papers in *Crane Research and Protection In Europe* (1995).

Protected Areas

Most of the Eurasian Crane's breeding sites are remote and scattered, and are found outside of established protected areas. However, some breeding areas are within protected areas in China, Russia, Ukraine, Poland, Germany, and several other countries (Ma and Li 1994, Harris 1992a, Patrekeev 1995, Estafyev 1995, Gromadzki 1995, Nowald in press). Staging areas are also generally unprotected. Of 166 major (>100 cranes) staging areas identified in Russia, only Taldom and the Oka Biosphere State Nature Reserve have been protected. More than 17 of these areas support over 1000 cranes (Y. Markin pers. comm.).

Full or partial protection is provided for migrating cranes at many key stopover sites, including the Xianghai, Keerqin, Momoge, Dalainor, and Dalinor Nature Reserves in China (Harris 1992a, Ma and Li 1994); two areas in Pakistan along the Kurrum, Gambeela, and Indus Rivers (UNEP/CMS 1995); Hornborga Lake in Sweden (Lundin 1995); Nationalpark Vorpommersche Boddenlandschaft in northern German; two sites (Hortobagy National Park and Kardoskut) in Hungary (Bankovics 1995); the Plain of Woe've and Lac du Der-Chanteqoc in France (Salvi et al. 1995); and Laguna de Gallocanta National Wildlife Reserve in Spain (Alonso et al. 1987a, Alonso et al. 1990). Prange (1995) estimates that 70-75% of habitats used as resting places are legally protected in Germany, allowing about 90% of migrating cranes to rest under secure conditions. However, at some protected areas (such as Laguna de Gallocanta in Spain) cranes remain subject to disturbance and harassment from farmers concerned about possible crop damage (Alonso et al. 1991, J. A. Alonso pers.

comm.).

Protected areas in the species' winter range include Yancheng, Shengjin Lake, Poyang Lake, Dongting Lake, Cao Hai, and Luguhu Nature Reserves in China; Massa National Park in Morocco; and several partially protected areas in southern France (Harris 1992a, Salvi et al. 1995). In the Spanish region of Extremadura, twelve reserves have been established through purchase or agreement with landowners (ADENEX 1995). The total area of these reserves, however, is small, and cannot ensure the long-term viability of these areas as wintering sites (J. A. Alonso and J. C. Alonso pers comm.).

Habitat Protection and Management

Protection and management measures have been undertaken primarily in habitats outside the breeding range. In China, habitat management takes place mainly within reserves, and in connection with the needs of other crane species. The Center for Independent Ecological Programs of the Russian Socio-Ecological Union has recently initiated a program, "To Save the Key Migrating Habitats of Common Cranes and Geese in Northwest Russia." The program focuses on the Kargopol District in Arkhangelsk Region, where Russia's largest known concentration of Eurasian Crane occurs (J. Almeida and N. Anzigitova pers. comm.).

The most intensive habitat management efforts have taken place in western Europe. These measures include: creation and restoration of wetlands; agreements with private land owners to protect key resting and wintering habitats[2]; clearing of dense vegetation from roosting areas; development of habitat management plans for protected areas; burial or relocation of utility lines; programs to encourage planting of lure crops and use of waste grain for diversionary feeding; and compensation programs for farmers suffering crop damage (Malik and Prange 1995, Swanberg 1987, Nowald 1994, Lundin 1995, Prange 1995, Salvi et al. 1995). Breeding pairs resettled former breeding habitats in the former West Germany after many of these measures were implemented (J. van der Ven pers. comm.).

Surveys/Censuses/Monitoring

Eurasian Cranes are often counted in the course of surveys of other cranes and waterfowl species. Breeding populations have been most closely monitored in Scandinavia, the Baltic nations, Poland, and Germany (Mewes 1989, 1994; Prange 1995). In recent years, surveys have been conducted regularly at key staging and wintering areas in Russia, Europe (Spain, Germany, France, Portugal, Hungary, Sweden, Estonia) and North Africa (Morocco and Tunisia) (Munoz-Pulido et al. 1988, Alonso and Alonso 1990, Almeida 1992, Sanchez Guzman et al. 1993, Lundin 1995, Prange 1995, Fintha 1995, Munoz-Pulido 1995, Newton in press a, Y. Markin pers. comm.). Since 1990, winter counts have been conducted in Asia and Africa under the auspices of the IWRB and AWB (Taylor and Rose 1994, Davies in press).

Research

Over the last two decades, research on the distribution, biology, ecology, and conservation status of the species has expanded significantly throughout the species' range. These include studies in China (e.g., Fan et al. 1994, Ji and Yu 1991, Liu et al. 1987b, Ma et al. 1993, Sai et al. 1991, Wang Q. 1991, Wu and Wang 1986); Russia (e.g., Ellis et al. 1992; Priklonski and Markin 1982, Markin and Sotnikova 1995); India and central Asia (e.g., Higuchi et al. 1994a; Khachar et al. 1991); Pakistan (Ahmad and Shah 1991, Landfried et al. 1995); and Israel (Levy and Yom-Tov 1991). Many of these studies have been published or summarized in the proceedings of the several international crane workshops, and in publications of the former USSR Crane Working Group (Litvinenko and Neufeldt 1982, 1988; Neufeldt 1982, 1989; Neufeldt and Kespaik 1987, 1989; Prange 1995).

Research on the Eurasian Crane has been most intensive in Europe. Field studies have focused on many aspects of the species' demographics, life history, feeding and wintering behavior, and habitat and conservation needs (e.g., Almeida 1995; Almeida and Pinto 1995; Alonso and Alonso 1992, 1993; Alonso et al. 1984, 1987a, 1987b, 1994b; Mewes 1989; Neumann 1987, 1991; Nowald 1994; Prange 1995). The results of many of these studies are reported in the proceedings of the meetings of the European Crane Working Group (Bankovics 1987, Prange 1995). The ECWG has studied the migration routes of the European populations since the mid-1980s through direct visual observation, color banding programs, and radio tracking, and has applied these research findings in new conservation measures (see papers in Prange 1995).

Non-Governmental Organizations

Several non-governmental organization have played an important role in the protection of the Eurasian Crane and its habitats. These include:

- The European Crane Working Group, and national groups in China, Estonia, Finland, France, Germany, India, Portugal, Russia, Spain, Sweden, and Ukraine.

- Naturschutz Deutschland (NADU). NADU has sponsored crane conservation activities since 1972 (von Treuenfels 1995).
  - Crane Protection Germany. This is a partnership of crane researchers, conservationists, officials, volunteers, and private enterprises (including Lufthansa Airlines) that organizes education projects; purchases breeding and resting habitats, manages habitats; counts, monitors, and observes cranes at staging and resting areas; and conducts diversionary feeding experiments

[2] These include management agreements prepared under EU Agri-environment Regulation EC Reg. 2078/92 to support extensive farming practices (J. Almeida pers. comm.)

(Prange 1995, von Treuenfels 1995).

- Euronatur. This a German organization that is helping to organize crane conservation projects in Spain (von Treuenfels 1995).
- The Estonian Ornithological Society, Estonian Nature Fund, and Prince Bernard Fund (Netherlands) have supported crane protection, research, and monitoring activities in Estonia (Kespaik 1995).
- Several organizations working with the French Working Group: Conservatoire des Sites Lorraine, Ligue pour la Protection des Oiseaux, and Centre Régional Ornithologique Aquitaine Pyrénées (A. Salvi pers. comm.).
- Asociación para la Defensa de la Naturaleza y los Recursos de Extremadura (ADENEX). Based in Extremadura, Spain, ADENEX promotes the conservation of the Eurasian Crane in its wintering habitats in southwest Spain through habitat protection and management, research, education, public relations, and advocacy campaigns (Meine 1994, ADENEX 1995).

Education and Training

Because Eurasian Cranes are the most easily observed crane species (and usually the largest bird species) in many portions of their range, they play a valuable role in education about cranes, wetlands, agriculture, and conservation. Public education is an important component of conservation programs at many of the key sites in Europe (e.g., Lake Hornborga in Sweden, Nationalpark Vorpommersche Boddenlandschaft in Germany, Lac du Der-Chantecoq in France, and the wintering sites in Spain). Crane Protection Germany is constructing an international crane information center on the coast of the Baltic Sea near Stralsund (von Treuenfels 1995). Landfried et al. (1995) provides a comprehensive review of education programs in Pakistan, where hunter education, professional training sessions, slide shows, and other activities have been undertaken to protect the three crane species that use this critical migration corridor into India. Further hunter education projects in this region are now underway (C. Mirande pers. comm.). Many education projects have also been developed in China, especially in the various nature reserves used by the Eurasian and other crane species. Formal training involving the species has been offered through the various working groups, through the 1993 African Crane and Wetlands Training Workshop in Botswana, and through ICF and other non-governmental organizations.

Captive Propagation and Reintroduction

The GCAR for cranes estimated that 279 Eurasian Cranes were being maintained in captivity as of 1993 (Mirande et al. in press a). The species is relatively easy to maintain and breed in captivity. The GCAR does not recommend establishing a captive program and assigns it C priority. The GCAR does note that there is interest in maintaining captive representatives of the species in China and in Europe for educational purposes. The species has also been used in captive propagation programs as a "foster parent" for other more endangered crane species. In Pakistan, captured cranes are often kept as pets.

It has been proposed that the species be reintroduced in parts of its range from which it has been extirpated as a breeding species (primarily southern Europe). However, Eurasian cranes have returned to former breeding areas on their own, and this process may be expected to continue as long as suitable wetland habitats are protected and/or restored. In these areas, the potential for reintroduction or natural recovery of the species should first be evaluated through (1) compilation and analysis of historical information on the occurrence of the species; (2) inventories of suitable wetland habitats; and (3) assessment of the opportunities for (and constraints on) restoration of the species and their habitats.

2.12.10 Priority Conservation Measures

Priority conservation measures for the Eurasian Crane (more so than those recommended for other crane species) reflect the widely varied ecological conditions, conservation status, and amount of available information across the species range. The measures recommended here need to be coordinated across the range, but are required to varying degrees within the different regions. The advanced work on the species in Europe provides an important foundation for work on the species throughout its range.

There are many opportunities to coordinate conservation actions for the Eurasian Crane and other crane species. The European Russian population of Eurasian Cranes shares priorities with the Black Sea and Kalmykia populations of Demoiselle Cranes. The Turkey populations of both the Eurasian and Demoiselle Crane require basic surveys and field studies. The Western Siberian population of the Eurasian Crane, the Kazakhstan/Central Asia and Eastern populations of the Demoiselle Crane, and the Western and Central populations of the Siberian Crane require many of the same actions along their migration routes and in their wintering grounds. In the east, the Central Siberia/Northern China and Tibetan populations of the Eurasian Crane share many of the priorities for the Siberian, White-naped, Hooded, Black-necked, and Red-crowned Cranes. See the accounts for these species in this volume.

Legal and Cultural Protection

1) Strengthen the legal foundation for protection of wetlands and other habitats in the Eurasian Crane's breeding grounds, along its migratory routes, and in its wintering grounds. Countries where this is a critical need include Afghanistan, Iran, Iraq, Pakistan, Turkmenistan, Tunisia, and Turkey.

2) Strengthen hunting regulations where greater protection is needed for Eurasian Cranes. Countries where this is a critical need include Afghanistan, Egypt, Pakistan, Romania, Tunisia, and the Balkan states.

3) Strengthen requirements for environmental impact assessments in the planning of development projects (dams and reservoirs, utility lines, roads, railways, etc.) affecting Eurasian Crane habitat. In general this is most important for migration stopover areas and in the species' wintering grounds.

International Agreements and Cooperation

The Eurasian Crane's extensive range and migration routes offer many opportunities for multinational conservation projects. High priority should be given to the following measures:

1) Support the signing and ratification of the Ramsar Convention in range countries where this has not yet occurred, and implementation of its provisions in signatory countries. In particular, the identification and protection of Wetlands of International Importance should proceed as quickly as possible.

2) Establish cooperative international conservation programs involving the countries along the migratory routes of all the main populations.

3) Expand international cooperation on research (especially monitoring and migration studies) and management strategies across the entire species' range.

4) Convene an international meeting, involving countries from throughout the species' range, to evaluate the status and conservation needs of the species as a whole.

5) Develop conservation incentives for the Western and Eastern Europe population under the European Common Agricultural Policy.

6) Develop a central database for information on all banded and observed cranes in Europe.

Protected Areas

1) Establish (or expand) protected areas at important breeding, staging, resting, and wintering areas.

   • *Breeding areas.* Identification of priorities for protection of specific breeding areas requires expanded field surveys. Immediate attention should focus on areas in Finland and other parts of Scandinavia, Poland, and Ukraine.

   • *Migration staging areas and stopover points.* Priority areas include sites in: Sweden (Lake Hornborga, Öland Island); eastern and southern France (Plain of Woëvre, Champagne Humide, Landes de Gascogne, Camp du Poteau, Lac du der Chantecoq); Estonia (Matsulu and possibly other spring stopover points in the Baltic republics; Spain (the Laguna de Gallocanta region); Germany (Nationalpark Vorpommershe Boddenlandschaft and the Rügen-Bock region); Russia (Kargopol); Romania (the Black Sea region); Ukraine (Sivash Bay); Turkey (Tuzla Gölü and Sultan's Marshes); and Kazakhstan (Turgaiski). Surveys to identify other critical areas should be undertaken in Germany, Russia, Poland, Turkmenistan, and Kazakhstan.

   • *Wintering areas.* Priority areas include sites in Yunnan Province, China (Luguhu Lake, Daqiao, and Changhaizi reservoirs); Portugal (Mourão-Moura, Évora, Castro Verde, Campo Maior); and Spain (Navalvillar de Pela, Brozas, Talavà, Zorita, Valdecañas, Borbollón, Gabriel y Galàn, Peraleda, Villanueva del Fresno). Surveys to identify other critical areas should be undertaken in India, Algeria, Tunisia, and East Africa.

2) Strengthen enforcement and management of existing protected areas. Priority areas are: Zhalong and Cao Hai Nature Reserves (China); Kurgaldzhinski and Naurzumski Nature Reserves (Kazakhstan); Nationalpark Vorpommersche Boddenlandschaft (Germany); Hortobagy National Park (Hungary); and Laguna de Gallocanta National Wildlife Reserve (Spain).

3) Develop a long-term international strategy to protect additional key Eurasian Crane habitats. This effort:
   - should be undertaken on a national and regional basis, but coordinated at the species level;
   - should entail breeding, migratory, and wintering habitats; and
   - should involve not only the establishment of formal reserves, but also protection through landowner agreements, incentive programs, and other measures.

Habitat Protection and Management

In general, habitat protection and management needs outside of Europe are outlined in other species accounts. The following measures are needed most urgently in breeding grounds in northern Europe; at important migration stopovers and resting areas throughout Europe; and at wintering grounds across the species range.

1) Provide alternative resting areas along the principal migration routes, especially by protecting and restoring smaller wetlands. (This pertains primarily to Europe, where such alternative areas are needed to prevent further concentration of migrating flocks).

2) Protect and manage existing wetlands, and restore degraded wetlands, that have the potential to provide nesting/roosting habitat. (This is most urgently needed within intensively cultivated or otherwise altered landscapes throughout Europe).

3) Protect wetlands, riparian forests, and floodplains in Central and Eastern Europe from further modification (i.e.,

dams, drainage, water diversions). (This pertains not only to major river systems such as the Oder, Elbe, Dnieper, and Danube, but also smaller streams and wetlands).

4) Protect and restore crane habitats on lands in Central and Eastern Europe now being returned to private individuals or local communities.

5) Provide incentives for farmers and other landowners whose land management practices benefit cranes. In particular, agricultural programs and policies should be modified to encourage the planting of crops used by cranes and to support traditional agricultural systems and practices (e.g., delayed fall plowing of stubble fields) in wintering areas. (This pertains primarily to western Europe).

6) Modify (through burial or marking) utility lines to reduce the incidence of collision. This is especially important in France, Spain, and portions of India and China.

7) Avoid inappropriate development of wind power facilities along flyways near the larger stopover points (as in the Rügen-Bock region).

Surveys/Censuses/Monitoring

1) Organize coordinated, simultaneous surveys and censuses in portions of the species' range where they are currently lacking. This is accomplished most easily through simultaneous surveys in wintering areas.

2) Continue and expand existing population and annual recruitment surveys, migration counts, and monitoring programs in Europe to gauge long-term trends in populations and habitats.

Research

1) Define and/or clarify the migration routes of the various populations.

2) Expand research on the number, status, distribution, and breeding and wintering areas of the various populations. This information should be used to produce a more accurate range map for the species.

3) Initiate field investigations of the size, status, habitats, and movements of the isolated populations in the Tibetan Plateau and Turkey.

4) Develop a coordinated, large-scale color banding and radio tracking project for *the* Eurasian Crane in Europe. This project would build upon the substantial amount of research that European scientists have undertaken in recent years, and would offer important benefits to researchers in other parts of the species' range.

5) Develop more systematic methods of assembling population and habitat-related data in order to evaluate realistically the status of the species. As part of this effort, improved methods of gathering, communicating, and coordinating scientific information across the entire range of the species will need to be developed. A central database should be established to maintain information on the species and its habitat.

6) Continue behavioral and demographic studies of the European populations (including investigations of age of pairing, degree of monogamy, dispersal rates, mortality, pair formation, breeding success, and tolerance of disturbance). These studies provide fundamental information of use in comparative studies of the species in other portions of its range, and in studies of more endangered crane species.

7) Clarify the intraspecific genetic structure and relationships among the populations.

Addressing Crop Depredation Problems

At present, the following actions are most critical in Sweden, Germany, France, and Spain, but are also relevant in Eastern Europe, Russia, India, and elsewhere.

1) Conduct additional research to evaluate accurately the level of crop damage, to distinguish between damage caused by cranes and that caused by geese, and to calculate fair levels of compensation.

2) Conduct research on crane feeding behavior and the effectiveness of diversionary feeding, lure crops, use of fallow lands, scare techniques, and other means of reducing the incidence of damage.

3) Improve farmer incentive and compensation programs involving cranes through adjustments in national and international agricultural policies.

Education and Training

1) Expand hunter education programs in Pakistan and Afghanistan (see the Demoiselle Crane species account in this volume).

2) Provide training programs for volunteers working in important wetland areas and in protected areas established for cranes.

3) Develop public education programs along the species' migration routes, with special emphasis on crane counts and the biology of migration. (In many areas, this can be *undertaken in conjunction with similar efforts for the* Demoiselle Crane).

4) Initiate public education programs in northern and eastern Africa.

5) Develop exchange programs involving students from the breeding and wintering areas of the various populations.

6) Develop collaborative public awareness projects involving government agencies and elected officials, conservation organizations and local volunteer groups, landowners, hunters and fishers, the media, and other organizations and individuals.

7) Develop programs directed specifically towards eco-tourists, emphasizing the value of cranes but also serving to prevent the level of human disturbance from increasing.

8) Support exchange programs and collaborative training opportunities for researchers from various parts of the species' range.

Captive Propagation and Reintroduction

1) Implement the following recommendations of the crane GCAR and CAMP (Mirande et al. in press a):
   - organize existing genealogical data on Eurasian Cranes that are being kept in captivity;
   - if bred, use birds of known genealogy to increase founder representation, equalize family sizes, and avoid inbreeding;
   - monitor breeding in the captive population and use this information to coordinate and allocate space in accordance with the needs of other crane species.
2) Monitor natural recovery in areas where the species has been extirpated (primarily western and southern Europe), assess the likelihood of further natural recovery, and determine the location and quality of potential recolonization and reintroduction sites.

2.13 WHOOPING CRANE (*Grus americana*)

2.13.1 Summary

The Whooping Crane is the rarest of the world's 15 crane species. The species' historic decline, near extinction, and gradual recovery is among the best known and documented cases in the annals of conservation. Over the last fifty years, a combination of strict legal protection, habitat preservation, and continuous international cooperation between Canada and the United States has allowed the only remaining wild population to increase steadily from a historic low of just 15 known individuals in 1940-41 to more than 150 at present. Since the mid-1960s, captive propagation has provided security against extinction of the species while affording opportunities to initiate new populations. The species provides an important case study in the conservation of rare and endangered species, and serves as a symbol for international cooperation in conserving not only threatened cranes, but biodiversity in general. The species is classified as Endangered under the revised IUCN Red List Categories.

The Whooping Crane occurs exclusively in North America. The historic mid-continental breeding range stretched from Alberta across the northeastern portions of the mid-continental prairies to near the southern end of Lake Michigan. The historic wintering grounds included the highlands of northern Mexico, the Texas Gulf coast, and portions of the Atlantic coast. Non-migratory populations occurred in Louisiana and possibly other areas in the southeastern United States. The species declined rapidly in the late 1800s and early 1900s as a result of hunting, collecting, and the conversion of its habitats to agriculture. By 1940, only the one self-sustaining flock remained.

As of August 1996 the adult Whooping Crane population numbered 205 in the wild and another 91 birds in captivity. In the wild, the species exists in three separate populations[1]: the historic Aransas-Wood Buffalo population; an experimental cross-fostered population, containing 3 birds, in the Rocky Mountains of the U. S.; and an experimental non-migratory population of released birds in central Florida. Whooping Cranes are maintained in captivity at five locations.

Historically, the species bred primarily in wetlands of the northern tall- and mixed-grass prairies and aspen parklands. The remnant wild population breeds at the northernmost extreme of the historic range in intermixed muskeg and boreal forest in Canada's Wood Buffalo National Park. During migration, this population uses a variety of feeding and roosting habitats, including croplands, marshes, and submerged sandbars in rivers along the migration route. They winter in bays and coastal marshes in and near the Aransas National Wildlife Refuge on the Texas Gulf Coast. The cross-fostered population in the Rocky Mountains utilizes high elevation marshes and riparian wetlands from Idaho to New Mexico. The experimental non-migratory population inhabits palmetto grasslands, savannahs, and shallow marshes in the Florida's Kissimmee Prairie region.

Whooping Cranes continue to face multiple threats, including habitat loss and pollution in their traditional wintering grounds, collision with utility lines, human disturbance, disease, predation, loss of genetic diversity within the population, and vulnerability to natural and human-caused catastrophes. Concern over the near extinction of the Whooping Crane has prompted a broad range of conservation actions, including national and international legal protections; comprehensive scientific research and monitoring programs; protection of key

[1] The Whooping Cranes in the experimental Rocky Mountain population did not successfully reproduce, while those in the Florida population have not yet reached sexual maturity. Thus, these are not self-sustaining biological populations in the strict sense. The term "population" is used in this account to differentiate the three wild flocks.

T.A WIEWANT

Whooping Crane (*Grus americana*)

habitats; development of Whooping Crane recovery teams and comprehensive recovery plans; and extensive public education campaigns.

Priority conservation measures for the future include: integration and implementation of the U.S. and Canadian Whooping Crane Recovery Plans; special attention to key problems within existing habitats, potential breeding areas, and potential reintroduction sites; continued efforts to establish two additional self-sustaining wild populations and a viable self-sustaining captive population; and research on a variety of specific topics important for the recovery and establishment of the species.

2.13.2 Subspecies/populations

No subspecies. In the wild, the species exists in three populations: the historic Aransas-Wood Buffalo population (AWP); an experimental cross-fostered Rocky Mountains population (RMP); and an experimental population of recently released non-migratory birds in central Florida (FP).

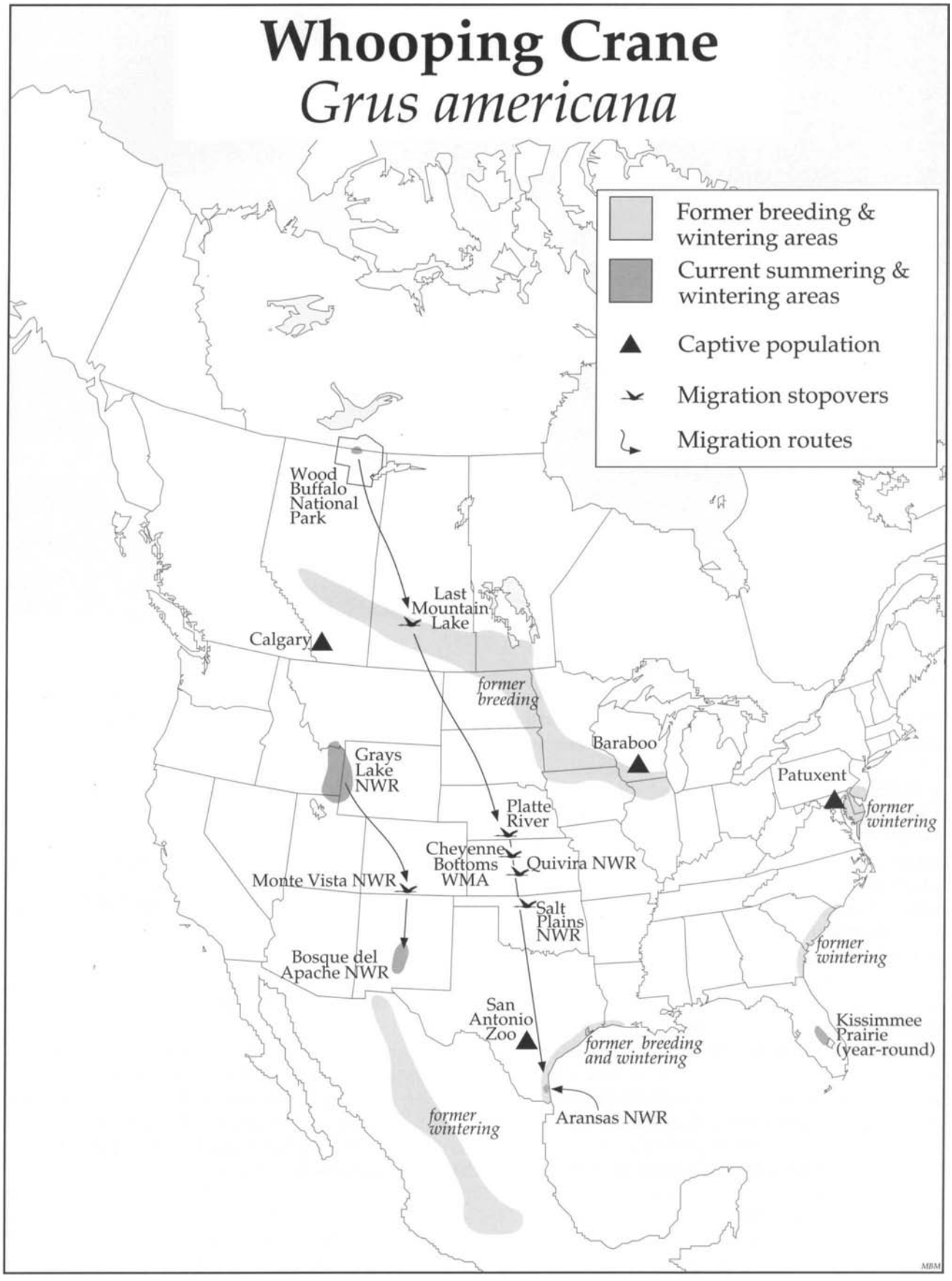
2.13.3 Population Numbers and Trends

Population	Number[2]	Trend
Aransas - Wood Buffalo	150	Increasing slowly
Rocky Mountain	3	Declining
Florida	52	Increasing through

2.13.4 Conservation Status

IUCN category	Endangered, under criterion D (also meets sub-criterion B1, but does not meet either B2 or B3; in order to fully qualify for Endangered under Criterion B, two out of three sub-criteria must be met).
CITES	Appendix I

[2]Population numbers current as of August 1996. These numbers include only adult birds. At this time, another 91 adult birds were being maintained in captivity at five sites (see table 1.2). All numbers and information on trends in the Whooping Crane population provided by Dr. James Lewis of the U.S. Fish and Wildlife Service and the members of the Canadian and U.S. Whooping Crane Recovery Teams.


Whooping Crane
Grus americana
Former breeding & wintering areas
Current summering & wintering areas
Captive population
Migration stopovers
Migration routes
Wood Buffalo National Park
Last Mountain Lake
Calgary
former breeding
Baraboo
Grays Lake NWR
Patuxent
former wintering
Platte River
Cheyenne Bottoms WMA
Quivira NWR
Monte Vista NWR
Salt Plains NWR
Bosque del Apache NWR
former wintering
San Antonio Zoo
former breeding and wintering
Kissimmee Prairie (year-round)
Aransas NWR
former wintering
MBM

2.13.5 Historic and Present Distribution

The Whooping Crane was likely never very common in historic times. The total population prior to 1870, when European settlement began to have a significant impact on the species and its habitats, has been variously estimated at between 500 and 1400 (Allen 1952, Banks 1978, Lewis 1995b). The principal historic breeding range stretched across central North America from central Alberta through southern Saskatchewan and Manitoba, northeastern North Dakota, western Minnesota, southern Wisconsin, northern Iowa, and northern Illinois (Allen 1952). Wintering grounds included southwestern Louisiana, the Gulf Coast of Texas, interior west Texas, the highlands of northern Mexico, and Atlantic coastal areas of New Jersey, Delaware, South Carolina, and Georgia (Allen 1952, Howell and Webb 1995). Non-migratory populations were found in coastal Louisiana, and possibly in other portions of the southeastern United States (Nesbitt 1982, Gomez 1992, USFWS 1994).

The species' range shrank rapidly in the second half of the 19th century, and by the 1890s it was extirpated from the U.S. portion of the historic breeding range (Allen 1952, McNulty 1966). Nesting in the aspen parklands of Canada was last observed in 1929, with unconfirmed reports continuing into the early 1930s (Hjertaas 1994). By the late 1930s, only two breeding populations remained: a remnant non-migratory population around White Lake in southwestern Louisiana, and a migratory population that wintered in coastal Texas but whose breeding grounds were unknown. Birds in the Louisiana population last nested in 1939. A hurricane in August 1940 reduced this population from 13 to 6 individuals. The last member of this flock was taken into captivity in 1950.

The only remaining flock of wild Whooping Cranes, the wintering population in coastal Texas, reached a low of 15 birds in the winter of 1941-42, and hovered between the low 20s and mid 30s over the next two decades (Boyce 1987, USFWS 1994) (see Figure 2.1). Efforts to locate the flock's breeding grounds intensified following World War II. Evidence of breeding was first reported in 1954, when several adults and pre-fledged juveniles were observed in Wood Buffalo National Park (WBNP) in Northwest Territories, Canada. Researchers were able to locate the first nests the following year (Allen 1956). The inaccessibility of the breeding grounds, protection of the wintering grounds, and extensive public education campaigns have contributed to the population's increase to its current (August 1995) level of 150 birds (Lewis 1995a). Since 1967, biologists have removed single eggs from two-egg clutch nests of the population, using these eggs in establishing captive and experimental wild populations (Erickson 1976, Kuyt 1993, Edwards et al. 1994).

The Aransas-Wood Buffalo flock remains the only self-sustaining wild population. The 47 known breeding pairs within the population (as of 1995) nest almost exclusively within the borders of WBNP. The population follows a relatively narrow (80-300 km wide) migration route across nine provinces and states: Alberta, Saskatchewan, Montana, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas (Kuyt 1992). The wintering grounds are found within and near the Aransas National Wildlife Refuge (ANWR) in Texas.

In 1975, experimental efforts to establish a second migratory wild flock through cross-fostering began at Grays Lake National Wildlife Refuge in southeastern Idaho (see Drewien and Bizeau 1978 for a summary of the methods used in this program). Eggs were transferred from the nests of AWP Whooping Cranes to nests of Greater Sandhill Cranes. Sandhill Crane "foster parents" raised the Whooping Cranes and taught them their traditional migration route to wintering grounds along the middle Rio Grande Valley in New Mexico. Continued artificial supplementation increased the number of Whooping Cranes in this population to a peak of 33 in the winter of 1984-85. However, the cross-fostered birds failed to form pair-bonds with others of their species. High mortality rates within the population, the failure of the birds to pair and breed (due likely to improper sexual imprinting), and prolonged drought in the summer range led to the decision in 1989 to curtail the egg-transfer program (Lewis 1995b, J. Lewis pers. comm.). Three captive-reared, Whooping Crane-imprinted juveniles have subsequently been released to test the viability of using adults as "guide birds" to teach cranes raised in captivity to migrate. Three birds remain in the population (J. Lewis pers. comm.).

