

WANTED

Species Survival Plan Coordinator

Knowledgeable zoo or aquarium professional to manage propagation of hundreds of animals located in several states and countries. Must be versed in genetics, sophisticated computer software, and exotic animal husbandry. Will be responsible for keeping detailed animal records. Must like to travel and know how to deal with both domestic and foreign government agencies. Must perform job in addition to all regular duties. No salary. Apply to AZA Wildlife Conservation and Management Committee.

SSP Coordinator ad adapted from Wiese, R. J., and M. Hutchins. 1994. Species Survival Plans: Strategies for Wildlife Conservation. American Zoo and Aquarium Association. Alexandria, Virginia.

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Does this ad sound like something of interest to you? It has to staff members of many zoos and aquariums across the country! In fact, there are Species Survival Plan (SSP) Coordinators for the red-crowned crane, wattled crane and white-naped cranes.

What is a SSP?

- ✓ The SSP Program was created in 1981 by the American Zoo and Aquarium Association (AZA) to help ensure the survival of selected wildlife species, many of which are threatened by extinction.
- ✓ Each SSP manages the captive breeding of a species in North American zoos and aquariums .
- ✓ In addition to captive breeding, SSPs also coordinate public education, research, reintroduction, and field conservation efforts directed toward each species.

Why are SSPs important?

- ✓ Captive breeding and reintroduction are sometimes the last remaining option for reestablishing a healthy wild population of a wildlife species. SSPs help coordinate breeding efforts so that captive populations remain healthy and become self-sustaining. One way that zoo and aquarium professionals maintain healthy captive populations is through the use of **studbooks**. These databases contain the records for an entire captive population of a species. A studbook is like a pedigree for a purebred dog, through which conservationists can determine the relationship between individuals within a population for breeding purposes.



CAPTIVE BREEDING:

Maintaining Healthy Wildlife Populations

An important factor in a healthy wildlife population is **genetic diversity**, or variation in the genetic composition of individuals in a population. Species Survival Plans (SSPs) for endangered species, such as the whooping crane, attempt to retain as much of a population's genetic diversity as possible. Through the use of **studbooks**, or pedigrees, SSPs identify breeding pairs to maximize genetic variation in a population and to minimize **inbreeding**, or the mating of closely related individuals. Inbreeding may cause individuals to become more susceptible to disease and less reproductively healthy.

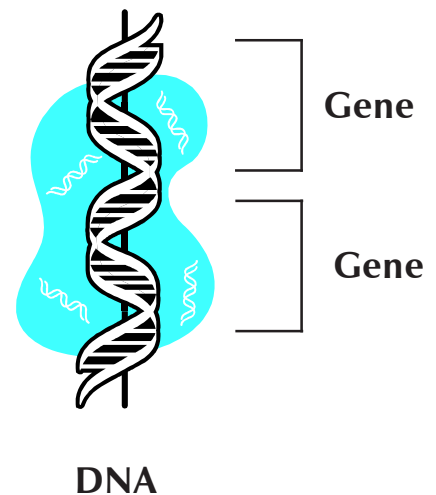
To understand how researchers maintain genetic diversity in a population, let's first examine a few of the basic components of life: **genes, DNA and chromosomes**.



Our genetic composition is determined by specific chemicals within our cells. The nucleus of each cell contains many **chromosomes**, which are made of long strands of molecules called Deoxyribo Nucleic Acid - don't worry about remembering

this name, as it is commonly referred to as **DNA**. In turn, our DNA is comprised of many small segments called **genes** (genetics is the study of these genes). Our genes code for particular characteristics, such as our eye or skin color. Combined in our DNA, genes carry the instructions for building and maintaining a living organism.

Different kinds of organisms have a different number of chromosomes in each cell. For example, humans have 46 chromosomes, which are divided into 23 pairs. In contrast, whooping cranes have 82 chromosomes, or 41 chromosome pairs in each cell. We inherit our genetic composition from our parents through the genetic information in our chromosomes (DNA and genes). In humans, each of our parents contributes one chromosome to each of our 23 chromosome pairs, so half of our genetic instructions come from our mother and half from our father.



