
MANAGEMENT PLAN FOR THE EASTERN POPULATION OF SANDHILL CRANES

Prepared by the Ad Hoc Eastern Population
SANDHILL CRANE Committee

2010

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Prepared for

The Atlantic and Mississippi Flyway Councils

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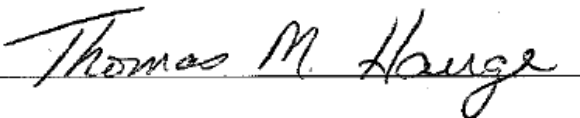
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Forward

The management of migratory birds is facilitated by administrative units organized along general migratory pathways. There are four flyways established for North America; each with a council of members from the states and provinces within that flyway. The four Flyway Councils are administrative bodies established in 1952 to represent the state and provincial wildlife agencies and work cooperatively with the U.S. Fish and Wildlife Service (USFWS), the Canadian Wildlife Service (CWS), and Mexico for the purpose of protecting and conserving migratory game birds in North America in accordance with the migratory bird treaties. The Councils have prepared numerous management plans for most populations of swans, geese, doves, pigeons, and sandhill cranes (*Grus canadensis*) in North America. These plans focus on populations, which are the primary unit of management, but may be specific to a species or subspecies. Management plans serve to:

- Identify common goals
- Establish priorities and processes for management actions
- Guide and coordinate the collection and analysis of biological data
- Emphasize research needs for improved management

Flyway management plans are products of the Councils, developed and adopted to help state, provincial, and federal agencies cooperatively manage migratory birds by providing guidance from a common set of goals and principles. The management strategies within the plans are recommendations that agencies have agreed to use in guiding management but are not legally binding documents that commit agencies to specific actions or schedules. The level and timing of the implementation for specific strategies are subject to the fiscal, legislative, and priority constraints of cooperating agencies.

The breeding, migration and wintering range of the Eastern Population (EP) of greater sandhill cranes is located within the Mississippi and Atlantic Flyways. The EP sandhill cranes are currently not hunted while the Mid-Continent Populations of sandhill cranes are hunted in the Central and Pacific Flyways under the direction of a management plan for those populations (Central Flyway Council 2006). The Mississippi Flyway Council Technical Section has discussed the status of EP sandhill cranes, issues related to the increasing population and the potential for hunting seasons on this population since the early 1980s. However, due to other priorities and workloads these discussions failed to produce a management plan. In 2004, the Mississippi and Atlantic Flyway Councils agreed to renew efforts to work cooperatively on an EP sandhill crane management plan and a team of game and non-game biologists collectively experienced in flyway management and sandhill crane biology was formed to develop this plan. The plan is intended to summarize current knowledge, identify information gaps and issues and set a course for the future management of the Eastern Population of sandhill cranes.

GOAL

To manage the Eastern Population (EP) of Sandhill Cranes in the Mississippi and Atlantic Flyways at a sustainable population level that is consistent with habitat conditions and societal values.

Opportunities exist to manage EP sandhill cranes to enhance benefits to people while reducing conflicts. Benefits and conflicts associated with this resource will vary along with crane spatial and temporal distribution, abundance, impact on other resources of value (crops) and by interaction between consumptive and non-consumptive users.

I. Introduction

A. History and Status

Sandhill cranes (*Grus canadensis*) are the most numerous of the world's cranes with a total population size likely exceeding 600,000 birds (Tacha et al. 1992, Meine and Archibald 1996, Sharp et al 2009). Migratory populations of sandhill cranes have a broad breeding range extending across North America from coast to coast in Canada and the northern United States (U.S.). There are few reliable records regarding the distribution of sandhill cranes before European settlement but the species was probably more widely distributed, especially in its southern breeding range (Tacha et al. 1992). Sandhill cranes also breed in eastern Siberia and migrate through North America to wintering areas. During migration from provinces and northern states, sandhill cranes congregate in large numbers at staging areas of mid-latitude states and then migrate to wintering areas in the southern U.S. and Mexico though in recent years, wintering individuals have occurred at higher latitudes (Indiana Department of Natural Resources and Tennessee Wildlife Resources Agency unpubl data). The breeding, migration, and wintering range of the Eastern Population (EP) of greater sandhill cranes (*G. c. tabida*) is located within the Mississippi and Atlantic Flyways. This plan summarizes the current knowledge of the EP and describes the future management of this population.

Six subspecies of sandhill cranes have been taxonomically identified since the early part of the 18th century. Three of these subspecies migrate throughout North America: the lesser (*G. c. canadensis*), greater (*G. c. tabida*), and Canadian (*G. c. rowani*) sandhill crane. The other three subspecies do not migrate: the Mississippi (*G. c. pulla*), Florida (*G. c. pratensis*), and Cuban (*G. c. nesiotis*) sandhill crane (Walkinshaw 1973, Lewis 1977, Tacha et al. 1985, Meine and Archibald 1996). As migratory birds, sandhill cranes

are protected under migratory bird treaties among the nations within their North American range. Within Canada, the U.S. and Mexico, migratory sandhill cranes are considered a game species. The non-migratory Florida sandhill crane is listed as state threatened. The Mississippi and Cuban sandhill cranes are listed as threatened or endangered under the U.S. Endangered Species Act (ESA) and exist in small somewhat isolated populations within relatively restricted ranges in the southern United States and Cuba (Meine and Archibald 1996). The Mississippi and Cuban sandhill cranes are listed as Critically Endangered (ESA) and in CITES Appendix I.

Scientific discussion on the taxonomic classification of the migratory sandhill cranes is ongoing. Rhymer et al. (2001) suggest that analysis of mitochondrial DNA sequences indicate significant population genetic differentiation between all subspecies of sandhill cranes except greater and Canadian sandhill cranes, which are indistinguishable, and that recognition of the latter be abandoned. Jones et al. (2005) also suggests the abandonment of Canadian sandhills as a subspecies but explains that Canadian sandhills are a hybrid form of lesser and greater, not just an alternative form of the greater. Peterson et al. (2003) concluded there existed two valid subspecies based on genetic analysis of the Mid-Continent Population (i.e., lesser and greater sandhill cranes) and recommended that further investigation is necessary to determine the status of the Canadian sandhill crane within the population.

The greater sandhill crane, morphologically the largest of the subspecies, was estimated to have a total population size of 70,000-80,000 in the early 1990s (Meine and Archibald 1996). This subspecies is further divided into five regional populations based on wintering grounds, migration routes, and morphological differences: Eastern, Prairie, Rocky Mountain, Colorado River Valley and Central Valley (Meine and Archibald 1996). Tacha et al. (1992) differentiate a total of nine geographic populations. The U. S. Fish and Wildlife Service (USFWS) recognizes 6 migratory populations of sandhill cranes for management purposes based on geography rather than subspecies; Pacific Flyway (Lesser), Central Valley (Greater), Lower Colorado River Valley (Greater), Rocky Mountain (Greater), Eastern (Greater) and Mid-Continent (Lesser, Greater and Canadian). Given the documented growth in the Eastern and Rocky Mountain (RMP) greater sandhill crane populations since these estimates, the current continental population of greater sandhill cranes is likely in the range of 80,000-100,000 (Sharp et al. 2009, Table 1). Though a small amount of gene flow occurs between the EP and the Mid-Continent Population (MCP), Jones et al. (2005) suggested that the EP is genetically distinct enough to be managed separately. However, in this study the EP samples were only collected from Wisconsin breeding cranes, not sandhill cranes breeding in southern or central Ontario where genetic exchange is more likely. Breeding sandhill cranes from the EP have been documented for many years in the east/central areas of Minnesota while sandhill cranes in northwest Minnesota are assumed to be part of the MCP (Henderson 1978, Tacha and Tacha 1985). However, continuing range expansion may be resulting in exchange of sandhill cranes between these breeding areas (Minnesota Ornithological Union 2009). In Ontario, numerical increases and geographic expansion of the sandhill cranes is such that the species can be found almost anywhere where suitable habitat exists (Sutherland and Crins 2008). Although the delineation between the EP and MCP ranges

is now less clear than formerly, there are still major high density clusters indicating a separation of the two populations with a low density area of potential overlap in central Ontario.

The EP has rebounded from near extirpation in the 18th and 19th centuries (Walkinshaw 1949, 1973; Leopold 1949). By the 1930s, only 25 breeding pairs were recorded in Wisconsin (Henika 1936). Since that time, hunting regulations along with the protection, restoration and management of wetlands have allowed this population to increase to a level that exceeded 30,000 sandhill cranes by 1996 (Meine and Archibald 1996). The cranes have also adapted to change by nesting in smaller wetlands and feeding in agricultural fields. While this population remains absent from portions of its historic former range, EP cranes from core breeding areas of Wisconsin and Michigan now occupy many areas of their historic range including the extensive breeding area of south-central Ontario. With much of the best breeding habitat in Wisconsin and Michigan occupied by breeding pairs, the continued population growth is fueling expansion of the breeding range in all directions.

While migratory sandhill cranes are considered a game species at the federal level, some states within the range of the EP have previously listed the migratory sandhill crane as a rare species. However, the increasing population and expanding range of the EP is resulting in changes to state rare species lists and in most states the sandhill crane has been de-listed. The state of Ohio is the only state in the EP range which still lists the EP sandhill crane as endangered within the state. The states of Florida and Mississippi have listed non-migratory sandhill cranes but EP sandhill cranes are not listed in these states.

B. Population and Distribution

The majority of the EP breed across the Great Lakes region (Wisconsin, Michigan, Ontario) and winter in Florida and southern Georgia (Figure 1). In late summer and early fall, EP cranes leave their breeding grounds and congregate in large flocks on traditional staging areas. EP cranes stage for several weeks before beginning their southward migration through their primary east-central corridor that includes Illinois, Indiana, Ohio, Kentucky, Tennessee and Alabama, enroute to wintering grounds in southern Georgia and central Florida (Walkinshaw 1973, Lewis 1977, Tacha et al. 1992, Meine and Archibald 1996). In recent years with mild winters more sandhill cranes have remained further north for the winter months in Tennessee, Kentucky, Indiana and even in southern Ontario on Lake Erie.