In the 1980s, other options for release programs were explored. Potential sites for establishing a third wild population were selected for evaluation in 1983 and research at these sites began the following year. In 1988, the U.S. Whooping Crane Recovery Team selected the Kissimmee Prairie area in Florida for establishment of an experimental non-migratory population. This decision was made based on the failure of the cross-fostered migratory Whooping Cranes to pair and reproduce, and the lack of a proven technique for teaching migra-

M.A. BISHOP

Whooping Cranes unison calling, Aransas National Wildlife Refuge, Texas, USA

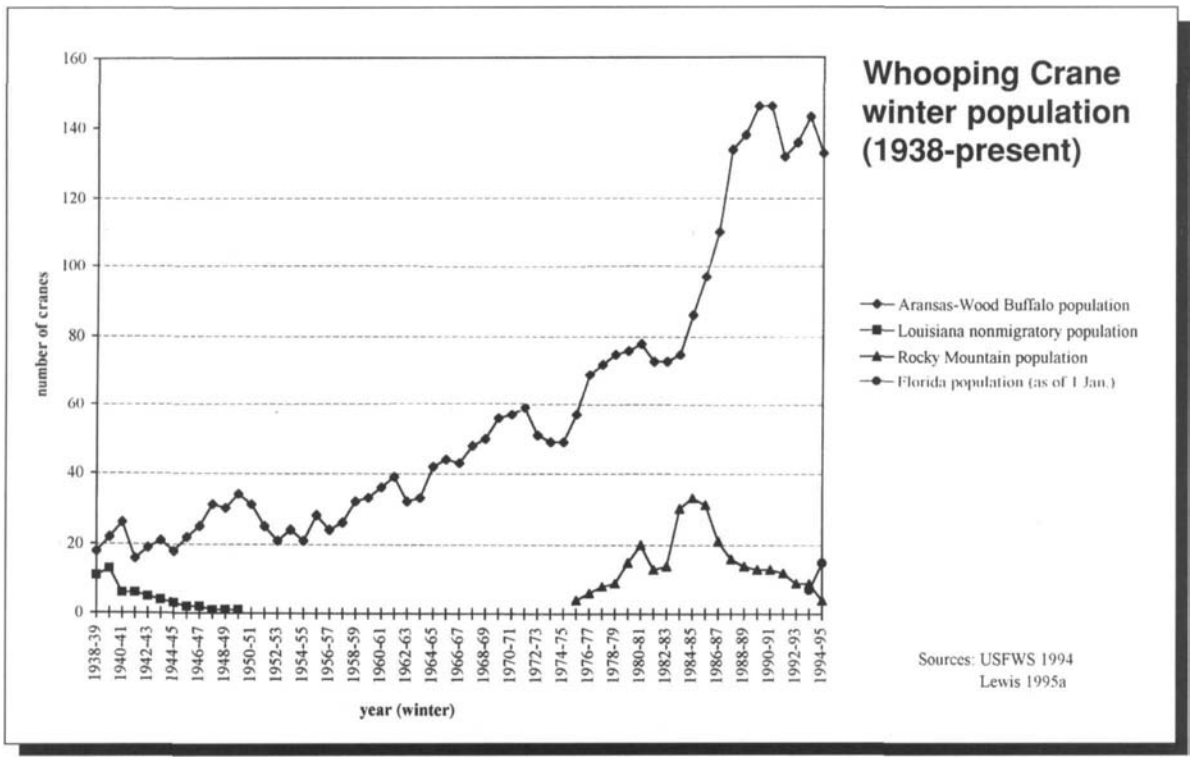


Figure 2.1

tion to captive-raised birds. The project was endorsed by the Canadian recovery team in 1988 and approved by the respective government wildlife agencies in 1989. The first releases, involving 33 captive-reared juvenile cranes, occurred from January 1993 to March 1994 (Nesbitt 1994b). As of August 1996, 52 of the released birds had survived. Additional releases of 20 to 40 birds annually are planned until the population is self-sustaining.

In addition to the wild populations, approximately 91 (as of August 1996) captive Whooping Cranes are maintained at five locations (see "Captive Propagation and Reintroduction" below) (Lewis 1995a).

2.13.6 Distribution by Country

Canada	B (AWP)
Mexico	X
United States	NB (RMP), R (FP), W (AWP)

B =	Present during breeding season
NB =	Present during breeding season but not currently breeding
R =	Permanent resident; not currently breeding
W =	Present during winter
X =	Extirpated

AWB =	Aransas-Wood Buffalo population
FP =	Florida population
RMP =	Rocky Mountain population

2.13.7 Habitat and Ecology

Historical records indicate that during the breeding season the migratory populations used the aspen parklands and wetlands along the northern and eastern borders of the tall- and mixed-grass prairie regions of central North America. In the winter, these populations foraged in grasslands, coastal marshes, and other wetlands on wintering grounds in Texas and Louisiana and along the Atlantic coast. The extirpated non-migratory population in Louisiana used tallgrass (*Panicum*) prairie.

The nesting grounds of the AWP within Wood Buffalo National Park are in poorly drained areas where muskeg and boreal forest intermix (Allen 1956, Novakowski 1966, Kuyt 1981a). Nesting territories range widely in size, from 1.3 to 47.1 km^2 (Kuyt 1981a, 1993). The cranes nest in emergent vegetation (primarily bulrush and sedges) in the shallow portions of ponds, small lakes, and wet meadows (Kuyt 1995). Nests are usually constructed of bulrush and other surrounding wetland vegetation in shallow (14-28 cm) water (Allen 1956; Kuyt 1981a, 1981b, 1995). Kuyt (1995) provides a comprehensive summary of data on Whooping Crane nests and eggs collected over 25 years at WBNP. More than 90% of clutches contain two eggs. The incubation period is 29-30 days (Kuyt 1982). Chicks fledge at 80-90 days. Whooping Cranes are omnivorous. On breeding grounds, they feed primarily on mollusks and crustaceans, insects, minnows, frogs, and snakes (Allen 1956, Novakowski 1966).

During migration, they feed and roost in a wide variety of habitats, including croplands, large and small freshwater marshes, the margins of lakes and reservoirs, and submerged

G.L HOLROYD

Whooping Crane nesting grounds, Wood Buffalo National Park, Canada

sandbars in rivers (including the South Saskatchewan, Platte, Niobrara, Cimarron, and Red) along the migration route (Howe 1989, Armbruster 1990, Kuyt 1992). Especially in the Canadian portion of the migration route, waste grain (barley and wheat) are an important part of the diet.

Most of the winter is spent in the brackish bays, estuarine marshes, and tidal flats of the Gulf of Mexico in and near Aransas NWR in Texas (Allen 1952, Stehn and Johnson 1987). These areas are dominated by salt grass, cordgrass, and other aquatic vegetation (Allen 1952, Labuda and Butts 1979). There the cranes feed primarily on blue crabs, clams, fiddler crabs, shrimp, and other aquatic invertebrates, small vertebrates, and plants (Allen 1952, 1956; Blankinship 1976). Upland areas are also used, especially when flooded or prescribe-burned. Cranes forage there for acorns, snails, insects, rodents, and other food items (Hunt 1987).

The cross-fostered population at Grays Lake shares the habitat of the Rocky Mountain population of Greater Sandhill Cranes: high elevation marshes and riparian wetlands in the Idaho-Wyoming-Montana border region, along the migration route through Utah and Colorado, and on wintering grounds in the middle Rio Grande valley. The cross-fostering site was an 8900 ha marsh at 1946 m elevation. The birds also use grain fields and pastures on private lands surrounding the refuge (Lewis 1995b).

The birds of the experimental Florida population are being released in the Kissimmee Prairie region — a flat, open area of palmetto *(Serenoa repens)* grassland and savannah interspersed with shallow freshwater marshes and lake-edge wetlands (Lewis 1995b). The release area also contains open, low-growth grasslands, including nearby private ranches where native grassland has been converted to pasture.

2.13.8 Principal Threats

Several factors contributed to the historic decline of the species. Much of the former range became unsuitable as a result of conversion to agriculture (Allen 1952). The migratory populations of the mid-continent lost large portions of their breeding and wintering habitat in the late 1800s and early 1900s. Conversion to rice culture deprived the non-migratory population of much of its habitat in the coastal marshes and prairies of Louisiana and Texas. In addition to outright habitat loss, these activities increased the level of human disturbance, which may have had adverse effects on crane behavior. At the same time, hunting, egg collecting, and specimen collecting were a substantial drain on the population, particularly from 1870 to 1920 (Allen 1952, Doughty 1989).

Whooping Cranes continue to face a wide variety of threats.

- Habitat loss and alteration continue to be sources of concern. The threat is greatest at Aransas NWR. In 1941, the Gulf Intracoastal Waterway was dredged through the core of the winter range. Due mainly to construction and maintenance of the waterway, an estimated net loss of 11 % of crane habitat had occurred at Aransas NWR as of 1986 (Sherrod and Medina 1992). Heavy use of the waterway has also resulted in erosion of the tidal marsh shoreline, a process that may be accelerating (Zang et al. 1993). Habitat alteration is also a major threat along the Platte River and at other migration stopovers (Currier et al. 1985, Faanes 1988, Faanes and Bowman 1992; for further discussion, see the Sandhill Crane species account).
- Pollution is a major threat to the wintering cranes at Aransas NWR. Since its construction, the Gulf Intracoastal Waterway has become one of the most heavily used barge traffic routes in the world. Much of the cargo consists of petrochemical products. Contaminants have been detected in the waters of the refuge, and small-scale spills have occurred in the past (Ramirez et al. 1993). A large-scale accident in or near

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The Gulf Intracoastal Waterway (top right) runs through the Whooping Crane's wintering grounds at Aranses National Wildlife Refuge.

the refuge could have catastrophic effects on the cranes and/or their habitat and food supply. The U.S. *Whooping Crane Recovery Plan* (1994) notes that the adoption of the North American Free Trade Agreement may increase the amount of traffic and the risk of accidents in the waterway.

- Oil drilling and extraction in and near Aransas NWR poses a potential threat to the AWB population's winter habitat. Drilling operations are prohibited when Whooping Cranes are present.
- The potential loss of freshwater inflow is an important long-term threat to the health and productivity of the bay systems in and near the Aransas NWR. Water flowing from the rivers into the bay is subject to rising demand for irrigation and for residential, commercial, and industrial development. Such withdrawals are predicted to have significant impacts on habitat conditions and the availability of food (especially blue crabs) for Whooping Cranes (T. Stehn pers. comm.).
- Human disturbance in the form of increased tourism, recreational and commercial boat traffic, waterfowl hunting, and other activities also poses a threat in and around Aransas NWR. Some of these disturbances cause cranes to leave the area, while other biological effects may be more subtle (USFWS 1994). The U.S. Recovery Plan notes that "[the] sources and intensity of disturbance are expected to increase in the future."
- Collision with utility lines has been the principal known cause of Whooping Crane mortality during migration (Howe 1989, USFWS 1994, Brown and Drewien 1995). Since 1956, at least 19 Whooping Cranes have been killed or seriously injured by such collisions. In a study of radio-marked juveniles conducted in the early 1980s, 2 of 9 individuals died as a result of collisions within their first 18 months of life (Kuyt 1992). Collisions with barbed-wire fences have also resulted in death (Allen and Ramirez 1990).
- Illegal and accidental shooting has occurred along the migration routes and near Aransas NWR. As hunting of Sandhill Cranes has expanded in recent years, the risk to Whooping Cranes has increased (Konrad 1987b). Inexperienced hunters are liable to mistake Whooping Cranes for Sandhill Cranes, snow geese, or tundra swans.
- According to Brand et al. (1991), "disease appears to be a significant, but insufficiently investigated factor adversely affecting the successful recovery of the Whooping Crane." Avian tuberculosis probably poses the greatest threat to wild Whooping Cranes. Avian cholera is of concern in the springtime, when cranes and waterfowl are concentrated along the Platte River. Mycotoxicosis and coccidia are also of significant concern. Unvaccinated Whooping Cranes appear to be extremely susceptible to the eastern equine encephalitis virus in areas where the mosquito vector is present. This is of special concern for the experimental flock in Florida, where repeated vaccinations will be difficult.
- Loss of genetic diversity and subsequent inbreeding depression are general concerns for the small and narrowly based Whooping Crane population (Mirande et al. 1993). Having come through an extreme genetic bottleneck -- the current population is derived from at most 12 (and more likely 6-8) founding individuals - the species is susceptible to inbreeding effects. The incidence of scoliosis and tracheal deformities among captive Whooping Cranes is higher than would be expected based on studies of wild Whooping Cranes and other cranes. The distribution of scoliosis cases among captive birds suggests that there may an inherited susceptibility within the population.
- Population models developed for the Whooping Crane Population Viability Analysis (see below) explored the potential impact of different degrees of inbreeding on population dynamics (Mirande et al. 1993). Estimates of genetic variability in the Whooping Crane population, along with data on the degree of relatedness of living Whooping Cranes, are now being gathered to evaluate these effects (see "Population Viability Analysis" discussion below). Recent mitochondrial DNA analysis (Snowbank 1995) indicates that only one maternal haplotype may be present in living birds.
- Drought on the breeding grounds of the AWP could have a critical impact on the population by reducing nesting habitat, reducing food supplies, forcing newly hatched chicks and their parents to move to other wetlands, and increasing the susceptibility of chicks to predation (E. Kuyt pers. comm.). Drought also poses a threat at Aransas NWR, mainly by altering salinity levels and food supplies in coastal wetlands and bays. The three populations are vulnerable to catastrophic events, including hurricanes and other extreme weather events.

2.13.9 Current Conservation Measures

Legal and Cultural Protection

The Whooping Crane is legally protected at the international level under the Migratory Bird Treaty (1916) and the Convention on International Trade in Endangered Species (1975). At the national level, legal protection is provided by the U. S. Migratory Bird Treaty Act (1918), the Canadian National Parks Act (1930), the Canada Wildlife Act (1972), the U. S. Endangered Species Act (1973), and the Canadian Migratory Birds Convention Act (1994). Although the species no longer occurs in Mexico, it is legally protected there.

International Agreements and Cooperation

The Whooping Crane provides an important example of international cooperation on behalf of wildlife, and a model for collaborative efforts to protect other migratory cranes. Lewis (1991) notes that, "cooperation between Canada, which

protects the nesting ground and important fall staging areas, and the United States, which manages the wintering grounds and migration stopovers, has been essential [in bringing] the species back from the brink of extinction."

The Canada-U.S. Migratory Bird Treaty of 1916 provided the first international-level protection for the Whooping Crane. The conservation agencies of the two countries had already worked together successfully for several decades when their respective roles and responsibilities were formally outlined in 1985 in a Memorandum of Understanding (MOU) on the Conservation of the Whooping Crane Relating to Coordinated Management Activities. The MOU has been renewed twice, in 1990 and 1995. The parties to the MOU are the USFWS, the CWS, the U.S. National Biological Service, and the Canadian Parks Service. The MOU provides mechanisms for shared decision-making and implementation of recovery activities, and for appointment of coordinators to facilitate such cooperation.

Cooperative conservation activities have also been stressed at the state and province level. To reduce the risk of loss during migration and to improve treatment of sick or injured birds when necessary, a Contingency Plan for Federal-State Cooperative Protection of Whooping Cranes was developed and adopted in 1985. The plan, approved by thirteen states and the USFWS, coordinates monitoring and response activities along the Whooping Crane's migration route. In Canada, a parallel contingency plan has been in place since 1987. The plan was outlined in the initial *Canadian Whooping Crane Recovery Plan* (Cooch et al. 1988). These contingency plans have also been incorporated into the Canada-U.S. MOU (Lewis 1992).

Whooping Crane Recovery Plans

The U.S. Endangered Species Act (1973) provides for the development and implementation of recovery plans for endangered species. These plans are prepared and periodically updated by recovery teams appointed by the U.S. Secretary of the Interior. The U.S. Whooping Crane Recovery Team was appointed in 1976 and the USFWS published its first Whooping Crane Recovery Plan in 1980. Since then, the plan has been revised twice, in 1986 and 1994. The Canadian Whooping Crane Recovery Team was established in 1987 to define and coordinate recovery activities within Canada. Its first plan was published in 1988 (Cooch et al. 1988) and revised in 1994 (Edwards et al. 1994)[3].

Recovery activities have been closely coordinated between the two nations, and the 1995 MOU on Conservation of the Whooping Crane calls for the preparation of a combined plan and the formation of a single recovery team comprising five U.S. and five Canadian members. At the time of publication these steps had not yet been taken, but were expected to be achieved directly (J. Lewis pers. comm.). The goals and strategies of the two national recovery plans are outlined below in the "Priority Conservation Measures" section.

Protected Areas

Much of the critical nesting, migration, and wintering habitat of the AWP is contained within protected areas. The main nesting grounds are located within Wood Buffalo National Park (established in 1922). Many of the population's migration stopovers and staging areas are protected within federal, state, and provincial wildlife refuges, waterfowl management districts, and other designated conservation areas. Several Whooping Crane staging areas are protected under Saskatchewan's Wildlife Habitat Protection Act of 1992 (B. Johns pers. comm.). Saskatchewan's Last Mountain Lake National Wildlife Area (established in 1887) also protects a significant stopover site. In the U. S., migrating Whooping Cranes utilize approximately twenty national wildlife refuges in eleven states (Lewis 1991). The Cheyenne Bottoms State Wildlife Area in Kansas is an important stopover point. The Aransas NWR, established in 1937, protects the main wintering grounds. Additional habitat surrounding Aransas NWR has been purchased by the U.S. government and the state of Texas with the assistance of The Nature Conservancy (Doughty 1989). The National Audubon Society has also entered into leasing arrangements on lands outside Aransas.

The Rocky Mountains population is concentrated at Grays Lake NWR in the breeding season and Bosque del Apache NWR in the winter, and utilizes several other state and federal wildlife refuges (especially Ouray NWR in Utah and Monte Vista and Alamosa NWRs in Colorado) during migration.

The core of the area where the experimental Florida population has been established consists of state wildlife management areas and parklands, as well as several large and small private holdings (including lands owned by the National Audubon Society) (Lewis 1995b).

Habitat Protection and Management

In addition to the establishment of the protected areas noted above, extensive habitat protection and management activities have been undertaken. These include the following.

- Under the provisions of the U.S. Endangered Species Act, the U.S. Fish and Wildlife Service in 1978 designated nine sites in six states as critical habitat for Whooping Cranes.
- At Aransas NWR and adjacent Matagorda Island, special habitat protection and management measures include: artificial impoundment of freshwater in ponds; prescribed burning of upland habitats to improve cover characteristics and enhance food production (principally acorns); continuing efforts to halt and mitigate the loss of shoreline to erosion; and experimental efforts to create

[3] The Canadian National Recovery Plan for the Whooping Crane has been published under the auspices of the Recovery of Nationally Endangered Wildlife (RENEW) Committee. It is now required that recovery plans be prepared for all endangered and threatened species on the Canadian Endangered Species List, which is prepared annually by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). These plans are prepared following a standard format and are approved by the RENEW Committee. See Edwards et al. (1994) for further information.

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Captive-reared Whooping Cranes at release site in Kissimmee Prairie area, Florida, USA

wetlands using dredge material (Hunt 1987, USFWS 1994, Lewis 1995b).

- In 1993, the USFWS developed contingency plans for responding to oil spills at Aransas NWR (Robertson et al. 1993).
- Since the early 1980s, the Platte River Whooping Crane Habitat Maintenance Trust has been actively restoring critical roosting habitat along the Platte River (Strom 1987, Currier 1991). See the Sandhill Crane species account for additional discussion.
- Tests of special utility line marking devices to reduce crane collisions have been undertaken using Sandhill Cranes as a surrogate species. Techniques identified in these tests have reduced collisions by 40-60% (Morkill and Anderson 1993, Brown and Drewien 1995).
- At a number of national refuges and state wildlife management areas, habitat conditions have been enhanced through water management and the planting of food crops (corn, barley, wheat, and field peas) (Lewis 1995b).
- Parks Canada has launched a project to identify the extent of suitable unoccupied habitat within WBNP (B. Johns pers. comm.).

Surveys/Censuses/Monitoring

All three populations of the species are closely monitored. The AWP has been counted annually on its wintering grounds since 1938. The AWP has been monitored on the breeding grounds by CWS since 1966 (Novakowski 1966, Kuyt 1993). The USFWS initiated a migration monitoring program in 1975 to compile information on sightings and stopover points. The program has been expanded and coordinated with information gathering activities of the CWS and states and provinces along the migration corridor. Aerial surveys of the breeding grounds are undertaken each spring to determine the number of breeding pairs and their nesting success. Annual productivity in the population is determined through surveys conducted annually at the Aransas NWR by the USFWS (see Binkley and Miller 1983, Boyce and Miller 1985, Boyce 1987, and Nedelman et al. 1987).

From 1977-1988, a color banding program undertaken at WBNP allowed U.S. and Canadian biologists to identify and study individual birds, yielding valuable information on many aspects of the population's demographics, migration behavior, and habitat use (Kuyt 1992). Radiotelemetry studies of the local movements and migration patterns of the cross-fostered RMP were carried out from 1979 to 1982. Similar studies of the AWP were undertaken from 1981-83. These studies were especially useful in providing information on migration dynamics and causes of mortality (Drewien and Bizeau 1981, Drewien et al. 1989, Kuyt 1992).

Research

Since the 1940s, the Whooping Crane has benefited from intensive research on virtually all aspects of its biology, life history, and ecology. These efforts were first carried out under the Cooperative Whooping Crane Project (Allen 1952, 1956). Since then scientists have built upon this foundation with wide-ranging studies of demographics, genetics, reproductive biology, migration, food habits, environmental threats, behavior, habitat ecology and restoration, captive propagation,

health management, and reintroduction. This information has been summarized in several publications, including Walkinshaw (1973), Johnsgard (1983), Doughty (1989), Mirande et al. (1993), USFWS (1994), and Lewis (1995b). Recent research topics include studies of historical summer and breeding records, winter habitat and ecology, breeding range expansion, new reintroduction and release techniques, potential release sites, the availability of migration habitat, and conservation genetics (e.g., Armbruster 1990, Ellis et al. 1992, May 1992, Kuyt 1993, Hjertaas 1994, Snowbank 1995).

Non-governmental Organizations

Non-governmental organizations have played a key role in drawing attention to the Whooping Crane's precarious status and in supporting and coordinating conservation programs. These groups include:

- The Saskatchewan Natural History Society (now Nature Saskatchewan) and the Saskatchewan Museum of Natural History (now the Wascana Museum) became involved in Whooping Crane conservation work in the 1940s, monitoring the migration and disseminating information on the species (E. Kuyt pers. comm.).
- The National Audubon Society (NAS) has sponsored critical research, habitat protection, and educational activities. In 1945, the NAS and the USFWS jointly initiated the Cooperative Whooping Crane Project to undertake necessary field research. This led to the publication of Robert Porter Allen's *The Whooping Crane* (1952). The NAS has also secured protection for portions of the habitat surrounding the Aransas NWR and the Kissimmee Prairie release site.
- The Nature Conservancy (TNC) has assisted in efforts to safeguard lands on the south end of Matagorda Island, adjacent to Aransas NWR and part of the AWP's critical habitat.
- The Whooping Crane Conservation Association (WCCA) has promoted Whooping Crane conservation and education activities since its founding in 1961.
- The International Crane Foundation (ICF). ICF has participated in the captive propagation program for Whooping Cranes since 1976. In 1989, ICF became the second captive breeding center for the species, and now contributes juvenile birds to the Florida experimental flock. ICF also sponsors research and focuses on the Whooping Crane in many of its educational activities.
- The Platte River Whooping Crane Habitat Maintenance Trust, established in 1978, carries out habitat protection, management, and restoration activities along the Platte River.

Population Viability Assessment

A population viability assessment workshop for the Whooping Crane was conducted in August 1991. The workshop included representatives of the U.S. and Canadian Whooping Crane Recovery Teams, the USFWS and CWS, ICF, other captive breeding programs, and the IUCN/SSC Conservation Breeding Specialist Group. The final report (Mirande et al. 1993) analyzed genetic and demographic characteristics of both the wild and captive populations. Its findings included the following:

- Approximately 87% of the species' pre-1938 genetic diversity persisted as of 1990 (the cumulative genetic loss being equivalent to that which would be expected from one generation of mating between half-siblings).
- At the time the captive population was established, it retained about 96% of the wild population's genetic diversity. With improved genetic representation, this may reach 98.6%.
- Based on extrapolations of existing data, the AWP has a very low probability of extinction over the next 100 years (<1%), although temporary declines are likely.
- Assuming (optimistically) no further habitat limitations or effects of inbreeding depression, the AWP was projected to reach 500 individuals in about 27 years and 1000 individuals in about 42 years.
- Even if the reproductive and survival rates of the RMP improve, the population is unlikely to become self-sustaining.
- Based on preliminary modeling, Florida should be able to support a self-sustaining population of Whooping Cranes (assuming releases of 10 or 20 birds per year for ten years).
- With improved management, it will be possible for the captive population to sustain planned release efforts. (Subsequent improvements in propagation programs have validated this conclusion).

The final report also identified specific priorities for research and management to retain maximum genetic heterozygosity and to minimize the risk of extinction.

Education and Training

Educational programs have been key to the survival of the Whooping Crane. Over the decades, the story of the species has been widely disseminated through books, newspaper and journal articles, radio, television, and documentary films. These efforts date to the late 1940s, when the Royal Saskatchewan Museum in Regina undertook an extensive education program focused on the species (B. Johns pers. comm.).

After the discovery of the AWP breeding grounds in 1954, educational efforts were initiated along the population's migration route. Hunter education was and continues to be important in reducing the risk of hunter-caused mortality in both the Aransas-Wood Buffalo and Rocky Mountain populations. The U.S. and Canadian Contingency Plans for protection of the species include educational components designed to enhance the public's ability to identify cranes and to encourage reporting of observations during migration (Lewis 1992, Edwards et al. 1994).

The Whooping Crane is also used in educational programs to convey broader lessons involving the conservation of

endangered species and biodiversity in general. Recent education projects focused on Whooping Cranes include: a live interactive video conference for students coordinated by the Patuxent Environmental Science Center and the Alliance for Environmental Education; exhibits at the new National Wildlife Visitor Center at Patuxent; and a new Whooping Crane educational exhibit at the International Crane Foundation.

Captive Propagation and Reintroduction

Captive propagation of Whooping Cranes for conservation purposes was first proposed in the mid-1950s (see Doughty 1989 for a review of the history of the captive propagation program). The initial step in establishing the program was taken in 1966, when a single male bird was transferred to the USFWS Patuxent Wildlife Research Center (now the Patuxent Environmental Science Center). In 1967, the CWS and USFWS began to remove single eggs from the nests of the AWP for hatching and raising at Patuxent. Birds from these eggs produced their first eggs in 1975. To minimize the risk of disease outbreaks and other potential threats, the captive propagation program was eventually expanded to the International Crane Foundation in 1989 and the Calgary Zoo in 1992. The Patuxent program provided eggs for the experimental cross-fostering efforts at Grays Lake. The programs at Patuxent and ICF are currently providing juvenile birds for the establishment of the non-migratory flock in Florida (USFWS 1994).

As of August 1996, 91 adult birds were maintained at the three principal propagation centers: 39 at Patuxent, 29 at ICF, and 18 at the Calgary Zoo. In addition, 4 adult Whooping Cranes are maintained at the San Antonio Zoo and one bird at the White Oak Conservation Center. Studbooks for both the captive and wild populations of Whooping Cranes are maintained by Claire Mirande of the International Crane Foundation and are available through ICF. Mirande et al. (in press a) and Mirande (pers. comm.) summarize current trends in the captive populations as follows:

- Of the six mature wild birds that were taken into captivity, and that survived and had an opportunity to reproduce, four have been successful.
- Artificial insemination is being used to breed unrepresented non-copulating males.
- Intensive pairing efforts have induced breeding in several females that had not previously done so.
- Changes in management of the captive population (i.e., decreased human contact during rearing, initiation of pairing at 1-1/2 to 2 years) have brought about earlier reproduction and increased rates of natural copulation.
- The number of pairs successfully parent-rearing chicks is rising.

The GCAR for cranes has recommended that Whooping Cranes be given the highest priority for intensive management, and endorses current efforts to develop a viable, self-sustaining captive population and to establish two separate additional self-sustaining wild populations (as per the recommendations of the U.S. and Canadian recovery plans) (Mirande et al. in press a). At present, reintroduction and release efforts are focusing on: continued supplementation, monitoring, and evaluation of the experimental Florida population; evaluation and selection of future release sites in Canada; further development of release techniques for establishing a migratory population; and development and testing of techniques for teaching captive-raised birds to migrate and survive in the wild. In the summers of 1995 and 1996, preliminary efforts were undertaken to identify an appropriate release site in Canada for establishment of the third wild population (A. Burke pers. comm.).

Teaching migration to young Whooping Cranes continues to be the most significant barrier to reestablishing wild populations through captive propagation. At present, two methods are being tested on an experimental basis using Sandhill Cranes. The first involves using ultralight planes to guide imprinted juvenile cranes on migration. This method has been successfully used to guide Canada geese and is now being tested on cranes at two sites. The second method involves transporting captive-raised juvenile cranes along migration routes and releasing them at intervals (+/- 35 km) to allow them to orient themselves. If these methods prove successful with Sandhill Cranes, they may be used to teach migration to Whooping Cranes within several years (D. Ellis pers. comm.).

2.13.10 Priority Conservation Measures

Implementing the Whooping Crane Recovery Plans

Unlike other crane species, the Whooping Crane has long been the focus of intensive conservation programs. The conservation needs of the species are defined in detail in existing recovery plans of the Canadian Wildlife Service and the U.S. Fish and Wildlife Service (Edwards et al. 1994, USFWS 1994). Priority should be therefore be given to the full implementation of the actions recommended and described in these plans. The goals and recommendations of the plans are summarized here.

1) *The U.S. Whooping Crane Recovery Plan*

The long-term objective of the *U.S. Whooping Crane Recovery Plan* is to downlist the status of the species from Endangered to Threatened. The plan states that, "based on existing knowledge, the minimum requirements for downlisting are maintenance of the AWP above the current 40 nesting pairs and the establishment of at least two additional, separate, and self-sustaining population, each consisting of 25 nesting pairs" (USFWS 1994). The plan seeks to expand the AWP to 1000 individuals. These goals are to be met for ten consecutive years before the species is reclassified. In order to attain these goals, the plan prescribes specific actions under four categories:

- Increase the size of the AWP to minimize the risk of catastrophic events. (The plan describes actions to monitor movements, reduce mortality, restrict detrimental human activities, and identify, protect, manage, and create habitat).

- Increase captive populations. (The plan describes actions to develop and maintain captive populations, refine avicultural methods and productivity, and maintain captive management facilities).
- Establish two additional self-sustaining wild populations. (The plan describes actions to develop release techniques, select release sites, establish non-migratory populations, and establish a migratory population).
- Maintain an information/education program. (The plan describes actions to develop media projects and provide viewing opportunities).

The *Whooping Crane Recovery Plan* includes an implementation schedule that provides priority rankings for these tasks, assigns responsibility, and estimates costs.

2) *The Canadian National Recovery Plan for the Whooping Crane*

The Canadian *National Recovery Plan for the Whooping Crane* lays out a series of actions "to be carried out in Canada, which will protect and increase Whooping Crane populations in Canada and elsewhere, and which will result in an eventual downlisting of the species from its present endangered status" (Edwards et al. 1994). The primary objectives of the plan are (1) to establish a stable or increasing AWB population with a minimum of 40 breeding pairs by the year 2000, and (2) to establish and support two other wild Whooping Crane populations, each with a minimum of 25 breeding pairs, by the year 2020. These objectives are substantially the same as those defined in the U.S. Whooping Crane Recovery Plan and must also be met for ten consecutive years before the species is reclassified. The plan identifies five strategies to meet these objectives:

- protect Whooping Cranes and their habitat in and near WBNP, and maximize the productivity of the WBNP population;
- protect Whooping Cranes and their habitat in areas other than WBNP, including the migration corridor and stopover and staging areas;
- establish additional wild populations as per the Canada-U.S. MOU;
- establish a captive breeding population in Canada; and
- expand the comprehensive public relations program to increase awareness and support for the goals and objectives as stated in the recovery plan.

The plan describes specific activities to support these strategies and includes a detailed implementation schedule. The implementation schedule ranks these activities, assigns responsibility and target dates for carrying them out, and provides cost estimates.

Integrating the U.S. and Canadian Recovery Plans

1) Combine and coordinate the national recovery plans for the species. The Canada-U.S. MOU on the Conservation of the Whooping Crane directs the CWS and USFWS to work toward this goal, and efforts to do so should proceed.

Protected Areas

Priorities in this area are outlined within the recovery plans. Special attention, however, should be given to the following measures:

1) Prevent future habitat loss and mitigate current habitat degradation at the Aransas NWR.

2) Initiate long-term measures to maintain freshwater inflow from the rivers into the bay systems at and near Aransas NWR.

3) Monitor disturbance levels and minimize detrimental activities at Aransas NWR and adjacent wintering grounds.

Habitat Protection and Management

Priorities in this area are outlined within the recovery plans, while many others are discussed within the Sandhill Crane species account in this volume. Special attention should be given to the following needs:

1) Maintain instream flow of the Platte River.

2) Prevent habitat loss and mitigate habitat degradation on the Platte River and at other key stopover and staging areas.

3) Implement existing habitat management plans for the Kissimmee prairie release site in Florida.

4) Reduce the risk of utility line collisions.

5) Evaluate and develop preliminary habitat management guidelines for potential release sites in Canada.

Research

Priority topics for research on Whooping Cranes are:

1) The capacity of the Aransas NWR winter habitat to absorb more cranes if the population continues to increase.

2) Expansion of the AWP breeding range at WBNP.

3) Continuation of breeding and wintering ground surveys.

4) Continued development of techniques for reintroducing and establishing new breeding populations and for establishing migratory routes among released birds.

5) Continuation of current efforts to evaluate potential Canadian reintroduction sites.

6) Evaluation of disease risks and management of diseases in the wild, especially in relation to the existing and potential release programs (see research recommendations in Brand et al. 1991).

7) Genetic studies (see research recommendations in Mirande et al. 1993)

Captive Propagation and Reintroduction

Detailed recommendations can be found in the Canadian (Edwards et al. 1994) and U. S. (USFWS 1994) recovery plans. Following these recommendations, as well as those outlines in the GCAR and CAMP for cranes (Mirande et al. in press a), the following general priorities are endorsed.

1) Continue efforts to establish a viable captive population aimed at producing young birds to support release efforts. The goal, as described in the U.S. *Whooping Crane Recovery Plan* (1994), is to have 40 actively breeding pairs in captivity by the year 2000: 15 at Patuxent, 15 at ICF, and 10 at the Calgary Zoo.

2) Continue efforts to establish two additional, separate, self-sustaining, wild populations. Efforts to establish the Florida population should proceed as determined by the combined Whooping Crane Recovery Team. Immediate attention should be given to identification and selection of potential sites for establishment of a migratory breeding population of Whooping Cranes in Canada in the late 1990s (Edwards et al. 1994, USFWS 1994).