Where did you get those alleles?

The genetic information for creating a living organism is passed from parents to their offspring through the DNA and genes found in our chromosomes. Among other characteristics, genes carry instructions for our physical appearance, or our **phenotype**.

In humans, we inherit genes from each of our parents that determine our eye color. A gene can be either **dominant** or **recessive**. These alternate states of the gene are called **alleles**. Dominant alleles mask, or hide, recessive alleles, so the only way an individual can inherit a characteristic carried on a recessive allele, such as blue eye color, is by receiving two recessive alleles (one from each parent).

To examine how genes are passed to offspring from their parents, we can use a **punnet square**. The punnet square to the right examines the different gene combinations from a blue-eyed mother (dd) and a brown-eyed father (Dd).

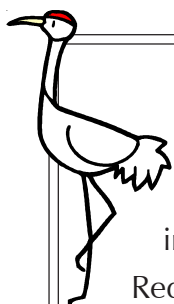
Heterozygous = different alleles

Homozygous = same alleles

		Female Parent	
		d	d
Male Parent	D	Dd	Dd
	d	dd	dd

*D = Dominant allele
(Brown pigment)*

*d = recessive allele
(Blue pigment)*



Did you know that in red-crowned cranes eye color is also an inherited trait?

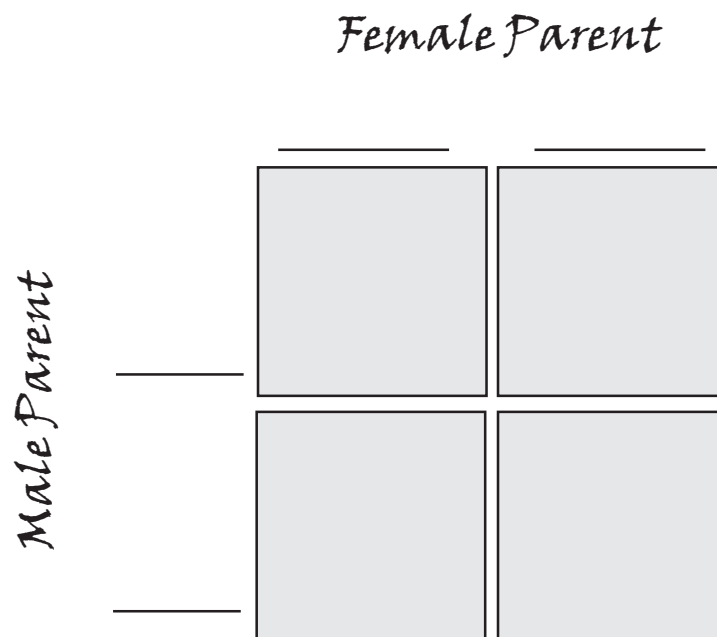
Red-crowned cranes may have black, brown, or green eyes. However, unlike human eye color, we do not fully understand how eye color is inherited in cranes.



SQUARED AWAY

NOW IT IS YOUR TURN TO DO A PUNNET SQUARE! CROSS PARENTS THAT ARE BOTH HETEROZYGOUS!

1. A heterozygous parent has different alleles: one dominant and one recessive.
2. Place the two parent's alleles above and beside the punnet square.
3. Bring the female parent's alleles down their respective columns - write them in.
4. Bring the male parent's alleles across their respective columns - write them in.
5. The resulting punnet square gives you the odds of the parents having a particular offspring with that gene.



Note: An individual that is heterozygous for a particular gene is also called a **carrier**. Although the individual does not express the recessive allele himself, that individual still can pass that gene on to offspring.

What are the odds of having an offspring with the dominant characteristic?

What are the odds of having an offspring with the recessive characteristic?