The northwestern boundary between the EP breeding and the MCP range remains unclear. In 1978, two breeding areas were defined in Minnesota, the northwest area which is now considered part of the MCP and the east central area which is considered EP range (Henderson 1978). The northwest area had 68 breeding pairs in seven counties and the east central area had 19 breeding pairs in seven counties in 1978. The Minnesota Ornithological Union now lists sandhill crane as a common breeder in 36 counties and while the two high density breeding areas are still the focal areas, a low density breeding region has connected the two high density areas (Minnesota Ornithological Union 2009).

To the south, the primary breeding range currently extends into northern Iowa, Illinois, Indiana and Ohio. In Ontario, sandhill cranes nesting in the Hudson Bay Lowlands are generally thought to migrate south and west with the MCP while sandhill cranes on the Pre-Cambrian Shield of south and central Ontario migrate south with the EP cranes. However, data from sandhill cranes marked with satellite transmitters in Louisiana showed that five cranes migrated along the MCP route while two cranes migrated up the Mississippi Valley to join other EP sandhill cranes (King 2008). Three of the seven marked sandhill cranes spent time in north central Ontario, with two having migrated through the MCP range west of Lake Superior and one having migrated through the EP range east of Lake Superior. Satellite studies on a few birds marked in south-central Ontario suggest that sandhill cranes from south-central Ontario and Quebec migrate south joining the general migration pattern of those breeding in Wisconsin and Michigan (Long Point Waterfowl - Bird Studies Canada 2009). However the breeding and migratory routes for sandhill cranes in south-central Ontario and the northern Atlantic Flyway are still poorly understood. A few sandhill cranes have been observed migrating south along the east coast to North and South Carolina presumably from those sandhill cranes breeding in the north Atlantic Flyway (Anne Lacy pers comm., Ohio DNR unpublished data). In addition, some sandhill cranes from the western or northern parts of the EP breeding range have been documented migrating down the Mississippi Valley to wintering areas in Louisiana where they mixed with MCP sandhill cranes (International Crane Foundation unpublished data, King 2008). Spring migrations appear to follow routes north similar to the fall migration routes. A recent workshop to identify priority information needs for migratory sandhill crane populations included a priority for better understanding the breeding, migration, and wintering distribution of EP cranes (D.J. Case and Associates 2009). A project to address this priority information need began in the fall of 2009 and will focus on identifying distribution patterns for cranes migrating through Jasper-Pulaski Fish and Wildlife Area in Indiana and Hiwassee State Wildlife Refuge in Tennessee.

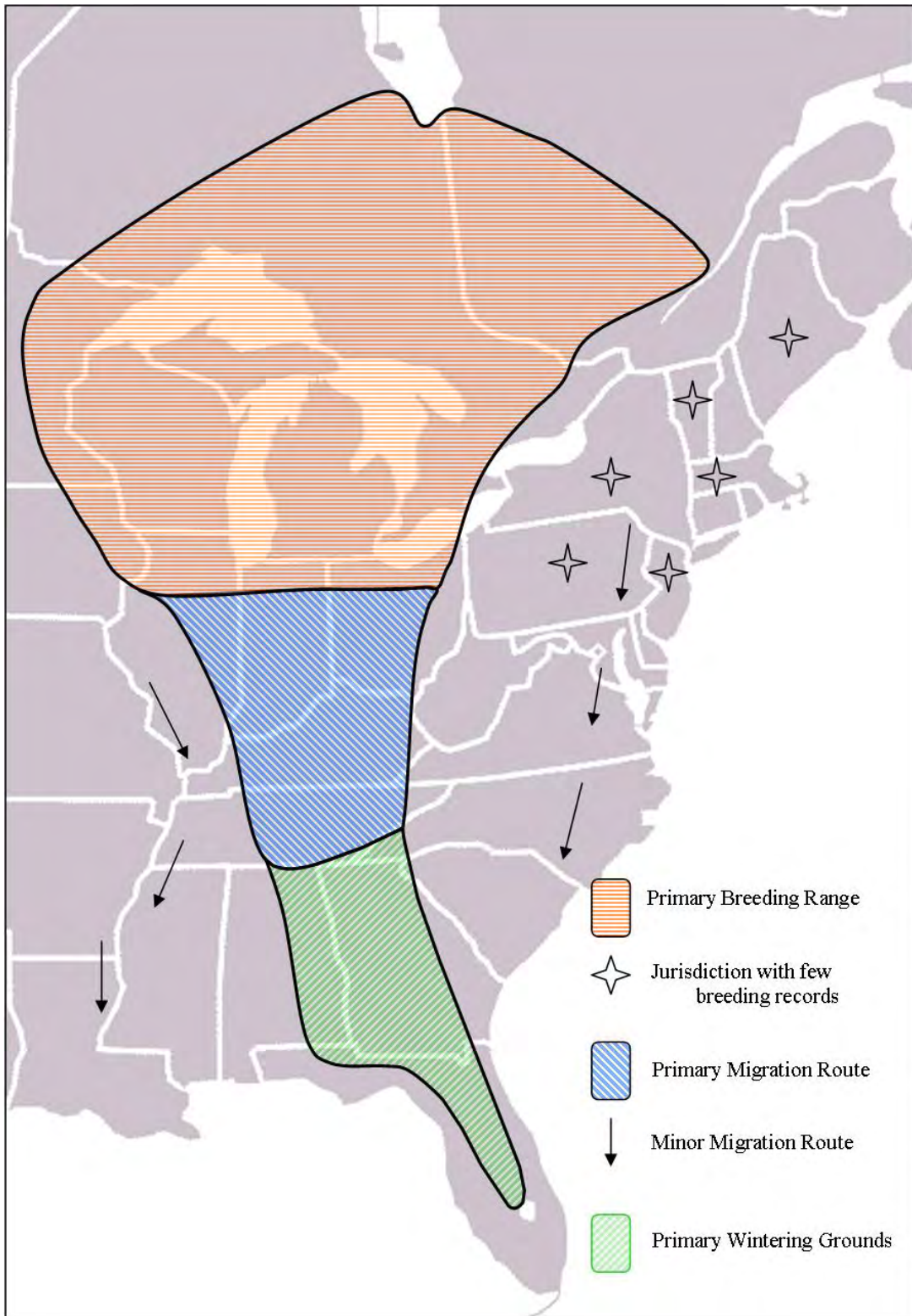


Figure 1. The approximate range of the Eastern Population of Sandhill Cranes. Adapted from Walkinshaw 1973, Jones et al. 2005, King 2008, Melvin 2008, Sutherland and Crins 2008, Canadian Wildlife Service unpublished data and International Crane Foundation unpublished data.

The EP crane population has shown significant growth over the past 30-40 years. While there is no survey designed to provide a population estimate for the EP, four separate regional or statewide surveys provide documentation of the growth of the EP. These surveys along with distribution data and local surveys combine to provide a picture of a significantly increasing and expanding population of sandhill cranes in eastern North America. The regional and state level surveys include: 1) USFWS coordinated Fall Sandhill Crane Survey; 2) Wisconsin Department of Natural Resources State Breeding Waterfowl Survey; 3) International Crane Foundation spring breeding survey; and 4) North American Breeding Bird Survey (BBS).

Fall Sandhill Crane Survey

The USFWS has coordinated a long-term (1979-present) fall survey of EP cranes in the Mississippi and Atlantic Flyways (Table 1). This survey has documented a long term increasing trend in this population from the lowest count of 11,943 in 1981 to the highest count of 59,876 in 2009. The survey is conducted annually on or about October 31 by volunteers and agency personnel (Sean Kelly, USFWS, pers. com.). During the survey, the number of cranes at historic migratory staging areas is recorded, providing a fall index of the population. This is neither a complete population survey nor a statistically designed population estimate. In addition, some key staging areas were not surveyed in some years. It is recognized that this index does not count the entire fall population and that the actual fall flight of the EP is larger. The survey is timed to count EP cranes when they are concentrated at staging areas in Indiana, Michigan and Wisconsin although the sandhill cranes at these locations come from a broader breeding range. The timing of this survey is supported by over 20 years of data at Manitoulin Island in northern Lake Huron, Ontario which is a significant staging area for thousands of Ontario breeding sandhill cranes on their way south (Brook 2008). These data indicate that sandhill cranes move through this area from early to late October with the peak numbers dropping off after mid-October. This suggests that Ontario breeding EP sandhill cranes have moved south into Michigan or Indiana by the time the USFWS survey is conducted. Limited satellite telemetry and survey data support this movement of EP cranes nesting in Ontario into the primary migration corridor covered by this survey (Boyd et al. 2007, Brook 2008, Long Point Waterfowl - Bird Studies Canada 2009).

Table 1. Fall survey counts of the eastern population of greater sandhill cranes. U.S. Fish and Wildlife Service unpublished data.

Year	Wisconsin	Michigan	Indiana	Tennessee	Georgia	Florida	Other Areas	Total
1979	1,373	757	11,900		118	237		14,385
1980	1,165	1,662	10,869	589	28	300	1,195	15,808
1981	1,331	1,021	9,284		215	92		11,943
1982	1,783	1,526	10,306		90	174		13,879
1983	1,653	1,708	11,048		44	445		14,898
1984	2,986	1,747	11,477		35	118		16,363
1985	2,842	1,634	11,452	17	25	200		16,170
1986	2,920	2,129	11,974		20	0		17,043
1987	5,689	2,906	13,310		38	399		22,342
1988	7,781	3,335	14,800			170		26,086
1989	7,830	2,318	12,568			69		22,785
1990	3,949	2,343	15,576	150	50	1,784		23,852
1991	3,385	3,059	19,598		15	99		26,156
1992	6,801	1,639	18,011		10	195		26,656
1993	8,537	2,937	14,499	39	32	143		26,187
1994	10,055	4,125	12,367	90	6	140		26,783
1995	10,978	5,507	17,050	109		130		33,774
1996	12,468	4,148	13,036	43	1	57		29,753
1997	9,625	5,363	12,615	5	10	23	1,807	29,448
1998	19,696	6,807	11,281		3	40		37,827
1999	13,940	5,715	13,812	56		60		33,583
2000	14,985	6,116	11,886	94		24		33,105
2002*	12,903	6,839	10,294	97	162	86	1,194	31,575
2003	1,996	9,954	15,722	1,539	15	74		29,300
2004	4,721	11,356	12,676	125	16	53		28,947
2005	8,103	15,191	14,184	160	28	42		37,708
2006	9,873	12,785	14,414	425	59	0		37,529
2007	5,964	16,707	12,311	899	24	40		35,945
2008	17,363	17,747	8,704	249	47	0		44,110
2009**	24,524	24,320	10,979	132	73	0		60,028
Averages								
79-80	1,269	1,210	11,385	255	73	269	598	15,097
81-85	2,119	1,527	10,713	3	82	206		14,651
86-90	5,634	2,606	13,646	30	36	484		22,422
91-95	7,951	3,453	16,305	48	16	141		27,911
96-00	14,143	5,630	12,526	40	5	41	361	32,743
02-05	6,931	10,835	13,219	480	55	64	238	31,883
06-09	14,431	17,890	11,602	426	51	10		44,403

* No data available for 2001 and survey in Wisconsin during 2003-07 likely undercounted cranes.