2.14 BLACK-NECKED CRANE (*Grus nigricollis*)

Mary Anne Bishop

2.14.1 Summary

The world's Black-necked Crane population is estimated at 5,600-6,000. The species' breeding range includes much of the Qinghai-Tibetan Plateau in China, with a small breeding population occurring in adjacent Ladakh in India. Six wintering subpopulations are identified. Wintering grounds include lower elevations of the Qinghai-Tibet and Yunnan-Guizhou Plateaus in China, with some birds also occurring in Bhutan and Arunachal Pradesh, India. Published records and local reports indicate that the species has declined in many breeding and wintering areas over the last seventy years, although the population seems to have stabilized since the 1970s. The species is classified as Vulnerable under the revised IUCN Red List Categories.

During the breeding season Black-necked Cranes use high altitude wetlands, nesting in grassy marshlands, sedge meadows, and marshes along the shores of lakes and streams, and foraging in shallow marshes, streams, and pastures. Their diet includes plant roots, tubers, snails, shrimp, small fish, and other small vertebrates and invertebrates. The cranes winter in lower elevation agricultural valleys, where they feed mainly on waste grains and other residue in fields and pastures. In both breeding and wintering areas, Black-necked Cranes are quite tolerant of local people, and regularly feed near human settlements and domestic livestock.

Loss and degradation of habitat are the main threats facing the Black-necked Crane. These problems are most serious in the wintering areas, where wetlands have been extensively affected by irrigation projects, dam construction, drainage and conversion to agriculture, river channelization, heavy grazing pressure, sedimentation, industrial pollution, and other factors. In Tibet, widespread changes in traditional agricultural practices have reduced the availability of waste barley and spring wheat, the main winter foods. Hunting has become an important threat in several wintering areas as a result of the introduction of firearms and greater access to formerly remote areas. Other factors, including egg collecting and predation by feral dogs, are significant threats in some locales.

Conservation measures for the species have expanded significantly since the late 1970s. These measures include: implementation of an integrated program of conservation and development at Cao Hai Lake, a key wintering area in Guizhou Province, China; establishment of key protected areas in China and Bhutan; regular population surveys in the main wintering areas; expanded field studies of the species' distribution, habitat use, breeding biology, wintering ecology, and conservation status; support for conservation programs from national and international non-governmental organizations; and training programs for local conservation officials and reserve personnel. Local religious beliefs have also played a critical role in safeguarding the Black-necked Crane across much of its range.

Priority conservation measures for the species include: stronger efforts to control poaching; improved management of existing protected areas (especially Cao Hai Nature Reserve); establishment of protected areas in Yunnan and India; protection of wetlands (especially in wintering areas) against further deterioration and development; establishment of agricultural management areas in key wintering and breeding areas; regular, coordinated counts of the wintering subpopulations; banding and satellite radio studies of the main wintering subpopulations; studies of roosting habitats in Tibet, Yunnan, and Bhutan; development of education programs in schools and for the general public; and expanded training opportunities for nature reserve personnel.

ICF

Family of Black-necked Cranes *(Grus nigicollis),* Cao Hai Nature Reserve, China

2.14.2 Subspecies/populations

There are no subspecies. There are six known wintering subpopulations: 1) northeast Yunnan and western Guizhou; 2) northwest Yunnan; 3) southcentral Tibet (from Lhaze east to Nedong); 4) eastern Tibet (near Gongbogyamda); 5) Bhutan; and 6) Arunachal Pradesh (India).

2.14.3 Population Numbers and Trends

Wintering Subpopulation	Number	Trend	Source
NE Yunnan/ W Guizhou	1300-1600	Unknown	Yunnan Env. Prot. Comm. pers. comm. (l993), Wu Z. pers. comm. (1993)
NW Yunnan	<100	Stable to declining	Wei et al. 1993, 1994
SC Tibet	3,900	Stable	Bishop 1993a
HTibet	<20	Declining	Bishop et al. in prep.
Bhutan	360	Stable	RSPN 1993
Arunachal Pradesh	<10	Declining	Gole 1990, 1993b
Total	5600-6000	Stable but Vulnerable	

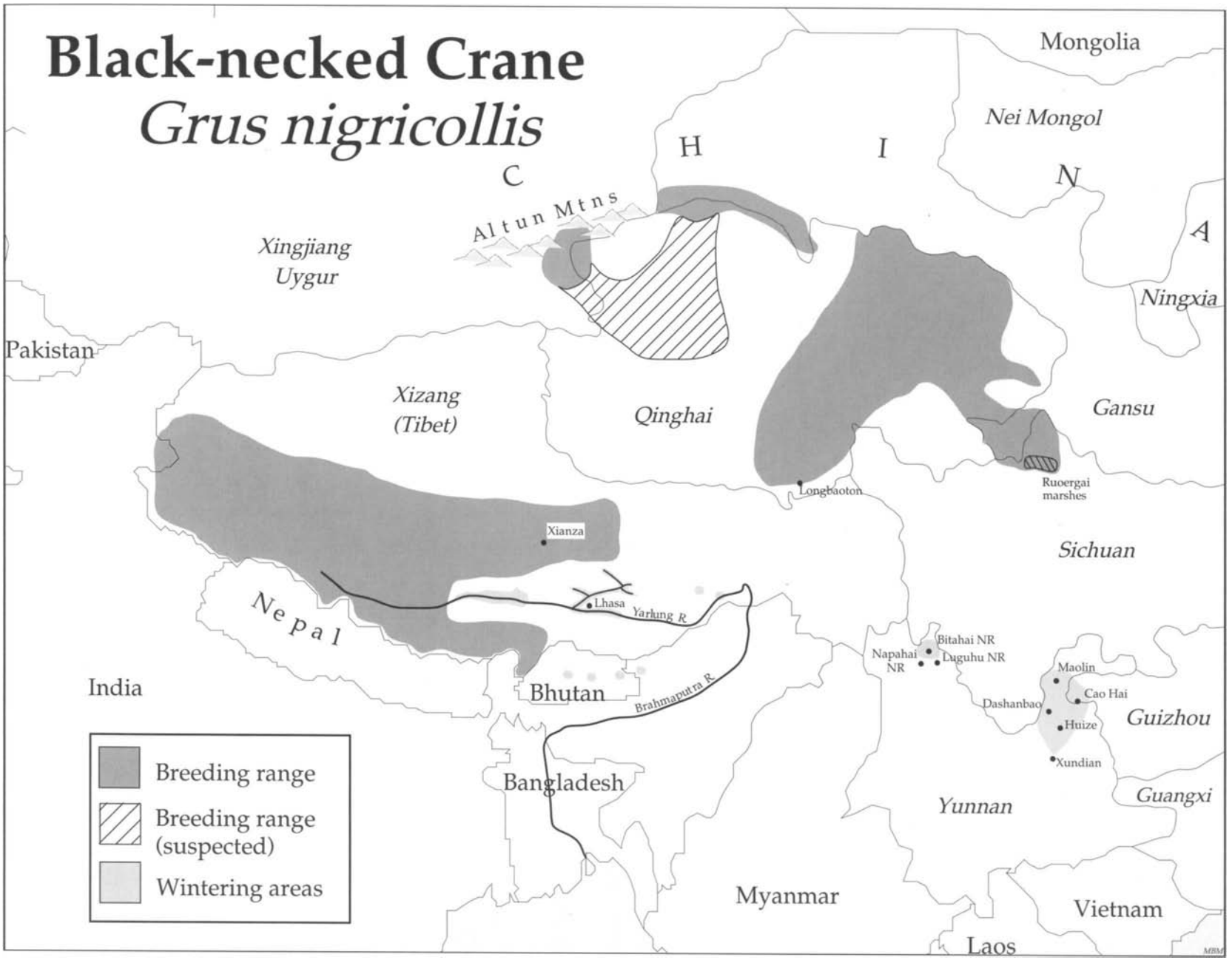
Coordinated counts were conducted annually from 1989 to 1993 on the wintering areas. The estimates here are based primarily on results obtained during the 1991-1992 winter count (Bishop 1993a). Some wintering subpopulations may not yet have been discovered. Additional wintering birds are most likely to be found in the more remote portions of Yunnan Province.

2.14.4 Conservation Status

IUCN category	Vulnerable, under criteria A1b,c,d A2c C1
CITES	Appendix I

2.14.5 Historic and Present Distribution

The range of the Black-necked Crane stretches across the Qinghai-Tibetan Plateau east to Cao Hai Lake on the Yunnan-Guizhou Plateau. The species breeds at elevations of 2950-4900 m in the Qinghai-Tibetan Plateau, from Ladakh (India) east to northern Sichuan Province. Within China breeding occurs in Qinghai, Tibet, Sichuan, Gansu, and Xinjiang Provinces. Breeding populations are widely distributed, with the largest and densest known concentrations at Longbaotan in southern Qinghai (Lu et al. 1980), the Ruoergai marsh in northern Sichuan (Li D. et al. 1991, D. A. Scott 1993), and Shenzha County in central Tibet (Feng 1989, Dwyer et al. 1992). The


Black-necked Crane
Grus nigricollis
Mongolia
Nei Mongol
H
I
C
N
A
Altun Mtns
Xingjiang Uygur
Ningxia
Pakistan
Xizang (Tibet)
Qinghai
Gansu
Longbaoton
Ruoergai marshes
Xianza
Sichuan
Lhasa
Yarlung R
Nepal
Bitahai NR
Napahai NR
Luguhu NR
Maolin
Cao Hai
India
Bhutan
Brahmaputra R
Dashanbao
Huize
Guizhou
Xundian
Bangladesh
Yunnan
Guangxi
Myanmar
Vietnam
Laos
Breeding range
Breeding range (suspected)
Wintering areas

only known breeding populations outside of China are in India's eastern Ladakh (<20 cranes) (Khacher 1981, Chacko 1992c, N. Kitchloo pers. comm.) and northern Sikkim (one pair) (U. Ganguli-Lachungpa pers. comm.). The loss of breeding populations is poorly documented, except at Lhasa in Tibet, where a few pairs formerly bred (Ludlow 1950).

Black-necked Cranes winter at lower altitudes (1900-3950 m) on the Qinghai-Tibet Plateau, on the Yunnan-Guizhou Plateau, in western central and northeastern Bhutan, and in northwest Arunachal Pradesh, India (Bishop 1993a). Very small numbers were recorded in Hadong Province in northern Vietnam earlier this century (Delacour 1927). The majority of Black-necked Cranes (approximately 4,000 birds) winter in southcentral Tibet in the Nyang, Lhasa, and Pengbo River valleys and along the middle reaches of the Yarlung Zsangbo (Bishop et al. in prep).

Although historical information on changes in the Black-necked Crane's range is limited, the species has evidently declined in many portions of its breeding range over the past 40 years. Historical records indicate that a small population (<30 cranes) wintered at Apa Tani Valley in central Arunachal Pradesh, India, until sometime in the 1970s (Khacher 1981). Due to habitat loss, other small populations have disappeared or declined to <10 cranes in northwest Yunnan (Lasihai Marsh in Lijiang County, Luguhu Lake in Ninglang County, and Caohai Marsh in Heqing County) (Wei et al. 1993, 1994); in southeastern Tibet (Linzhi County) (Liu 1986, Bishop et al. in prep); and in Bhutan (Bumthang) (Bishop 1989b, Chacko 1992a, 1992b).

While population counts for most wintering areas do not exist prior to the early 1980s, local people have noted substantial declines in some areas. Cao Hai Lake in Guizhou was drained during the 1970s, and crane numbers dropped to 35 by 1975. With the restoration of the lake in the 1980s the numbers climbed to about 400 by 1994 (Harris 1994b). At Xundian in northeast Yunnan, local observers have noted a sharp decline since 1984 (How-man et al. 1994). Black-necked Cranes were common in Tibet's Gyantse area in the 1920s; this population no longer exists (Ludlow 1928, Bishop et al. in prep.). Declines have also been reported by local people on the eastern Yarlung Zsangbo River and adjoining valleys between Gonggar and Nedong. In Bhutan, crane numbers at Bumdiling declined from 300 to <200 between 1974 and 1987 (D. P. Dorji unpubl. rept.).

2.14.6 Distribution by Country

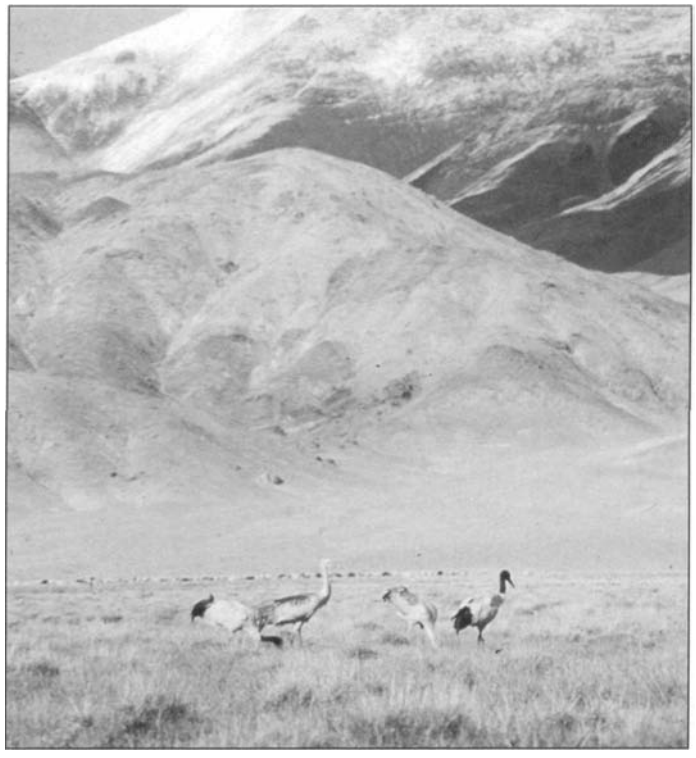
Bhutan	W
China	B,W
India	B, W (rare)
Myanmar	W?
Vietnam	X(w)

B = Present during breeding season
W = Present during winter
X = Extirpated: (w) as a wintering species

2.14.7 Habitat and Ecology

Black-necked Cranes breed in high altitude freshwater wetlands. Primary nesting areas are alpine grassy marshlands, small ponds in sedge bog meadows, lakeshore marshes, and riparian marshes along secondary channels or small streams (Li 1987). Nests are built on small, pre-existing grassy islands or in the water, and consist of mud, grass, sedges, and other aquatic plants. Depending on the area, cranes arrive on their breeding areas from late March through mid-May. Nesting densities as high as 2.2 pairs/km^2 have been recorded in central Tibet (Dwyer et al. 1992). Eggs are laid as early as the first week in May through mid-June. In central and western Tibet the mean laying date is May 28, with renesting attempts recorded as late as July 13 (Dwyer et al. 1992). Usually two eggs are laid. The incubation period is 30-33 days (Li 1987), and chicks fledge at about 90 days.

Black-necked Cranes are tolerant of local people and often establish territories near small pastoral settlements. In central Tibet, cranes nest within 200-2000 m of fixed sources of disturbance (roads and dwellings) and are within view of human habitations or domestic animals (Dwyer et al. 1992). Nests in Sichuan, Qinghai, Tibet, and Ladakh, however, are typically located in areas of deep mud, making them inaccessible to people, livestock, and mammalian predators. Preferred foraging habitats include shallow marshes, lakeshore marshes, small streams, and upland pastures. Cranes forage on plant roots and tubers, insects, snails, shrimp, fish, frogs, lizards, and voles (*Microtus brandtii*).



G. NARAYAN

Black-necked Cranes with chicks, Ladakh, India

Little is known about migration routes or staging areas. Based on limited banding studies, three migration routes have been suggested: 1) from northern Sichuan's Ruoergai breeding area to Cao Hai Lake in Guizhou some 800 km south; 2) from Longbaotan Marsh, Yushu County, Qinghai to Napahai, northwest Yunnan some 700 km south; and 3) southeast Xinjiang, western Qinghai, and northern Tibet south or southeast to southcentral Tibet (Wu et al. 1993, 1994). For Black-necked Cranes migrating to and from eastern Bhutan, the Kuri Chu (River) is a principal migration route (Chacko 1992b). Black-necked Cranes have been noted staging in spring at Damxung, Tibet (Dwyer et al. 1992). In the fall, cranes have been observed staging at Shenza in northern Tibet (Gu and Canjue 1993) and at Litang in western Sichuan (Dolan 1939).

Black-necked Cranes arrive on their wintering grounds between mid-October and early December and remain until March through mid-April. The cranes winter in lower elevation agricultural valleys, foraging mainly in agricultural fields and native and cultivated pastures. In agricultural fields they forage on residue of the fall harvest. In southcentral Tibet, northwest Yunnan, and Bhutan the principal crops include barley, spring and winter wheat, and (in Arunachal Pradesh and northeast Bhutan) rice. In northeast Yunnan and western Guizhou the cranes forage on cultivated crops, including maize, oats, buckwheat, carrots, radishes, potatoes, and turnips. In addition, Black-necked Cranes feed on tubers, seeds, earthworms, beetles, and snails. Cranes roost on the shores of reservoirs and in the secondary channels of rivers both at mid-day and in the evening. In a few cases, small wetlands are used as roost sites.

In northeast Yunnan and western Guizhou, Black-necked Cranes often winter with large flocks of Eurasian Cranes. Small numbers (<30) of Eurasian Cranes have been documented wintering with Black-necked Cranes in southcentral Tibet (Bishop et al. in prep) and at Bumdiling, Bhutan (R. T. Chacko pers. comm.). In southcentral Tibet (and less often in northeast Yunnan-Western Guizhou) cranes are also often seen foraging and roosting near Bar-headed Geese and Ruddy Shelducks. Throughout their winter range, Black-necked Cranes forage near domestic livestock, including yak, horse, cows, sheep, goats, and donkeys.

2.14.8 Principal Threats

Loss and degradation of habitat due to increasing human population pressures are the principal threats to the species in its winter range and also in some breeding areas. Irrigation,

A. AND A. BEACH

Habitat degradation is a major threat to Black-necked Cranes wintering at Cao Hai Nature Reserve in China

dam construction, drainage, sedimentation, and conversion to agriculture have affected wetlands and shallow lakes in many wintering areas, but especially in Yunnan and Guizhou. In Heqing County (Yunnan) and at Cao Hai (Guizhou), wetlands have been converted to deep fishing ponds that cranes are unable to use (Wei et al. 1993, 1994; Li 1994). In southcentral Tibet and Bumthang in central Bhutan, roosting habitat has been lost and local crane populations have declined as a result of the channelization of rivers for irrigation and flood control, and the conversion of crane habitat to cropland and tree plantations (Bishop et al. in prep.). Proposed hydroelectric projects along the Lhasa River (Anon. 1993) may also pose a severe threat to this important wintering area in Tibet.

Heavy livestock pressure has resulted in the degradation of grasslands and drainage of wetlands for pastureland at wintering areas at Cao Hai Lake, at Phobjikha (Bhutan), and at breeding areas in northern Sichuan and Ladakh (Li and Ma 1989a, Chacko 1992c, Elliott et al. 1989, D. A. Scott 1993). In northeast Yunnan, local people are mining peat for fuel from marshlands and reservoirs (Wang et al. 1990, Huang 1990, Rank 1994). Deforestation at Cao Hai Lake and at some of the Yunnan wintering areas has led to high rates of soil erosion and siltation of wetlands (Elliott et al. 1989, Li F. and Li M. 1991, Rank 1994). In addition, industrial pollution within the Cao Hai Lake watershed in Guizhou has increased due to the recent construction of zinc furnaces (Rank 1992, Li 1994).

Black-necked Cranes have also been affected by changing agricultural practices in southcentral Tibet. These changes have reduced the availability of residue barley and spring wheat, two of the species' principal winter foods. Whereas plowing traditionally took place in early spring, fall plowing is now mandated in some counties to control weeds and insects and to promote the warming of soil in the spring. As a result, waste barley and other surface residues have been reduced. At the same time, high-altitude varieties of winter wheat were introduced throughout southcentral Tibet beginning in the 1970s. Planted in late summer and harvested the following summer, winter wheat offers little surface food for the cranes (Bishop 1991). In Tibet, farmers using pesticides in the early spring have caused mortality in at least one wintering area (Gu and Canjue 1993).

Black-necked Cranes have been known to cause damage to crops (mainly potatoes, maize, and carrots) on wintering areas in northern and northeast Yunnan and at Cao Hai. In the Xundian area, crop depredation—and consequently the animosity towards cranes by Han and Yi farmers—is a recent phenomena and may reflect the loss of natural feeding habitat in local wetlands (How-man et al. 1994).

The introduction of firearms and new roads into once remote areas has made hunting a major threat in at least two wintering areas. In northwest Arunachal Pradesh, the increased availability of firearms and the heightened presence of non-native cultures has resulted in the decline and extirpation of local Black-necked Crane populations (Gole 1990, 1993b). Although hunting of Black-necked Cranes is prohibited by law in China, some Han and Yi farmers in Xundian and near Xuanwei (Yunnan) hunt Black-necked Cranes for food and use their wings in constructing scarecrows (How-man et al. 1994, He et al. 1995). In southcentral Tibet, crane hunting has been observed at six wintering sites, and local people report numerous other incidents (Bishop and Canjue 1993). Poaching has occasionally been observed at Cao Hai Lake and on the Tibetan breeding grounds.

In some breeding areas, egg collecting, feral dogs, and intense grazing pressures are also important threats. In Xinjiang Province in western China, the Uighur nomads in the Altun Mountains Nature Reserve collect eggs from crane nests in early summer each year (Zhang 1992). Feral dog predation on eggs and chicks has severely affected small breeding populations in Ladakh (Chacko 1992c). Overgrazing by domestic livestock in marsh areas degrades breeding habitats and, together with the increased human presence, likely disturbs breeding cranes. International trade is not of concern due to strict controls within China and Bhutan.

2.14.9 Current Conservation Measures

Legal and Cultural Protection

Cultural traditions have played an important role in the protection of the Black-necked Crane. On both wintering and breeding areas where Buddhism prevails (Bhutan, Tibet, Ladakh, Qinghai, western Yunnan, and western Sichuan), religious beliefs prevent the hunting of wildlife. Black-necked Cranes are regarded as supernatural spirits throughout their range, and appear often in religious images and on temple walls. They are also regarded as a symbol of luck and happiness and are recorded or mentioned in many historical books (Bishop 1993b).

The species is now legally protected throughout its range. By law, hunting of Black-necked Cranes is banned in China, India, and Bhutan. In China, all cranes have been listed as nationally protected animals since 1990 (Fan et al. 1994). Anyone convicted of killing a crane is imprisoned. In parts of Tibet, high fines are issued for both illegal hunting and egg collection (Gu and Liu 1987). In northeast Yunnan, rewards are given to farmers who bring in sick cranes (J. Harris pers. comm.). In Qinghai, the Black-necked Crane has been declared the "Provincial Bird," and special measures are taken for its protection (He 1990). It is also the symbol of Bhutan's Royal Society for the Protection of Nature, a non-governmental conservation organization.

International Agreements and Cooperation

International cooperation has played a key role in promoting conservation efforts on behalf of the species. In particular, much of the research undertaken in China, India, and Bhutan since the mid-1980s has entailed cooperative efforts among conservationists and biologists from these countries as well as the United States. At Cao Hai, the Guizhou Environmental Protection Bureau, ICF, and the Trickle Up Program (a New

York-based poverty alleviation organization) have collaborated since 1994 on a special watershed-scale conservation and community development program (Harris 1994b). The program involves four components: 1) community development; 2) scientific research and an experimental forestry project; 3) management of the Black-necked Cranes and the nature reserve; and 4) use of Geographical Informational Systems (GIS) in conservation planning (Li 1994). In support of these projects, two graduate students from China have undertaken studies at the University of Wisconsin-Madison in the United States.

Protected Areas

Most Black-necked Cranes nest outside protected areas. Within China, several nature reserves have breeding cranes: Longbaotan and Bird Island (Qinghai); Gahai, Ganhaizi, Big Suganhu and Small Suganhu (Gansu); Altun Mountain (Xinjiang); and Qomolangma (Tibet) (Ma and Li 1994). A special protected area has been proposed for breeding Black-necked Cranes in the Xiamen region of northern Sichuan (D. A. Scott 1993, J. Harris pers. comm.). The small (<20 birds) breeding population in Ladakh, India, occurs at the Changthang Cold Desert Wildlife Sanctuary (Chacko 1992c, N. Kitchloo pers. comm.).

Since 1983, several protected areas have been established to protect wintering Black-necked Cranes. In Bhutan, the Royal Department of Forestry has designated roosting areas in the Phobjika and Bumdiling Valleys as protected areas (RSPN 1991). In China, protected wintering areas in Yunnan Province include: Huize (Changhaizi, Daqiao, and Huohing Reservoirs), Dashanbao (Dashanbao in Zhaotong County and Maolin and Wuzhai in Yongshan County), Napahai, and Bitahai Nature Reserves; the Cao Hai Nature Reserve in Guizhou Province; and the Pengbo Nature Reserve in Tibet. These Chinese reserves are managed by several provincial agencies, including the Forestry Bureaus and Environmental Protection Bureaus, as well as county and municipal governments. Only one wintering area is now protected in Tibet. ICF has proposed to the Ministry of Agriculture that special agricultural management zones for cranes be established (Bishop and Canjue 1993). In Yunnan, the Xundian wintering area has been recommended for protection (How-man et al. 1994).

Habitat Protection and Management

Protection of Black-necked Crane habitat outside of protected areas has increased in recent years. In Ladakh, army officials have issued extensive instructions to all units near the breeding areas to mark and protect such areas. In addition, mounted patrols have been organized to prevent visitors from entering breeding areas. Stray dogs are regularly removed and fishing in these areas has been prohibited. No grazing is permitted in the nesting areas from May to August (R. T. Chacko pers. comm.). In Sangti Valley, Arunachal Pradesh, a committee of local people, assisted by the State Wildlife Department and Indian Army, maintains watch over the cranes and their wintering habitat (Gole 1995). In Bhutan, tourists at Phobjikha are able to watch, under supervision and from a distant blind, the cranes at their winter roosting sites.

Surveys/Censuses/Monitoring

Counts and surveys (primarily in wintering areas) have provided much new information on Black-necked Crane numbers and distribution since the mid-1970s. In India, surveys were initiated after the species was rediscovered in 1976 (see discussion under "Research"). Scientists and conservationists in Bhutan have conducted surveys of Black-necked Cranes since 1976 (Khacher 1981; Clements and Bradbear 1986; Dorji 1987a, 1987b; Bishop 1989a, 1989b; Gaston 1989; Gole 1989c; Chacko 1992a, 1992b). Between 1980 and 1987, surveys of wintering cranes were conducted at Cao Hai Lake and in southcentral Tibet (Lu 1983, 1986; Gu and Liu 1987; Li et al. 1988). From the winter of 1988-89 through the winter of 1992-93, Black-necked Crane surveys were conducted in Bhutan and in the Chinese Provinces of Yunnan, Tibet, and Guizhou under the auspices of ICF (Bishop 1989a, 1991, 1993). Infrequent surveys have also been undertaken in Vietnam and Arunachal Pradesh, India. On their breeding grounds, general surveys for Black-necked Cranes have been conducted in Qinghai (Yao 1982, 1986), Sichuan (D. A. Scott 1993), and Tibet (Feng 1989, Dwyer et al. 1992).

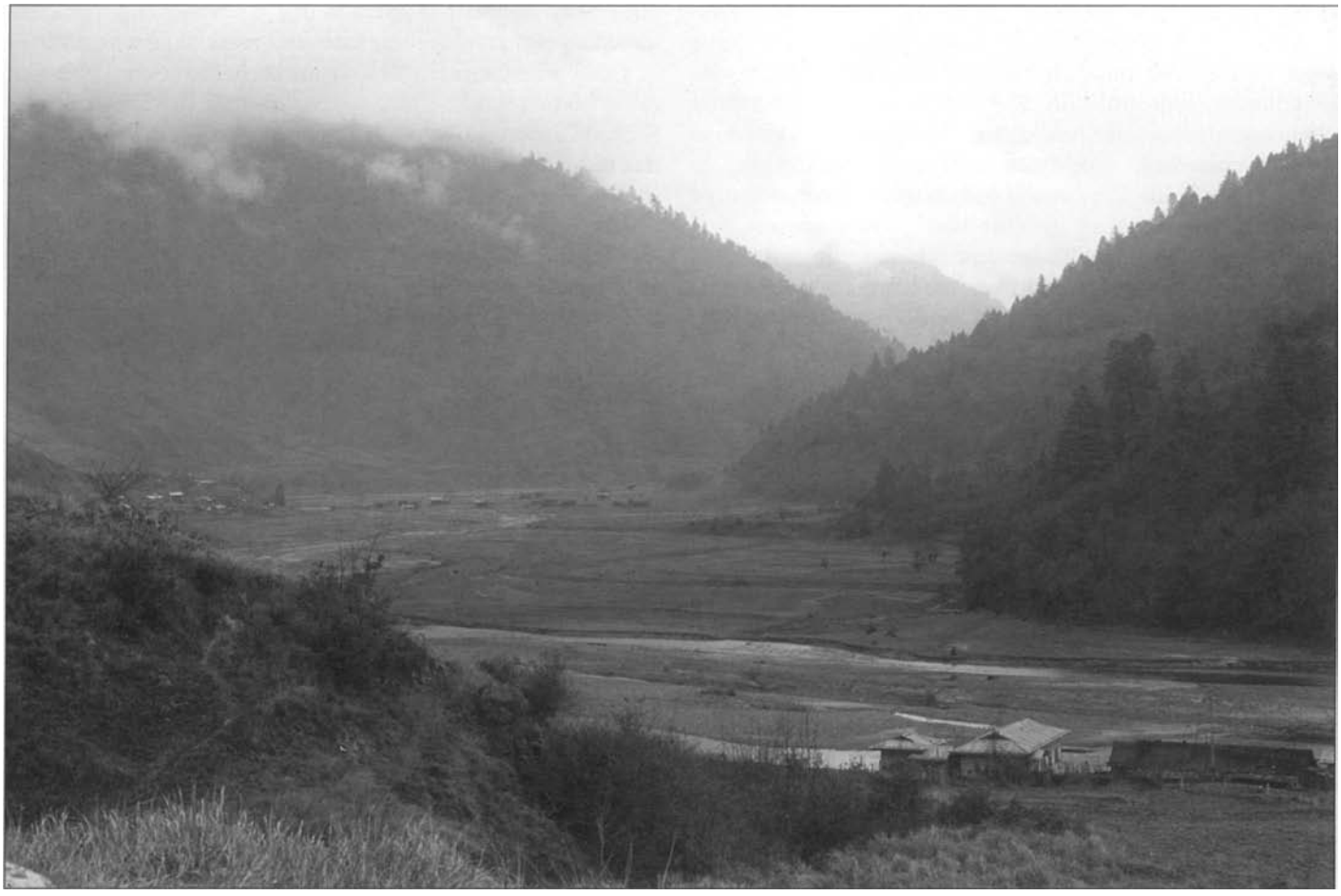
Research

Prior to the late 1970s, little was known about the status and ecology of the Black-necked Crane. Since then, however, field studies in China, Bhutan, and India have provided new information critical to the conservation of the species.

Since in the early 1980s, Chinese scientists have studied the status and distribution of the species throughout its range. These studies have been carried out mainly by scientists from the Academia Sinica Institutes of Zoology in Beijing and Kunming, the Guizhou Academy of Sciences, the Northwest Plateau Institute of Biology, the Shaanxi Institute of Zoology, and the Tibetan Plateau Institute of Biology. Major wintering areas in northeast Yunnan at Dashanbao, Wuzhai, and Mashu were documented in the late 1980s (Huang 1990, Wang et al. 1990, Wei et al. 1994, J. Wang and X. P. Chen pers. comm.). In 1993, scientists from the Yunnan Geographic Institute located a previously unknown wintering population at Xundian, 120 km northeast of Kunming, Yunnan (How-man et al. 1994).

Studies of the behavior and ecology of wintering Black-necked Cranes have been undertaken, mainly at Cao Hai Nature Reserve (Zhou et al. 1980, Wu and Li 1985, Li and Li 1985, Li et al. 1988, Li and Ma 1989a, Wu Zhikang et al. 1991, Li and Ma 1992). Since the mid-1980s, field studies of breeding biology have been conducted at Longbaotan Nature Reserve in Qinghai Province and the Hongyuan-Ruoergai Plateau marshes in northern Sichuan (Li and Zhou 1985, Lu 1986, Wang et al. 1989, Li and Ma 1989b, Li et al. 1991).

Beginning in 1990, ICF and the Tibet Plateau Institute of Biology began a cooperative five-year study of Black-necked Cranes in Tibet. In 1991 a breeding survey was conducted



P. GOLE

Winter habitat of the Black-necked Crane, Sangti Valley, India

primarily in northern Tibet (Dwyer et al. 1992). Extensive field research on the wintering grounds from the winter of 1990-91 through the winter of 1993-94 has determined the distribution, numbers, habitat utilization, and human-related pressures on Black-necked Cranes in southcentral Tibet (Bishop 1991, 1993; Gu and Canjue 1993; Bishop et al. in prep.). In December 1993 the first draft of a management plan for wintering Black-necked Cranes was completed and translated into Chinese (Bishop and Canjue 1993).

In Bhutan, field studies have begun to augment the information available from surveys (see above). During the winter of 1991-92, Chacko (1992a, 1992b) conducted an in-depth six-month study of Black-necked Cranes wintering in Bhutan. In addition to information on numbers and habitat use, he documented timing of migration, stopover sites, and a new migration route and roost sites along the Kuri Chu in Bhutan.

In India, research on Black-necked Cranes was stimulated by the rediscovery in 1976 of the small population of breeding Black-necked Cranes in Ladakh. Since then, several expeditions (in 1978, 1983, 1992, and 1994) have investigated the distribution, breeding ecology, and conservation status of this population (Gole 1981, 1993b; Khacher 1981; Hussain 1984, 1985; Chacko 1992c). Surveys for wintering Black-necked Cranes in Arunachal Pradesh in 1978 confirmed the disappearance of the flock at Apa Tani (Khacher 1981). Since 1990 Prakash Gole of India's Ecological Society has surveyed several valleys west of Apa Tani for both cranes and suitable crane habitat. He discovered that during some years a small (<5) flock winters at Sangti (Gole 1990, 1993b, pers. comm.).