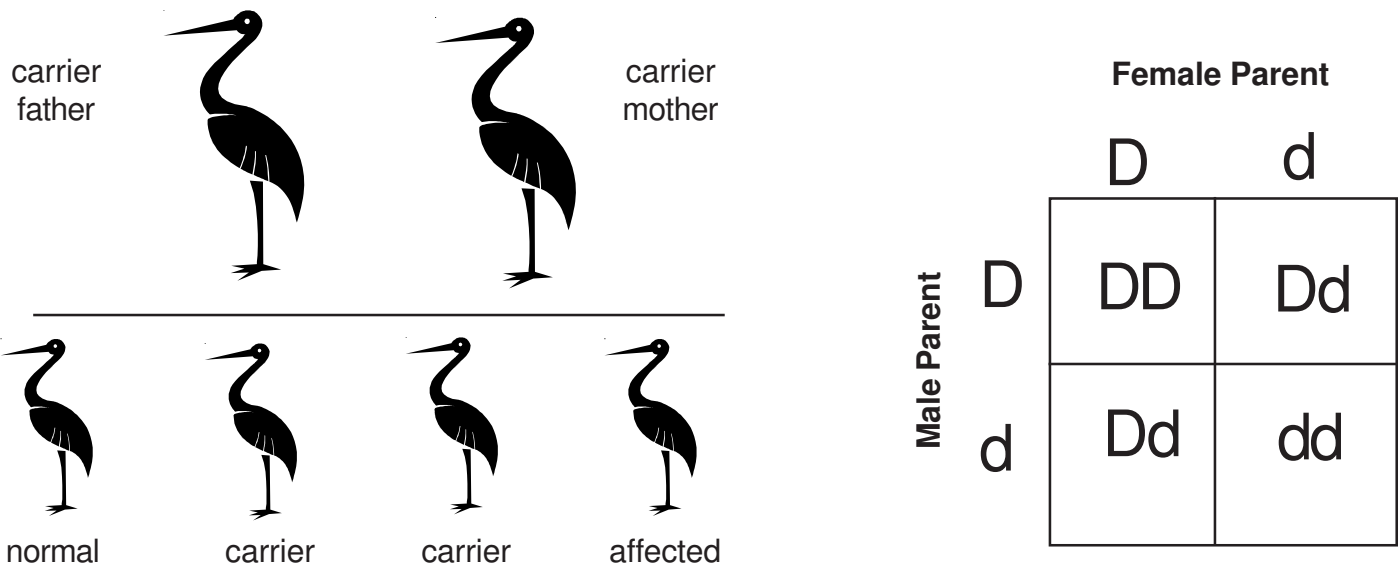
TOO CLOSE FOR COMFORT

The Dangers Of Inbreeding

Many genetic disorders are carried on recessive genes. In a healthy breeding population, the chances of inheriting a recessive allele for a genetic disorder is low due to high genetic diversity within the population.

However, inbreeding changes all of that! Inbreeding occurs when two closely related individuals breed and produce offspring. When this occurs, there is an increased chance that both parents will have a recessive allele for a genetic disorder that they can pass on to their offspring.

Note: Not all genetic disorders are carried on a recessive allele. For our purposes, we are focusing on recessive alleles, because they play an important role in inbreeding.