** Data are preliminary and include sites in Wisconsin that had not been surveyed for several years

Wisconsin Breeding Waterfowl Survey

The Wisconsin Department of Natural Resources annual statewide breeding waterfowl survey uses randomly located aerial transects following the design of the USFWS continental breeding duck survey (Van Horn et al. 2008). The survey timing and focus of the observers is designed for ducks so the number of sandhills counted may be an underestimate of the true value. Sandhill Crane data from the survey have shown a significant increase in Wisconsin sandhill cranes from the early 1990s through 2009 (Wisconsin Department of Natural Resources unpublished data). Counts on aerial transects have gone from zero in the early 1990s to over 100 during more recent surveys (Figure 2).

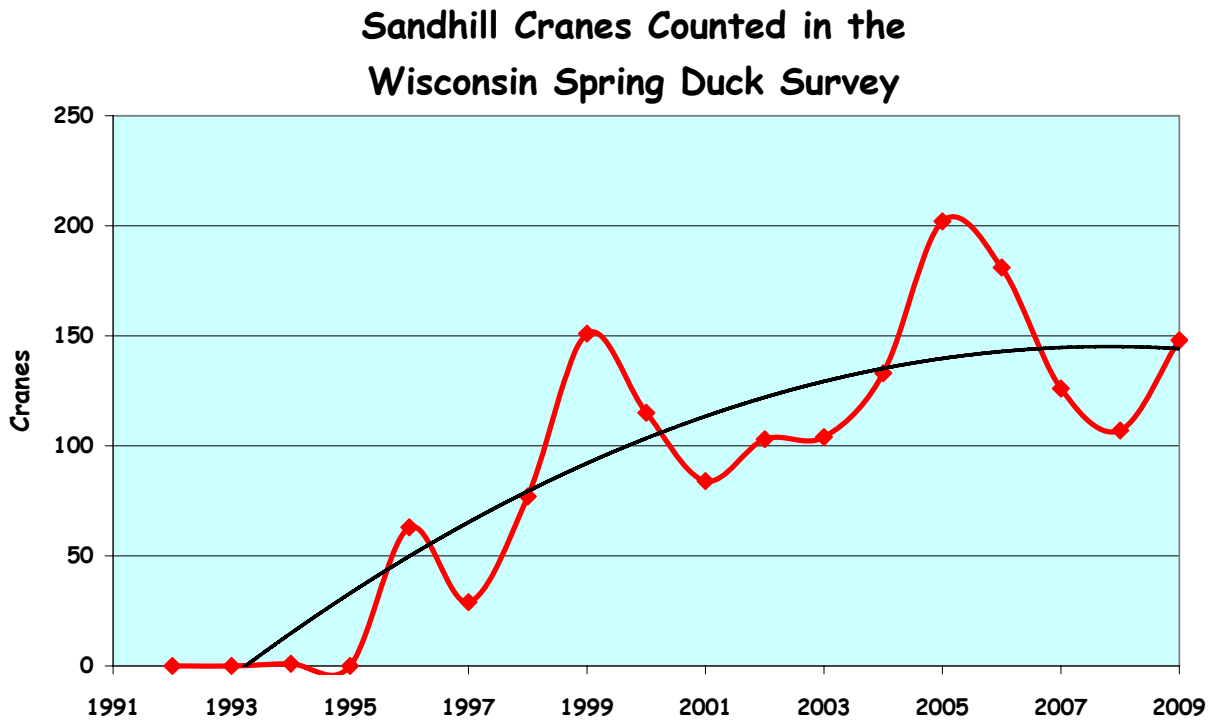


Figure 2. Sandhill cranes counted in the Wisconsin Waterfowl Breeding Population Survey 1992-2009, Ron Gatti unpublished data).

International Crane Foundation sandhill crane breeding survey

The second spring survey is a breeding sandhill crane count coordinated annually by the International Crane Foundation one morning each April (ICF) (Rod and Gutkowski 2007). This count expanded to a large scale in 1981 using over 2,000 volunteers to search wetlands across Wisconsin, and in recent years has included portions of other states. The observers record the total number of cranes at each site and the number of breeding birds indicated by observation of isolated pairs or pairs engaged in unison calling (Su et al. 2004). This is not a statistically designed survey and depends upon the commitment of volunteers so annual variation in survey effort should be considered,

however an extensive geographic area is sampled. Currently, the survey area includes over 100 counties in portions of five states (Wisconsin, Minnesota, Illinois, Michigan, and Iowa). This count has documented a significant population increase as well as an expanding distribution of breeding sandhill cranes in Wisconsin (Figure 3). During the period 1984 - 2008, the population of breeding sandhill cranes in Wisconsin more than doubled and the density of cranes per site increased while the number of sites surveyed increased by about 50% (Su et al. 2004).

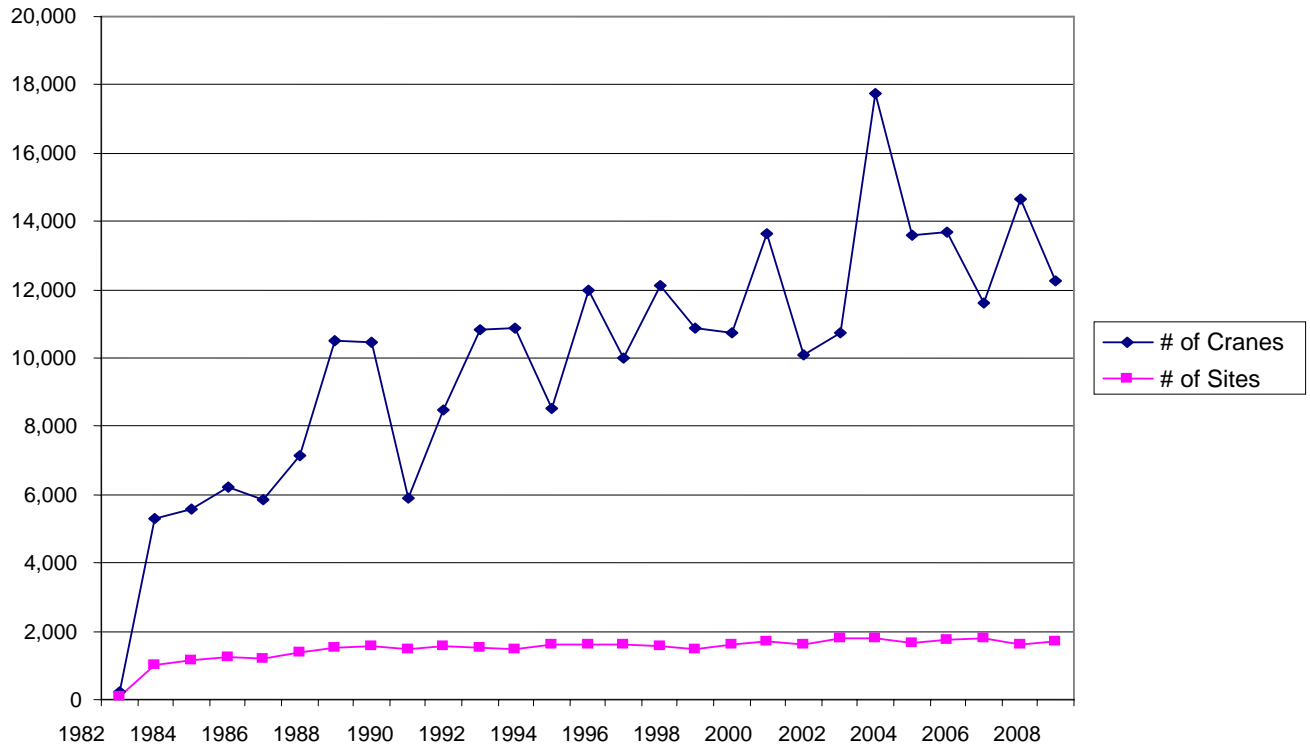


Figure 3. Changes in spring population and density of Sandhill Cranes in Wisconsin, 1982-2008. (Su et al. 2004, International Crane Foundation)

Another indicator of EP growth besides population size and distribution is the sandhill crane density within the existing breeding range. Within the state of Wisconsin, the largest central core of the EP breeding range appears to have reached a maximum density while two other areas have experienced increases in density that approach the density in the original core area (International Crane Foundation unpublished data) (Figure 4). Increasing density is important because as the density of sandhill cranes increases in a particular area, public attention and potential human-wildlife conflicts increase. In addition, these data suggest that once a maximum breeding density is reached in an area, dispersal increases to new areas.