Non-governmental Organizations

Conservation activities involving the Black-necked Crane have been supported and coordinated by various non-governmental organizations. ICF has coordinated winter counts throughout the Black-necked Crane's range (Bishop 1989a, 1989b, 1993). ICF has also sponsored cooperative field research in Tibet and at Cao Hai Nature Reserve. Throughout the 1980s and 1990s ICF arranged for technical exchanges, bringing together Black-necked Crane conservationists from Tibet, Yunnan, Guizhou, and Bhutan. The cooperative conservation projects at Cao Hai have been supported by ICF and the Trickle Up Program. Supporting organizations include the National Wildlife Federation, the John D. and Catherine T. MacArthur Foundation, and the Liz Claiborne and Art Ortenberg Foundation.

The World Wide Fund for Nature (WWF) has assisted the

Guizhou Environmental Protection Agency in managing the Cao Hai Nature Reserve by providing support for reserve administration and enforcement. WWF has also worked with government authorities in Sichuan to develop proposed management areas for cranes on the Hongyuan-Ruoergai breeding grounds. In cooperation with the Yunnan Geographic Institute, the China Exploration and Research Society (based in Hong Kong) initiated in November 1994 a conservation program at Xundian in Yunnan aimed at protecting wintering Black-necked Cranes. The program entails wetland restoration, public education, and design and development of a nature reserve (How-man et al. 1994).

In Bhutan, the Royal Society for the Protection of Nature (RSPN) and the Sherubtse College Nature and Trekking Club (Singekam) have been active in coordinating counts of wintering Black-necked Cranes. The WWF-United States Bhutan Program has supported the Black-necked Crane Cooperative Research Project of ICF and the Tibetan Plateau Institute of Biology, as well as conservation efforts in Bhutan. These projects have been supported by several other organizations, including the Chicago Zoological Society, the Wildlife Conservation Society (formerly the New York Zoological Society), the Brehm Fund for International Bird Conservation, the GS Fund, WWF-Netherlands, and the Pew Charitable Trusts. WWF-United States is funding construction of Bhutan's first Nature Research Centre at Kibethang near the Phobjika wintering grounds.

Education and Training

The administrative office of Cao Hai Nature Reserve at Weining contains an education center that is used by the public. Public education work at Cao Hai also includes limited extension work in the local markets. Education projects involving Black-necked Cranes have been undertaken by several NGOs as noted above. The China Exploration and Research Society has provided curriculum materials for schools in Xundian and Kunming (Yunnan), and has sponsored field trips by Kunming students to wintering areas in Xundian. Students in Arunachal Pradesh have been provided with slide shows and other educational materials, and are asked to record the arrival and departure of wintering Black-necked cranes. A conservation education center has been proposed for the Sangti Valley. International training for conservation officials and administrators, primarily from Guizhou, has been organized by ICF.

Captive Propagation and Reintroduction

Captive propagation and reintroduction programs have not been necessary for conservation purposes for the Black-necked Crane. The species breeds relatively easily in captivity. The crane GCAR (Mirande et al. in press a) estimate that between 77 and 94 Black-necked Cranes were in captivity in China as of 1993. Another 18 birds are in captivity at three other sites. An international studbook was published in 1991 (Zhao 1991). A limited founder base may pose problems to the population. Several of the captive pairs are breeding prolifically, with potentially deleterious impacts for the captive population, including higher inbreeding rates and reduced genetic diversity. Other wild-caught birds have not bred, and several birds are being housed singly. China strictly controls its captive Black-necked Crane population; international trade has been limited due to high prices.

2.14.10 Priority Conservation Measures

Legal Protection

1) Protect all wintering populations from poaching, with special emphasis in Xundian and Xuanwei Counties (Yunnan).

2) Institute a reward system for reporting poaching incidents.

3) Regulate the timing and use of pesticides and herbicides to prevent harm to cranes and other wildlife.

4) Institute proper legal measures for water management in the breeding and wintering habitat.

Protected Areas

1) Support and continue to strengthen cooperative efforts among the various Chinese government agencies that currently manage China's wetland reserves.

2) Improve the effectiveness of existing protected areas through the following actions:
   - Determine and mark boundaries for all protected areas.
   - Define land uses and develop and implement management plans for all protected areas.
   - Prohibit new road construction through protected areas.
   - Reduce grazing pressures within all protected areas.
   - At wintering nature reserves in China and Bhutan, determine whether present reserve boundaries and land use regulations within the reserves and in the associated watershed are sufficient to maintain crane habitat.
   - Hire wardens at key protected areas (including the Changthang Cold Desert Wildlife Sanctuary in Ladakh and the Phobjikha and Bumdiling Nature Reserves in Bhutan) exclusively to collect data, to serve as guides, and to ensure that the birds are not disturbed.
   - Disseminate throughout China information on the cooperative management projects at the Cao Hai Nature Reserve.

3) Improve management of the Cao Hai Nature Reserve in Guizhou through the following actions:
   - Develop and submit for approval by the Chinese government a management plan for the reserve.
   - Regulate water levels so as to minimize conflicts between cranes and people while protecting crane habitat.

- Halt further agricultural incursion into the remaining marsh area and surrounding uplands.
- Develop programs to restore the lake margins to natural habitat and to encourage the adoption of new farming practices that conserve soil while generating increased income.
- Conduct food plot experiments to determine the potential for minimizing crop depredation (this also applies to the Huize Nature Reserve and the area around Xundian).

4) Establish a protected area for wintering cranes at Sangti (Arunachal Pradesh).

5) Strengthen protections for cranes at the recently established protected area at the Xundian wintering grounds in Northeast Yunnan.

Habitat Protection and Management

1) Halt further deterioration, drainage, and conversion of wetlands for croplands, pastureland, or fish ponds, especially on wintering areas, and restore wetlands where necessary (especially at the Cao Hai, Xundian, and Dashanbao wintering areas).

2) Establish agricultural management zones (rather than reserves) for wintering cranes in southcentral Tibet, and for the breeding population at the Ruoergai marshes in Sichuan. Land uses should be defined and management plans developed and implemented for these management zones.

3) Prohibit new road construction and reduce grazing pressures near important roost sites.

4) Provide incentives for farmers to practice sustainable farming methods that directly and indirectly benefit cranes (e.g., spring plowing).

5) Discourage the use of barbed wire fences in areas used by cranes.

6) Discourage tree planting along riparian roosting areas in southcentral Tibet.

7) Minimize disturbance to cranes by tourists through construction of blinds and special trails (as has been done in Phobjikha, Bhutan).

Surveys/Censuses/Monitoring

1) Conduct a coordinated winter count on all areas every three years to monitor trends in population.

2) Conduct field surveys to locate additional potential wintering areas for Black-necked Cranes in Yunnan.

Research

1) Identify current land and habitat use and determine the habitat preferences of Black-necked Cranes on wintering areas in northeast Yunnan.

2) Study agricultural harvest and tillage practices to determine which practices most benefit the cranes and minimize crop depredation.

3) Identify and determine roost site characteristics at wintering sites along the Lhasa and Yarlung Zsangbo rivers in southcentral Tibet, northeast Yunnan, and Bhutan.

4) Determine through banding and satellite radio tracking the migration routes, staging areas, and breeding grounds of the northeast Yunnan, southcentral Tibet, and Bhutanese wintering populations.

5) Determine food habits on wintering areas.

6) Determine the potential impact of hydroelectric projects at Zhikong and Yamdrok Tso on crane roosting habitat along the Lhasa River.

7) Study the impact of pollution for areas (such as Cao Hai) that are near industrial sites.

8) Locate and monitor populations in winter roosting areas and at stopover sites in central Bhutan at Khotokha, Gyetsa, Thangby, and Kharsa.

9) Study the impact of increased tourism on cranes at the Phobjika (Bhutan) and Cao Hai (Guizhou) Nature Reserves, and at Xundian (NE Yunnan).

10) Identify and document former breeding areas.

Education and Training

1) Develop education programs aimed at the general public.
   - Produce educational materials for local people on both wintering areas and important breeding grounds (e.g., the Ruoergai-Hongyuan breeding area). Use legends, idioms, and symbols involving cranes in education campaigns.
   - Work with local radio, newspapers, and political and religious leaders to provide information about the protected status of the cranes.
   - Share information about the importance of cranes, their cultural significance, and their protected status with local police, military personnel, and officials. Stress the existence of laws that protect wildlife and provide for punishment of transgressors.

2) Develop conservation programs in schools.
   - Incorporate information about the importance of nature and habitat protection and preservation in elementary and secondary school text books and other teaching materials.
   - Organize programs involving visits to schools by local conservation officials and visits by students to local reserves.
   - Organize through college and school nature clubs activities involving the collection of data on the cranes and the local flora and fauna.
3) Undertake extension work with local farmers to promote farming practices that benefit both cranes and farmers.
4) Provide training opportunities for researchers and nature reserve personnel.
   - Train and equip guards and local managers of reserves. Training should include instruction in ornithology, censusing techniques, patrolling, crane conservation education, and community involvement in conservation.
   - Train nature reserve personnel in wetland ecology, ecological monitoring, and reserve and management planning.
   - Provide opportunities for researchers and reserve managers to train within China and abroad.
5) Promote ecotourism opportunities at Cao Hai and south-central Tibet that provide local economic benefits while avoiding disturbance of the Black-necked Crane as well as other wildlife and their habitats.

Captive Propagation and Reintroduction

1) Assess the distribution, status, and needs of the captive population of Black-necked Cranes in China.
2) Implement the recommendations of the GCAR and CAMP for cranes (Mirande et al. in press a). These are to:
   - Manage the captive population of Black-necked Cranes at the Intensive-2 (B priority) level, with a tentative target population of 200 well-managed birds. Efforts may intensify if the status of the species in the wild changes.
   - Undertake further husbandry research in order to breed the species more consistently and to ensure adequate founder representation.
   - Use rehabilitated birds to expand the captive population's genetic pool.
   - Develop a Global Animal Survival Plan (GASP) for the species.
   - Encourage Chinese representatives to assume the lead role in maintaining the international studbook and coordinating the GASP.
3) Utilize captive-bred cranes in education programs at established nature reserves with high tourism potential (e.g., Cao Hai and Xundian).

2.15 RED-CROWNED CRANE (*Grus japonensis*)

Scott R. Swengel

2.15.1 Summary

The Red-crowned Crane is the second rarest crane species, with a total population in the wild of 1,700-2,000 birds. They breed in large wetlands in temperate East Asia and winter along rivers and in coastal and freshwater marshes in Japan, China, and the Korean Peninsula. There are two main breeding populations: a migratory population on the East Asia mainland (northeastern China and Russia) and a resident population on the island of Hokkaido in northern Japan. In the winter, the mainland population divides into two or three wintering subpopulations (depending on whether wintering birds in the Korean Peninsula are considered a single group). The total population has fluctuated over the last century, probably reaching its lowest point in the years following World War II. Although the species has recovered in some areas, a substantial amount of habitat has been lost to agricultural development and other human economic activities. The species is classified as Endangered under the revised IUCN Red List Categories.

Red-crowned Cranes prefer to nest and feed in marshes with relatively deep water, and will nest only in areas with standing dead vegetation. They are generalist feeders and prefer wetter feeding sites, but also forage along dikes and in croplands. On their wintering grounds they feed on waste (or human-provided) grain, and on aquatic plants and animals in coastal marshes and open watercourses.

Habitat loss and degradation constitute the principal threats to the species. Continued agricultural and industrial development affects breeding areas in Hokkaido, the Sanjiang Plain in northeastern China, and the Amur River basin in Russia. Water control and diversion projects (including proposed dams on the Amur River and on the Yangtze River) and the potential for conflict or development in the Korean Demilitarized Zone pose large-scale threats to breeding, migration, and wintering habitat. Other anthropogenic threats include disturbance, intentional setting of fires, and overharvesting of wetland resources in key breeding areas.

Conservation measures that have been taken to protect the species and its habitats include: international agreements and cooperative research (especially involving migration routes); establishment of protected areas to safeguard habitat and minimize disturbance; development of winter feeding stations and the marking of nearby utility lines in Japan; regular surveys on breeding and wintering grounds; preparation of a Population Habitat and Viability Analysis for the species; cooperative conservation and education programs focused on the species;

and several limited reintroduction efforts.

Priority conservation measures include: adoption of an umbrella international agreement on the cranes of East Asia; continued international cooperation in research on migration routes and patterns; protection of key habitats on the Korean Peninsula; adoption of improved methods of resource management (including both wetland resources and agricultural lands) in and around existing protected areas; annual surveys of the main wintering populations; research on the impacts of human resource use on breeding habitats and breeding behavior; development of education programs to encourage farmers and other local residents to adopt sustainable resource use practices; and development of a comprehensive recovery plan for the species.

2.15.2 Subspecies/populations

There are no subspecies. Two main populations exist: on the mainland of East Asia and in northern Japan. Archibald (1976) proposed that mainland (*G. j. panmunjonii*) and Japanese (*G. j. japonensis*) subspecies be distinguished based on differences in the note structure of the female unison call. Ilyashenko (1988) suggested that morphological differences existed between the two populations, and Winter (1981) noted that the mainland birds had larger eggs with less variable color than Japanese birds. Preliminary genetic analyses, however, have shown no significant differences between the populations. During the winter, the two populations can be further divided into three or four subpopulations.

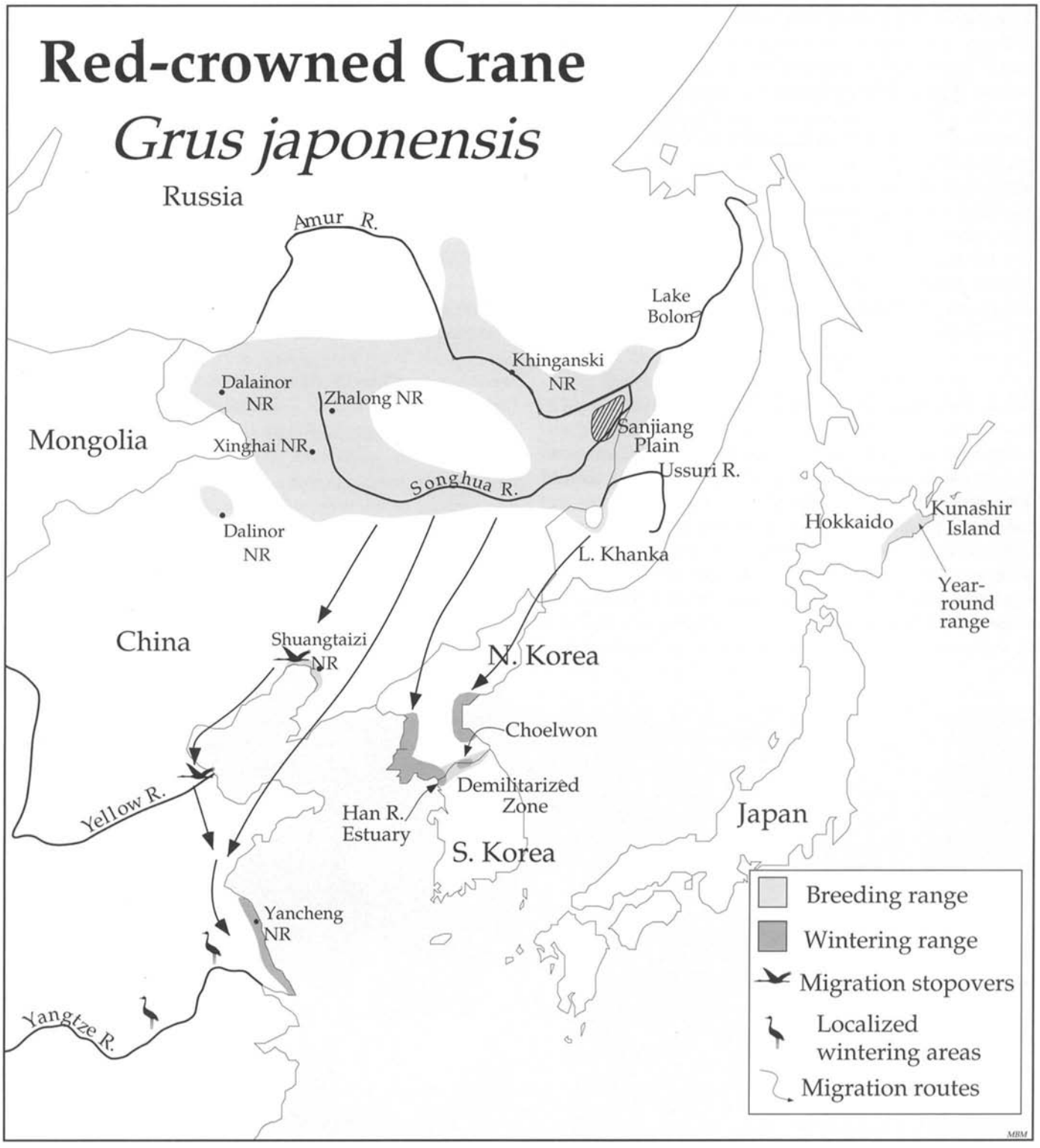
2.15.3 Population Numbers and Trends

Wintering Subpopulation	Number	Trend	Source
China	600-800	Unknown	Wang 1995
North Korea	300-350	Increasing	J. R. Chong pers. comm.
South Korea	200-300	Unknown	Pae and Won 1994, F. Kaliher pers. comm.
Japan (Hokkaido)	594	Increasing	Kushiro ECRPT 1993, H. Masatomi pers. comm.
Total	1700-2000	Stable to declining (based on loss of breeding habitat)	

The highest counts for mainland regions come from different years. Thus, the total presented here assumes some movement

S. TRANEVING

Red-crowned crane *(Grus japonensis)* unison calling, Zhalong Nature Reserve, China


Red-crowned Crane
Grus japonensis
Russia
Amur R.
Lake Bolon
Khinganski NR
Dalainor NR
Zhalong NR
Mongolia
Xinghai NR
Sanjiang Plain
Ussuri R.
Songhua R.
Dalinor NR
L. Khanka
Hokkaido
Kunashir Island
Year-round range
China
Shuangtaizi NR
N. Korea
Choelwon
Demilitarized Zone
Yellow R.
Han R. Estuary
S. Korea
Japan
Yancheng NR
Yangtze R.
Breeding range
Wintering range
Migration stopovers
Localized wintering areas
Migration routes
MBM

between alternate wintering grounds among years. In addition, 281 of those included here in the South Korea data were found in the Demilitarized Zone (DMZ) (Kaliher 1993). A significant number of these birds might also be included within North Korea's total.

There are few historical data on the mainland population. Studies from China suggest that the subpopulation there was stable from 1979-1984 (Feng and Li 1985, Ma and Jin 1987), but there have been losses in land area used by the cranes (see below). Winter counts at Yancheng have varied from 546 in 1990-91 to 775 in 1991-92, with several other recent counts of 530-775 (ICF 1990, 1991; Wang 1995). A small Liaoning subpopulation may be declining.

The North Korean wintering subpopulation appears to be increasing (J. R. Chong, pers. comm.), while the South Korean numbers have remained stable over the years (Kaliher 1993c). This suggests a possible increase in birds breeding in the far northeast part of the range, or a shift in wintering ground choice.

Masatomi (1982a) reviewed historical information on Red-crowned Crane populations in Japan. The Hokkaido population has increased steadily since winter counts began. When the first feeding station was established in 1952, a December count recorded 33 birds (Masatomi 1981b). The population had grown to about 600 by the winter of 1993-94 (Kushiro ECRPT 1993, H. Masatomi pers. comm.). Improved winter survivorship is probably the main factor behind the population increase, since the recruitment rate has fallen over the past 20 years and is now stable (Masatomi 1981b, Momose and Nakamura 1983, Masatomi 1991). From 1986-87 to 1991-92 the population grew at 4.85% per year, somewhat lower than in the previous six years. The proportion of juveniles in the winter population averaged 11.1% during this period, similar to the preceding six-year period (Masatomi 1993a, Masatomi and Momose 1995). The marking of Hokkaido's utility lines beginning in 1971 has also greatly decreased the incidence of crane mortality (see current "Habitat Protection and Management" section below).

2.15.4 Conservation Status

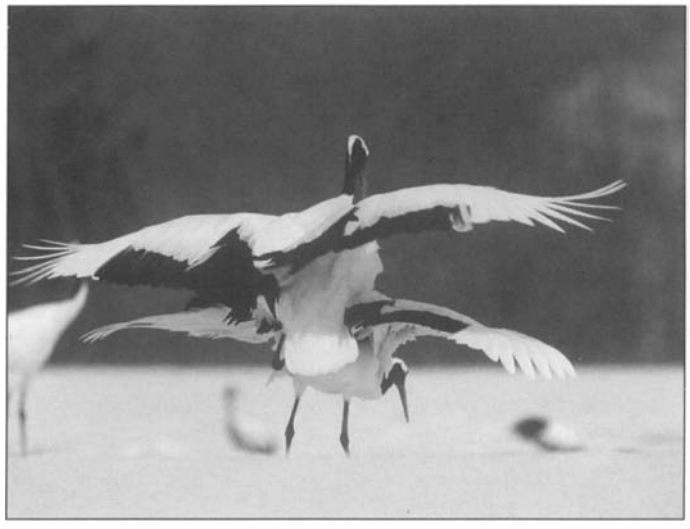
IUCN category	Endangered, under criterion C1
CITES	Appendix I

2.15.5 Historic and Present Distribution

Red-crowned Cranes currently breed in northeastern China (Inner Mongolia and Heilongjiang, Jilin, and Liaoning Provinces) and adjacent parts of Russia, and are year-round residents on the island of Hokkaido in Japan (Su 1993, Fan et al. 1994, Ma and Li 1995, Shibaev and Andronov 1995, Masatomi and Momose 1995). There are three main breeding areas. More than half of the population breeds in northeastern China and adjacent Russia. The species occurs rarely in the summer in far eastern Mongolia (Bold et al. 1995). The non-migratory birds of Hokkaido—about one-third of the population—represent the remainder. One pair of birds is known from the southern Kuril Islands. Wintering areas are on Hokkaido, on the Korean Peninsula (primarily within the DMZ), and in coastal Jiangsu and nearby parts of China.

The historical record is inadequate for reconstructing the Red-crowned Crane's former range in China (Su 1993). In the past Red-crowned Cranes may have wintered in southern Liaoning, China (see Johnsgard 1983), but these could be migration records. Red-crowned Cranes do not winter in this area today (Su L. pers. comm.). In recent years, the breeding range in the Sanjiang Plain (Heilongjiang) has become smaller and more isolated with increasing agricultural development (Su 1992). In the Dulu River Region, for example, the numbers of cranes and nests have dropped from 90 and 17 in 1984 to near zero in 1994 (Harris 1994c). The main breeding area in the Zhalong region of Heilongjiang shifted to the north between 1981 and 1984 (Feng and Zhao 1991). Mongolia had at least one nesting record in the 1920s, but the species no longer nests there (Bold et al. 1995).

In Korea, Red-crowned Cranes were reported to be common as far south as Seoul in the late 1800s (Austin 1948). In Japan the breeding range included southwestern, and perhaps the northern tip, of Hokkaido, until about 1890 (Masatomi 1981a, Archibald 1987). Some cranes also migrated from Hokkaido to Honshu, Japan, wintering there regularly until after 1850 (Masatomi 1981a). Red-crowned Crane habitat (especially breeding habitat) in Japan has gradually decreased due to development pressure, causing cranes to breed in lower quality sites (Archibald 1987) and in ever greater densities in the areas that remain (Masatomi 1993b).



T. SATO

Copulating pair of Red-crowned Cranes, Hokkaido, Japan

2.15.6 Distribution by Country

China	B.M.W
Japan	R
Mongolia	M
North Korea	M,W
Russia	B
South Korea	M,W

B = Present during breeding season
M = Present during migration
R = Year-round resident
W = Present during winter

2.15.7 Habitat and Ecology

Red-crowned Cranes are highly aquatic cranes with large home ranges (Masatomi 1981a, 1993b). They feed in deeper water than sympatric cranes, using a "walk-and-peck" feeding technique more than repeated probing and digging (Su 1993). From summer to fall they forage regularly on pasture lands in Japan, In winter they use coastal salt marshes, rivers, freshwater marshes, rice paddies, and cultivated fields. Most of the birds breeding in China migrate along the coast of the Bo and Yellow Seas between their breeding grounds and their wintering grounds in Jiangsu. Most of the Russia-breeding birds migrate through North Korea between their breeding grounds and wintering grounds in the Korean Peninsula.

Reported summer home range sizes are 2.6 (+/- 0.6) km^2 in China, 1-7 km^2 in Japan, and 4-12 km^2 in Russia (Winter 1981, Kitagawa 1982, Andronov et al. 1988, Su 1993). Families may use <1% of the home range at certain times of the breeding season (Kitagawa 1982), or use wholly different areas for feeding and nesting (Winter 1981). In high quality habitat, nesting densities of 0.05/km^2 in Russia, 0.21-0.24 pairs/km^2 in China, and 0.06-0.82/km^2 in Japan have been recorded (Winter 1981, Su 1993, Masatomi et al. in press b). Winter ecology, habitats, and behavior in China and Korea are described by Li and Feng (1985), Chong (1988), Won (1988), Zhou (1988), Kaliher (1993c, 1994), Pae and Won (1994), and Halvorson and Kaliher (1995).

Smirenski (1980), Winter (1981), Kitagawa (1982), Andronov et al. (1988), Masatomi (1993b), and Su (1993) have described the species' nesting and feeding habitats and preferred food items at different times in the summer range.

ICF

Wintering flock of Red-crowned Cranes at Choelwon, Korean Demilitarized Zone

Nesting Red-crowned Cranes show a significant preference for wetter wetland types, such as reed-sedge marsh, reed marsh, cattail marsh, and floating reed-sedge mat in China; these, along with croplands and dikes, also comprise the preferred feeding habitats (Su 1993). In Russia, they use vast cottongrass-sedge bogs and similar habitats (Smirenski 1980, Winter 1981). Red-crowned Cranes select uncut marsh habitat over cut marsh habitat for feeding (Su 1993).

Red-crowned Cranes are generalist feeders, eating a wide variety of insects, aquatic invertebrates, fish, amphibians, and rodents, as well as reeds (e.g. *Calamagrostis* spp., *Sagittaria* spp., and *Potamogeton* spp.), grasses, heath berries, corn, and other plants during the warm season (Andronov et al. 1988, Masatomi 1993b, Su 1993). They consume upland insects more in July-August than in other seasons (Andronov et al. 1988). The winter diet varies depending on the site. In Hokkaido, they feed on human-provided corn and on aquatic plants and animals in unfrozen watercourses. In Korea, the diet consists of waste grain and animal food items. In the coastal salt marshes (from damp to water-covered areas) of China, they feed on aquatic invertebrates, plants, and some human-provided grain (Won 1981, Masatomi 1993b, J. Harris pers. comm.).

Nests are built on wet ground or in shallow water up to 44 cm deep in Japan, and to 20-50 cm deep in Russia (Andronov et al. 1988, Masatomi 1993b, H. Masatomi pers. comm.). The cranes nest in areas with standing dead reeds 30-200 cm tall (Winter 1981, Smirenski 1988), and preferentially place nests in areas not cut the previous winter (Su 1993). Fire is the leading cause of nest destruction, and often prevents nesting from taking place at all (Winter 1981; Smirenski 1980, 1988). Usually two eggs are laid. The incubation period is 29-34 days, and chicks fledge at about 95 days.

2.15.8 Principal Threats

The conservation status of Red-crowned Cranes in Japan is described by Inouye (1981), Masatomi (1981a, 1982b, 1993b), Momose and Nakamura (1983), and Archibald (1987). Won (1981, 1988), Pae and Won (1994), Kaliher (1993a, 1993, 1993c), and Holvorson and Kaliher (1995) discuss crane conservation in the Republic of Korea. Flint and Smirenski (1978) and Smirenski (1989a) have reviewed the status and conservation of cranes in Russia. Harris (1989, 1992a, 1994a) describes recent crane conservation activities in China, and provides additional information (1991a) relevant to the status of the Red-crowned Crane. Wang (1995) describes the status of the species at its main Chinese wintering area in Jiangsu Province.

The Red-crowned Crane is seriously threatened by loss of habitat throughout its range. Economic development, especially agricultural expansion, river channelization, deforestation, and road building, is destroying many of the breeding wetlands in Hokkaido (Momose and Nakamura 1983, Archibald 1987, Masatomi et al. 1990), which support more than a quarter of the population. In China, agricultural development of breeding and wintering grounds is a critical threat. Between 1979 and 1984, two-thirds of the marshland in the Dulu River region of northeastern China, a major breeding area, vanished due to cultivation (Feng and Li 1985). By 1994, nearly all the breeding Red-crowned Cranes in this region had disappeared or gone elsewhere (Harris 1994c). Continued agricultural development of the Sanjiang Plain in Heilongjiang Province, another important breeding area, constitutes a major threat to the mainland population (Su 1992, Harris 1994c). Development of oil wells and agriculture threaten the Panjin Marsh, the species' southernmost breeding area in China (Kanai et al. 1993), and the wintering grounds in coastal Jiangsu, where 40% of all Red-crowned Cranes winter (Wang 1995).

J. HARRIS

Agricultural development in China's Sanjiang Plain

In and around Zhalong Nature Reserve, reeds are currently being harvested at a level that depletes the species' preferred nesting habitat, and much of its feeding habitat (Su 1993). Smaller amounts of reed cutting might maintain a better mix of habitats; ideal habitat would have some areas of reeds cut (in winter), but others left uncut. In contrast to past practices, farmers who benefit directly from their crops now chase cranes out of fields more actively (Su 1993). Overfishing may also be limiting the food base in the Zhalong wetlands (Harris 1989, Su 1993).

Water control and diversion projects also threaten the species' habitat. Water diversions reduce the area of suitable nesting habitat at the Zhalong (Harris 1989) and Hong He (Harris 1994c) Nature Reserves. By altering sedimentation processes, the proposed Three Gorges Dam on the Yangtze River may result in the loss of the wintering habitat in the coastal marshes of Jiangsu (in a manner similar to the current loss of lands in the Mississippi River Delta). This project would also change, and perhaps even destroy, the water bird habitat at Poyang, Dongting, and Shengjin Lakes, the three most important wintering sites for Siberian, Hooded, and White-naped Cranes in China.

Habitat-related threats are also of serious concern on the Korean Peninsula (Halvorson and Kaliher 1995). The Korean

DMZ now functions as a *de facto* protected area. Armed conflict in this area would be disastrous for cranes and other forms of wildlife that find refuge there. If, on the other hand, North and South Korea unite (and unless special measures are taken), the area is likely to be developed rapidly and to disappear as a crane wintering area (see the White-naped Crane species account in this volume). Other problems in South Korea include human disturbance of cranes, ineffective environmental protection policies, increasing land use pressures on cranes, and lack of professional experience in wildlife management (Pae and Won 1994, Halvorson and Kaliher 1995).

Flint and Smirenski (1978), Borodin et al. (1984), and Andronov (1988) report that drainage of wetlands, agricultural fires, and cattle grazing have reduced the species' nesting habitat in Russia. About 40% of Red-crowned chicks in Russia fail to fledge; combined with the inability of some pairs to find suitable nest sites because of human activities, this may explain the very low proportion (1-3%) of juveniles in the South Korean wintering population (Smirenski 1988). Large scale threats are of immediate concern in the Amur basin. Seven dams have been proposed for the Amur River; if built, these would alter water levels at critical times of the year for wildlife, and would have harmful effects on the cranes' food base (Smirenski 1992a, Smirenski et al. 1995).

Harassment by people, agricultural fires, and poisoning from pesticide-treated grain directly harm Red-crowned Cranes in Russia (Flint and Smirenski 1978, Borodin et al. 1984, Andronov 1988). Hunting of cranes has increased recently in Russia due to the immigration of people with different cultural traditions (Smirenski 1992b). In Japan, tourism and recreational activities pose a threat to the breeding behavior of the species (H. Masatomi pers. comm.). In China, disturbance of nests after a critical point in the breeding season can prevent Red-crowned Cranes from renesting successfully (Su and Zhou n. d.). Egg collecting also occurs in China (G. Archibald pers. comm.). At least 17 Red-crowned Cranes have recently been poisoned by duck hunters at Yancheng (Wang 1995).

2.15.9 Current Conservation Measures

Note: many of the measures described in this section have also benefitted the Demoiselle, Siberian, White-naped, Hooded, and Eurasian Cranes of East Asia.

Legal and Cultural Protection

It is illegal to hunt Red-crowned Cranes in all of the nations where they normally occur. They are designated as natural monuments or nationally protected birds in all of the countries where they breed or winter. Kushiro ECRPT (1993) provides a thorough review of the laws and international treaties under which the species is protected in Japan.

International Agreements and Cooperation

The Siberian and White-naped Crane species accounts in this volume describe international agreements and cooperative ventures that are also relevant to the conservation of the Red-crowned Crane. China, Japan, and Russia have signed the Ramsar Convention. Since 1984 these same countries have cooperated in exchanging information about summer and winter surveys of Red-crowned Cranes. Dr. Hiroyuki Masatomi (1985a, 1988), with support from the Wild Bird Society of Japan and other organizations, has periodically compiled these data. Japan, China, Russia, and North and South Korea are cooperating on international radiotelemetry studies for the Red-crowned and other cranes (e.g., Higuchi 1993; Chong et al. 1994; Higuchi et al. 1992, 1994b, 1995).