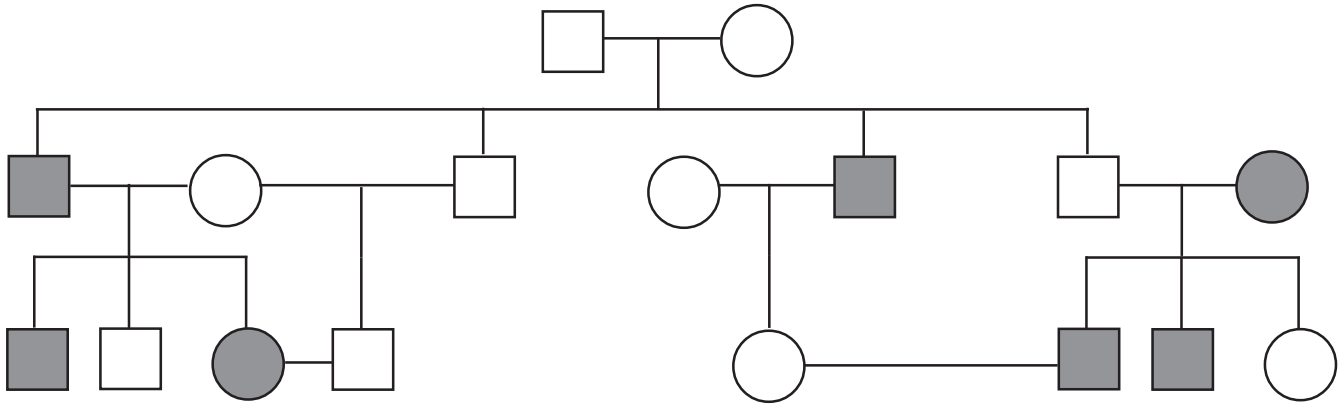
The above diagram shows how recessive genetic disorders are passed down from one generation to another. Think of it as a roll of the dice. When one of the parents is a carrier of a recessive genetic disorder, there is always a 1 in 4 chance of passing the disorder to their offspring. If the parents are closely related, there is an increased chance that both parents will carry the recessive disorder, which in turn increases the chance that their offspring will inherit the disorder.

How do you think this applies to endangered species?



Family Affair:

Using Pedigrees to Manage Captive Populations



A pedigree is a diagram of successive generations that may be used to trace a genetic trait over several generations. The above pedigree shows a total of three generations descended from a single pair. In the pedigree, males are represented by squares and females are represented by circles. Individuals that have produced offspring together are connected by a line. An individual that is affected by a **recessive genetic disorder** is shaded.

Pedigrees are an essential tool in endangered species management. Many captive breeding facilities, like the International Crane Foundation, keep pedigrees, or **studbooks**, on animals in their collections. The studbooks allow researchers to trace the relationships between individuals to reduce the chance that closely related pairs, which may carry a recessive genetic disorder, will breed and produce affected offspring.

Use the pedigree to answer the following questions:

1. Based on the pedigree, are the male and female in the first generation carriers of the recessive genetic disorder? Hint: To determine if the original pair are carriers, first look at the second generation. Are any of the individuals in the second generation affected by the genetic disorder? Remember that in order to be affected by a recessive genetic disorder, an individual must have two recessive alleles - one inherited from each parent.
2. Identify instances of inbreeding in the pedigree. If you were managing this captive population, what would you change to reduce the chances of inbreeding in the population?



ACTIVITY:

GENETIC DIVERSITY AND WILDLIFE POPULATIONS

Whooping Crane Scoliosis

Scoliosis, or curvature of the spine, is rare in cranes. However, its increased incidence in the captive whooping crane population suggests that there may be an inherited susceptibility to scoliosis within this population.

In this activity, we will use a coin toss to determine how random changes in allele frequency may effect a wildlife population.

Heads: R = less susceptible to scoliosis (dominant allele)

Tails : r = more susceptible to scoliosis (recessive allele)

1. Each person in the class represents a whooping crane in our captive population. To begin the activity, everyone in the class should flip a coin to determine their allele for scoliosis.
2. Record the alleles represented by the coin toss.
3. How many dominant alleles did the class get? How many recessive alleles did the class get? Record the results below:

Dominant Alleles _____

Recessive Alleles _____

A disease outbreak occurs in your population!
Flip the coin to determine who survives (Heads = survive).

4. For the surviving cranes, how many dominant alleles remain? How many recessive alleles remain? Use your original allele!

Dominant Alleles _____ *Recessive Alleles* _____

A natural disaster strikes your captive breeding facility!
Flip the coin to determine who survives (Heads = survive).