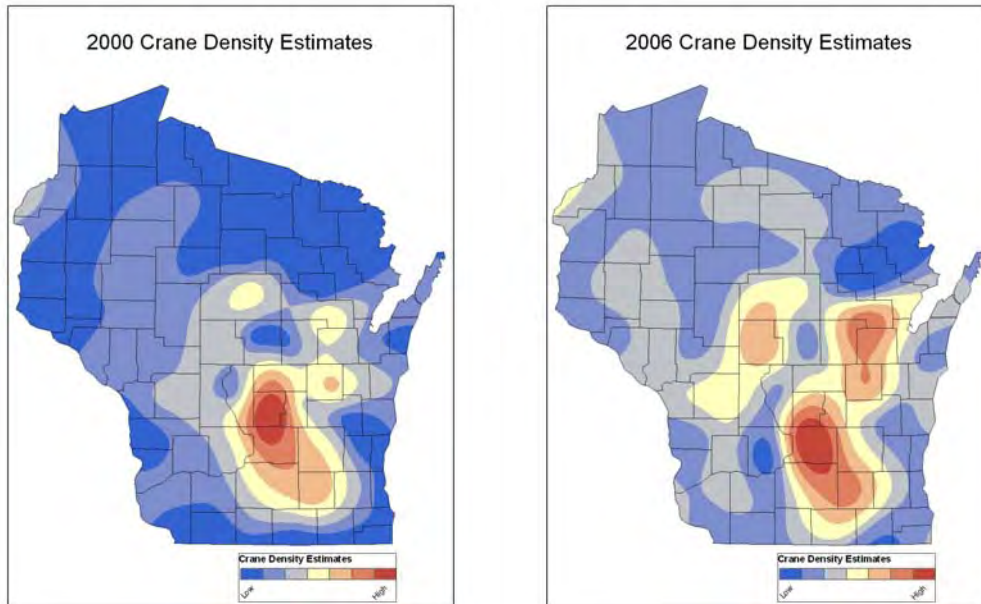


Figure 4. Increasing Sandhill Crane breeding density in Wisconsin for 2000 to 2006 from spring breeding surveys. (International Crane Foundation)

North American Breeding Bird Survey

A third source of breeding data for the EP comes from the BBS (Sauer et al. 2008). Data from the BBS for Region 3 (MN, WI, MI, IN, IL, OH, MO, and IA) of the USFWS provides annual breeding indices (birds/route) for the U.S. core of the EP breeding range. Indices of BBS data are available from 1966 to 2007 and are often the only long-term source of information on breeding populations for non-game birds. This survey is a road based survey which may decrease detectability of some birds because of noise and disturbance associated with the road and its design is generally considered to be better for land based versus wetland birds. Despite these limitations, the BBS data indicate that the number of sandhill cranes counted per route has increased from under two cranes per route in the late 1960s to over 10 cranes per route in the early 2000s (Figure 5). Analysis of BBS data indicate an increasing long-term (1966-2007) population trend of 9.6 %/year ($p < 0.001$, $n = 133$) and a short-term (1997-2007) increase of 5.8 %/year ($p < 0.001$, $n = 228$) for Region 3 of the USFWS (Sauer et al. 2008).

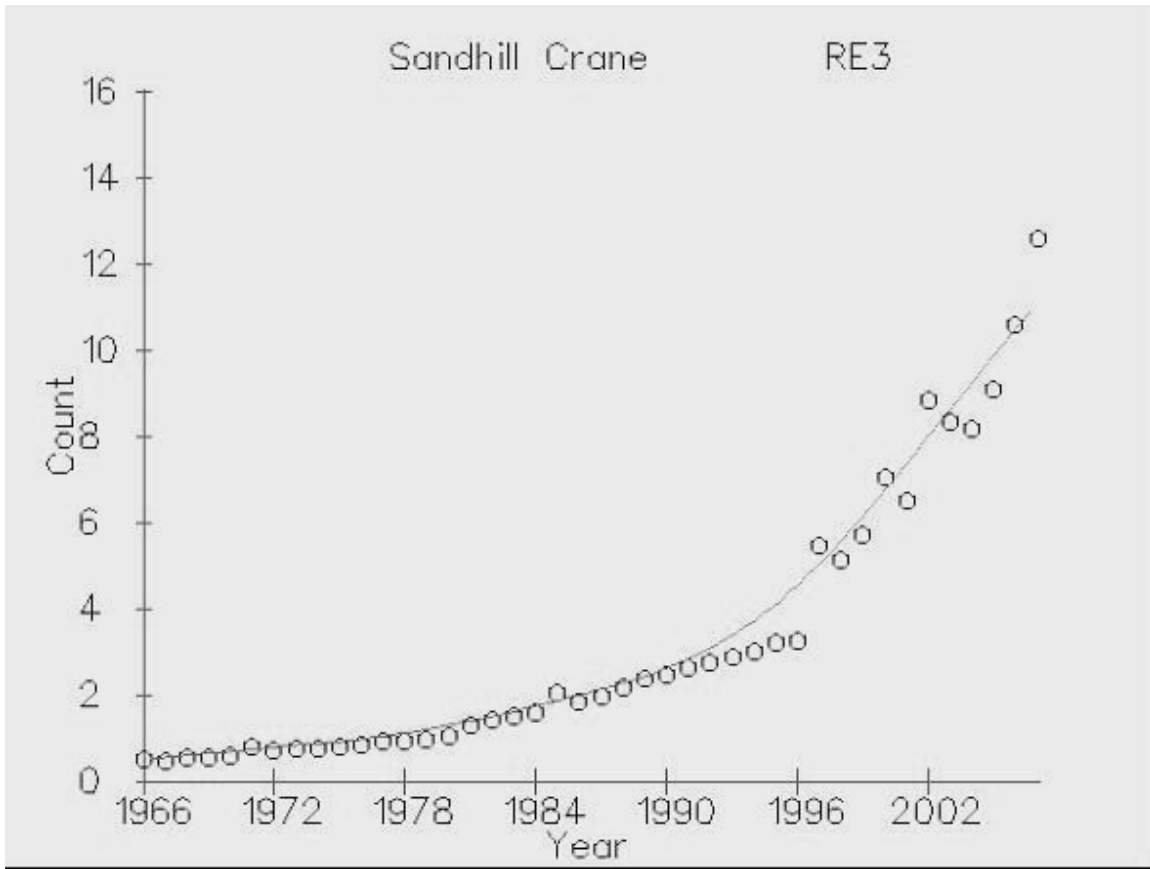


Figure 5. Breeding Bird Survey indices (birds/route) for sandhill cranes in USFWS Region 3 (MN, WI, MI, IN, IL, OH, MO, IA) 1966-2007; (Sauer et al. 2008).

Breeding records

In addition to these regional or statewide surveys, new breeding records show further support for the significant population increase and range expansion of the EP. The core of the EP breeding range is in south-central Ontario, Michigan, and Wisconsin extending into adjacent Illinois, Iowa, Minnesota, and Quebec (Meine and Archibald 1996, Sauer et al. 2008, Sutherland and Crins 2008). However, EP cranes have been steadily expanding their breeding range. The Ontario Breeding Bird Atlas documented that the probability of observation for sandhill cranes across the province increased from 12% during the first atlas of 1981-85 to 33% during the second atlas conducted 2001-05 (Sutherland and Crins 2008). While these province-wide observations included MCP sandhill cranes, significant increases in observations occurred in areas within the EP range. Breeding pairs occurred for the first time in Indiana in 1982, Ohio in 1987, Iowa in 1992, Pennsylvania in 1994, and in New York state in 2003 (Meine and Archibald 1996, Anne Lacy pers comm.). In addition to these records, other states in the northern Atlantic Flyway that have reported paired or nesting sandhill cranes include: Maine, Massachusetts, Vermont, and New Jersey (Melvin 2008). Sandhill cranes nested in south-central Maine between 2000 and 2008, in New Jersey in 2005, in western Massachusetts and west-central Vermont in 2007 and 2008. Overall in the northeastern states, 19 instances of nesting sandhill cranes at six locations in Maine, Massachusetts,

New Jersey and Vermont were confirmed between 2000 and 2008. In addition to eastward expansion, the number of breeding pairs has increased in eastern parts of the range; Ohio has now recorded as many as 23 nesting pairs in 2008 with 18 young fledged (Ohio Division of Wildlife 2008). In Quebec 1-4 breeding sandhill crane pairs were observed each year from 1990-2000 in the annual waterfowl survey of 5 km x 5 km plots uniformly positioned across the region (Christine Lepage pers comm.). However, since 2001 the frequency of observed pairs in the plots has increased to 8-13 pairs providing a mean indicated breeding pair estimate of 1200 pairs across the survey area for the period 2002-2008.

Local staging area surveys

Local surveys along the migration route have documented the general timing and population increases at staging areas. While these increases could represent a shift in staging area concentrations rather than a population increase, combined with the information from regional surveys and breeding records they provide a more complete picture of the increasing EP. On Manitoulin Island in Lake Huron, Ontario, the Manitoulin Nature Club has counted staging sandhill cranes since the 1980s; counts have increased from a few birds to several thousand each October (Brook 2008). On the nearby north shore of Lake Huron, as many as 9,000 staging sandhill cranes were observed in the fall of 2004 (Boyd et al. 2007). The Jasper-Pulaski Fish and Wildlife Area (FWA) in northwest Indiana and the Hiwassee Wildlife Refuge in eastern Tennessee are critical migration areas. Large flocks of sandhill cranes can be seen at Jasper-Pulaski beginning in October and weekly counts are conducted throughout the fall documenting the peak number of cranes each year (Figure 6). The crane population at this staging area peaks at over 20,000 birds in mid-November and the sandhills normally resume their journey south in December. Counts at Hiwassee have documented significant growth in numbers of migrating and wintering sandhill cranes with peaks near 14,000 in recent years (Figure 7). During recent warm winters some of these migration stops are also holding cranes throughout the winter.