Protected Areas

During the breeding season, wetland reserves in China support more than 500 Red-Crowned Cranes (Harris 1992a). These are (from those with the largest breeding populations to those with the smallest): Zhalong (in Heilongjiang Province), Shuangtaizi (Liaoning), Xingkai Hu (Heilongjiang), Honghe (Heilongjiang), Xianghai (Jilin), Keerqin (Inner Mongolia), Changlindao (Heilongjiang), Watonghe (Heilongjiang), Chaganhu (Jilin), Momoge (Jilin), Dalainor (Inner Mongolia), and Dalinor (Inner Mongolia) Nature Reserves (Harris 1992a, Ma and Li 1994). Reserves have been proposed for the Hui River area of Inner Mongolia (Ma and Li 1991) and the Sanjiang Plain in Heilongjiang (Harris 1994c). Russia has important breeding sites within Lake Khanka, Khinganski, and Ganukan Nature Reserves (Archibald and Mirande 1985, Andronov 1988). Other Russian protected areas supporting Red-crowned Cranes include Ulma, Jashina, Muravienka, Amursky, Bolon, Urmi, Chauka, Kurilski, Zhuravlini, and Muraviovka (a private reserve) (Smirenski 1985).

The Tanyang and Huanghe Delta Nature Reserves protect the migration stopover site at the mouth of the Yellow River in Shandong Province, China (Ma and Li 1994, J. Harris pers. comm.). Stopover sites along the Tumen River and in other areas remain poorly known, and are not protected (Shibaev and Surmach 1994).

Yancheng Nature Reserve in Jiangsu Province, China, protects the habitat of the largest wintering subpopulation, which reached a high of 775 in 1991-92 (Wang 1995). North Korea has designated four areas—Kangryong, Panmun, Kumya, and Anbyon—as natural monuments to protect wintering Red-crowned Cranes (Sonobe 1987, J. R. Chong pers. comm.). The Choelwon Bird Reserve provides protection for a small portion of the wintering grounds in South Korea. The Korean DMZ functions as a protected area due to its relative lack of intensive economic development.

Portions of the breeding grounds on Hokkaido are designated Natural Monuments (Kushiro ECRPT 1993, Masatomi 1993b), but much of the habitat remains unprotected. After at least 17 years of stable breeding numbers at Kushiro Mire, which is under the strictest protection in Japan (part of the area was designated a national park in 1987), the number of pairs increased from 22 to 48 between 1988 and 1992 (Masatomi 1993b). The marsh has also been registered as a Wetland of

International Importance under the Ramsar Convention (Kushiro ECRPT 1993).

Habitat Protection and Management

In many protected areas, such as Zhalong, Muraviovka, and Khinganski, agricultural activity in the marshes has been or is now being restricted in order to promote crane nesting. Su (1992, 1993) studied the effects of several human activities and management methods, and found that both disturbance by humans and overharvesting of reeds were detrimental to crane nesting efforts.

Tsujii (1994) reviews the conservation status and needs of the wetlands used by the Hokkaido population. Active habitat management in the Korean peninsula has been limited. See Pae and Won (1994) and Halvorson and Kaliher (1995) for discussion of the conservation status and needs of key crane habitats in the south and along the DMZ.

In Japan two active habitat management measures have allowed the Red-crowned Crane population to increase. First, the winter feeding station established in 1952 (and several others that have since been built) have helped the Hokkaido population to grow steadily by improving winter survivorship. Feeding stations, however, have also increased the risk of catastrophic mortality if a disease epidemic were to strike when the cranes were concentrated there. Second, installation of conspicuous markers on utility lines has reduced the rate of mortality from collisions. Prior to marking, 50-70% of Red-crowned Crane deaths were due to utility line collisions. Since markers were added in the late 1970s, the death rate from collisions has dropped approximately 60% (Masatomi 1991, M. Yamaguchi pers. comm.).

Surveys/Censuses/Monitoring

China and Russia conduct periodic aerial surveys of Red-crowned Cranes during the breeding season, and Japan surveys breeding birds annually. Winter populations are counted annually in coastal Jiangsu (China) and Japan, and periodically in South Korea. North Korea also surveys wintering cranes, but it has been difficult to gain access to this information. Shibaev and Surmach (1994) report the results of an autumn migration survey conducted in Russia's Primorye region in 1988.

Winter counts are the most reliable index of the population. Breeding season surveys record fewer Red-crowned Cranes than do winter counts. A simultaneous aerial survey conducted in Russia, China, and Japan during the 1984 breeding season counted one-third fewer cranes than did winter surveys conducted from 1979-1985 in the same areas (Masatomi 1985b). Masatomi et al. (1985), Shibaev (1985), and Smirenski et al. (1988) all reported areas that could not be completely covered in their respective spring censuses. The aerial survey in China was also incomplete (Fei D. pers. comm.). In addition to the one pair of cranes from the Hokkaido population known to summer in the Kuril Islands, the Hokkaido survey probably missed other individuals, since it recorded only 70% (in 1984) and 80% (in 1993) as many cranes as had been found on winter counts (Masatomi 1985b, Masatomi et al. in press a). The Russian survey found about 213 cranes, while intensive studies in the summer of 1986 found a breeding population of at least 350 Red-crowned Cranes (Andronov 1988, Ilyashenko 1988, Shibaev and Glushchenko 1988).

Research

Extensive research on habitat, habitat loss, breeding biology, and wintering ecology of the Red-crowned Crane has been conducted since 1970. Many of these studies are cited in other portions of this account. Japanese researchers (e.g., Masatomi 1970-1994, Akiyama 1981, Kitagawa 1982) have led the way, but since 1980 Chinese, Korean, and Russian scientists have expanded research on many aspects of the species' distribution, biology, and ecology (e.g., Smirenski 1980, Winter 1981, Andronov 1988, Li and Feng 1985, Chong 1988, Ilyashenko 1988, Smirenski et al. 1988, Zhou 1988, Ma and Li 1991). Banding studies have been carried out in China (Xu et al. 1995). Satellite radiotelemetry of Red-crowned Cranes migrating to and from Russia is now in progress by Dr. Hiroyoshi Higuchi and his colleagues (e.g. Higuchi et al. 1994a, 1994b, 1995). Much of the information from these recent studies has been published in the *Proceedings of the 1983 International Crane Workshop* (1987), *The Palearctic Cranes* (1988), the *Proceedings of the 1987 International Crane Workshop* (1991), *The Future of Cranes and Wetlands* (1994), and *Cranes and Storks of the Amur Basin* (1995).

Population and Habitat Viability Analysis

A crane PHVA that included significant preliminary work on Red-crowned Cranes was conducted in Calgary, Canada, in 1992, by the IUCN/SSC Conservation Breeding Specialist Group with the assistance of ICF (Mirande et al. in press a). A subsequent meeting focussing on Red-crowned Cranes was held in Shenyang, China in March 1993. Meeting participants were able to determine more accurately the parameters of the captive and wild populations, and offered a series of observations, conclusions, and recommendations, including the following (Mirande et al. in press a):

1) The mainland Red-crowned Cranes may function as three breeding populations.

2) Habitat loss in the China-Russian border region is accelerating due to land privatization in Russia and new agricultural initiatives in China.

3) Chinese wintering ground salt marshes are threatened by development and by the Three Gorges Dam.

4) The amount of available habitat in Japan is declining.

5) Red-crowned Cranes had recently been poisoned by duck hunters at Yancheng.

6) Agricultural fires in mainland breeding areas should be stopped.

7) Trade in wild Red-crowned Cranes is not a significant problem.

8) Inbreeding has reduced success in captive propagation programs.

9) Reintroduction research should continue in China, Japan, and Russia.

10) Breeding areas should be protected and detrimental human activities regulated in surrounding areas.

11) Winter surveys should continue in order to establish population trends.

Non-governmental Organizations

The Wild Bird Society of Japan (WBSJ), ICF, the Socio-Ecological Union (SEU), other conservation groups, and university researchers have joined forces in efforts to conserve the Red-crowned Crane. SEU has established the 5,200 ha Muraviovka Reserve in Russia with funding support help from WBSJ and a Japanese company, POP Group International. SEU is also helping farmers to improve crop production efficiency, so that adequate amounts of food can be produced on much smaller amounts of land than under current methods. Many other examples of such cooperative measures can be found in the examples and publications cited in this account.

Education and Training

The Hokkaido government has sponsored annual Red-crowned Crane winter counts by school children since 1952 (Kushiro ECRPT 1993). The feeding stations there allow residents to observe the cranes closely. The Akan International Crane Center opened in Hokkaido in 1996. The Center, a cooperative venture of the Tancho Sanctuary in Tsurui, the Tancho Natural Park in Kushiro, and the Tancho Protection and Propagation Center of the Kushiro Zoo, is devoted to education and research on cranes.

The Zhalong and Yancheng Nature Reserves in China provide educational opportunities for the public through visitor centers. Visitors can observe captive cranes at Zhalong or observe cranes at a feeding station at Yancheng. The SEU and ICF are collaborating on teacher exchanges and other education projects in Russia. Recent international conferences, especially the Amur (1992) and Tokyo (1993) meetings, and those organized by the Rowe Sanctuary in Nebraska, have linked crane conservationists together to promote conservation in a variety of ways.

Captive Propagation and Reintroduction

Red-crowned Cranes have been maintained in captivity for centuries and are known to have bred in captivity by 1861 (Johnsgard 1983). In general, they readily breed under captive conditions and have a relatively high rate of survivorship (Belterman and King 1993). The species can maintain a stable captive population with a low reproductive rate (Swengel 1985), thus allowing managers to increase the genetic diversity of the captive population by encouraging equal genetic representation among founders.

The first international studbook was published in Japan in 1972. The draft 31 December 1992 studbook lists 747 birds in 158 institutions (Komiya 1994). Regional studbooks are now maintained in North America, China, Europe, and the United Kingdom. Although the species is being bred at many facilities, the Shenyang Zoo has emerged as the largest producer, with up to 20 chicks fledged per year, beginning in 1991.

In the past, founder representation within the captive population was highly skewed. As a result, genetic diversity within the European, Japanese, and North American captive populations has been low relative to their population sizes. A number of zoos in Europe, Japan, and the USA have exchanged individuals to improve genetic management of the species, but others are still inbreeding the birds. Since 1990 Chinese zoos have accelerated their domestic and international Red-crowned Crane exchanges, helping to increase genetic diversity in captive facilities around the world.

Reintroduction of Red-crowned Cranes has taken place on a limited basis at three natural breeding sites. At Kushiro, Zhalong, and Khinganski, cranes have been released from nearby captive breeding facilities; at Khinganski, cranes from North American captive breeding facilities were also released. The Tancho Natural Park in Hokkaido was established with five male cranes in 1958 (Masatomi 1981b). These males attracted wild females and the resulting park-bred juvenile cranes were allowed to fly out of the pens to the wild. At least 16 cranes, all of them chicks produced at the park, were released to the wild from 1973-1991 (Asakura and Ito 1982, Kushiro ECRPT 1993).

The Zhalong Nature Reserve in China has a crane breeding center and has released captive-bred Red-crowned Cranes in nearby marshes. About 20 were released in 1985-1986 (Xu J. et al. 1991). Some of these formed semi-wild breeding pairs, while others bred with wild cranes. The staff at Zhalong removed some of the early clutches from nests to increase egg production and to raise additional chicks in captivity (Xu et al. 1986b, Xu J. et al. 1991). In this way the center was able to raise more chicks for release while allowing wild and semi-wild pairs to continue breeding (Xu J. et al. 1991). In recent years five of the pairs have nested in the wild and returned in the autumn with their chicks to spend the winter near the captive cranes. In spring the juveniles leave the parents and join the wild cranes. As of 1994, 29 cranes have joined the wild flock in this way.

The Khinganski Reserve in eastern Russia began experimental releases of young Red-crowned Cranes in 1989 with the hope that released cranes would breed in areas near human settlements that appeared suitable but had no breeding pairs. Some cranes have become established in the wild. This study is still in progress (R. Andronova pers. comm.).

2.15.10 Priority Conservation Measures

Most of the priority conservation measures for the Red-crowned Crane also apply to the sympatric cranes of East Asia. In particular, the priority measures described in the White-naped Crane species account under the categories "Legal Protection," "International Agreements and Cooperation," and "Protecting the White-naped Crane on the Korean Peninsula" apply in large part to the Red-crowned Crane. The measures recommended below pertain particularly to the Red-crowned Crane, rather than the sympatric species. Many of the recommendations build upon findings of the Population Habitat and Viability Analysis for the Red-crowned Crane (Mirande et al. in press a; see above).

International Agreements and Cooperation

1) Address the conservation needs of the Red-crowned Crane within an umbrella international agreement on the conservation of the migratory cranes of East Asia (Japan, Russia, China, Mongolia, and North and South Korea).

2) Support efforts to create an international protected area in the southern Kuril Islands.

3) Provide continued support for international crane migration studies.

Protected Areas

1) Encourage adoption of sustainable methods of reed harvesting, grazing, and other resource use in the northeastern Chinese and Russian protected areas used by breeding Red-crowned Cranes (see item 1 under "Research" below).

2) Regulate activities found to disrupt nesting of Red-crowned Cranes at Zhalong Nature Reserve and in the Russian protected areas (including overharvesting of reeds, agricultural fires, use of vehicles near nests, and water diversions).

3) Establish protected areas at any critical, newly discovered migration stopover sites, especially if they close large gaps in the network of protected areas along the migration corridor. It is likely that new protected areas are especially needed in North Korea. Researchers there have proposed that the government designate new areas as reserves for staging cranes.

Habitat Protection and Management

1) Undertake studies to assess the impacts of the Three Gorges dam on the wetlands of the Yangtze River basin and to develop possible mitigation strategies.

2) Assess and disseminate information on the social and environmental impacts of the dams proposed for the Amur River.

3) Promote more efficient farming practices in areas of the China-Russian border (the Amur basin and Sanjiang Plain) where wetlands are now being converted to agriculture at a rapid rate. Higher yields, especially in Russia, may reduce the need for further conversion.

3) To safeguard wintering areas in the Korean peninsula:
   - seek legal protection for the Choelwon basin (including adjacent valleys with high quality habitat) and ensure enforcement of management guidelines;
   - reduce disturbance of cranes through restrictions on access to crane habitat and construction of special observation posts in appropriate areas;
   - encourage continued coexistence between cranes and farmers in the Civilian Control Zone adjacent to the DMZ; and
   - seek the cooperation of farmers in timing their agricultural activities to promote crane conservation.

4) Develop and implement techniques to alleviate significant human causes of mortality in the Yancheng Salt Flats (see item 3 under "Research" below).

5) Concentrate habitat conservation measures in areas where monitoring indicates that populations are declining, or in areas with small populations whose viability could be increased. (However, because monitoring efforts may not be very sensitive to population changes, actions may need to be taken based on probable population trends).

Surveys/Censuses/Monitoring

1) Continue annual surveys of the Hokkaido's resident subpopulation.

2) Initiate annual surveys of the Chinese and Korean Peninsula wintering sites. Survey data should be reported annually to a central location (e.g., the Akan International Crane Center or ICF). In Korea, it is important that simultaneous counts be carried out in the North and South in order to avoid duplication.

3) Conduct periodic (e.g., every five years) aerial surveys of main nesting areas in Russia and Heilongjiang in order to detect significant shifts in their use by cranes.

Research

1) Study the effects of different reed harvesting, grazing, and other resource use practices on breeding Red-crowned Cranes in northeastern China and adjacent areas in Russia. In particular, studies are needed to determine the impact of the timing of different practices;

some methods may benefit (or at least not harm) cranes, while others may not.

2) Study the impact of various rice planting and harvesting methods and paddy management regimes used at these sites by wintering Red-crowned Cranes in Korea.
3) Study the incidence of crane mortality due to human factors (especially poisoning and utility line collisions) in the Yancheng Salt Flats wintering area in China.
4) Model the impact of the proposed Three Gorges Dam on the Yancheng wintering area.
5) Survey the Heilongjiang-Beidaihe migration route and the Chinese coast for critical migration stopover areas (see "Habitat Protection and Management" above).

Education and Training

1) Develop educational programs on the sustainable use of wetland resources for farmers and other local residents in Red-crowned Crane breeding areas.
2) Advise local inhabitants in China, Russia, and Japan of the adverse effects of certain human activities on breeding Red-crowned Cranes during the nesting season.
3) Support local educational efforts in Korea's Choelwon basin that stress the international significance of these wintering grounds and the dependence of the cranes on farming practices.
4) Encourage public participation in counts of the wintering subpopulation in China.

Population and Habitat Viability Analysis

1) Complete the preliminary PHVA initiated in Calgary in 1992 with broader representation of experts from all range countries.

Captive Propagation and Reintroduction

1) Develop a comprehensive recovery plan for the species, coordinating habitat protection measures and the captive propagation program. All future decisions on releases of Red-crowned Cranes should be based on such a plan. If improved management of habitat will allow wild populations to recover, these measures should receive priority and releases should be avoided.

2) Continue research on reintroduction in China, Japan, and Russia, especially involving the development of techniques that encourage wild birds to use habitat now abandoned due to human activity.

3) Implement the following recommendations outlined in Red-Crowned Crane PHVA and in the GCAR and CAMP for cranes (Mirande et al. in press a):
   - Manage the captive population of Red-crowned Cranes at the Intensive-1 (B priority) level, with a target population of 250 well managed birds.
   - Determine management strategies to handle the growing population of captive birds and to address the desire of holding institutions to breed additional birds.
   - Focus captive propagation efforts on breeding unrepresented founders, balancing founder representation, and reducing the degree of inbreeding.
   - Examine the results of DNA analysis of genetic divergence between the Japanese and mainland populations to determine if current captive management recommendations should be revised.

SECTION 3
Global and Regional Recommendations

In this section, the conservation needs of the world's cranes are identified on a global and regional basis. Section 3.1 outlines recommended crane conservation actions that pertain to the family as a whole. Section 3.2 outlines recommended actions within nine regions around the world. The recommendations are derived from the priority conservation measures described in the species accounts in Section 2.

A regional, rather than national, approach has been adopted in this section for several reasons (see Table 3.1 for the distribution of cranes by region). Cranes are found in more than 100 countries on five continents. Some countries, such as China, Russia, India, and Ethiopia, harbor several species over the course of a year; others support only a single species during migration. Presenting detailed action plans for each country would thus be cumbersome and uneven. Each of the species occurs in more than one country, and populations of the migratory species of Europe and Asia cross many national boundaries during migration. Thus, in most cases conservation actions for cranes have required, and will continue to require, cooperation on a regional basis. Especially in the case of the endangered taxa, regional coordination is essential to successful conservation. Finally, many of recommended actions benefit two or more species simultaneously. Regional-scale approaches thus allow for more efficient planning and implementation of crane conservation measures.

Although the actions recommended in this section are not defined at the national level, they do contain and reflect country-specific priorities (many of which are also included in the species accounts). In addition, many countries, especially in Europe and Africa, have developed national-level action plans. Information from these plans has been taken into account in preparing the regional recommendations. Existing national action plans are available upon request from the various Crane Working Groups and from the International Crane Foundation. (For the benefit of countries that have not yet developed national-level action plans, Appendix 4 provides a basic format).

3.1 Recommended Actions at the Global Level

1) Support programs to integrate crane and wetland/ grassland conservation with sustainable economic development at the local level.

Throughout the world, the long-term needs of cranes, their habitats, and local people and communities are threatened by inappropriate development of grasslands, wetlands, and river systems. At the same time, many protected areas that have been established to safeguard cranes and their habitats have not been managed in such a way as to address threats from surrounding land uses, nor have managers of protected areas taken advantage of opportunities to work with local communities on sustainable development projects. In recent years, however, there has been a growing realization that local economic development strategies and conservation measures for cranes and their habitats can and must be integrated. Cranes and critical wetlands that provide crane habitat have already served as

Table 3.1
Distribution of cranes by region

Region	Species
1. West Africa	Black Crowned Crane Demoiselle Crane Eurasian Crane
2. East Africa	Black Crowned Crane Grey Crowned Crane Demoiselle Crane Wattled Crane Eurasian Crane
3. Southern Africa	Grey Crowned Crane Blue Crane Wattled Crane
4. Western Palearctic	Demoiselle Crane Siberian Crane (?) Eurasian Crane
5. Central Asia	Demoiselle Crane Siberian Crane Sarus Crane Eurasian Crane Black-necked Crane
6. East Asia	Demoiselle Crane Siberian Crane Sandhill Crane White-naped Crane Eurasian Crane Hooded Crane Red-crowned Crane
7. Southeast Asia	Sarus Crane
8. Australia/New Guinea	Sarus Crane Brolga
9. North America	Sandhill Crane Whooping Crane

the focal point for several specific sustainable development projects—in the Kafue Flats of Zambia, at China's Cao Hai Nature Reserve, at Vietnam's Tram Chim National Reserve, in the Amur River basin along the China-Russia border. Opportunities exist for many other integrated conservation programs to be developed. Support should be given to development of these innovative programs, which provide lasting benefits for cranes, and for the people and local communities with which they coexist.

2) Develop and implement integrated, watershed-scale conservation programs for important river systems and wetland complexes.

A number of river and wetland systems are of special importance for one or more species of cranes, and for regional biodiversity in general. In many cases, these systems are also under increasing demand from growing human population and development pressures. Cranes can, and in many cases have, provided a focus for conservation programs in these areas. However, the challenge of maintaining the biological diversity, hydrological functions, and ecological processes of these systems, and of sustainably managing the economic resources they provide, is a larger-scale and longer-term undertaking. For this reason, crane and wetland conservationists in these areas will need to join with other conservationists, scientists, local communities, administrators, officials, and other supporting individuals and organizations to craft integrated conservation programs. In a few cases, the preparation and implementation of such programs may already be underway; in others, they have yet to be initiated.

River and wetland complexes that are of global scale importance to the future well being of the world's cranes include:

- **West Africa:** the Senegambia basin; the Inner Niger delta; Lake Chad basin.
- **East Africa:** the Sudd wetlands; Lake Victoria wetlands.
- **Southern Africa:** the Okavango River and Delta; the Makgadikgadi Pans; the Zambezi River and Zambezi Delta (Marromeu Complex); the Bangweulu Swamps; the Kafue Flats; Etosha Pan.
- **Western Palearctic:** Azov-Sivash wetlands; the Danube River delta.
- **Central Asia:** Cao Hai Lake; the Llasa/Yarlong/Zarbo River basin; Ruoergai marsh; the Indus River; the Brahmaputra River; the Kunovat-Ob River basin; Lake Ab-i-Estada.
- **East Asia:** the Daurian steppe/wetland complex; the Amur River basin; the Ussuri River basin; the Sanjiang Plain; Lake Khanka/Xingkai Hu; the Yancheng salt flats; the middle Yangtze River (including the wetlands at Poyang Lake and Dongting Lake); the Yellow River delta; the Han and Imjin Rivers and the Han River estuary.
- **Australia/New Guinea:** the Fly River wetlands; coastal wetlands of northeastern Australia; the Burdekin River basin; the Murray-Darling river system.
- **Southeast Asia:** the Mekong River; Tonle Sap.
- **North America:** the Platte River; shallow lakes of the southwestern U.S. (Texas and New Mexico) and Mexico; coastal wetlands of the Gulf of Mexico in Louisiana, Texas, and Mexico; Cuba's Zapata Swamp.

Watershed-scale planning is no less important for the smaller river and wetland complexes in these regions. Crane and wetland conservationists should work with other conservation and development planners to promote coordinated policies and actions that will benefit cranes, other elements of biodiversity, and the local communities in these areas.

3) Encourage the signing and ratification of the Ramsar Convention in countries where this has not yet occurred, and full implementation of its provisions in signatory countries.

In the long run, the fate of most of the world's cranes rests upon actions taken to protect, maintain, and restore healthy wetlands. A key step in assuring a viable future for cranes and other wetland-dependent species is adoption and implementation of the Convention on Wetlands of International Importance, Especially Waterfowl Habitat (the "Ramsar Convention"). Especially important are provisions in the Convention that require signatory countries to include wetland conservation considerations in natural resource planning, to designate Wetlands of International Importance, and to promote wetland conservation through the establishment of protected areas. The obligations outlined in the Convention provide an important foundation upon which detailed crane conservation strategies can be developed at the national and regional levels. Table 3.2 shows the countries that have signed the Ramsar Convention (as of 31 May 1996).

4) Strengthen the network of crane working groups.

The various crane working groups have been essential to crane conservation efforts around the world (see Section 1.7 and Appendix 2). Through the working groups, crane conservationists are able to meet, share information, publish scientific studies and newsletters, organize research and conservation projects, and coordinate international programs. Strengthening the groups is a high global priority. The groups have varied needs. In China and in Russia and other portions of the former Soviet Union, rebuilding effective working groups is the highest priority. The groups in Africa require support for regular meetings and for publication of newsletters. Europe's working group hopes to have more regular interaction with crane researchers from North Africa, the Middle East, and Eurasia. The priority measures described in this action plan have been identified with the assistance and review of the working

Table 3.2
Ramsar List of Convention Wetlands of International Importance

	Country	Date Convention came/comes into force	# sites	(hectares)
1	Albania	29.03.96	1	20,000
2.	Algeria	04.03.84	2	4,900
3.	Argentina	04.09.92	5	176,074
4.	Armenia	06.11.93	2	492,239
5.	Australia	21.12.75	49	5,039,121
6.	Austria	16.04.83	8	102,599
7.	Bangladesh	21.09.92	1	596,000
8.	Belgium	04.07.86	6	7,935
9.	Bolivia	27.10.90	1	5,240
10.	Brazil	24.09.93	5	4,536,623
11.	Bulgaria	24.01.76	5	2,501
12.	Burkina Faso	27.10.90	3	299,200
13.	Canada	15.05.81	33	13,030,568
14.	Chad	13.10.90	1	195,000
15.	Chile	27.11.81	1	4,877
16.	China	31.07.92	6	586,870
17.	Comoros	09.06.95	1	30
18.	Costa Rica	27.04.92	5	70,368
19.	Cote d'Ivoire	27.06.96	1	19,400
20.	Croatia	25.06.91	4	80,455[1]
21.	Czech Republic	01.01.93	9	37,541[2]
22.	Denmark	02.01.78	38	1,832,968
23.	Ecuador	07.01.91	2	90,137
24.	Egypt	09.09.88	2	105,700
25.	Estonia	29.07.94	1	48,640
26.	Finland	21.12.75	11	101,343
27.	France	01.12.86	17	778,085
28.	Gabon	30.04.87	3	1,080,000
29.	Germany	26.06.76	31	672,852
30.	Ghana	22.06.88	6	178,410
31.	Greece	21.12.75	11	107,400
32.	Guatemala	26.10.90	2	61,872
33.	Guinea	18.03.93	6	225,011
34.	Guinea-Bissau	14.05.90	1	39,098
35.	Honduras	23.10.93	2	91,375
36.	Hungary	11.08.79	13	114,862
37.	Iceland	02.04.78	2	57,500
38.	India	01.02.82	6	192,973
39.	Indonesia	08.08.92	2	242,700
40.	Iran, Islamic Republic of	21.12.75	18	1,357,550
41.	Ireland	15.03.85	21	13,035
42.	Italy	14.04.77	46	56,950
43.	Japan	17.10.80	10	83,530
44.	Jordan	10.05.77	1	7,372
45.	Kenya	05.10.90	2	48,800
46.	Latvia	25.11.95	3	43,300
47.	Liechtenstein	06.12.91	1	101
48.	Lithuania	20.12.93	5	50,451
49.	Malaysia	10.03.95	1	38,446
50.	Mali	25.09.87	3	162,000
51.	Malta	30.01.89	2	16
52.	Mauritania	22.02.83	2	1,188,600
53.	Mexico	04.11.86	4	700,546
54.	Morocco	20.10.80	4	10,580
55.	Namibia	23.12.95	4	629,600
56.	Nepal	17.04.88	1	17,500
57.	Netherlands	23.09.80	24	326,928
58.	New Zealand	13.12.76	5	38,868
59.	Niger	30.08.87	1	220,000
60.	Norway	21.12.75	23	70,150

continued...

table 3.2 continued

63.	Papua New Guinea	16.07.93	1	590,000
64.	Paraguay	07.10.95	4	775,000
65.	Peru	30.03.92	3	2,415,691
66.	Philippines	08.11.94	1	5,800
67.	Poland	22.03.78	8	90,455
68.	Portugal	24.03.81	10	30,563
69.	Romania	21.09.91	1	647,000
70.	Russian Federation	11.02.77	35	6,337,601[4]
71.	Senegal	11.11.77	4	99,720
72.	Slovak Republic	01.01.93	7	25,519[2]
73.	Slovenia	25.06.91	1	650[1]
74.	South Africa	21.12.75	12	228,344
75.	Spain	04.09.82	35	157,857
76.	Sri Lanka	15.10.90	1	6,210
77.	Suriname	22.11.85	1	12,000
78.	Sweden	21.12.75	30	382,750
79.	Switzerland	16.05.76	8	7,049
80.	The former Yugoslav Republic of Macedonia	08.09.91	1	40,000[1]
81.	Togo	04.11.95	2	194,400
82.	Trinidad & Tobago	21.04.93	1	6,234
83.	Tunisia	24.03.81	1	12,600
84.	Turkey	13.11.94	5	59,350
85.	Uganda	04.07.88	1	15,000
86.	United Kingdom	05.05.76	103	400,018
87.	United States of America	18.04.87	15	1,163,690
88.	Uruguay	22.09.84	1	435,000[5]
89.	Venezuela	23.11.88	1	9,968
90.	Viet Nam	20.01.89	1	12,000
91.	Yugoslavia	28.07.77	4	39,861
92.	Zaire	18.05.96	2	866,000
93.	Zambia	28.12.91	2	333,000
	former USSR		9	1,770,551[4]
			800	**53,735,361** [6]

NOTES:

1 = Croatia, Slovenia and The former Yugoslav Republic of Macedonia have each deposited with UNESCO a Declaration of Succession to Yugoslavia. UNESCO has advised the Bureau that the Convention entered into force for Croatia and Slovenia on 25 June 1991, and on 8 September 1991 for The former Yugoslav Republic of Macedonia.

2 = The Czech Republic and Slovak Republic have each deposited with UNESCO a Declaration of Succession to the former Czech & Slovak Federal Republic which became a Contracting Party on 2 July 1990. UNESCO has advised the Bureau that the Convention entered into force for both these states on 1 January 1993.

3 = The Bureau has been notified that the total area of wetlands designated by New Zealand is approximate.

4 = The Russian Federation has informed UNESCO that it continues to exercise the rights and carry out the obligations of the former USSR under the Ramsar Convention. Of the sites designated in 1976 by the former USSR, 3 are now in the Russian Federation and 1 is in Estonia; the remaining 9 sites are in other independent States (Azerbaijan 1, Kazakhstan 2, Kyrgyzstan 1, Turkmenistan 1, Ukraine 4). Tajikistan and Uzbekistan have deposited with UNESCO a Declaration of Succession to the former USSR but have not yet designated any site for the List. None of the sites designated by the former USSR are in Tajikistan or Uzbekistan.

While awaiting confirmation by certain members of the Commonwealth of Independent States (Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Turkmenistan and Ukraine) of their status as Parties to the Convention, the Ramsar Bureau points out that these States, together with the Russian Federation, Tajikistan and Uzbekistan, have undertaken, in the Alma-Ata Declaration of 21 December 1991 to guarantee "in conformity with their legislative procedures, the fulfilment of international obligations, stemming from the agreements signed by the former USSR". The Bureau is also in contact with Georgia with regard to its status as Parties to the Ramsar Convention.

The area of wetlands given for the Russian Federation does not reflect all 32 sites designated in 1994. The Russian Federation has indicated that maps and geographical data for these sites will be deposited with the Bureau as soon as the necessary information has been received from local authorities.

5 = The area of the "Banados del Este" site is under review, within the framework of the Ramsar Monitoring Procedure.

6 = Total figure is for 790 Ramsar Sites where area data are provided.

UNESCO has informed the Bureau that the following documents have been received:

Israel: Instrument of Signature Subject to Ratification
Luxembourg: Instrument of Signature Subject to Ratification
Tajikistan: Declaration of Succession to the former USSR (no sites yet designated)
Uzbekistan: Declaration of Succession to the former USSR (no sites yet designated)

These States will become Contracting Parties as soon as they have completed the necessary formalities.

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groups, and in many cases these actions will be carried out through the groups. Supporting the operations of the groups is thus key to the implementation of the action plan as a whole.

5) Support future international and regional crane workshops.

Since the mid-1970s, regional and international workshops and conferences have played an indispensable role in bringing together crane conservation biologists from different regions, promoting the exchange of information, and developing conservation strategies (see Table 1.4). Proceedings of most of the workshops have been published, and serve as important sources of information for scientists, students, agency officials, non-governmental organizations, and others interested in the conservation of cranes and the ecosystems where they are found (a list of the proceedings is provided in the Literature section). Crane workshops continue to be the principal vehicle through which new information on cranes and their habitats is presented and shared, and new conservation needs are identified. Institutional and financial support is needed to maintain this important function, and especially to provide more opportunities for conservation biologists from developing countries to participate.

BOX 3
The Ron Sauey Memorial Library for Bird Conservation

The late Dr. Ronald Sauey was a co-founder of the International Crane Foundation. In his memory, his family supported construction of the Ron Sauey Memorial Library for Bird Conservation at ICF headquarters in Baraboo, Wisconsin, U.S.A. The library includes a collection of 7,000 research reports, popular articles, papers, and dissertations about cranes worldwide; 2,000 monograph titles in the areas of general conservation, cranes, ecology, zoology, and ornithology; 12 major journals in ornithology and conservation biology; and over 200 newsletters and magazines. A professional librarian maintains the collection and provides bibliographies and copies of papers upon request. The collection, including papers, journal articles, and book chapters, has been indexed and entered into an in-house computer catalog, facilitating access to information and the printing of bibliographies. Translations of the most important non-English papers (mainly in Chinese, German, Japanese, and Russian) are available. A list of new documents is provided annually and sent to crane researchers worldwide. Further information about the library and its resources is available through ICF.

6) Develop a program to monitor crane populations and habitats, synthesize monitoring data, compile reports, and disseminate information.