5. For the survivors, how many dominant alleles remain? How many recessive alleles remain? Use your original allele!

Dominant Alleles _____ *Recessive Alleles* _____



Genetic Drift

Activity Summary: Genetic Diversity and Wildlife Populations

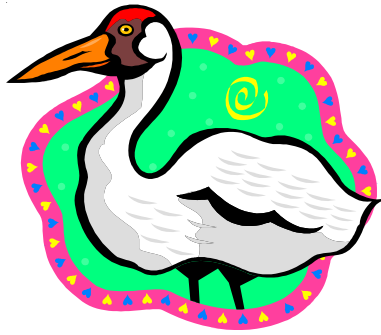
Did you lose an allele along the way? It is likely that after completing this activity, you experienced a decline in the frequency, or number, of one of the two traits (alleles) as your population declined. If you reduce your whooping crane population even further, you may lose either the dominant or recessive allele. You could just as easily lose the dominant allele as the recessive allele. It is completely random - the flip of the coin! This random change in allele frequency is called **genetic drift**. In this example, if the frequency for the recessive allele increased (more susceptible to scoliosis), the population could have an increased incidence of scoliosis, which might have a detrimental impact on the future health of the population.

Endangered species have a lot to worry about! More and more factors keep stacking up against them as their population gets smaller and smaller. Not only are many species losing their habitats, but they are also losing their genetic integrity as well. Inbreeding and loss of genetic diversity decrease a species' chances of survival. The more genetic diversity in a population, the more flexible and adaptable the species is to changes in its environment. However, once genetic diversity is reduced, it is extremely difficult to regain.



A genetic bottleneck describes the process through which a population undergoes a reduction in size and a resulting loss of genetic diversity. Often the population has since recovered in size but has not recovered its former genetic diversity. See the whooping crane handout for a history of a species that has gone through a genetic bottleneck.





The Whooping Crane

Population

- mid 1800s: 1,200 - 1,400
- 1941: 21
- 2006: approximately 4475

The whooping crane population passed through a severe genetic bottleneck after decimation of the species' population size in the late nineteenth and early twentieth centuries. As a result of this loss of genetic diversity, the current captive population may have an increased incidence of scoliosis, or curvature of the spine.

Range

The remaining migratory population breeds in northwestern Canada at the Wood Buffalo National Wildlife Refuge and winters at the Aransas National Wildlife Refuge on the Texas Gulf Coast. In 1993, reintroduction efforts were initiated to form a nonmigratory population in central Florida. In 2001, biologists initiated a second reintroduction project in central Wisconsin. This population will breed in Wisconsin at the Necedah National Wildlife Refuge and migrate to the Gulf Coast of Florida for the winter.

The tallest North American bird, the whooping crane is also the rarest species of crane. Probably never an abundant bird, biologists estimate there were 500 to 1,400 whooping cranes alive in prior to 1870. Hunting, egg collecting, disturbance and draining of wetlands took a heavy toll on the population, and by 1941 only twenty one birds remained. Six of these were in a nonmigratory flock in Louisiana and fifteen in a flock that migrated between northwestern Canada and the Texas Gulf Coast.

In 1954, the nesting grounds of the remaining wild flock were discovered. Ironically, the cranes were nesting in Canada's Wood Buffalo National Wildlife Refuge, an area already protected for the wood bison. Conservation of this area, along with the cranes' winter home at Aransas National Wildlife Refuge on the Texas Gulf Coast and critical migratory habitat, is allowing this population to recover.

To ensure survival of whooping cranes, biologists in the 1960s began building a captive population. Because whooping cranes lay two eggs each year, but usually only one chick survives, biologists were able to take the extra egg from wild nests that contained two eggs and raise the chicks in captivity.

However, of the fifteen whooping cranes that wintered at the Aransas National Wildlife Refuge in 1941, only three or four pairs had an opportunity to pass on their genes to future generations, forcing the population through a genetic bottleneck. Without enough genetic diversity, endangered species can succumb to the reduced vigor that results from inbreeding even years after the bottleneck occurs. When managing captive populations, curators must be very careful in their selection of pairs so that genetic diversity is preserved. A whooping crane population viability analysis (PVA) was conducted in the early 1990s, and although we know that significant genetic diversity was lost in the bottleneck, the PVA indicated that there was enough diversity that this species should be able to recover.