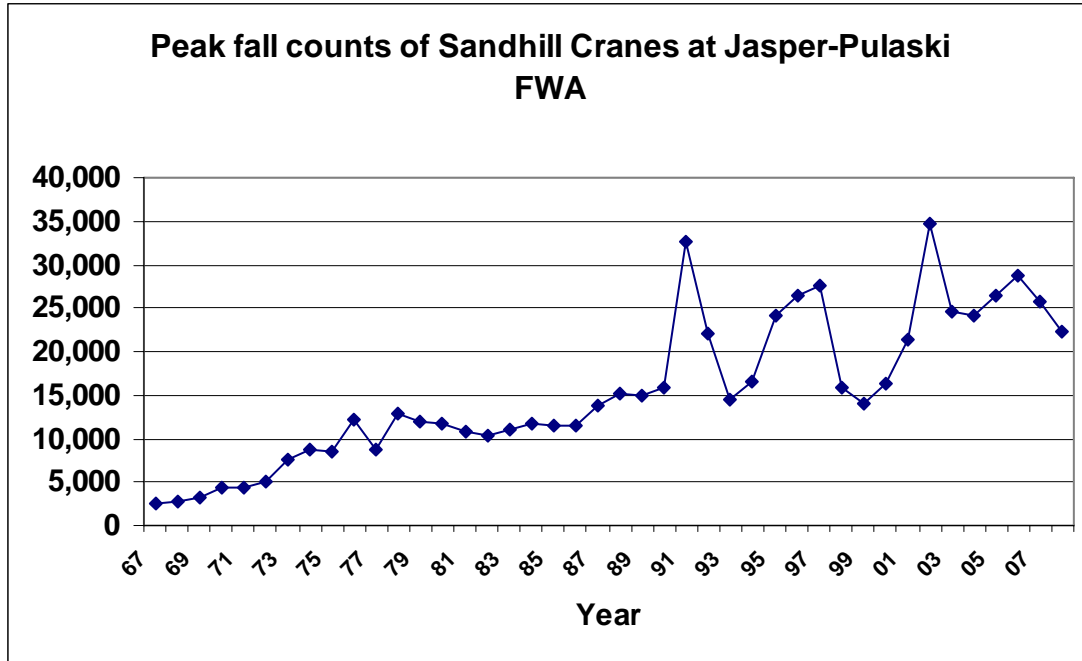


Figure 6. Peak fall counts of sandhill cranes at Jasper-Pulaski FWA, Indiana. These data represent the highest count each fall from weekly counts conducted throughout the fall (Indiana Department of Natural Resources unpublished data).

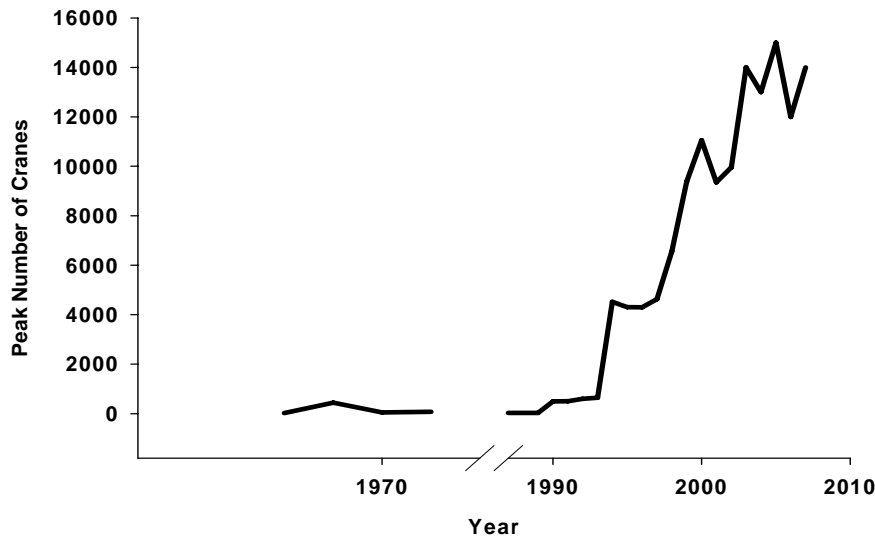


Figure 7. Peak numbers of Sandhill Cranes at Hiwassee Wildlife Refuge, TN. (Aborn et al. 2008).

C. Life History

Sandhill cranes can be found in a diversity of wetlands across North America from Alaska to south Florida, however, an open landscape of grasslands and freshwater wetlands is their preferred habitat (Tacha et al. 1992). Wetlands adjacent to agricultural fields often provide a similar setting. Research on EP birds at Seney National Wildlife Refuge in Michigan, indicated that cranes selected locations near seasonally flooded emergent wetlands and avoid forested uplands (Baker et al. 1995). Sandhill cranes are omnivorous and feed on a wide variety of plant tubers, seeds and grains, invertebrates, and small vertebrates found in both uplands and wetlands. The sandhill crane's attraction to plant tubers and grains has put this bird in conflict with the agricultural community because a flock of sandhill cranes can feed so efficiently in a corn field that the entire crop may need to be replanted (Barzen and Lacy 2007).

Sandhill crane nests are normally constructed over water in wetlands using the surrounding vegetation. Dry land nests, though rare, do occur. The most productive habitat complexes for nesting territories in Wisconsin contain open wetlands such as sedge meadows that are adjacent to short vegetation on surrounding uplands. They typically lay a single two-egg clutch annually but rarely fledge more than one young each year (Tacha et al. 1992). Incubation is about 30 days and young are able to leave the nest walking or swimming within 24 hours of hatch. Parents feed and eventually lead young to food in a slowly increasing range out from the nest into adjacent wetlands and open uplands. The age of first flight ranges from 67-75 days after which the young soon become strong fliers. Sandhill cranes are perennially monogamous with family units normally remaining together 9-10 months. During the breeding season, non-breeding cranes form small flocks consisting of non-breeding age birds, adults of breeding age without territories and failed breeders (Hayes and Barzen 2006). These summer flocks can be spread out in groups of two or three birds over large areas or they can become concentrated in flocks of 80-100 birds, depending upon habitat conditions. Family units and nonbreeders combine into large flocks during fall and winter, often concentrating at migratory staging areas that consist of large wetland complexes.

Sandhill cranes are long-lived birds (20+ years) with relatively low recruitment rates and high survival rates (Tacha et al. 1992, Drewien et al. 1995, Drewien et al. 2008). The oldest wild sandhill crane reported from the RMP was 35 years old (Drewien et al. 2008). From 1972-1992 annual survival ranged from .91-0.95 for RMP sandhill cranes while data for EP sandhill cranes showed survival rates of 0.87 for males and 0.86 for females (Tacha et al. 1992, Drewien et al. 1995). Sandhill cranes normally attempt first breeding between two and seven years of age and can breed for 15-20 years (Tacha et al. 1992, Nesbitt 1992). The mean age for successful reproduction, as defined by rearing of young to the age of independence from the parents (9-10 months), reported for EP sandhill cranes was 4.3 years (n = 19) (Nesbitt 1992). In observations of 37 marked sandhill cranes in Wisconsin, the mean age at pairing was 22 months, however, most pair bonds lasted only a few months in the initial attempts (Matthew Hayes unpublished data). Average age at first territory defense was 4.5 years old, with females (mean = 3.9 years old, n=12) defending territories earlier than males (average = 5.1 years old, n=13). The

15 cranes that fledged young, ranged from age 3 years to 10 years old at the first year of successfully fledging young. The females were productive at an earlier age with a mean at first year of successfully fledging young being 4.75 years (n=8) while for males it was 7.14 years (n=7).

Productivity of marked EP sandhill cranes has been monitored in good breeding habitat within the core breeding range of Wisconsin since 1990 (Anne Lacy unpublished data). Since 1990, the number of territories with pairs that have been monitored has increased from seven in 1990 to as many as 65 pairs in 2006 over a much larger area (6,500 ha.). In 1991, seven pairs produced eight chicks to fledging which was the highest productivity observed during this period but was derived from a small sample. Since 1993, the productivity has ranged from high of nearly 0.70 chicks surviving to fall migration per pair territory in 1995 to a low of 0.23 chicks per pair territory in 1998 with over 20 pairs monitored per year (Figure 6). Nesbitt (1992) reported an annual productivity of 0.35 for EP sandhill cranes if all observed pairs were included but this increased to a productivity of 0.49 if only previously successful pairs were included.

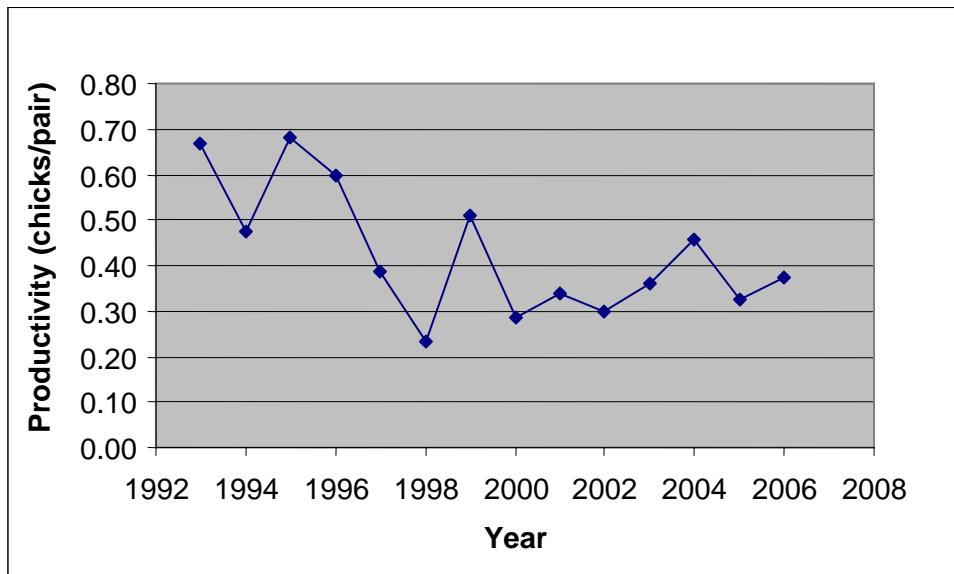


Figure 8. Sandhill Crane productivity in Wisconsin. (# of chicks surviving to fall migration per territory per year) (International Crane Foundation unpublished data).