Cranes are among the most closely monitored groups of organisms on earth. This is due in large part to the network of ornithologists, avian and wetland ecologists, and crane conservationists that has developed in recent decades in response to the threats that cranes face. There is as yet, however, no systematic means of gathering, organizing, and disseminating data from various monitoring efforts. To provide a more accurate and timely overview of the status of the world's cranes and the ecosystems in which they occur, steps should be taken to develop a program for reporting and compiling monitoring data. Such information can be efficiently received and delivered by taking advantage of computer networks and other electronic communications technology. Reports should be published on an annual or biennial basis, allowing researchers to share and update information, and to identify significant gaps in local and regional monitoring efforts. Such a program may also serve as a useful model for other taxonomically based monitoring programs.

7) Coordinate international migration studies for all the migratory species.

For the migratory crane species, an understanding of migration routes, timing, and behavior is fundamental to conservation planning. This is a need that in most cases transcends national and regional boundaries, and thus requires international coordination and support. While the major migration routes of some species and populations are known, most have not yet been clearly defined, and several critical routes are still poorly known (for example, those of the Western and Central populations of the Siberian Crane). Further data is needed on many aspects of migration, including the number of cranes using different routes, the factors affecting migration timing and duration, and important staging and resting areas. In recent years banding, radio-tracking, and satellite telemetry studies have begun to provide critical information on crane migration. These studies should receive continued support, and should be expanded to help fill in gaps in our knowledge. In addition, migration studies offer many opportunities for innovative international education projects. Researchers should take advantage of these opportunities in the design and implementation of their studies.

8) Provide greater access to, and training in the use of, geographic information system (GIS) technology.

Geographic information system (GIS) technology represents an important new tool for crane and wetland scientists and conservationists (e.g. Kondoh 1994 et al., Kanai et al. 1994). Through computer-based storage, manipulation, and processing of spatial data, GIS offers opportunities for

sophisticated analysis of the factors affecting crane populations and habitats. Potential applications of GIS include: habitat identification and classification using remotely-sensed data; watershed-level analysis and planning; development of management plans for protected areas; production of maps for research and education programs; monitoring of habitat restoration projects; modeling of environmental impacts on crane habitat; and synthesis of ecological and socioeconomic data in the development of integrated conservation programs. Providing access to GIS technology will be key to helping crane conservationists address larger-scale and longer-term threats in the future.

9) Provide financial support to meet critical equipment needs.

In many cases, the most critical needs facing crane conservationists are the most basic. Inadequate (or non-existent) field and office equipment can be important obstacles to effective conservation projects. General needs include vehicles, tools, binoculars, scientific instruments, communication devices, and computers. More specialized needs include leg bands, radio transmitters, and satellite transmitters (PTTs) for studies of migration and behavior; slide projectors and video equipment for use in education projects; incubators, pens, feeds, and veterinary supplies for use in captive propagation and release programs; and aerial photos and satellite data for habitat analysis and inventory. The success of many of the measures recommended in this action plan requires that such basic needs be met. Effective administration and enforcement of protected areas, for example, requires that personnel be able to patrol their area and communicate with one another and with local officials.

10) Provide technical and financial support for the translation and dissemination of scientific information on cranes and crane conservation.

Much of the information on cranes and crane conservation is of limited use because it is unavailable to scientists and conservationists in their native language, or because it is unavailable altogether. Crane conservationists worldwide share many of the same challenges in terms of research, habitat protection and management, sustainable development strategies, education, and husbandry and reintroduction techniques. In many cases, researchers working in one portion of a species' range are unaware of, or unable to incorporate findings from, work being done in other portions. Support is thus needed for translation of publications and for enhancing their availability. The advent of electronic computer networks offers many new opportunities to share research results quickly and efficiently. The Ron Sauey Memorial Library for Bird Conservation at ICF (see Box 3) has begun to explore such opportunities for making its collections accessible to off-site researchers through computer networks. In the future, it should be possible for individuals to report as well as receive information through one or more main locations.

11) Provide training opportunities for agency and non-governmental organization personnel.

Professional training in conservation concepts and techniques has been essential to long-term success in protecting the world's cranes. Such training has been offered through conservation agency training programs, through universities, and through special programs developed by ICF and other non-governmental organizations. In most cases training takes place in-country. In many cases, however, international exchange and training programs have proven to be essential in providing experience, disseminating knowledge, and promoting cooperation and camaraderie among conservationists from various countries. This is especially important for scientists, officials, and educators from developing countries, where opportunities for training and working with foreign colleagues are more limited. Support is required at the national, regional, and international levels to provide continuing opportunities for professional training and development.

12) Implement existing recommendations for the sound management and propagation of cranes in captivity and for the coordination of *in situ* and *ex situ* conservation strategies.

Since the early 1980s, the objective in managing captive cranes for conservation has moved away from the propagation of individual pairs and towards the maintenance of viable populations. In order to assure that the populations remain viable, aviculturalists are managing the captive flocks in such a way that high levels (at least 90%) of genetic diversity can be retained over the long run (at least 100 years). The coordination of strategies for genetic management and production of the rarest taxa (Wattled, Siberian, Mississippi Sandhill, White-naped, Whooping, and Red-Crowned Cranes) for release and reintroduction projects also requires careful planning and cooperation among the institutions involved in captive propagation.

To ensure that the populations of captive cranes are managed in a sound fashion, and that these efforts dovetail with reintroduction and habitat protection programs, the IUCN/SSC Conservation Breeding Specialist Group has sponsored a series of intensive management workshops, the recommendations of which are recorded in the Crane Conservation Assessment and Management Plan (CAMP) and the Global Crane Action Recommendations (GCAR) (Mirande et al. in press a; see also Section 1.8). Specific recommendations are presented on a species-by-species basis under "Priority Conservation Measures" in the species accounts in Section 2. Several recommendations are presented on a regional basis in the remainder of this section. These recommendations should be fully implemented as part of a comprehensive crane conservation effort, and should be reviewed and updated regularly.

3.2 Recommended Actions at the Regional Level

1. West Africa

Countries Included

Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Cote d'lvoire, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bisseau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo, Zaire (northwest).

Species Present

This region includes the mixed savannahs and wetlands of the Sahel and sub-Sahel, stretching along the southern edge of the Sahara Desert from Senegal to Chad (Sudan and Ethiopia are included in Region 2). Three species occur in the region. The West African subspecies of the Black Crowned Crane is endemic to the region, and has been declining in many areas since the 1970s. Lake Chad is a major wintering areas for western populations of the Eurasian and Demoiselle Cranes.

Recommended Actions

International Agreements and Cooperation

1) Transfer the Black Crowned Crane from CITES Appendix II to Appendix I.

2) Establish a West African Crowned Crane Recovery Team to coordinate all recovery efforts within the subspecies' range.

3) Expand participation in international projects involving banding, monitoring, research, and protection of the migratory populations of Demoiselle and Eurasian Cranes wintering at Lake Chad and elsewhere in the region.

Legal and Cultural Protection

1) Adopt stronger wetland protection policies and legislation at the province and national level throughout the range of the West African Crowned Crane.

2) Strengthen enforcement of existing laws prohibiting hunting and live-trapping of cranes, and protecting cranes within designated protected areas.

3) Review and, where needed, strengthen existing laws and penalties to enhance the conservation status of the West African Crowned Crane at the national level. Especially important are laws to bring trade under control.

4) Strengthen requirements for environmental impact assessments in the planning of development projects affecting wetlands and crane habitat in general.

Protected Areas

1) Strengthen administration of existing protected areas that are important for West African Crowned Cranes.

2) Identify and designate new protected areas (especially key breeding areas) to ensure the survival of the Black Crowned Crane in West Africa. In areas where the species has been extirpated, identify remaining habitat that may again support cranes. Key areas for consideration should include:
   - the Inner Niger River Delta (Mali);
   - the Lake Chad basin (especially the Chingurme-Duguma sector of Nigeria's Chad Basin National Park);
   - the Senegal River basin (Senegal and Mauritania);
   - the Hadejia-Nguru wetlands (northern Nigeria).

3) Provide financial and political support for cooperative international efforts to strengthen existing protected areas in the Lake Chad basin (especially Camaroon's Waza National Park) and to integrate habitat protection and sustainable resource management in the region.

Habitat Protection and Management

1) Develop community-based wetland conservation and management projects in areas where Black Crowned Cranes are found. Such projects can often involve local NGOs and should entail crane monitoring, research, education, and habitat restoration programs.

2) Prepare national-level wetland inventories as a first step toward developing conservation plans. Some countries have already taken steps to do so, and support should be given to further implementation projects.

3) Develop and implement integrated land use and conservation programs for critical wetland complexes within the region, including the Lake Chad basin, the Inner Niger Delta, the Senegambia basin, and the Hadejia-Unguru wetlands. In some cases, such plans have already been outlined.

4) Develop and implement plans for the restoration of degraded wetlands and adjacent uplands.

Surveys/Censuses/Monitoring

1) Develop a coordinated surveying and monitoring program to verify the current status, distribution, size, and trends of the West African Crowned Crane population.

2) Provide technical and financial support for the West African Subregion Management Plan Project and the Black Crowned Crane Coordinating Centre in Kano, Nigeria to coordinate and disseminate survey results.

3) Develop a coordinated program to monitor all crane populations at Lake Chad. This program should involve all four nations bordering Lake Chad (Camaroon, Chad, Niger,

and Nigeria) and should build upon existing monitoring programs.

4) Working with colleagues in Region 2, develop an updated species range map for the Black Crowned Crane.

Research

1) Conduct field studies of various aspects of Black Crowned Crane biology in the region, especially population density, limiting factors, demographics, nesting success, productivity, habitat characteristics, feeding habits, local and seasonal movements, and behavior.

2) Conduct basic ecological studies of the region's wetlands.

3) Support research on the development of sustainable land use practices appropriate for the wetland-upland complexes of the Sahel Savanna. This should include research on restoration of degraded wetlands.

4) Undertake studies of the status and environmental characteristics of specific protected areas and other critical habitats.

5) Determine more precisely, through banding and satellite radio tracking studies, the migration routes and resting areas used by the wintering populations of Demoiselle and Eurasian Cranes at Lake Chad.

Education and Training

1) Develop community-based conservation education and awareness programs involving West African Crowned Cranes and their wetland/savannah habitats.

2) Develop targeted education programs aimed at crane trappers and dealers, policy makers, resource managers, students, and other groups. These programs should provide information on the status of West Africa's cranes and wetlands, and on sustainable land use practices.

3) Provide opportunities for professional training in crane censusing and monitoring techniques, ecological research, wetland management and restoration, and conservation education.

Captive Propagation and Reintroduction

1) Assess the need for a release program to reestablish the Black Crowned Crane in areas where it has been extirpated. This assessment should, however, stress the need to ensure protection and sound management of habitat before any releases are undertaken.

2) Expand training opportunities in crane husbandry, propagation, and reintroduction techniques.

2. East Africa

Countries Included

Burundi, Djibouti, Ethiopia, Kenya, Rwanda, Sudan, Somalia, Tanzania, Uganda, Zaire (eastern)

Species Present

Five crane species occur in this region. The majority of both Grey and Black Crowned Cranes are found here. The northern population of resident Wattled Cranes occurs in the Rift valley and highlands of western Ethiopia. Eurasian Cranes from the East European, European Russia, and Turkey populations, and Demoiselle Cranes from the Black Sea, Turkey, and Kalmykia populations overwinter in Sudan, Ethiopia, and other portions of the region.

Recommended Actions

International Agreements and Cooperation

1) Transfer the Black Crowned, Grey Crowned, and Wattled Cranes from CITES Appendix II to Appendix I.

2) Establish international research and conservation programs involving the Demoiselle and Eurasian Crane populations that winter in the region. Such programs should build links among scientists and conservationists in Sudan and Ethiopia, in countries along the migration routes, and in the breeding range countries of these populations.

Legal and Cultural Protection

1) Place strict controls on the export of Black and Grey Crowned Cranes.

2) Strengthen national laws to protect cranes, especially through increased penalties for trapping, hunting, capture, and illegal possession.

3) Adopt stronger laws to protect wetlands against overexploitation, to prevent indiscriminate use of pesticides, to require environmental impact assessments in the planning of development projects, and to discourage encroachment upon and conversion of key crane habitats.

Conservation of the Wattled Crane in Ethiopia

1) Review the provisions and enforcement of existing legislation protecting Wattled Cranes and their habitats and formulate detailed recommendations.

2) Strengthen administration and community-based conservation activities in protected areas used by Wattled Cranes.

3) Conduct surveys to identify areas of critical Wattled Crane habitat for designation as protected areas and for development of community-based conservation programs.

4) Organize and conduct a census of the Ethiopian population as part of the larger effort to conduct a range-wide census for the Wattled Crane.

5) Establish a long-term population monitoring program for known habitats in the highlands and Rift valley.

6) Initiate a research program to gather basic information on the biology, ecology, and conservation needs of the population. Studies should focus on the distribution, population status, habitat requirements and availability, wetland ecology, the life history of breeding and non-breeding cranes.

7) Initiate a banding program to collect information on habitat requirements, population dynamics, seasonal movements, and movements of non-breeding adults and juveniles.

8) Conduct genetic studies to determine whether the Ethiopian population is distinct from the rest of the species.

9) Stimulate local interest in the population through crane counts and other educational programs involving cranes and their habitats.

Protected Areas

1) Strengthen administration and enforcement in existing protected areas that are important for Black and Grey Crowned Cranes (see species accounts for specific areas).

2) Identify key breeding areas and areas where large concentrations of Black and Grey Crowned Cranes are known to occur. Identify core and buffer areas for potential designation as protected areas.

3) Develop special buffer zone programs for landowners and villages near protected areas to strengthen management programs and to harmonize conservation and development goals.

Habitat Protection and Management

1) Prepare national-level inventories of wetlands as a first step in developing national-level crane and wetland conservation plans in the region. Some countries have already taken steps to do so, and support should be given to further implementation projects.

2) Develop coordinated land use and conservation programs for critical wetlands within the region, especially the Sudd wetlands and other breeding areas outside of designated protected areas.

3) Identify important wintering habitats of the Eurasian and Demoiselle Crane and assess the need for protective measures.

4) Require environmental impact assessments for all large-scale development schemes affecting crane habitat, especially the Sudd wetlands.

Community Conservation Programs

1) Work with community-based NGOs to develop crane monitoring, research, education, and habitat restoration programs.

2) Develop and implement community-based conservation programs that combine wetland protection, restoration, and management activities with local economic development opportunities.

3) Support existing community-based crane and wetland conservation programs, in particular the Kipsaina Wetland Conservation Organization and the Kaisagat Environmental Conservation Youth Group in Kenya. These programs may serve as models adaptable to other parts of the region.

Surveys/Censuses/Monitoring

1) Develop a coordinated surveying and monitoring program to verify the current status, distribution, size, and trends of the Sudan Crowned Crane and East African Crowned Crane populations.

2) Conduct local crane counts in the region. Non-governmental organizations can and should play a key role in organizing and coordinating these counts.

3) Provide support for the Black Crowned Crane Coordinating Centre in Kano, Nigeria to coordinate and disseminate survey results (including data on the Black-Crowned Crane and East Africa).

4) Use survey data to develop updated species range maps for the Black and Grey Crowned Cranes.

5) Initiate regular surveys of the Eurasian and Demoiselle Crane at known wintering areas in Sudan and Ethiopia.

Research

1) For the region's Black and Grey Crowned Cranes:
   - Conduct basic ecological studies of habitat requirements. Information from these studies should be used to identify critical habitat, especially breeding habitat, for these species.
   - Conduct banding studies to understand local and seasonal movements and the demographics of their populations.
   - Conduct basic studies of the two species' population density, nesting densities, nesting success, recruitment rates, feeding habits, and behavior.
   - Conduct focused research on factors (including human

activities) affecting productivity in different parts of the region.

- Assess the extent and impact of the capture, sale, and export of the two species.

2) For the region's wintering populations of Demoiselle and Eurasian Cranes:
   - Conduct field surveys to identify and describe critical wintering areas.
   - Determine more precisely, through banding and radio tracking projects, the migration routes, resting areas, and wintering grounds.
   - Develop improved procedures to communicate and coordinate scientific information from the breeding range, migration routes, and winter range of the populations.

3) Develop sustainable land use practices appropriate for the wetland-upland complexes of the Sudan Savanna region and for the wetlands in the region as a whole.

4) Assess the impact of Grey Crowned Cranes on agricultural crops and determine the factors that influence the timing and location of crop damage.

Education and Training

1) As a component of community-based conservation programs, develop crane counts and other education and awareness programs involving Black and Grey Crowned Cranes and wetlands.

2) Provide professional training opportunities for crane researchers, wetland conservationists, and protected area managers in crane censusing and monitoring techniques, ecological research, wetland management and restoration, and conservation education.

3) Integrate public education efforts into all local crane research and conservation projects.

4) Develop special programs aimed at groups critical to the conservation of Black and Grey Crowned Cranes, especially teachers, rural landowners, and those who are involved in the capturing of cranes for trade.

6) Develop international programs involving students from the breeding range, migration routes, and winter ranges of the Demoiselle and Eurasian Crane populations that winter in the region.

Captive Propagation and Reintroduction

1) Restrict, if necessary, the reproduction rate among captive Grey Crowned Cranes to allow more space for Black Crowned Cranes.

2) Develop a Global Animal Survival Plan and full PHVA for the Wattled Crane. *In situ* and *ex situ* conservation needs of the Ethiopian population should be determined as part of this process.

3. Southern Africa

Countries Included

Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, Zimbabwe

Species Present

The Blue Crane is endemic to the region. The majority of Africa's Wattled Cranes and the South African subspecies of the Grey Crowned Crane also occur here.

Recommended Actions

International Agreements and Cooperation

1) Transfer the Grey Crowned, Blue, and Wattled Crane from CITES Appendix II to Appendix I.

2) Expand regional cooperation in projects to understand crane movements.

Legal and Cultural Protection

1) Strengthen existing laws prohibiting the capture, keeping in captivity, shooting, intentional poisoning, hunting, injuring, or disturbing of cranes without a permit from the relevant national conservation agency.

2) Enact strict controls on the export of Grey Crowned Cranes from the region.

3) Enforce existing legislation regulating resource use and settlement within protected areas.

4) Introduce specific legislation to encourage conservation of Wattled Crane breeding habitat outside of protected areas.

5) Develop and enforce requirements for environmental impact assessments in the process of issuing permits for significant changes in land-use (especially afforestation permits).

Protected Areas

1) Provide greater protection for the key crane habitats by expanding existing protecting areas, upgrading their protective status, establishing buffer zones, and/or strengthening management capacities. High priority areas are: the Okavango River and Delta; the Makgadikgadi Pans; Etosha Pan; the Bangweulu Swamps and Kafue Flats (Zambia); the Zambezi delta/Marromeu Complex (Mozambique); the Blood River Vlei and grasslands in and near Wakkerstrom and Dullstroom (South Africa).

2) Restore degraded ecosystems within protected areas to improve conditions for cranes and other wildlife. Required measures include: restoration of native plant species and communities (in part through the removal of plantation trees and other alien plant species); timing of burning schedules to avoid destruction of eggs or pre-fledged chicks; and controlled livestock grazing.

3) Conduct surveys to identify additional areas of critical crane habitat for designation as protected areas.

4) Expand cooperative programs involving local landowners and communities to strengthen management of protected areas and buffer zones and to better integrate conservation and development goals.

Habitat Protection and Management

1) Develop for the Grey Crowned and Wattled Cranes community-based habitat protection and management programs that stress the importance of maintaining breeding habitats outside protected areas and of restoring and managing wetlands.

2) Develop and implement comprehensive programs to promote conservation of cranes and crane habitats among farmers and other private landowners in the region. These programs should include: participation of landowners in surveys and inventories of wetlands used by cranes; incentives for setting aside suitable nesting habitat; monitoring and assessment of planned or possible land use changes that threaten breeding sites; identification and adoption of agricultural practices that improve habitat conditions; dissemination of information on habitat protection and management practices; and reimbursement programs for landowners in areas where crop damage occurs.

3) Address habitat losses associated with afforestation of South Africa's grasslands. Measures should include: development of grassland restoration programs; requirements for impact assessments on all lands that are to be devoted to timber plantations; requirements for greater communication and coordination of activities among local and national conservation agencies and other organizations involved in forestry programs.

4) Include crane conservation measures in the development and implementation of national-level crane and wetland conservation policies and plans in the region.

5) Assess and ameliorate to the extent possible large-scale development pressures on the Kafue Flats, the Okavango Delta, the Makgadikgadi Pans, and the Zambezi River delta.

6) Carry out the projects outlined in the Conservation Programme for the Blue Crane in the Overberg (A. Scott 1993), and use the Overberg program to demonstrate conservation concepts with region-wide relevance.

7) Mark utility lines in areas where collisions are a significant problem for cranes and other birds (especially in the Overberg region and the KwaZulu-Natal midlands.

Responding to the Poisoning of Cranes

1) Develop and implement a comprehensive program of response to the threat of poisoning. This program should include the following components: stronger legislation to restrict the use of poisons; educational campaigns on the use of pesticides, and alternative means of controlling pest damage; expanded cooperation with private landowners on crane protection measures; establishment of a reporting system through which the incidence of crop damage can be assessed and monitored; establishment, where necessary, of compensation programs for farmers suffering crop damage. Existing programs in South Africa should be maintained and expanded.

2) Conduct research on the extent, nature, and timing of crop damage caused by cranes; alternative farming practices and damage control methods; the extent and location of poisoning incidents; types of poisons employed; methods of use; persistence of poisons; effects on species other than cranes; and economic aspects of crop damage and poisoning.

3) Address the issue of crop damage caused by associated "problem" species in order to prevent indirect persecution or poisoning of cranes.

Surveys/Censuses/Monitoring

1) Develop regular crane counts at the national level in all countries of the region.

2) For Blue Cranes:
   - undertake summer breeding censuses throughout South Africa to confirm estimates of the total population;
   - repeat roadside transect surveys at 5-year intervals in South Africa;
   - initiate monitoring programs for the small and/or vagrant populations in Botswana, Swaziland, and Lesotho.

3) Organize (together with researchers in Ethiopia) a range-wide Wattled Crane census.

4) Continue regular monitoring of the populations of all cranes at Etosha Pan in Namibia.

5) Establish long-term crane monitoring programs at several major wetland complexes and at established flocking and nesting sites in the region.

6) Develop a standard method for conducting aerial surveys of Wattled Cranes.

7) Working with colleagues in Region 2, use new survey data to develop updated range maps for the Grey Crowned and Wattled Cranes.

Research

1) Expand studies of habitat (especially breeding habitat) characteristics and requirements of the region's three species.

2) Expand color banding, radiotelemetry, and satellite tracking studies of all three species to improve understanding of seasonal movements, population dynamics, demographics, territory size, habitat requirements, and life history.

3) Study the impact of dams and other water development projects on the hydrological dynamics of floodplains, and the potential for ameliorating negative impacts on Wattled Crane habitat through revised water management policies.

4) Assess the actual and potential incidence of crop damage by cranes and determine the factors that influence the timing, extent, and location of crop damage.

5) Conduct studies of the extent and impact of commercial afforestation on grassland ecosystems in South Africa.

6) Describe and study the populations of Wattled Cranes in Angola, Mozambique, and Tanzania.

7) Undertake basic studies of the Grey Crowned Crane (e.g., distribution, population, ecology, recruitment rates), its interactions with people, and conservation threats in the region.

8) Assess the extent and impact of the capture, sale, and export of Grey Crowned Cranes.

Education and Training

1) Stimulate local interest in crane conservation through crane counts, special educational programs involving cranes and their habitats, involvement of local citizens in crane research and conservation projects, and development of workshops to assist local community leaders in the use and dissemination of educational materials.

2) Enhance awareness of the legal protection of cranes through educational efforts throughout the region.

3) Provide support for dissemination of the recently published booklet *Cranes and Farmers* (Allan 1994).

4) Support development of the Crane Education Forum's education programs in South Africa.

5) Develop education programs specifically aimed at farmers and other private landowners, farm workers, teachers, students, and those who are involved in the capturing of cranes for trade.

6) Address the poisoning problem specifically through a broad-based information campaign in the mass media.

7) Promote the Blue Crane as the national bird and as an indicator species for the endangered grassland ecosystem in southern Africa and encourage existing environmental education programs to include Blue Crane and grassland conservation as a component of their curricula.

8) Provide expanded training opportunities for crane researchers, wetland conservationists, and managers of protected areas in the region, especially through expanded international training programs.

Captive Propagation and Reintroduction

1) Strengthen and coordinate on a regional basis the captive management program of Blue Cranes in the region.

2) Improve coordination among captive flock managers, field researchers, and habitat managers in the development and implementation of comprehensive conservation strategies for the Blue and Wattled Cranes.

4. Western Palearctic

Countries Included

Albania, Algeria, Austria, Belgium, Belorus, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iraq, Israel, Italy, Jordan, Kuwait, Latvia, Lebanon, Libya, Lithuania, Luxembourg, Macedonia, Malta, Moldova, Morocco, Netherlands, Norway, Oman, Poland, Portugal, Qatar, Romania, Russia (western), Saudi Arabia, Slovakia, Slovenia, Spain, Switzerland, Sweden, Syria, Tadzhikistan, Tunisia, Turkey, Ukraine, United Arab Emirates, United Kingdom, Western Sahara, Yemen, Yugoslavia.

Species Present

Two species occur in this region. More than 120,000 Eurasian Cranes breed in the region's northern latitudes and winter in the Iberian Peninsula, North Africa, the Middle East, Chad and Sudan (Chad and Sudan are included in Regions 5 and 6 respectively). More than 30,000 Demoiselle Cranes breed between the Caspian and Black Seas and migrate over the Middle East to wintering grounds in Sudan. In addition, the region include the highly endangered resident population of Demoiselle Cranes in the Atlas Plateau of northwest Africa and isolated breeding populations of Demoiselle and Eurasian Cranes in Turkey. The Siberian Crane occurred historically in northern and eastern portions of the region, and if the breeding grounds of the Western population are found to be in European Russia, they may again be included within the region.

Recommended Actions

International Agreements and Cooperation

1) Expand cooperative conservation efforts for the Eurasian Crane among the countries of Central and Eastern Europe and European Russia where the species breeds and migrates (especially Belorus, Bulgaria, Georgia, Moldova, Romania, Russia, Turkey, and Ukraine) and the countries of northern Africa where they winter (Tunisia, Algeria, Morocco, Libya, Egypt).

2) Provide financial, political, and institutional support international banding, monitoring, research, and habitat management programs for the Eurasian Crane throughout the region.

3) Develop crane and wetland conservation incentives under the European Common Agricultural Policy.

4) Develop a central database for information on all banded and observed cranes in Europe.

Legal and Cultural Protection

1) Enact stronger laws and strengthen enforcement of existing laws restricting the hunting of cranes, especially in Egypt, Romania, and the Balkan Peninsula.

2) Strengthen legal protection for wetlands and other habitats in the Eurasian Crane's breeding grounds, along its migratory routes, and in its wintering grounds. Countries where this is a critical need include Iraq, Pakistan, Tunisia, and Turkey.

3) Strengthen requirements for environmental impact assessments in the planning of development projects (utility lines, roads, railways, wind power facilities, etc.) affecting crane habitat, especially near migration stopover areas and in wintering grounds.

Protecting Rare and Isolated Populations

1) Develop and implement a conservation program for the Atlas population of Demoiselle Cranes.

2) Develop and implement a conservation program for the Black Sea population of Demoiselle Cranes.

3) Develop and implement conservation programs for the breeding populations of Demoiselle and Eurasian Cranes in Turkey.

(See the Demoiselle and Eurasian Crane species accounts for more detailed outlines of the programs recommended above.)

Protected Areas

1) Provide protection for key breeding, staging, resting, and wintering areas of the Eurasian Crane in the western portion of its range (high priority areas are listed in the Eurasian Crane species account).

2) Strengthen enforcement and management of existing protected areas at Vorpommersche Boddenlandschaft (Germany), Hortobagy National Park (Hungary), and Laguna de Gallocanta National Wildlife Reserve (Spain).

Habitat Protection and Management

1) Provide alternative resting areas along the principal migration routes, especially by protecting and restoring smaller wetlands.

2) Protect and manage existing wetlands, and restore degraded wetlands, that have the potential to provide nesting/roosting habitat.

3) Protect wetlands, riparian forests, and floodplains in Central and Eastern Europe from further modification (from dams, drainage, water diversions, etc.).

4) Undertake a comprehensive assessment of the impact of agricultural development on the Black Sea population of the Demoiselle Crane.

5) Develop and implement policies to protect and restore crane habitats on lands in central and eastern Europe now being returned to private individuals or local communities.

6) Provide incentives for farmers and other landowners whose land management practices benefit cranes.

7) Modify (through burial or marking) utility lines to reduce the incidence of collision.

Surveys/Censuses/Monitoring

1) Continue existing population and annual recruitment surveys, migration counts, and monitoring programs to gauge long-term trends in crane populations and habitats. As part of this effort, coordinated, simultaneous crane surveys should be organized in wintering areas.

2) Develop a monitoring program to determine the size of, and trends in, the Kalmykia population of Demoiselle Cranes.

3) Expand the monitoring of crane migration along the Middle East migration corridors. At present, only Saudi Arabia has initiated a continuing monitoring program.

Research

1) Continue and expand efforts to define and/or clarify the migration routes of all crane populations in the region.

2) Continue and expand research on the number, status, distribution, and breeding and wintering areas of the Demoiselle and Eurasian Crane populations in the region.

3) Develop a coordinated, large-scale color banding and radiotracking project for the Eurasian Crane in Europe.

4) Continue studies of the factors affecting Demoiselle Crane breeding success in agricultural areas, giving special attention to the impact of various crop production methods. This information should be used to develop extension programs and services to work with farmers in breeding areas.

5) As a component of efforts to protect rare and isolated crane populations (see above), assess the status of the Eurasian and Demoiselle Crane populations and their habitats in Turkey.

6) Develop more systematic methods of assembling population and habitat-related data in order to evaluate realistically the status of the Eurasian Crane in the region.

7) Continue behavioral and demographic studies of the Eurasian Crane as the basis for comparative studies of the species in other portions of its range.

Addressing Crop Depredation Problems

1) Conduct a comprehensive review of the incidence of crop damage by migrating cranes in the region.

2) Conduct research to evaluate accurately the level of crop damage caused by cranes.

3) Conduct research on crane feeding behavior and the effectiveness of strategies for reducing the incidence of damage.

4) Strengthen farmer incentive and compensation programs involving cranes through adjustments in national and international agricultural policies.

Education and Training

1) Provide training opportunities for personnel, especially volunteers, working in important wetland areas and in protected areas established for cranes.

2) Initiate public education programs in areas of North Africa where cranes occur.

3) Develop exchange programs involving students from the breeding and wintering areas of the various populations.

4) Develop local education programs for students and the general public in areas where Demoiselle and Eurasian Cranes breed. These programs should emphasize the ecology of native wetland and steppe communities.

5) Develop public education programs along the various migration routes and on the wintering grounds of the Demoiselle and Eurasian Cranes, with special emphasis on crane counts and the biology of migration.

6) Develop and disseminate information on alternative agricultural production practices that minimize interference between cranes and people on the breeding grounds, along migration routes, and on the wintering grounds.

7) Develop targeted hunter education programs in areas where illegal hunting is a problem.

Captive Propagation and Reintroduction

1) Monitor the natural recovery of the Eurasian and Demoiselle Cranes in areas from which they have been extirpated, have reached critically low numbers, or occur only during migration; assess the likelihood of further natural restoration and determine the location and quality of potential reintroduction sites.

2) Determine the need for, and possible means of, supplementing the Atlas population of Demoiselle Cranes.

5. Central Asia

Countries Included

Afghanistan, Armenia, Azerbaijan, Bangladesh, Bhutan, western China (including Tibet, Gansu, Guizhou, Ningxia, Qinghai, Shaanxi, Sichuan, and Xijiang Provinces); portions of Yunnan Province), India, Iran, Kazakhstan, Kirghizia, western Mongolia, Nepal, Pakistan, Russia (Siberia), Tadzhikistan, Turkmenistan, Uzbekistan

Species Present

Five species of cranes are present in this region: the Central and Western populations of the Siberian Crane, which breed in Russia and winter in India and Iran; the entire population of the threatened Black-necked Crane; tens of thousands of Eurasian and Demoiselle Cranes, which migrate from their northern breeding grounds through Tibet, Afghanistan, and Pakistan, to wintering areas on the Indian subcontinent; and the entire population of non-migratory Indian Sarus Cranes (resident in the sub-continent).

Recommended Actions

International Agreements and Cooperation

1) Secure the participation of all nations within the range of the Siberian Crane in the Memorandum of Understanding Concerning Conservation Measures for the Siberian Crane, in establishment of a Siberian Crane Recovery Team, and in efforts to develop a Siberian Crane Recovery Plan.

2) Transfer the Sarus Crane from CITES Appendix II to Appendix I.

3) Expand international cooperation on banding studies, monitoring (especially of migration routes), research, and

management strategies for the Eurasian, Demoiselle, and Black-necked Cranes.

Legal and Cultural Protection

1) Strengthen enforcement of existing laws prohibiting or restricting the hunting of cranes in Afghanistan, China, India, Nepal, Pakistan, and Turkmenistan.

2) Strengthen legal protections for wetlands at the national level.

3) Adopt legislation to protect wetlands along key migration routes and at wintering grounds of the Siberian, Eurasian, and Demoiselle cranes.

4) Protect wintering populations of the Black-necked Crane against poaching, in part through development of a reward system for reporting poaching incidents.