Age ratios in fall surveys of sandhill cranes have been used for many years as an indication of recruitment across a population. During fall counts, the number of adults and juveniles in a flock are counted and these data are used as a measure of recruitment, however the published ratios are often different and not comparable. Data were standardized from a number of studies using the ratio of juveniles/total cranes X 100 and compared (Drewien et al. 1995). Based on this method, recruitment ranged from 5 to 14% for several different sandhill crane populations (Drewien et al. 1995). For RMP greater sandhill cranes, annual recruitment was approximately 8% over a 21 year period

(1972-92) while the recruitment measure for lesser sandhill cranes in the MCP was approximately 11% over a six year period (1987-92). Hunting was initiated in the RMP in 1981 while hunting began in a portion of the MCP range in 1961. At the Jasper-Pulaski Fish and Wildlife Area in Indiana where a large proportion of the EP stages, fall recruitment counts were conducted from 1983-1986 and averaged 10.1% for as measured in October surveys. (C. Iverson, unpublished data). Among greater sandhill cranes the EP had the highest average recruitment among several populations at 12% as averaged from several EP staging areas (Drewien et al. 1995). This higher recruitment in the EP was attributed to the more widespread and stable breeding habitat in comparison to many western breeding areas that are often limited annually by water. Drewien et al. (1995) suggest that recruitment rates of 5-10% are necessary for population maintenance.

D. Socio-economic considerations

For the past several decades, the primary interest in sandhill cranes in eastern North America came from conservationists and bird enthusiasts. However, the steadily increasing numbers in the EP has attracted the attention of additional segments of society. There are three primary socio-economic interests concerning sandhill cranes in the Mississippi and Atlantic Flyways: non-consumptive wildlife viewing, agricultural damage conflicts and the potential for hunting.

Wildlife Viewing

The sandhill crane is a large, graceful bird with a distinct prehistoric call. These characteristics make it popular with many people, who simply enjoy hearing and watching them. The species' fall and spring migrations can include concentrations of up to 20,000 birds at key staging areas. Large numbers of people are attracted annually to these staging areas to view this migration spectacle. For example, up to 30,000 visitors per year have visited the Jasper-Pulaski Fish and Wildlife Area in northwest Indiana during the fall migration period. Similarly, most sandhill cranes of this population migrate through or winter at the Hiawassee State Wildlife Refuge in Tennessee where concentrations of up to 15,000 cranes have been present. The large concentration of cranes at Hiawassee attracts numerous visitors and spawned a local sandhill crane festival. Several thousand people attended this annual event while over 100 people visit the state refuge each weekend during fall and winter to observe the cranes. For several years, visitors to the festival spent about \$25,000/year while visiting this small community (Aborn 2001). However, in 2008 the festival was cancelled because it required significant local fundraising to host. Even smaller staging sites like the Michigan Audubon Society's Baker Sanctuary in Calhoun County, Michigan can attract large numbers of visitors and provide an economic boost to local communities. The Sanctuary hosts an annual crane festival which drew more than 6,000 visitors in 2008.

The sandhill crane also holds special significance among the wildlife viewing public as a conservation victory since the crane's plight was made famous by the writing of renowned conservationist Aldo Leopold. This public views the recovery of the crane as a symbol of conservation success. Future management decisions will need to consider the high wildlife viewing value of sandhill cranes to people throughout their range.

Agricultural Conflicts

During the 1990's the EP increased to approximately 30,000 cranes as measured by the USFWS fall survey. It was during this period that conflict with the agricultural community intensified; primarily in Minnesota, Wisconsin, Michigan, Tennessee and Ontario. Sandhill crane crop depredation is increasing because of their attraction to new shoots of spring agricultural crops, including corn and winter wheat. Cranes uproot the germinating seed of corn plants or other crops and feed on the attached kernel (Barzen and Lacy 2007). In Tennessee, farmers are concerned about grazing and trampling damage to winter wheat as well as damage to standing unharvested corn when large concentrations of sandhill cranes are present (Aborn et al. 2008, Wally Akins, pers. comm.). However, agricultural losses in Tennessee are not well documented. While the agricultural damage of sandhill cranes may not be widespread across the region, individual farmers can lose hundreds of acres of spring crops to foraging cranes. For example, United States Department of Agriculture - Wildlife Services in Wisconsin reported 84 sandhill crane crop damage complaints with an estimated loss of \$263,000 during the spring of 2007 (Daniel Hirschert, pers. comm.).

At various political levels, this damage has resulted in demands for crane population reduction, lethal control, hunting seasons, and government damage compensation. Standard crop damage deterrents such as scare and noise devices have demonstrated limited effectiveness and tend to simply move the problem cranes from one field to another. Sandhill crane kill permits have been issued to remove problem cranes in the eastern U.S. and Canada (Table 2). The Canadian Wildlife Service reported only the number of permits rather than sandhill cranes taken, however, we know that in 2008, 27 permits resulted in a take of 140 sandhill cranes within the EP range of Ontario. The U.S. Department of Agriculture (USDA) – Wildlife Services and ICF have cooperated on research into chemicals that would make crops unpalatable to sandhill cranes. For a number of years, Lindane was used as a pretreatment for seed corn, but the manufacturer decided to discontinue maintaining the label for this type of use. Research by ICF and various partners has identified a new chemical (9, 10 anthraquinone) as having promise as a seed treatment chemical to reduce spring crop damage by sandhill cranes. Challenges related to chemical application and use by the agricultural community are being addressed (Barzen 2007). Trials for new application methods have shown promise across Minnesota, Wisconsin, Michigan, and Texas. If the chemical deterrents are accepted by the agricultural community they can be implemented on a large scale in the marketplace. In 2008, farmers treated 41,300 acres in Wisconsin; 12,500 in Michigan and 1,200 acres in Minnesota to prevent crane damage to planted corn. Landowners paid for this treatment (estimated at \$275,000 – or \$5.00/acre) without government compensation (Lacy and Barzen 2008).

Table 2. Sandhill crane take resulting from depredation permits issued in the range of the Eastern Population, 2002-2008 (U.S. Fish and Wildlife Service and Canadian Wildlife Service, unpublished data 2008).

Year	MI	TN	WI	MI, TN, and WI Total	Ontario * (permits issued)
2002	10			10	6
2003	23		14	37	12
2004	77		32	109	19
2005	188		42	230	20
2006	168		40	208	16
2007	130		50	180	20
2008	90	25	30	145	27
Total	686	25	208	919	120

*Unknown number of cranes taken per permit

Hunting

With a growing sandhill crane population, there is an increased interest among the hunting public to institute a hunting season for sandhills in the Mississippi Flyway. Three populations of sandhill cranes are hunted in 11 states and three provinces in the Central and Pacific Flyways, with many hunters from more eastern states traveling to the Central Flyway to harvest ducks, geese and sandhill cranes. As the population of these highly visible birds increases in the home areas of these hunters, they want to hunt them locally. Minnesota is currently exploring hunting the portion of the mid-continent population which inhabits the northwestern corner of Minnesota. This would be the first sandhill crane hunting within the Mississippi Flyway in nearly 100 years. However, as noted above as many as 200-300 EP sandhill cranes are being shot but not utilized each year as part of agricultural damage control activities.

Cranes (family Gruidae) are protected internationally under the migratory bird treaty conventions between the United States and Canada (as amended in 1997) between the U.S. and Mexico (as amended in 1997), Japan (1972) and Russia (1976). Hunting of migratory birds in the U.S. is regulated by the Migratory Bird Treaty Act (MBTA, 40 Stat. 755; 16 U.S.C. 703) that gives effect to these international treaties. Migratory birds defined as game birds in the terms of these conventions and MBTA are listed in section 20.11 of Part 1, Title 50, Code of Federal Regulations and include the family Gruidae (Central Flyway Council 2006). Within the EP range, Ohio is the only state that lists the EP cranes as state endangered. This is not a barrier to hunting EP cranes in other Mississippi Flyway states because these classifications are often based on local breeding populations rather than regional or flyway-wide populations and one state's laws cannot prohibit a legal activity in another state.

A general closed season was established on all cranes in the U.S. on May 20, 1916 (Central Flyway Council 2006). It remained in effect until January 1, 1961, when a 30-day season was authorized on lesser sandhill cranes in eastern New Mexico and western Texas. Texas did not participate at that time because cranes were not defined as game birds in state statute. In the fall of 1961, a 30-day season was authorized for Alaska (AK,

Sept. 1-30) and in New Mexico and western Texas (Nov. 4-Dec. 3). Since that initial period, expansions and changes to hunting of mid-continent populations of sandhill cranes have occurred resulting in the current status of 11 states conducting annual hunting seasons. Sandhill crane hunting seasons also occur in Mexico and in Canada within the provinces of Manitoba, Saskatchewan and the Yukon Territory.

The history of managing sandhill crane hunting in North America from two populations in the Central and Pacific Flyways has provided a foundation for the possible expansion of sandhill crane hunting into the Mississippi and Atlantic Flyways. A recent estimate of the MCP based on a three year spring index average for 2006-2008 was 382,271 (Sharp et al. 2009). This estimate is based on a photo corrected spring aerial count at major migration concentrations. This survey assumes that 90% of the MCP population is counted by this spring survey. This estimate is within the MCP management plan's population objective range of 349,000-472,000 for the spring population. A fall population prior to the hunting season would be higher with the addition of that year's production. During the 2007-2008 hunting season a total of 116,250 U.S. hunters were either HIP-certified or obtained crane hunting permits but only 9,808 hunters participated in the MCP sandhill crane season. A preliminary harvest estimate of 36,567 sandhill cranes (including crippling loss) for the 2007-08 season includes all North American (U.S., Canada and Mexico) harvest of MCP sandhill cranes. The RMP is monitored with a September pre-migration survey which provided a three year average index count of 20,732 cranes for 2004, 2005, and 2007 (no survey in 2006) which is within the population objective range of 17,000-21,000 for this index (Sharp et al. 2009). In the 2007-08 hunting season, 820 cranes (not including crippling loss) were harvested from the RMP. These harvest levels in two sandhill populations of different sizes have proven sustainable to date and are managed within an established framework.

An additional consideration related to a hunting season within the EP range is the presence of the reintroduced experimental population of endangered whooping cranes (*Grus americana*) (Wisconsin Department of Natural Resources 2006). A small breeding population of whooping cranes was established in Wisconsin in 2001. These birds follow a similar migration route as the EP sandhill cranes to their primary wintering area in Florida. Similar to sandhill cranes, some whooping cranes may be found in other southeastern states as far north as Tennessee during winter. A hunting season on EP cranes has the potential to result in accidental shooting of whooping cranes that are mistaken by hunters for sandhill cranes. There is also the potential for changes to whooping crane use of current crane concentration areas if hunting is introduced to those areas (Richard Urbanek pers comm.). However, the primary known cause of mortality in whooping cranes in the Central Flyway is collision with utility lines and only a few shooting deaths have been documented (Canadian Wildlife Service and U.S. Fish and Wildlife Service 2005). From 1968-1991, there were four documented shootings of whooping cranes in the Central Flyway; 2 were accidental shootings by snow goose hunters and 2 were shot by vandals. Since 1991, 3 or 4 whooping crane deaths have occurred as a result of accidental shootings by sandhill crane hunters. Federal rules establishing the nonessential experimental population (NEP) of whooping cranes in the eastern U.S. created a provision that the Federal Endangered Species Act (FESA)

penalties would not apply if the take of an NEP whooping crane occurred accidentally and incidental to an otherwise legal activity [66 Fed. Reg. 123 (June 26, 2001) (to be codified at 50 CFR pt. 17)]. In other words, if the NEP whooping cranes that are breeding in Wisconsin and wintering in Florida are accidentally shot or killed in the course of lawful activities (i.e., hunting other species in accordance with all laws and regulations), the shooting would not be considered in violation of the FESA. The absence of a sandhill crane hunting season in the EP range does not guarantee that shootings of whooping cranes will not occur. Since the establishment of the NEP whooping cranes, there have been two documented shootings in the Mississippi Flyway. One was apparently by a vandal and the other was by a snow goose hunter (Cole et al. 2009).

While there is a legal provision for an accidental shooting of whooping cranes in the eastern U.S. and the likelihood of this happening is small based on experience in the Central Flyway, a jurisdiction (state or province) initiating an EP sandhill crane hunting season would need to take steps to minimize this potential. The geographic range, hunting culture and crane habitats (both whooping crane and sandhill crane) differ in each jurisdiction so the most effective strategies for minimizing accidental shootings are best developed locally. Therefore, hunting season proposals submitted by a jurisdiction for flyway review should include provisions for minimizing potential impacts to whooping cranes through hunter education, use of whooping crane migration data, and possible segregations of sandhill crane hunting from whooping cranes by time or space. Education tools and communications should aid hunter identification and understanding of how to avoid shooting non-target species particularly whooping cranes and non-migratory sandhill cranes (where applicable). Whooping crane migrations are closely monitored and these data are available to assist jurisdictions in management of sandhill crane hunting seasons. Tools and strategies developed in the Central Flyway for hunter education and avoidance of whooping crane impacts should be reviewed by jurisdictions preparing a hunting season proposal.

Decades of managed hunting of sandhill cranes in the Central and Pacific Flyways have established a significant precedent for hunting of sandhill cranes where there is interest and the population can sustain a harvest. Hunters from the eastern U.S. that hunt waterfowl and sandhill cranes in the western U.S. see extension of hunting into the EP range as a logical next step. However, an extension into the EP range would need to be controlled and likely management intensive for those jurisdictions that are interested. The documentation on the sustainability of a hunting program by the state and federal agencies that manage hunting of the MCP and RMP sandhill cranes will be helpful in extending hunting into the EP range. The next step from a legal and management perspective to initiate hunting within the EP range is the completion of this management plan, which establishes a monitoring program and outlines the process for implementing a hunting season. Following completion of this management plan, a jurisdiction will still need to follow the steps outlined in this plan prior to requesting approval of a hunting season from the USFWS or CWS (See Appendix 1 for proposed harvest strategy including steps necessary to initiate a hunt). Consistent with flyway management plans for other migratory game birds, this plan leaves the social discussion of whether to hunt

sandhill cranes at the state or provincial level to be addressed within each jurisdiction's unique cultural and social climate.

The three socio-economic interests related to EP cranes, as summarized above, have a complex social interaction which must be recognized in the overall management of this population. Many people that value the EP cranes for viewing and their presence on the landscape may oppose hunting within the EP range and are often unaware of the negative impact of EP cranes on some agricultural areas. Agricultural producers impacted by sandhill cranes do not see the crane's general value on the landscape as justification for the farmer's personal financial loss and often advocate for government crop programs to compensate them for crop damage or a hunting season in order to reduce the population. The hunting public may also value sandhill cranes for wildlife viewing, but some within this group also recognize the growing population as a new opportunity for their recreation. These users may not want harvest opportunities to be reduced by lethal take used to address depredation issues. Hunters do not wish to be placed in a negative light from other conservationists if hunting of EP cranes is considered and expect state wildlife agencies to advocate on their behalf. Hunters sometimes use the complaints of the agricultural community as further justification for their interest in hunting EP cranes. A fall hunting season would not provide direct assistance to areas impacted primarily by spring crop damage, however, a managed harvest of EP cranes could slow or stabilize population growth and potentially minimize further expansion of crop depredation conflicts. It is important for the state, provincial and federal agencies involved in the management of EP cranes to consider these social groups, their perceptions and their interactions in the decision making process for the future management of EP cranes.

Management Goal and Objectives:

Goal

To manage the Eastern Population of Sandhill Cranes in the Mississippi and Atlantic Flyways at a sustainable population level that is consistent with habitat conditions and diverse societal values.

Objective 1 – Manage the EP to maintain an interim (five year) population index of 30,000 - 60,000 sandhill cranes as measured by the USFWS's fall survey. This goal recognizes the current positive growth rate and allows for range expansion and density increase in some areas. The fall survey is an index, not a population estimate. It is understood that this numerical goal will need assessment and possible revision in the future. However, the index is a measure of the population status and when this index reached about 30,000 cranes an increase in requests for agricultural damage depredation permits and for a hunting season in the Mississippi Flyway was observed. This target level (30,000-60,000) as measured by the fall survey index should be evaluated for adjustment at five year intervals following completion of this plan.

Strategy 1 – Continue to conduct, review and refine as necessary the annual fall staging area survey coordinated by Region 3 of the USFWS. This strategy will require the

continued commitment of the USFWS, states, provinces and other organizations that participate in this survey. If a hunting season is initiated in part of the EP range, any change in the fall count for those states or neighboring areas resulting from altered crane behavior should be documented.

Strategy 2 – Support and encourage research necessary to better define the range boundary and expansion of the EP throughout the annual cycle. In particular, more clearly define the boundary between EP and MCP sandhill cranes, both in Ontario north of the upper Great Lakes and in Minnesota.

Strategy 3 – Identify and manage key habitats on breeding, staging, migration, and wintering areas. Some of these key areas are already known and protected as described in this management plan; however, the expansion of the population and the importance of new areas needs to be documented and incorporated into this plan as it is revised. Evaluation and planning for managed sandhill crane sites should avoid attraction to areas that could lead to increased agricultural conflicts and disturbance.

Strategy 4 – Use existing state, provincial and federal wildlife disease programs to monitor and address any significant disease issues that develop in the EP and make adjustments to other aspects of this management plan as appropriate.

Objective 2 – Reduce agricultural damage and conflicts associated with the EP sandhill cranes.

Strategy 1 – The USDA Wildlife Services, other appropriate federal agencies, states, provinces and cooperators will continue to provide property specific integrated control guidance to farmers. This integrated control assistance can include, but is not limited to, recommendations for changes to management practices, scare devices, repellants and lethal control permits.

Strategy 2 – Improve documentation and tracking of agricultural damage and conflicts within the range of the EP. Assess the relationship between agricultural damage levels and sandhill crane populations and breeding densities.

Strategy 3 – Continue to advocate for and support the development and use of chemical deterrents to reduce sandhill crane impacts on agricultural crops available in the marketplace.

Objective 3 – Provide for and monitor non-consumptive uses for EP sandhill cranes and develop public education opportunities.

Strategy 1 – Develop educational materials for the flyway websites related to the distribution, status and management of the EP.

Strategy 2 - Encourage state, provincial and local agencies and non-governmental organizations to develop and promote sandhill crane viewing opportunities throughout the EP range.

Strategy 3 - Provide a report every five years to the Mississippi and Atlantic Flyway Councils on non-consumptive uses.

Objective 4 – Provide hunting opportunities for EP sandhill cranes.

Strategy 1 – Provide a framework for state and provincial hunting season submission, approval and management (Appendix 1). Hunting season proposals for states or provinces will include: a state, provincial or local population count, past counts and future monitoring strategies, proposed hunting season structure, permit system and allocation request, method of data collection on harvest and hunter participation, a hunter education program, and strategies to avoid impacts to whooping cranes and other non-target species.

Strategy 2 - Monitor and maintain harvest and allocations among jurisdictions at sustainable levels.

Strategy 3 – Develop a cooperative education program to educate hunters and non-hunters about a hunting season for EP sandhill cranes. This should include education on identification of non-target species such as whooping cranes for sandhill crane hunters.

Strategy 4 - Ensure that the research programs outlined below are supported and underway, so that there is a strong scientific basis for assessing impacts of the harvest and adjusting management of hunting within the EP population.

Strategy 5 - It is assumed that tribal harvest of EP sandhill cranes will be minimal and not appreciably impact non-tribal harvest or the status of the EP. However, if tribal harvest is planned then the intent for harvest and the resulting harvest should be reported to the respective flyway council and approvals received from the appropriate federal agency.

Research Needs

In April 2009, The Migratory Shore and Upland Game Bird Task Force under the direction of the Association of Fish and Wildlife Agencies convened a workshop of sandhill crane experts in order to identify priority information needs for the six migratory populations of sandhill cranes (D.J. Case and Associates 2009). The second priority developed at the workshop was specific to developing a better monitoring program for EP sandhill cranes. The priority was broken into two parts:

1. Conduct a critical review of the current survey to identify deficiencies, conduct a statistical analysis of historic data, and recommend methodological

improvements to increase its reliability. This review also would include development of a standardized protocol for conducting the survey.