Protected Areas

1) Strengthen management of existing protected areas used by cranes. Particular needs include: marking of boundaries; development and implementation of comprehensive management plans; assessment of the effectiveness of present boundaries and the impact of land use in the surrounding watershed; and development of effective warden forces. High priority areas include:
   - Cao Hai Nature Reserve (Guizhou Province, China);
   - the protected area at Xundian (in Yunnan Province, China);
   - Astrakahn Nature Reserve (Russia);
   - Kurgaldzhinski and Naurzumski Nature Reserves (Kazakhstan);
   - the Changthang Cold Desert Wildlife Sanctuary (India); and
   - the Phobjikha and Bumdiling Nature Reserves (Bhutan);

2) Establish new protected areas. High priority areas for consideration include:
   - breeding grounds of the Siberian Crane in the Kunovat River basin;
   - any new Siberian Crane breeding sites that may be located through further surveys;
   - Ruoergai marsh (Sichuan Province, China)
   - Black-necked Crane wintering grounds at Sangti (Arunachal Pradesh, India);
   - the Borgoi steppe and Eravninsky regions of Buryatia (Russia);
   - Demoiselle Crane breeding areas in Tuva and Kalmykia (Russia); and
   - the Turgaiski region (Kazakhstan).

3) Identify and secure protection for important Indian Sarus Crane breeding areas in India.

4) Expand the existing Kurgaldzhinski and Naurzumski Nature Reserves (Kazakhstan).

5) Secure international technical and financial support for development of the Lumbini Crane Sanctuary in Nepal.

6) Develop a long-term international strategy to protect additional important crane habitats within the region.

Habitat Protection and Management

1) Strengthen habitat protection measures for the Siberian Crane's Central population at its migration stopover area at Ab-i-Estada in Afghanistan and for the Western population on its wintering grounds at Fereidoonkenar in northern Iran (see the Siberian Crane species account).

2) Halt further deterioration, drainage, and conversion of wetlands in Black-necked Crane wintering areas.

3) Establish agricultural management areas (rather than reserves) for wintering Black-necked Cranes in southcentral Tibet and for the breeding population in Sichuan, and develop and implement management plans for these areas.

4) Determine the feasibility of restoring Black-necked Crane habitats at Xundian, and at historically used sites in western Yunnan and in and around Cao Hai Lake.

5) Develop a pilot program to protect, maintain, and restore small wetlands in India and Nepal that are, or may potentially be, used by Indian Sarus Cranes. Wetlands in the Brahmaputra Valley are especially important.

Improving the Relationship Between Cranes and Agriculture

In this region, concerns include not only the incidence of crop damage by Eurasian and Demoiselle Cranes, but the effects of changing agricultural practices on Black-necked Cranes and of farming and forestry methods on watersheds and wetlands used by cranes.

1) Develop research programs to:
   - determine the impact of traditional and modern agricultural production methods on cranes;
   - assess the extent and nature of crop damage in areas where this occurs;
   - calculate fair levels of compensation for farmers where damage occurs;
   - improve understanding of crane feeding behavior and the effectiveness of various methods in reducing crop damage.

2) Develop and implement farmer education and extension programs to improve farm practices, to provide information about sustainable agriculture practices and the impor-

tance of wetlands, and to disseminate information on alternative agricultural production practices that minimize interference between cranes and people.

3) Develop incentive programs for farmers who adopt farming methods that benefit cranes (e.g., spring plowing, planting of lure crops, etc).

Surveys/Censuses/Monitoring

1) For the Siberian Crane:
   - Continue aerial surveys of the Central and Western populations in breeding areas of western Russia.
   - Continue annual counts of the Central and Western populations on their wintering grounds.
   - Conduct comprehensive aerial and land surveys in India to identify possible alternative wintering sites of the Central population.
2) For the other species in the region, establish systematic monitoring programs to track trends in their populations.
   - For the Black-necked Crane, coordinated counts should be carried out on all wintering areas every three years.
   - For the Demoiselle and Eurasian Cranes, surveys should aim to define, estimate the size, and gauge trends in the populations and should be coordinated with surveys undertaken in other portions of the species' ranges. Regular winter surveys should be continued in India, and expanded to cover the entire subcontinent.
   - For the resident Sarus Crane populations in India and Nepal, surveys should be undertaken on an annual basis.
3) Conduct field surveys of potential wintering areas of the Black-necked Crane in Yunnan Province, China.

Research

1) Determine more precisely the breeding grounds, migration routes, resting areas, and wintering grounds of the Western and Central populations of the Siberian Crane; the northeast Yunnan, southcentral Tibet, and Bhutan wintering populations of the Black-necked Crane; and the region's populations of Eurasian and Demoiselle Cranes.

2) Conduct further research on other crucial aspects of Siberian Crane biology and ecology (see the Siberian Crane species account).

3) Conduct further research on the ecology, habitat, and conservation needs of the Black-necked Crane on wintering areas in southcentral Tibet, northeast Yunnan, and Bhutan (see the Black-necked Crane species account).

4) Continue studies of Indian Sarus Crane population trends, habitat needs, threats, local and seasonal movements, and wetland ecology.

5) Conduct field investigations of the size, status, and habitats of the Tibet population of the Eurasian Crane.

Education and Training

1) Expand hunter awareness programs in Pakistan and Afghanistan to address problems resulting from high hunting pressure on cranes.

2) Develop locally-based education and awareness programs, for students and for the general public, focusing on the biology of cranes, the ecology of the steppe and wetland ecosystems, threats to cranes, minimizing of human impacts, and collection of data on the cranes and local flora and fauna.

3) Establish education centers and develop specially targeted programs in Iran and India emphasizing the uniqueness of the local wintering populations of Siberian Cranes and the need for effective conservation programs.

4) Complete the planned environmental education center and develop programs for local people and pilgrims at the Lumbini Crane Sanctuary in Nepal.

6) Provide training opportunities for protected area personnel, including guards, local managers, and volunteers, in field ornithology, censusing techniques, wetland ecology, patrolling, and management and planning.

Captive Propagation and Reintroduction

1) Continue immediate efforts to bolster the Western and Central populations of the Siberian Crane through the release of captive-raised birds in Russia, India, and Iran.

2) Assess the status of existing Indian Sarus Crane habitat and the potential for natural recolonization in Pakistan, eastern India, and other portions of the species' historic range where the species has been extirpated or has reached critically low numbers.

3) Assess the need for and feasibility of reintroduction of the Demoiselle Crane in areas of the species' historic range where the species has been extirpated, has reached critically low numbers, or occurs only during migration.

6. East Asia

Countries Included

Eastern China, eastern Mongolia, North Korea, South Korea, Japan, Russia (Transbaikal and Far East).

Species Present

This region has the greatest diversity of cranes in the world. Seven species occur regularly: the Demoiselle,

Siberian, Sandhill, White-naped, Eurasian, Hooded, and Red-crowned Cranes. Four of these (Siberian, White-naped, Hooded, and Red-crowned) are threatened. Three (White-naped, Hooded, and Red-crowned) are endemic to the region. The great majority of the world's Siberian Cranes occur here. The breeding range of the Lesser Sandhill Crane extends into the region in extreme northeastern Siberia. These Sandhill Cranes migrate to northern Mexico, but occasional vagrants winter in Japan and elsewhere in the region.

Recommended Actions

International Agreements and Cooperation

1) Develop an umbrella international agreement on the conservation of the migratory cranes in the region.

2) Secure political support for efforts to designate significant portions of the Korean Demilitarized Zone as an international protected area. As part of this initiative, institutional and financial support should be given for increased interaction and exchanges between North and South Korean ornithologists, wetland experts, and other biologists, and their counterparts in other parts of the region.

3) Secure stronger political support for ongoing international efforts to integrate conservation and sustainable development goals in the Amur River basin.

4) Develop comprehensive recovery plans for the Red-crowned and Siberian Cranes to coordinate habitat conservation, surveys, research, education, and (if necessary) captive propagation and release programs.

5) Provide support for cooperative management of the international protected areas at Lake Khanka on the China-Russia border and in the China-Russia-Mongolia border region.

6) Continue and expand cooperative crane migration studies and the application of this information in collaborative conservation projects.

7) Develop procedures to improve inter-regional coordination and communication of scientific information on the Demoiselle, Sandhill, and Eurasian Crane populations.

Legal and Cultural Protection

1) Develop educational materials to enhance awareness of existing legislation protecting cranes.

2) Strengthen legal protections for wetlands at the national level.

3) Strengthen law enforcement capacity to protect cranes and regulate economic activities in protected areas.

4) Strengthen efforts to curtail poaching of cranes and other protected wetland species through increased patrolling both within and outside protected areas and through adoption of increased fines. This is especially important at Poyang Lake in China.

5) Strengthen requirements for environmental impact assessments in the planning of large-scale development projects (dams and reservoirs, utility lines, roads, railways, etc.) affecting crane habitat.

6) Develop in Russia a comprehensive policy and program to protect the breeding grounds of the Hooded Crane.

Protected Areas

1) Strengthen management of existing protected areas used by cranes. This often involves development and implementation of comprehensive management plans (see species accounts for more specific measures). Priority areas for attention are:
   - the Daguurun, Daurski, and Dalinor Nature Reserves in the China-Mongolia-Russia border region;
   - the Lake Khanka and Xingkai Hu Nature Reserves on the China-Russia border;
   - Muraviovka Nature Park and the Norski and Khinganksi Nature Reserve (Russia);
   - Zhalong, Shuangtaizi, Yancheng, Poyang Lake, and Dongting Lake (East, West, and South) Nature Reserves (China);
   - Kumya, Panmun, and Anbyon Natural Monuments (North Korea);
   - the Han River Estuary and Chuontang Natural Monuments and the Hooded Crane Protection Area at West Taegu (South Korea);
   - Izumi Crane Park and the crane sanctuary at Yashiro (Japan).

2) Expand existing protected areas, or upgrade the current protected status, to protect additional wetlands and adjacent vulnerable grassland areas used by cranes, and to provide for effective buffer zones. Priority areas are:
   - breeding grounds of the Siberian Crane in and near the Elon, Khroma, and Tchaigurgino refuges (zakazniks) near Churkodah in Yakutia (Russia);
   - Daurski, Lake Khanka, and Khinganski Nature Reserves, Muraviovka Nature Park, and the Amurski and Zhuravlini Game Refuges (Russia);
   - Daguurun Nature Reserve (Mongolia);
   - Momoge, Xingkai Hu, Keerqin, Changlindao, Hong He, Yancheng, Shengjin Lake, South Panjin, Tanyang, Huanghe Delta, Poyang Lake, and East Dongting Lake Nature Reserves (China);
   - Kumya Natural Monument (North Korea);
   - the Han River Estuary and Chuontang Natural Monuments (South Korea);.
   - Izumi Crane Park; Kushiro National Park, Furen Lake, and Bekanbeushi River on Hokkaido (Japan).

3) Designate new protected areas. Priority areas for consideration are:
   - key stopover points and wintering grounds now protected by the Korean Demilitarized Zone (the Han and Imjin Rivers and the Choelwon basin). This should be pursued as part of a broad effort to designate significant portions of the DMZ as an international protected area.
   - known breeding habitats of the Siberian Crane in Yakutia (Russia);
   - areas along the Bijan River and Ganukan River (Russia);
   - Bolon Lake (Russia);
   - breeding areas of the Hooded and White-naped Cranes in southeastern Russia's Chita District;
   - wetlands (especially smaller wetlands) in northeastern Mongolia;
   - significant Hooded Crane breeding areas in China's Heilongjiang Province;
   - wetland complexes near Baoli, Sanmenwangjia, and Longzhao in Jilin Province (China);
   - smaller wetlands as well as important crane breeding, staging, and migration stopover areas in the Sanjiang Plain of northeastern China;
   - the Beidaihe region along the Bohai Bay in China;
   - additional areas in the Yellow River delta, Shandong Province (China);
   - important stopover points in south China between Bohai Bay and Poyang Lake;
   - staging and resting areas and sites of known historic occurrence of cranes in North Korea, including Mundok and Yongyon (Pyongyangnam-do) and Eunyool (Hwanghae-do);
   - sites near the existing Hooded Crane Protection Area near Taegu (South Korea);
   - the large area of reclaimed rice paddies on the west coast of South Korea in the Sosan region;
   - additional habitats (existing and potential) throughout the Korean peninsula;
   - Ishahaya, Nakamura, and other newly used wintering areas in Japan.
4) Encourage the adoption of sustainable methods of reed harvesting, grazing, and other resource use in protected areas of northeastern China and southeast Russia used by breeding cranes.

5) In China, upgrade provincial nature reserves to the status of national-level reserves.

6) Encourage stronger in-country cooperation among the national agencies with jurisdiction over protected areas.

Habitat Protection and Management

1) Undertake studies to assess the environmental impacts of the Three Gorges dam on the wetlands of the Yangtze River basin and to develop possible mitigation strategies.

2) Assess and disseminate information on the social and environmental impacts of the dams proposed for the Amur River.

3) Develop plans for dispersing the wintering flocks of Hooded and White-naped Cranes at Izumi, Japan.

4) Restrict further greenhouse development in and near the Taegu Hooded Crane Protection Area in South Korea.

5) Discontinue aerial target bombing of the buffer zone at Lake Khanka on the China-Russian border.

6) Undertake basic measures to protect the aquatic ecosystems of the Chinese wetland reserves (especially through more effective measures to control grazing, cutting of grasses and reeds, and inflow of sewage and pollution).

7) Develop integrated, watershed-scale land use and conservation programs in areas with critical wetland habitat. (See global recommendation #2 above).

8) Identify smaller wetlands within farmlands in the Sanjiang Plain and other portions of northeastern China that are important for wildlife, and develop and disseminate simple management guidelines for them.

9) To reduce the pressure to convert additional wetlands, support the adoption of more efficient farming practices in areas of the China-Russian border (the Amur basin and Sanjiang Plain), especially through educational programs, demonstration sites, and rural development projects. More effective processing and marketing methods are also needed (especially on the Russia side of the border).

10) Develop techniques to reduce crane mortality from poisoning and utility line collisions in China's Yancheng Salt Flats region.

11) Assess the impact of grazing and agricultural development on the Siberia/East Asia population of the Demoiselle Crane.

Surveys/Censuses/Monitoring

1) Initiate or continue annual counts of the threatened crane species at their wintering grounds:
   - Siberian, White-naped, Hooded, and Red-crowned Cranes in China;
   - White-naped, Hooded, and Red-crowned Cranes in the Korean peninsula;
   - Hooded and White-naped Cranes in Japan; and
   - the resident population of Red-crowned Cranes at Hokkaido, Japan.

2) Conduct aerial surveys of all wintering cranes at least once each winter (preferably more often) at Poyang Lake Nature Reserve and in surrounding lands.

3) Conduct regular counts of migratory cranes at key points along their migration routes in the Korea Peninsula and in China (e.g., at Beidehe).

4) Monitor breeding populations:
   - of the White-naped Crane through periodic simultaneous surveys (both aerial and field surveys) of known breeding grounds in China, Mongolia, and Russia, and through continuous observations of selected control sites;
   - of the Red-Crowned Crane through periodic (e.g., every five years) aerial surveys of the main nesting areas in Russia and Heilongjiang (China);
   - of the Hooded Crane by identifying and regularly surveying the breeding grounds in Russia and China.

5) Develop a coordinated and standardized monitoring program to determine the size of, and trends in, the region's populations of Demoiselle, Sandhill, and Eurasian Cranes.

Research

1) Continue banding, radio telemetry, and satellite radio tracking programs to define and further clarify the migration routes, staging and stopover areas, wintering grounds, and local movements (especially on the wintering grounds) of cranes in the region. This should include support for development and deployment of more reliable satellite telemetry equipment for monitoring migration routes. Habitat studies should be undertaken to complement tracking studies.

2) Conduct coordinated international studies to better understand the timing of migration, the numbers involved, flight behavior, and climatic influences on migration patterns.

3) Expand basic research on Siberian Crane biology and ecology in the region (see the Siberian Crane species account for recommended research topics).

4) Expand research on habitat characteristics and requirements of the threatened crane species in the region. Specific high priority topics include:
   - likely impacts of changes in the hydrological functions of the Yangtze River due to construction of the Three Gorges dam;
   - ecological studies of the cranes and ecosystems at protected areas, especially Poyang and Dongting Lakes;
   - ecological studies of known migration stopovers in the Korean peninsula and China;
   - ecological studies of the Hooded Crane's breeding grounds in Russia and China;
   - ecological studies of White-naped Crane nesting habitat requirements and nesting success;
   - more precise identification (using satellite images, aerial surveys, and field surveys) of known and potential breeding areas of the White-naped and Red-crowned Crane in the Amur River basin, northeastern China, and eastern Mongolia;
   - monitoring of Siberian Crane breeding habitat using satellite images and aerial surveys;
   - use of GIS techniques to determine the amount of available Siberian Crane breeding habitat in Yakutia;
   - assessment of the status of present and potential sites used by wintering cranes in South Korea to protect areas that could provide alternatives to the crowded sites in Japan.

5) Expand research on cranes in the Korean Peninsula. Priority topics include: monitoring of populations along migration corridors and in wintering areas; field studies of the cranes wintering along the Sachon River; continued surveys of the Han River, Imjin River, and Choelwon wintering sites, the Han River estuary stopover site, and other known and potential migration and stopover sites; and studies of the impact of different agricultural practices on crane habitat.

6) Assess the risk of disease outbreak and monitor risk factors at the wintering grounds at of the Hooded and White-naped Cranes at Izumi, Japan.

7) Conduct research on the use of wetland resources by people (both within and beyond protected areas), the impacts of these uses on cranes, and sustainable alternatives to overexploitation. This is especially critical in the Amur River basin; at Zhalong, Changlindao, and Hong He Nature Reserves in China; and in the middle Yangtze River basin.

8) Study the incidence of crane mortality due to human factors (such as poisoning and utility line collisions) at the Yancheng Salt Flats in China.

9) Expand research on the number, status, distribution, and breeding and wintering areas of Demoiselle, Sandhill, and Eurasian Cranes in the region.

Education and Training

1) Develop a comprehensive crane and wetland conservation education strategy for the region, emphasizing the need to develop linkages within watersheds and flyways.

2) Develop and disseminate educational materials for students and for the general public that provide basic biological information about cranes. This is especially important in northern and eastern China, along the middle Yangtze River, and in coastal China, eastern Mongolia, and the

Russian Far East. Materials should be prepared in local languages and designed specifically for each area.

3) Promote exchange programs involving students from the breeding and wintering ranges of the various species and populations.

4) Strengthen professional training programs involving crane and wetland conservation and the management of protected areas.

5) Provide opportunities for conservationists, scientists, and officials to participate in international exchanges and training, and for international teams to participate in cooperative field work and conservation planning exercises.

6) Disseminate information on protected area management and conservation planning to administrators, policymakers, and managers through conferences, field trips, demonstration areas, and various media.

7) Encourage public participation in crane counts and surveys, especially along migration routes and at wintering grounds.

8) Develop special educational programs on crane conservation and the sustainable use of wetland resources for farmers and other local residents in and near protected wetlands and other important crane areas. In particular, farmers and the general public in North and South Korea should be provided with more information about cranes through television programs, publications, and other media.

9) Provide farmers (especially in Russia and China) with information on more efficient and sustainable methods of agricultural production and processing.

10) Develop observation posts and interpretive materials for ecotourists in protected areas used by cranes. These should serve not only to inform visitors, but to reduce the incidence of human disturbance of cranes.

Captive Propagation and Reintroduction

1) Ensure that no contact between wild and captive-reared cranes takes place during the winter at artificial feeding stations in Japan and China.

2) Continue research on the release of cranes in Japan and Russia, especially the development of techniques that encourage wild birds to use habitat altered by human activity.

7. Southeast Asia

Countries Included

Cambodia, China (portions of Yunnan Province), Laos, Myanmar, Philippines, Thailand, Vietnam.

Species Present

The Eastern Sarus Crane is the only crane that now occurs in this region. Its range within the region has been fragmented, and its breeding grounds and seasonal movements are poorly known. The subspecies has been decimated in recent decades and immediate steps need to be taken to gain information about its status, to protect and manage key remaining habitats, and to stimulate international conservation projects. Black-necked Cranes were formerly found during the winter in portions of Myanmar and Vietnam, but are no longer believed to occur in these countries. Demoiselle and Eurasian Cranes formerly wintered in the region, but are now found rarely if at all.

Recommended Actions

International Agreements and Cooperation

1) Promote international-level watershed planning for conservation and sustainable development in the Mekong River basin.

2) Transfer the Sarus Crane from CITES Appendix II to Appendix I.

Legal and Cultural Protection

1) Enact strong laws to protect cranes in Cambodia and Laos.

2) Strengthen enforcement of existing laws prohibiting the hunting or capture of cranes and protecting their wetland habitats in China and Thailand.

3) Adopt trade restrictions and penalties to discourage dealers who capture or deal in wild cranes in Cambodia and Thailand.

Protected Areas

1) Identify and secure protection for important breeding areas in Cambodia, Laos, and Myanmar.

2) Identify and secure protection of dry season habitats in Cambodia, China, Laos, and Vietnam.

3) Designate a second protected area (in addition to Tram Chim National Reserve) in Vietnam to protect early dry season habitat.

4) Implement the existing management plan for the Tram Chim National Reserve in Vietnam.

Habitat Protection and Management

1) Develop and implement national-level wetland conserva-

tion plans in Vietnam, Laos, Cambodia, Laos, Myanmar, Thailand, and Vietnam.

1) Include provisions for the protection of Sarus Cranes and wetlands within watershed-level plans for conservation and sustainable development in the Mekong River basin.

2) Define dry-season habitat needs for Sarus Cranes outside of the existing protected areas in the Plain of Reeds in Vietnam and Cambodia.

Surveys/Censuses/Monitoring

1) Develop long-term surveying and monitoring programs at Tonle Sap and other breeding areas in northern Cambodia during the breeding season, and in the Mekong River delta between Phnom Penh and the Cambodia-Vietnam border during the dry season.

2) Assess the status of the Eastern Sarus Crane in Laos, Myanmar, and southern and western Yunnan Province in China.

Research

1) Determine the location, habitat needs, and behavior of breeding cranes in Cambodia and Laos, and of dry season flocks in the wetlands of the Vietnam/Cambodia border region.

2) Determine the distribution of Eastern Sarus Cranes in Myanmar and Laos to clarify whether there are one or two populations.

3) Expand hydrological studies of the wetlands of the Plain of Reeds.

4) Conduct banding and satellite tracking studies of the cranes at the Tram Chim National Reserve to determine local and seasonal movements.

5) Confirm the extinction of the Sarus Crane in the Philippines and assess the potential for natural recolonization or reintroduction of the species.

6) Confirm the extirpated status of the Black-necked Crane in Myanmar and Vietnam.

7) Determine the status of wintering Eurasian and Demoiselle Cranes in the region.

Population and Habitat Viability Assessment

1) Complete the PHVA that has been initiated for the Eastern Sarus Crane.

Education and Training

1) Develop local educational programs for students on the biology and conservation of Eastern Sarus Cranes.

2) Complete the planned environmental education center at Tram Chim National Reserve in Vietnam.

3) Provide expanded training opportunities for wildlife conservation officials in Cambodia and Laos.

4) Support farmer education and extension programs involving sustainable agriculture and the importance of wetlands.

Captive Propagation and Reintroduction

1) Determine the subspecies and reproductive status and history of the Sarus Cranes in Thailand's captive propagation centers, and develop a studbook to summarize this information.

2) Assess the status of existing habitat and the potential for natural recolonization of the Eastern Sarus Crane in Cambodia, China, Thailand, and the Philippines.

8. Australia/New Guinea

Countries Included

Australia, Indonesia (New Guinea), Papua New Guinea.

Species Present

Two species occur in this region: the Brolga (in much of northern and eastern Australia and in southern New Guinea) and the Australian Sarus Crane (primarily in Queensland). Neither of these are threatened at the regional scale, although the southern population of the Brolga has declined substantially in portions of Australia.

Recommended Actions

International Agreements and Cooperation

1) Transfer the Sarus Crane from CITES Appendix II to Appendix I.

2) Support international exchanges of conservation biologists, ornithologists, and officials from New Guinea, Australia, and Southeast Asia.

Legal and Cultural Protection

1) Enact stronger wetland conservation policies and legislation at both the local and national level in Australia.

Initiating a Brolga Conservation Program in New Guinea

1) Assess the past and present status of New Guinea's Brolga populations and their habitats, and the movements of Brolgas between Australia and New Guinea.

2) Define the conservation needs of these populations and their habitats.

3) Assess the need for stronger legal protection for wetlands in New Guinea.

Habitat Protection and Management

1) Strengthen watershed-level approaches to wetland management within the region, especially in the coastal wetlands of northeastern Australia, the Burdekin River basin, and the Murray-Darling river system.

2) Identify and protect critical dry season Brolga congregation areas.

3) Conduct a general assessment of the status of crane habitat in northeastern Australia.

4) Define critical habitat for Brolgas, both breeding and non-breeding dry season habitat.

5) Develop coordinated programs to encourage farmers and other private landholders to maintain and restore crane habitat, especially breeding habitat in southern Australia.

Surveys/Censuses/Monitoring

1) Establish a systematic censusing and monitoring program for both Brolgas and Sarus Cranes in Australia, and for Brolgas in New Guinea.

2) Monitor the movements of crane populations through an expanded banding and radio tracking program.

Research

1) Determine the size of, and trend in, the Brolga population.

2) Determine with grater accuracy the size and distribution of the Australian Sarus Crane population.

3) Conduct studies of the traditional flocking sites used by Brolgas during their seasonal movements as a basis for protection of these areas.

4) Define critical habitat, especially optimal breeding habitat, for the Australian Sarus Crane.

5) Conduct studies of Brolga breeding habitat and biology throughout the species' range.

6) Identify and assess the status of potentially threatened Brolga populations in southern Australia.

7) Conduct studies to support the restoration of degraded wetlands and other habitats used by cranes.

8) Conduct studies of the interspecific relationship between Brolgas and Sarus Cranes during the dry season.

Education and Training

1) Expand education programs throughout the region, with emphasis on the function and conservation of wetland ecosystems.

2) Expand extension and advisory services to foster the involvement of farmers and other private landowners in crane conservation activities.

3) Secure financial support for development of the permanent wetland/Brolga interpretive center at Cromarty.

Captive Propagation and Reintroduction

1) Develop a regional management plan for the captive population of Brolgas.

2) Determine the need to develop a studbook and/or to review and update International Species Information System (ISIS) data on the Brolga.

9. North America

Countries Included

Canada, Cuba, Mexico, United States of America

Species Present

This region includes the world's most abundant crane species, the Sandhill, and the world's rarest, the Whooping Crane. The breeding range of the Sandhill Crane extends into northeastern Russia (Region 6). Endangered subspecies of the Sandhill Crane occur in Cuba and Mississippi (USA).

Recommended Actions

Implementing Recovery Plans

1) Fully implement the recovery actions recommended and described in the *U.S. Whooping Crane Recovery Plan* (USFWS 1994) and *Canada's National Recovery Plan for the Whooping Crane* (Edwards et al. 1994).

2) Fully implement the *Mississippi Sandhill Crane Recovery Plan* (USFWS 1991). See "Recovery of the Mississippi Sandhill Crane" in the Sandhill Crane species account in Section 2.

International Agreements and Cooperation

1) Combine and coordinate the U.S. and Canadian Whooping Crane recovery plans.

2) Support continued international cooperation in developing a comprehensive conservation program for the Cuban Sandhill Crane.

3) Expand cooperation between biologists in Mexico's

Sandhill Crane wintering grounds and those working in the breeding range of these populations.

Legal and Cultural Protection

1) Secure legal protection for the instream flow of the Platte River.

2) Consider separate listing of the Florida Sandhill Crane by the USFWS.

Surveys/Censuses/Monitoring

1) Continue annual breeding and wintering ground surveys of the Whooping Crane.

2) Continue semi-annual censuses of the Mississippi Sandhill Crane.

3) Continue field surveys of the Cuban Sandhill Crane population and establish a monitoring program to assess trends in, and threats to, the populations and their habitats.

4) Continue current surveys and counts of migratory Sandhill Crane populations.

5) Develop improved methods to assess the size, status, and population dynamics of the mid-continental population of Sandhill Cranes.

6) Continue close monitoring of the legal kill, crippling losses, and poaching of Sandhill Cranes in areas they are hunted.

Protected Areas

1) Continue efforts to prevent habitat loss due to shoreline erosion at Aransas NWR.

2) Ensure long-term maintenance of freshwater inflow into the bay systems at and near Aransas NWR.

3) Monitor the level of human disturbance at Aransas NWR and adjacent wintering grounds, and institute measures to minimize detrimental activities.

Habitat Protection and Management

1) Maintain instream flow of the Platte River.

2) Provide continued financial and institutional support for efforts to protect and restore wet meadows and riparian roosting areas at spring staging areas along the North Platte and Platte Rivers. Broaden efforts to increase public understanding of and support for habitat protection and restoration in these areas through education and appropriate incentives and policy adjustments.

3) Implement existing habitat management plans for Whooping Crane release sites in the Kissimmee prairie region in Florida.

4) Evaluate and develop preliminary habitat management guidelines for potential Whooping Crane release sites.

5) Identify priority wetland and upland habitats of the Cuban, Florida, and Mississippi Cranes for strengthened protection.

6) Expand habitat restoration efforts in areas used by (or that may potentially be used by) the Cuban and Mississippi Cranes.

7) Strengthen protection and management of critical staging and wintering areas of the migratory Sandhill Cranes, especially the seasonal playa lakes of western Texas and eastern New Mexico, wintering grounds of the Greater Sandhill Crane in Florida, riparian wetlands in the western United States and northern Mexico, and Laguna de Babicora in northern Mexico.

8) Develop compensation programs and policy incentives to reward farmers whose management practices benefit cranes.

9) Expand efforts to reduce utility line collisions in areas where this is a significant problem.

10) Encourage adoption of habitat management techniques (e.g., lure crops) to minimize potential damage from crop depredation.

Research

Priority topics for crane research in the region are:

1) The capacity of the Aransas NWR winter habitat to absorb additional Whooping Cranes if the population continues to increase.

2) Expansion of the breeding range of the Aransas-Wood Buffalo of Whooping Cranes at Wood Buffalo National Park.

3) Development of techniques for reintroducing and establishing new breeding populations of Whooping Cranes and for establishing migratory routes among released birds.

4) Evaluation of potential Whooping Crane reintroduction sites in Canada.

5) Monitoring and evaluation of disease risks among the concentrated populations of Sandhill Cranes and among all Whooping Cranes.

6) Development of a detailed research agenda and management plan for the Cuban Sandhill Crane, with recommendations for habitat management and the establishment or expansion of protected areas.

7) Improved assessments of the size, status, demographics, and population dynamics of the mid-continental Sandhill Crane populations.

8) Clearer delineation of populations, migration routes, range expansions, and winter ranges of migratory Sandhill Cranes.

9) Continued studies of the factors behind poor reproduction and recruitment rates of Mississippi Sandhill Cranes in the wild.

10) Clarification of the intraspecific genetic structure and phylogenetic relationships among Mississippi, Florida and Cuban Sandhill Cranes; and among Lesser, Canadian, and Greater Sandhill Cranes.

11) Determination of the extent of crop depredation problems in different portions of the Sandhill Crane's range.

12) Research relevant to management of Sandhill Crane populations that are now hunted. Analyses should seek to determine the differential impact of hunting on subspecies and subpopulations.

Education and Training

1) Develop education programs that involve students in crane counts, censuses, and long-term monitoring programs.

2) Develop cooperative projects involving schools in Russia, Canada, the United States, and Mexico in the study of avian migration, using Sandhill Cranes as a model.

3) Develop primary and secondary school curriculum materials that use Sandhill Cranes to communicate information about wetlands and the biology, status, and conservation of Sandhill Cranes and other crane species.

4) Provide international training opportunities for Cuban field ecologists, ornithologists, and conservationists.

5) Develop in Cuba a model education program focused on the importance, status, and conservation needs of the Cuban Sandhill Crane.

6) Use present knowledge of crane social behavior to communicate lessons about the role of animal behavior in conservation.

7) Develop extension programs and demonstration projects to involve farmers in conservation education and habitat protection activities.

Captive Propagation and Reintroduction

1) Continue efforts to establish two additional, separate, self-sustaining, wild populations of Whooping Cranes.

2) Continue efforts to establish a viable, self-sustaining population of Whooping Cranes in captivity.

3) Implement the recommendations of the Mississippi Sandhill Crane PHVA (USFWS 1991), including completion of the transfer of breeding pairs to new locations in the southern United States.

4) Assess the need for a captive propagation and reintroduction program in Cuba.

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APPENDIX 3
IUCN Red List Categories

Prepared by the IUCN Species Survival Commission

As approved by the 40th Meeting of the IUCN Council
Gland, Switzerland

30 November 1994

1) Introduction

1. The threatened species categories now used in Red Data Books and Red Lists have been in place, with some modification, for almost 30 years. Since their introduction these categories have become widely recognised internationally, and they are now used in a whole range of publications and listings, produced by IUCN as well as by numerous governmental and non-governmental organisations. The Red Data Book categories provide an easily and widely understood method for highlighting those species under higher extinction risk, so as to focus attention on conservation measures designed to protect them.

2. The need to revise the categories has been recognised for some time. In 1984, the SSC held a symposium, 'The Road to Extinction' (Fitter & Fitter 1987), which examined the issues in some detail, and at which a number of options were considered for the revised system. However, no single proposal resulted. The current phase of development began in 1989 with a request from the SSC Steering Committee to develop a new approach that would provide the conservation community with useful information for action planning.

In this document, proposals for new definitions for Red List categories are presented. The general aim of the new system is to provide an explicit, objective framework for the classification of species according to their extinction risk.

The revision has several specific aims:

- to provide a system that can be applied consistently by different people;

- to improve the objectivity by providing those using the criteria with clear guidance on how to evaluate different factors which affect risk of extinction;

- to provide a system which will facilitate comparisons across widely different taxa;

- to give people using threatened species lists a better understanding of how individual species were classified.

3. The proposals presented in this document result from a continuing process of drafting, consultation and validation. It was clear that the production of a large number of draft proposals led to some confusion, especially as each draft has been used for classifying some set of species for conservation purposes. To clarify matters, and to open the way for modifications as and when they became necessary, a system for version numbering was applied as follows:

Version 1.0: Mace & Lande (1991)
The first paper discussing a new basis for the categories, and presenting numerical criteria especially relevant for large vertebrates.