2. Document the geographic extent of breeding, migration, and wintering ranges of Eastern Population cranes and make appropriate changes to the spatial/temporal design of the population survey to reflect contemporary distributions and migration patterns. This project will be accomplished by placing solar-powered satellite transmitters on cranes at important migration stopover locations. The long life expectancy of such transmitters will allow documentation of wintering ranges and subsequent breeding locations of cranes. This information also will provide insight to the approximate boundary between the Eastern and Mid-Continent populations. In addition to tracking cranes via transmitters, an attempt will be made to capture and color-mark cranes on several breeding sites. Information from re-sightings of color-marked cranes during migration and winter will complement results obtained from satellite tracking of cranes. Information gained from the satellite telemetry project will then be used to conduct a review of the current population survey to identify deficiencies and make recommendations for improving the existing survey or recommending a new survey protocol. Work on this project was initiated in the fall of 2009.

Developing an adequate monitoring system for the EP sandhill crane population is the most important objective for the immediate future. Completing the tasks identified above will be critical in developing a sufficient monitoring program that better informs management decisions.

Additional research should be directed toward:

1. Assessing recruitment and pre-fledging survival for EP cranes
2. Evaluate the extent of agricultural conflicts and improve techniques for controlling and minimizing crop depredation.

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Appendix 1. Eastern Population of Sandhill Crane Harvest Strategy

Introduction

The purpose of this strategy is to establish guidelines for the coordinated harvest management of the Eastern Population (EP) of sandhill cranes within the United States and Canada. The format of this strategy is based on elements in recently approved flyway plans for the Mid-Continent Population (MCP) of sandhill cranes and the eastern population of tundra swans (Central Flyway Council 2006, Caswell et al. 2007).

This harvest strategy is consistent with the objectives stated in the EP management plan and is designed to function within a fall count of 30,000-60,000 EP cranes based on a three year average population index from the cooperative fall survey coordinated by the U.S. Fish and Wildlife Service (USFWS). It should be recognized that at current EP population levels, sandhill crane impacts to agricultural are resulting in the annual issuance of 200-300 kill permits each year in Mississippi Flyway states and over 100 additional kill permits being issued in Ontario. While these are kill permits issued in the spring to specifically address agricultural damage, the issuance of these permits has already established an annual take of cranes within the EP with no notable impact on population growth. This harvest strategy should be reviewed at least every five years. The recommended framework dates for proposing a hunting season for sandhill cranes would be September 1 – January 31 with a limit of 60 days within each jurisdiction. Parameters for season proposals are described below.

Harvest Objective

A review of similar harvest strategies is helpful in establishing the structure of the EP harvest strategy. Within the Central Flyway, the MCP has been hunted since 1961 with a gradual expansion of opportunity and harvest. During recent years this population has had a three year average index over 350,000 sandhill cranes. For a five year period in the Central Flyway (2002-2006), there were an average of 66,890 crane hunt permit holders and they harvested an average estimate of 16,372 sandhill cranes from the MCP. That is a 24% success rate among permit holders. The initial crippling loss calculated in the Central Flyway in 1975 was 16% and has declined to 10% recently (Sharp et al. 2009).

The Management Plan for the Eastern Population of Tundra Swans was approved by the flyway councils and USFWS in 2007 using a harvest strategy similar to the one outlined here (Caswell et al. 2007). In recent years 9,600 hunt permits for tundra swans were approved based on a three year winter survey index of near 100,000 swans. However, not all permits were issued. The hunter success rate for swan hunting was initially assumed to be 50% for planning purposes but under this framework the success rate was actually 37%. With over 25 years of management under this format, the harvest rate has been about 3.7%.

Drawing upon the experience of these similar management efforts, a more conservative approach was taken for this harvest strategy. An initial maximum harvest permit issuance of 10% of the three year average of the USFWS coordinated fall survey will be

used. This recognizes the following; the three year average of the USFWS fall survey serves as an index, this index is an underestimate of the total population, not all permits will likely be issued and not all permits will result in a harvested sandhill crane. Thus the actual rate of harvest will be below 10%. An approximate success rate of 50% among permit holders and a 20% crippling loss will be assumed (Central Flyway Council 2006, Caswell et al. 2007). For example, with a fall index three year average of 40,000 sandhill cranes, 4,000 harvest permits would be available across the entire eastern United States and Canada. Assuming a 50% success rate among hunters would result in a retrieved harvest of 2,000 cranes and additional crippling loss of 500 cranes for a total mortality of 2,500 cranes. Crippling loss is calculated using $K = 1.25h$ where K = Kill rate and h = harvest rate (Andersen and Burnham 1976). Again, based on experience with similar harvest management efforts, the harvest will likely be lower than this estimate.

Permit System

A special permit system will be established in each participating hunt jurisdiction (state or province). It is assumed that tribal harvest of EP sandhill cranes will be minimal and not appreciably impact non-tribal harvest or the status of the EP therefore, reference to jurisdiction in this plan does not apply to tribes. However, if tribal harvest is planned then the intent for harvest and the resulting harvest should be reported to the respective flyway council and agreements reached with the appropriate federal agency. If a Canadian Province within the EP range is unable to establish a permit system as described below, then an equivalent season framework proposal which predicts and monitors for a harvest level at about the level allocated to that province will need to be presented. A monitoring program would also be proposed that ensures reasonably precise estimates to ensure that the predicted harvest level is not exceeded. A permit with either an accompanying hunter-questionnaire response card and approved tag or some other method of validating the harvest, acceptable to the USFWS or Canadian Wildlife Service (CWS), must be used. The permittee must sign the permit to validate it and must have the permit in personal possession while sandhill crane hunting. Immediately upon harvesting a sandhill crane, the bird must be tagged and the date of harvest recorded. Each jurisdiction is responsible for collecting and reporting these harvest data along with survey information as described below under evaluation procedure.

Permit Distribution

Because EP sandhill cranes are currently not harvested in the Atlantic and Mississippi Flyways, there is no precedent for allocation of harvest permits. Based on the current distribution and migration of EP cranes, there are only certain jurisdictions where hunting would be feasible at this time and most of those are in the Mississippi Flyway. If multiple jurisdictions seek to submit sandhill crane hunting season proposals within the EP range, the proposal should include a requested proportion of the total permits. Permit distributions must be jointly approved by the Mississippi and Atlantic Flyway Councils.

New Hunt Jurisdictions

A one-year lead time is required for new season requests (Caswell et al. 2007). Requests to the Atlantic and Mississippi Flyway Councils need to be made in July the year prior to initiation of a new season. This will allow time for flyway council and ultimately USFWS or CWS review and potential changes to the proposal. Hunting season requests from a jurisdiction will include the following:

1. An estimate of the peak number of sandhill cranes and timing of migration in that jurisdiction over at least a five year period. Include supporting data showing when the population reaches its highest levels within the jurisdiction during the potential hunting period (September 1 - January 31).
2. Proposed season dates, season length, and any hunting zones within the jurisdiction.
3. Proposed jurisdiction permit system (or alternative for provinces) for allocating the sandhill crane hunt permits.
4. Method of data collection on harvest and hunter participation.
5. Proposed number of permits, not to exceed 10% of the peak number of sandhill cranes observed in that jurisdiction in the previous five years. The peak in sandhill crane numbers will be determined by surveys conducted by the requesting jurisdiction. Some jurisdictions have existing surveys while other jurisdictions may need to initiate a survey.
6. The total of all state level requests cannot exceed the maximum number of permits allowed for the EP. If permit requests exceed the maximum for the population, then the number of permits issued to each state will be allocated in proportion to the estimated crane population in each state among all states requesting permits. For example, if 6,000 permits are allowed for the entire EP according the survey results, and state A requests 4,000 permits based on a state survey of 40,000 cranes and state B requests 3,000 permits based on a state survey of 30,000 cranes (total requested exceeds allowed by 1,000 birds) then state A would be allocated 3,429 permits ($6,000 \times (40,000/70,000)$). Similarly, state B would be allocated 2,571 permits ($6,000 \times (30,000/70,000)$).
7. Education tools and communications that will help hunters understand sandhill crane hunting and how to avoid harvest of non-target species particularly whooping cranes (and subspecies of non-migratory sandhill cranes, if applicable). Jurisdictions proposing EP sandhill crane harvest should consider reducing the potential for whooping crane accidental take by temporal and spatial considerations in season proposals. Data on whooping crane movements and migrations should be used as appropriate for the location.

All new seasons will be considered experimental for a three year period following their initiation (Caswell et al. 2007). The results of operational and experimental hunting seasons will be monitored annually by each jurisdiction by means of a special sandhill crane harvest survey. Annual reports for both experimental and operational hunts should include a summary of how hunts were administered; number of applications submitted

and permits issued, hunter participation rate (active hunters), reporting rate (percent survey returned), retrieved and un-retrieved harvest (via hunter survey question), and age ratio in the harvest. Adjustments in operational seasons or closures will be considered annually during the process of establishing migratory bird hunting regulations. Evaluation procedures in the US will be in accordance with a Memorandum of Agreement between each state and the USFWS (Caswell et al. 2007) and equivalent procedures be followed in Canada.

Harvest Management Thresholds in Relation to Permit Numbers

The following thresholds will be used to establish the maximum number of hunting permits that may be issued:

- At a three year fall survey average below 30,000, the EP sandhill crane hunting season will be closed and remain closed until the three year fall survey average exceeds 30,000.
- When the three year fall survey average is at or above 30,000, maximum permit allocation will be 10% of the three year fall survey average.
- When the three year fall survey average is above 60,000, the maximum permit allocation will be 12% of the three year fall survey average.

Evaluation Procedure for All New EP Sandhill Crane Seasons

- 1) Each jurisdiction will distribute permits to hunters according to its licensing practices. Permits should be uniquely identified. Each jurisdiction will develop a list of the names and addresses of the permittees.
- 2) Each jurisdiction will provide each permittee with a sandhill crane harvest questionnaire or mandatory harvest registration to assess: (a) number of days hunted for sandhill cranes, (b) whether a sandhill crane was harvested, (c) date and location of harvest, and (d) how many sandhill cranes were wounded but not retrieved. The permit will also request leg-band numbers and recovery information of harvested sandhill cranes.

A follow-up survey (postal mail questionnaire, internet questionnaire or telephone interview) will be conducted if the response rate to the initial survey is below 75%. Each jurisdiction will summarize these findings in an annual report to the Mississippi and Atlantic Flyway Councils and USFWS or CWS by 1 June following the hunting season.