Version 2.0: Mace et al. (1992)
A major revision of Version 1.0, including numerical criteria appropriate to all organisms and introducing the non-threatened categories.

Version 2.1: IUCN (1993)
Following an extensive consultation process within SSC, a number of changes were made to the details of the criteria, and fuller explanation of basic principles was included. A more explicit structure clarified the significance of the non-threatened categories.

Version 2.2: Mace & Stuart (1994)
Following further comments received and additional validation exercises, some minor changes to the criteria were made. In addition, the Susceptible category present in Versions 2.0 and 2.1 was subsumed into the Vulnerable category. A precautionary application of the system was emphasised.

Final Version

This final document, which incorporates changes as a result of comments from IUCN members, was adopted by the IUCN Council in December 1994.

All future taxon lists including categorisations should be based on this version, and not the previous ones.

4. In the rest of this document the proposed system is outlined in several sections. The Preamble presents some basic information about the context and structure of the proposal, and the procedures that are to be followed in applying the definitions to species. This is followed by a section giving definitions of terms used. Finally the definitions are presented, followed by the quantitative criteria used for classification within the threatened categories. It is important for the effective functioning of the new system that all sections are read and understood, and the guidelines followed.

References:

Fitter, R., and M. Fitter, ed. (1987) *The Road to Extinction. Gland,* Switzerland: IUCN.

IUCN. (1993) *Draft IUCN Red List Categories.* Gland, Switzerland: IUCN.

Mace, G. M. et al. (1992) "The development of new criteria for listing species on the IUCN Red List." *Species* 19: 16-22.

Mace, G. M., and R. Lande. (1991) "Assessing extinction threats: toward a reevaluation of IUCN threatened species categories." *Conserv. Biol.* 5.2: 148-157.

Mace, G. M. & S. N. Stuart. (1994) "Draft IUCN Red List Categories, Version 2.2". *Species* 21-22: 13-24.

2) Preamble

The following points present important information on the use and interpretation of the categories (= Critically Endangered, Endangered, etc.), criteria (= A to E), and sub-criteria (= a,b etc., i,ii etc.):

1. Taxonomic level and scope of the categorisation process

The criteria can be applied to any taxonomic unit at or below the species level. The term 'taxon' in the following notes, definitions and criteria is used for convenience, and may represent species or lower taxonomic levels, including forms that are not yet formally described. There is a sufficient range among the different criteria to enable the appropriate listing of taxa from the complete taxonomic spectrum, with the exception of micro-organisms. The criteria may also be applied within any specified geographical or political area although in such cases special notice should be taken of point 11 below. In presenting the results of applying the criteria, the taxonomic unit and area under consideration should be made explicit. The categorisation process should only be applied to wild populations inside their natural range, and to populations resulting from benign introductions (defined in the draft IUCN Guidelines for Re-introductions as "..an attempt to establish a species, for the purpose of conservation, outside its recorded distribution, but within an appropriate habitat and eco-geographical area").

2. Nature of the categories

All taxa listed as Critically Endangered qualify for Vulnerable and Endangered, and all listed as Endangered qualify for Vulnerable. Together these categories are described as 'threatened'. The threatened species categories form a part of the overall scheme. It will be possible to place all taxa into one of the categories (see Figure 1).

3. Role of the different criteria

For listing as Critically Endangered, Endangered or Vulnerable there is a range of quantitative criteria; meeting any one of these criteria qualifies a taxon for listing at that level of threat. Each species should be evaluated against all the criteria. The different criteria (A-E) are derived from a wide review aimed at detecting risk factors across the broad range of organisms and the diverse life histories they exhibit. Even though some criteria will be inappropriate for certain taxa (some taxa will never qualify under these however close to extinction they come), there should be criteria appropriate for assessing threat levels for any taxon (other than micro-organisms). The relevant factor is whether any one criterion is met, not whether all are appropriate or all are met. Because it will never be clear which criteria are appropriate for a particular species in advance, each species should be evaluated against all the criteria, and any criterion met should be listed.

4. Derivation of quantitative criteria

The quantitative values presented in the various criteria associated with threatened categories were developed through wide consultation and they are set at what are generally judged to be appropriate levels, even if no formal justification for these values exists. The levels for different criteria within categories were set independently but against a common standard. Some broad consistency between them was sought. However, a given taxon should not be expected to meet all criteria (A-E) in a category; meeting any one criterion is sufficient for listing.

5. Implications of listing

Listing in the categories of Not Evaluated and Data Deficient indicates that no assessment of extinction risk has been made, though for different reasons. Until such time as an assessment is made, species listed in these categories should not be treated as if they were non-threatened, and it may be appropriate (especially for Data Deficient forms) to give them the same degree of protection as threatened taxa, at least until their status can be evaluated.

Extinction is assumed here to be a chance process. Thus, a listing in a higher extinction risk category implies a higher expectation of extinction, and over the time-frames specified more taxa listed in a higher category are expected to go extinct than in a lower one (without effective conservation action). However, the persistence of some taxa in high risk categories does not necessarily mean their initial assessment was inaccurate.

6. Data quality and the importance of inference and projection

The criteria are clearly quantitative in nature. However, the absence of high quality data should not deter attempts at applying the criteria, as methods involving estimation, inference and projection are emphasised to be acceptable throughout. Inference and projection may be based on extrapolation of current or potential threats into the future (including their rate of change), or of factors related to population abundance or distribution (including dependence on other taxa), so long as these can reasonably be supported. Suspected or inferred patterns in either the recent past, present or near future can be based on any of a series of related factors, and these factors should be specified.

Taxa at risk from threats posed by future events of low probability but with severe consequences (catastrophes) should be identified by the criteria (e.g. small distributions, few locations). Some threats need to be identified particularly early, and appropriate actions taken, because their effects are irreversible, or nearly so (pathogens, invasive organisms, hybridization).

7. Uncertainty

The criteria should be applied on the basis of the available evidence on taxon numbers, trend and distribution, making due allowance for statistical and other uncertainties. Given that data are rarely available for the whole range or population of a taxon, it may often be appropriate to use the information that is available to make intelligent inferences about the overall status of the taxon in question. In cases where a wide variation in estimates is found, it is legitimate to apply the precautionary principle and use the estimate (providing it is credible) that leads to listing in the category of highest risk.

Where data are insufficient to assign a category (including Lower Risk), the category of 'Data Deficient' may be assigned. However, it is important to recognise that this category indicates that data are inadequate to determine the degree of threat faced by a taxon, not necessarily that the taxon is poorly known. In cases where there are evident threats to a taxon through, for example, deterioration of its only known habitat, it is important to attempt threatened listing, even though there may be little direct information on the biological status of the taxon itself. The category 'Data Deficient' is not a threatened category, although it indicates a need to obtain more information on a taxon to determine the appropriate listing.

8. Conservation actions in the listing process

The criteria for the threatened categories are to be applied to a taxon whatever the level of conservation action affecting it. In cases where it is only conservation action that prevents the taxon from meeting the threatened criteria, the designation of 'Conservation Dependent' is appropriate. It is important to emphasise here that a taxon may require conservation action even if it is not listed as threatened.

9. Documentation

All taxon lists including categorisation resulting from these criteria should state the criteria and sub-criteria that were met. No listing can be accepted as valid unless at least one criterion is given. If more than one criterion or sub-criterion was met, then each should be listed. However, failure to mention a criterion should not necessarily imply that it was not met. Therefore, if a re-evaluation indicates that the documented criterion is no longer met, this should not result in automatic down-listing. Instead, the taxon should be re-evaluated with respect to all criteria to indicate its status. The factors responsible for triggering the criteria, especially where inference and projection are used, should at least be logged by the evaluator, even if they cannot be included in published lists.

10. Threats and priorities

The category of threat is not necessarily sufficient to determine priorities for conservation action. The category of threat simply provides an assessment of the likelihood of extinction under current circumstances, whereas a system for assessing priorities for action will include numerous other factors concerning conservation action such as costs, logistics, chances of success, and even perhaps the taxonomic distinctiveness of the subject.

11. Use at regional level

The criteria are most appropriately applied to whole taxa at a global scale, rather than to those units defined by regional or national boundaries. Regionally or nationally based threat categories, which are aimed at including taxa that are threatened at regional or national levels (but not necessarily throughout their global ranges), are best used with two key pieces of information: the global status category for the taxon, and the proportion of the global population or range that occurs within the region or nation. However, if applied at regional or national level it must be recognised that a global category of threat may not be the same as a regional or national category for a particular taxon. For example, taxa classified as Vulnerable on the basis of their global declines in numbers or range might be Lower Risk within a particular region where their populations are stable. Conversely, taxa classified as Lower Risk globally might be Critically Endangered within a particular region where numbers are very small or declining, perhaps only because they are at the margins of their global range. IUCN is still in the process of developing guidelines for the use of national red list categories.

12. Re-evaluation

Evaluation of taxa against the criteria should be carried out at appropriate intervals. This is especially important for taxa listed under Near Threatened, or Conservation Dependent, and for threatened species whose status is known or suspected to be deteriorating.

13. Transfer between categories

There are rules to govern the movement of taxa between categories. These are as follows: (A) A taxon may be moved from a category of higher threat to a category of lower threat if none of the criteria of the higher category has been met for five years or more. (B) If the original classification is found to have been erroneous, the taxon may be transferred to the appropriate category or removed from the threatened categories altogether, without delay (but see Section 9). (C) Transfer from categories of lower to higher risk should be made without delay.

14. Problems of scale

Classification based on the sizes of geographic ranges or the patterns of habitat occupancy is complicated by problems of spatial scale. The finer the scale at which the distributions or habitats of taxa are mapped, the smaller the area will be that they are found to occupy. Mapping at finer scales reveals more areas in which the taxon is unrecorded. It is impossible to provide any strict but general rules for mapping taxa or habitats; the most appropriate scale will depend on the taxa in question, and the origin and comprehensiveness of the distributional data. However, the thresholds for some criteria (e.g. Critically Endangered) necessitate mapping at a fine scale.

3) Definitions

1. Population

Population is defined as the total number of individuals of the taxon. For functional reasons, primarily owing to differences between life-forms, population numbers are expressed as numbers of mature individuals only. In the case of taxa obligately dependent on other taxa for all or part of their life cycles, biologically appropriate values for the host taxon should be used.

2. Subpopulations

Subpopulations are defined as geographically or otherWisc distinct groups in the population between which there is little exchange (typically one successful migrant individual or gamete per year or less).

3. Mature individuals

The number of mature individuals is defined as the number of individuals known, estimated or inferred to be capable of reproduction. When estimating this quantity the following points should be borne in mind:

- Where the population is characterised by natural fluctuations the minimum number should be used.

- This measure is intended to count individuals capable of reproduction and should therefore exclude individuals that are environmentally, behaviourally or otherwise reproductively suppressed in the wild.

- In the case of populations with biased adult or breeding sex ratios it is appropriate to use lower estimates for the number of mature individuals which take this into account (e.g. the estimated effective population size).

- Reproducing units within a clone should be counted as individuals, except where such units are unable to survive alone (e.g. corals).

- In the case of taxa that naturally lose all or a subset of mature individuals at some point in their life cycle, the estimate should be made at the appropriate time, when mature individuals are available for breeding.

4. Generation

Generation may be measured as the average age of parents in the population. This is greater than the age at first breeding, except in taxa where individuals breed only once.

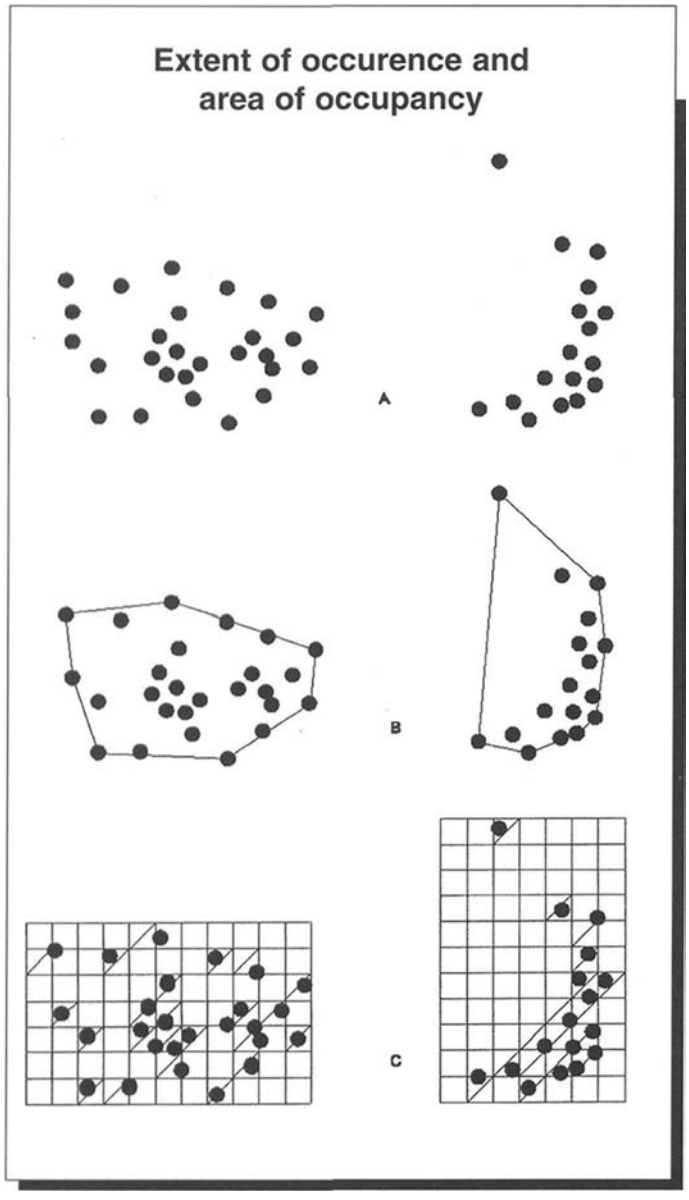
5. Continuing decline

A continuing decline is a recent, current or projected future decline whose causes are not known or not adequately con-

trolled and so is liable to continue unless remedial measures are taken. Natural fluctuations will not normally count as a continuing decline, but an observed decline should not be considered to be part of a natural fluctuation unless there is evidence for this.

6. Reduction

A reduction (criterion A) is a decline in the number of mature individuals of at least the amount (%) stated over the time period (years) specified, although the decline need not still be continuing. A reduction should not be interpreted as part of a natural fluctuation unless there is good evidence for this. Downward trends that are part of natural fluctuations will not normally count as a reduction.



7. Extreme fluctuations

Extreme fluctuations occur in a number of taxa where population size or distribution area varies widely, rapidly and frequently, typically with a variation greater than one order of magnitude (i.e., a tenfold increase or decrease).

8. Severely fragmented

Severely fragmented is refers to the situation where increased extinction risks to the taxon result from the fact that most individuals within a taxon are found in small and relatively isolated subpopulations. These small subpopulations may go extinct, with a reduced probability of recolonisation.

9. Extent of occurrence

Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy. This measure may exclude discontinuities or disjunctions within the overall distributions of taxa (e.g., large areas of obviously unsuitable habitat) (but see 'area of occupancy'). Extent of occurrence can often be measured by a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180 degrees and which contains all the sites of occurrence).

10. **Area of occupancy**

Area of occupancy is defined as the area within its 'extent of occurrence' (see definition) which is occupied by a taxon, excluding cases of vagrancy. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may, for example, contain unsuitable habitats. The area of occupancy is the smallest area essential at any stage to the survival of existing populations **of a** taxon (e.g. colonial nesting sites, feeding sites for migratory taxa). The size of the area of occupancy will be a function of the scale at which it is measured, and should be at **a** scale appropriate to relevant biological aspects of the taxon. The criteria include values in km^2, and thus to avoid errors in classification, the area of occupancy should be measured on grid squares (or equivalents) which are sufficiently small (see Figure 1).

Figure 1. Two examples of the distinction between extent of occurrence and area of occupancy. (a) is the spatial distribution of known, inferred or projected sites of occurrence. (b) shows one possible boundary to the extent of occurrence, which is the measured area within this boundary. (c) shows one measure area

4) The categories

EXTINCT (EX)

A taxon is Extinct when there is no reasonable doubt that the last individual has died.

EXTINCT IN THE WILD (EW)

A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E) on page 275.

ENDANGERED (EN)

A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E) on page 276.

VULNERABLE (VU)

A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to D) on page 277.

LOWER RISK (LR)

A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

1. Conservation Dependent (cd). Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.

2. Near Threatened (nt). Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.

3. Least Concern (lc). Taxa which do not qualify for Conservation Dependent or Near Threatened.

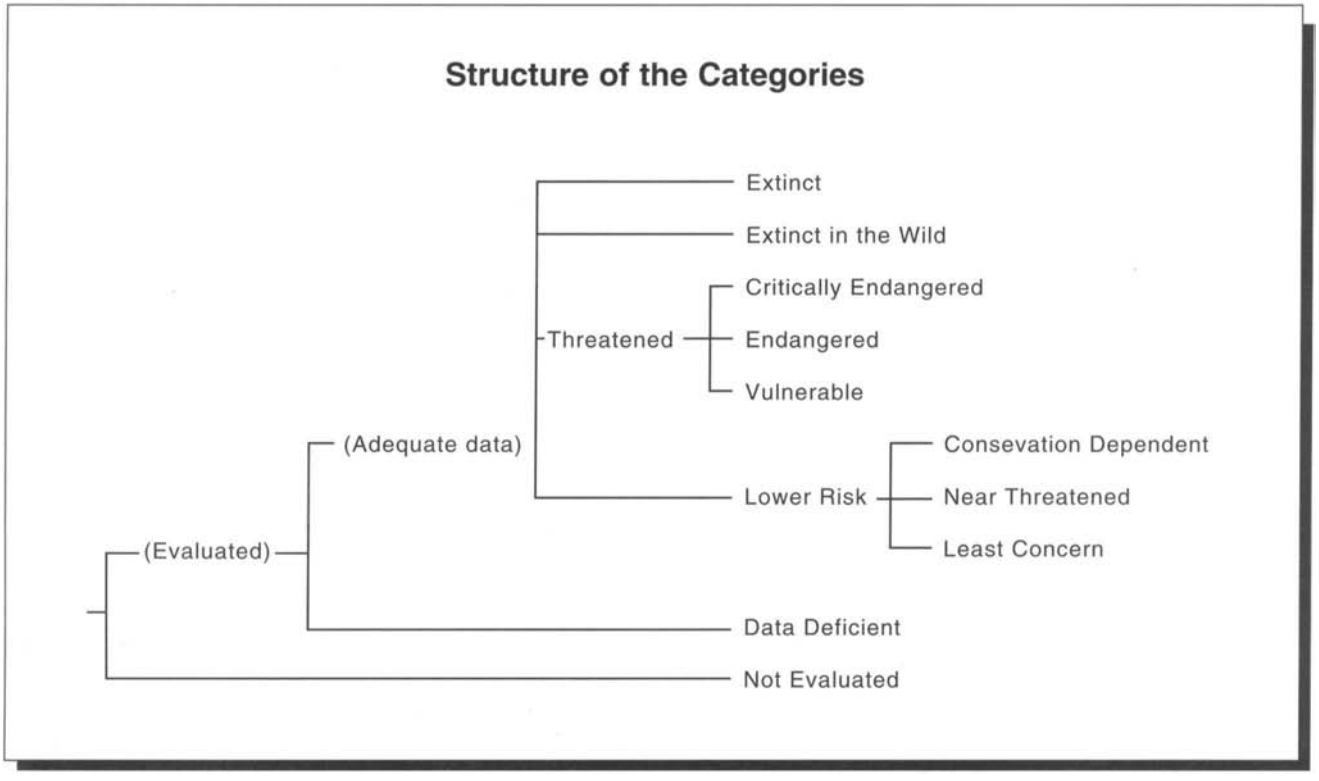


Figure 2

DATA DEFICIENT (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Data Deficient is therefore not a category of threat or Lower Risk. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)

A taxon is Not Evaluated when it is has not yet been assessed against the criteria.

5) The Criteria for Critically Endangered, Endangered and Vulnerable

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:
   a)direct observation
   b) an index of abundance appropriate for the taxon
   c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   d) actual or potential levels of exploitation
   e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 80%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 100 km^2 or area of occupancy estimated to be less than 10 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at only a single location.

2) Continuing decline, observed, inferred or projected, in any of the following:
   a) extent of occurrence
   b) area of occupancy
   c) area, extent and/or quality of habitat
   d) number of locations or subpopulations
   e) number of mature individuals.

3) Extreme fluctuations in any of the following:
   a) extent of occurrence
   b) area of occupancy
   c) number of locations or subpopulations
   d) number of mature individuals.

C) Population estimated to number less than 250 mature individuals and either:

1) An estimated continuing decline of at least 25% within 3 years or one generation, whichever is longer or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:

a) severely fragmented (i.e. no subpopulation estimated to contain more than 50 mature individuals)

b) all individuals are in a single subpopulation.

D) Population estimated to number less than 50 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or 3 generations, whichever is the longer.

ENDANGERED (EN)

A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 50% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:

a) direct observation

b) an index of abundance appropriate for the taxon

c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

d) actual or potential levels of exploitation

e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 50%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d), or (e) above.

B) Extent of occurrence estimated to be less than 5000 km^2 or area of occupancy estimated to be less than 500 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at no more than five locations.

2) Continuing decline, inferred, observed or projected, in any of the following:

a) extent of occurrence

b) area of occupancy

c) area, extent and/or quality of habitat

d) number of locations or subpopulations

e) number of mature individuals.

3) Extreme fluctuations in any of the following:

a) extent of occurrence

b) area of occupancy

c) number of locations or subpopulations

d) number of mature individuals.

C) Population estimated to number less than 2500 mature individuals and either:

1) An estimated continuing decline of at least 20% within 5 years or 2 generations, whichever is longer, or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:

a) severely fragmented (i.e. no subpopulation estimated to contain more than 250 mature individuals)

b) all individuals are in a single subpopulation.

D) Population estimated to number less than 250 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or 5 generations, whichever is the longer.

VULNERABLE (VU)

A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 20% over the last 10 years or three generations, whichever is the longer,, based on (and specifying) any of the following:
   a) direct observation
   b) an index of abundance appropriate for the taxon
   c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   d) actual or potential levels of exploitation
   e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 20%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 20,000 km^2 or area of occupancy estimated to be less than 2000 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at no more than ten locations.

2) Continuing decline, inferred, observed or projected, in any of the following:
   a) extent of occurrence
   b) area of occupancy
   c) area, extent and/or quality of habitat
   d) number of locations or subpopulations
   e) number of mature individuals.

3) Extreme fluctuations in any of the following:
   a) extent of occurrence
   b) area of occupancy
   c) number of locations or subpopulations
   d) number of mature individuals.

C) Population estimated to number less than 10,000 mature individuals and either:

1) An estimated continuing decline of at least 10% within 10 years or 3 generations, whichever is longer, or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
   a) severely fragmented (i.e. no subpopulation estimated to contain more than 1000 mature individuals)
   b) all individuals are in a single subpopulation.

APPENDIX 4
Preparing National Crane Action Plans[1]

This action plan identifies recommended activities for crane conservation at the global and regional scale. However, these activities are likely to be supported and implemented at the national level. The preparation and refinement of national action plans is therefore a useful next step in carrying forward, and developing in greater detail, the plans outlined here. National action plans have been critical to the development of the action plan; conversely, the action plan provides guidance for initiatives that can and should be undertaken at the national level. Action plans have already been developed for many countries. These are available upon request through the various Crane Working Groups and through the International Crane Foundation.

There are many advantages to preparing national action plans for cranes. National action plans can provide more detailed information on the status, threats to, and conservation needs of a nation's cranes and their wetland and grassland habitats. They allow this information to be conveyed to other parts of the country (where such information may be unavailable), as well as neighboring nations and the world at large. National action plans help to identify the gaps in our knowledge of cranes and their habitats. They provide researchers and conservationists (especially those working under isolated conditions) with direction by prioritizing research and conservation activities. These priorities also aid scientists, resource managers, agency officials, funding organizations, and political leaders in allocating available resources. In general, the information and recommendations provided in the national action plans should be presented in a manner that makes them as relevant to, and usable by, the implementors as possible. Most national action plans will contain the following elements.

Executive Summary

Each action plan should begin with a brief executive summary, aimed at the implementors, that summarizes the plan's findings and highlights its key points.

Introduction

The action plan should begin with a brief discussion of the species of cranes present in the country and their importance. On the latter point, topics that might be covered include: cranes as symbols of a nation; cranes as part of a nation's natural and cultural heritage; cranes and ecotourism; cranes as objects of biological research; cranes as creatures of beauty; and cranes as indicators of ecosystem health. The introduction should lay out the need for, and rationale behind, a national-level plan. It is important that the crane conservation be discussed within the broader context of biodiversity conservation efforts within the country.

The introduction should also provide basic information on the nation's wetlands (and grasslands in countries where these habitats are important): the types present and their location. Wetlands, in this context, are defined broadly, and include areas of land that are permanently or periodically inundated: lake shores, ponds, swamps, marshes, bogs, riparian or lacustrine flood plains, pans and wadis, coastal salt marshes, mangrove swamps, and artificial impoundments. The key wetlands that cranes inhabit (and the periods when they are present) should be identified. The importance of wetlands should be discussed, including their value as a source of food, forage, and fiber; as a source of money through tourism; as a source of water for fish ponds and other agricultural activities; as a means of controlling flooding and regulating other ecosystem functions; and as a natural water purification mechanism.

Species and Habitat Accounts

The plan should provide species accounts of the cranes (including subspecies) that occur within the country, with comments on range (including maps), historical and present status and distribution, population numbers and trends, habitat and ecology, and official conservation status (following the revised IUCN (1994) Red List Categories). The plan also should describe critical wetlands: their location, extent, climate, topography, flora and fauna, hydrology, ecology, human impact and utilization, and conservation status.

Threats

The plan should provide comments on the principal threats to cranes and their habitats. Possible threats include agricultural expansion, use of pesticides and fertilizers, overgrazing and degradation of wetlands, construction of dams, afforestation of grasslands, pollution, utility lines, hunting, live trapping for commercial trade and domestication, poisoning, and disturbance by people and warfare. (See Section 1 of this document for a review of threats to cranes).

[1] This appendix is adapted from Emil Urban, "Preparation of National Crane and Wetland Action Plans," presented at the African Crane and Wetlands Training Workshop, Maun, Botswana, 8-15 August 1993.

Current and Recommended Conservation Measures

The plan should review current conservation measures and recommend projects at the national level. Focus areas may include censusing and monitoring, habitat protection and management, research (for example, on food habits, behavior, reproduction and field ecology, migration, and the effects of pesticides and poisons), captive propagation, reintroduction, and education and training. Recommendations should be prioritised through consensus. Factors determining priority should include: the urgency of the recommended action; the feasibility of success under existing constraints; and the readiness of the implementors to move ahead on the action. Wherever possible, potential implementors of the recommended actions should be specified.

Regional Cooperation

The action plan should identify projects that need to be pursued at the regional and continental scales. This section should specify the species and wetlands involved and the objectives, description, and justification. Focus areas may include: coordinated watershed planning; migration studies; international agreements; collaborative research projects; and international protected area networks.

Project Timelines and Budgets

Where possible, the action plan should specify project timelines and estimated budgets as a prelude to preparing full project proposals (see Appendix 5).

APPENDIX 5
Securing Financial Support for Crane Conservation Projects

The priority conservation measures and recommendations outlined in this action plan do not include detailed timelines or budgets. In some cases (as, for example, with Whooping Crane recovery efforts) the recommendations build upon ongoing programs and projects. In most cases, however, securing financial support is the next step — and the limiting factor — in implementing recommended actions. Financial resources are available, but it is sometimes a problem to identify these resources, and then to secure a grant. To overcome these obstacles, the following tips are offered.

Identifying Sources of Financial Support

In securing financial support for a project, it is crucial to identify funders interested in supporting projects involving wildlife research, conservation, and sustainable development. Grantors seldom support programs that fall beyond their carefully defined criteria. Thus, the first step in seeking support is to learn about the particular concerns of different funding organizations. Funders usually have published material about their areas of interest. Representatives of funding organizations often attend conservation meetings and publish announcements in newsletters and journals. If a project fits within a funder's area of interest, it is usually helpful to establish personal contact with the funder (or a member of the staff if the funder is an organization). It helps if someone within the organization can answer your questions or critique your proposal before it is formally submitted. Inviting the funder(s) to your project site is an excellent way to gain advice and cultivate interest among potential funders.

The Letter of Inquiry

Having selected the seemingly most appropriate sources, the applicant should write a letter of inquiry to each grantor to secure additional information. This provides an opportunity to cultivate the interest of the grantor without asking for support. Knowing more about the grantor will also facilitate developing a comprehensive proposal. A two-page letter should ask for information about the types of projects the grantor supports and the level of funding. The letter should summarize the importance of the proposed program, the achievable objectives, the methods to be applied, and the qualifications of the applicant. The inquiry letter should not actually request funds but should indicate the level of funding required. The actual amount requested should be determined after the grantor indicates the range of grant sizes. If the grantor asks for a formal proposal, the amount requested should fall within this range.

The Formal Proposal

If the potential grantor expresses interest in the proposed project, the next step is to prepare a formal proposal. This is often the most important step in any conservation effort. The proposal should be clear, concise, and well written to reflect the importance of the project and the motivation and ability of the applicant. A neat, preferably typewritten, proposal is crucial to developing the interest of the grantor; misspellings and typographical errors do not give a favorable impression.

The proposal should include a summary, a statement of the project's rationale and objectives, a description of the problem, an outline of the study methods and activities, and a specific timeline and budget. Literature sources that support statements in the proposal should be listed in alphabetical order by the author's last name at the end of the proposal. Three well respected people who know you and who are familiar with your work should be listed as personal references. Include their names, addresses, and telephone and fax numbers. References should provide their consent before you include them in your proposal. The budget should fit within the range of giving of the funder. Deadlines for submitting proposals and grant reports should be observed closely.

Securing and Managing a Grant

If a grant proposal is accepted, thank-you letters should be sent to funders and references after the grant has been approved and after funds have been received. If a grant is provided through a supporting institution, the accountants of that institution should be advised in advance so that they are prepared to receive and manage the grant. If funds are sent directly to the grantee, the funds should be placed in a special bank account independent of all other accounts. This facilitates accounting. Funds from the account should only be used for items listed in the proposal to the grantor. Receipts should be received for all funds spent.

Well written and concise project reports and accounting reports should be submitted to the funder midway through, and upon completion of, a project. Receipts for all funds used should be kept, and a complete financial report including receipts should be submitted upon completion of the project. Unused funds should be returned to the funder.

Communications

Written and verbal communication with grantors is vital in developing a productive relationship. Grantors are people too, and their lives are devoted to providing effective, constructive grants. They appreciate being appreciated. Sometimes grantees feel grantors owe them support and after a grant is received, the grantor is forgotten. Such behavior is a prescription for reducing the possibility of grant renewal.

Personal Contact

Receiving a grant is often based on personal contact between the grantee and grantor. If a grantor lives in or is visiting the grantee's region, the grantee should try to establish personal contact with the grantor. A 15-minute visit to the office of the grantor can be very productive and provide an opportunity to invite the grantor to visit project sites. Grantors of wildlife research and conservation projects are usually keenly interested in the natural world and welcome the opportunity to learn from specialists and to travel with them in the field.

Cultivating Support

In many cases, cultivation of the grantor leads to additional support, both through the grantor and through other funders with whom the grantor has contact. This usually depends upon direct personal communication between the grantee and the grantor. A grantee should be creative in cultivating this expanded support. For example, grantees should invite grantors on expeditions or short field trips, keep grantors informed about the progress and problems of the work, and seek the advice of grantors in areas where the grantor may have expertise. In short, grantors usually give to people rather than projects. Personal contact is therefore vital.

Persevering

Not all grant proposals can or will be funded, especially in the initial effort to gain support. You should not be discouraged by such results, but should look for opportunities to refine and improve the proposal, to identify more promising sources of support, and to learn from the process. In some cases, it may be necessary to redefine the focus, breadth, or organization of the project. In other cases, it may be useful to work with other individuals or non-profit organizations in your region on joint projects that offer different funding possibilities and that convey multiple benefits. In any case, it is important to continue to seek out information and contacts, and to communicate your enthusiasm for the project.

IUCN/SSC Action Plans for the Conservation of Biological Diversity

Action Plan for African Primate Conservation: 1986-1990. Compiled by J.F. Oates and the IUCN/SSC Primate Specialist Group, 1986, 41 pp. (Out of print.)

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Antelopes. Global Survey and Regional Action Plans. Part 1. East and Northeast Africa. Compiled by R. East and the IUCN/SSC Antelope Specialist Group, 1988, 96 pp. (Out of print.)

Dolphins, Porpoises and Whales. An Action Plan for the Conservation of Biological Diversity. 1988-1992. Second Edition. Compiled by W.F. Perrin and the IUCN/SSC Cetacean Specialist Group, 1989, 27 pp. (Out of print).

The Kouprey. An Action Plan for its Conservation. Compiled by J.R. MacKinnon, S.N. Stuart and the IUCN/SSC Asian Wild Cattle Specialist Group, 1988, 19 pp. (Out of print.)

Weasels, Civets, Mongooses and their Relatives. An Action Plan for the Conservation of Mustelids and Viverrids. Compiled by A. Schreiber, R. Wirth, M. Riffel, H. van Rompaey and the IUCN/SSC Mustelid and Viverrid Specialist Group, 1989, 99 pp. (Out of Print.)

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Asian Rhinos. An Action Plan for their Conservation. Compiled by Mohd Khan bin Momin Khan and the IUCN/SSC Asian Rhino Specialist Group, 1989, 23 pp. (Out of print.)

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