COSEWIC
Assessment and Status Report

on the

Whooping Crane
Grus americana

in Canada

ENDANGERED
2010

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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COSEWIC
Assessment Summary

Assessment Summary – April 2010

Common name
Whooping Crane

Scientific name
Grus americana

Status
Endangered

Reason for designation
Canada is home to 100% of the naturally occurring global breeding population of this species. Although never common, its population dipped to only 14 adult birds early in the last century, at which point the species was at the brink of extinction. Conservation efforts in Canada and the U.S. not only rescued the remnant population from extinction, but later resulted in population increases. To help ensure persistence of the species, efforts to establish wild flocks of captive-bred individuals outside Canada have been underway for several decades. Nevertheless, Canada's breeding population is still very small and is confined to a limited breeding area and only one wintering location. This situation exposes it to catastrophic natural events (e.g. droughts, hurricanes) and a variety of ongoing anthropogenic threats (e.g. loss and degradation of coastal wetland habitats on the wintering grounds, oil spills in coastal areas, and collisions with power lines and structures during migration). Last, because of delayed sexual maturity and a naturally low annual reproductive output, the population of this species has an inherently weak capacity to rebound from pressures that reduce survivorship or reproductive success.

Occurrence
Northwest Territories, Alberta, Saskatchewan, Manitoba

Status history
Designated Endangered in April 1978. Status re-examined and confirmed in November 2000 and in April 2010.

COSEWIC
Executive Summary

Whooping Crane
Grus americana

Species information

Adult Whooping Cranes have pure white plumage with black primary feathers on their wings, and black and red facial markings. Their long legs and large bill are black or greyish-black. Adult birds can reach 1.5 m in height, and most closely resemble Sandhill Cranes. Immature birds have a combination of greyish-white and reddish-cinnamon colouration.

Distribution

Whooping Cranes occur only in North America. Historically, the breeding grounds extended throughout the prairie regions of Canada and the United States, and the major wintering grounds were located on the Gulf Coast of Texas and in northeastern Mexico. The birds all but disappeared from these areas in the beginning of the 20th century, and today the only self-sustaining wild population breeds in Wood Buffalo National Park (WBNP), located in the Northwest Territories and northern Alberta. This population winters in and around Aransas National Wildlife Refuge (ANWR) in coastal Texas.

Two additional wild flocks (the result of a captive-breeding program begun from eggs collected from Canada) exist in the United States. One, established in 1993, is a non-migratory flock located in Florida. The second is a migratory flock located in the midwestern and southeastern United States, established in 2001. Both flocks are currently not self-sustaining and were established through the introduction of captive-bred cranes.

Habitat

Whooping Cranes breed in a unique wetland complex in WBNP, characterized by relatively small ponds with a soft substrate. A substantial amount of open water is present, allowing for easy detection of predators. Bulrush is the preferred nesting material, though sedge and cattail are also present. Common terrestrial vegetation includes Black Spruce, White Spruce, Tamarack and Labrador Tea.

During migration, Whooping Cranes use a variety of wetlands and croplands along their migration corridor for feeding and roosting. Wetlands are more important feeding areas for family groups than non-family groups.

Wintering habitat on the Texas Gulf Coast consists of estuarine marshes dominated by Salt Grass, Saltwort, Smooth Cordgrass, glasswort, and Sea Ox-eye, and salt flats dominated by Gulf Cordgrass. Oak, Redbay, and bluestem characterize upland areas that are managed for cranes and other wildlife.

Biology

Breeding begins when cranes are 4-5 years old, and occurs annually thereafter. Nesting in Wood Buffalo National Park begins upon late-April arrival; clutch initiation is usually complete by mid-May, and eggs are incubated for 30-35 days. Perennially monogamous pairs typically lay two eggs per clutch but rarely fledge more than a single young. Upon hatching, precocial young grow rapidly and begin sustained flights in mid-August. Home ranges vary in size, and have been estimated to be between 3.2 and 12 km^2.

Longevity in the wild is estimated to be 22-30+ years. Overall mortality for the Aransas-Wood Buffalo Population (AWBP) is 9.9% per year. Unguarded eggs and flightless young can be vulnerable to a variety of both avian and terrestrial predators, especially during periods of drought. Most adult mortality occurs during migration or on the wintering grounds, mainly due to human-related factors.

Fall migration begins about mid-September and is protracted, often involving staging for one to five weeks in south-central Saskatchewan. Arrival on Texas wintering grounds occurs in late October and mid-November. Non-breeding subadults begin fall migration earlier than family groups. Pairs and family groups establish fairly large territories during their winter tenure in Texas. Juveniles leave Texas with their parents in spring and accompany them on the majority of their northward migration, separating at or near the breeding grounds. From 1982-84, 43.7% of crane use-days during spring migration were spent in Saskatchewan.

Whooping Cranes are omnivorous throughout the year. The diet during the breeding season includes mainly forage fish and aquatic invertebrates, but may also include frogs, snakes, small rodents, seeds and berries. Staging areas used during migration provide waste grains, as well as tubers, a variety of insects and small rodents. On the wintering grounds, Blue Crabs and a variety of clams are the most important food items. Wolfberry and acorns are consumed in adjacent uplands.

Population size and trends

Whooping Cranes were never common, but based on known historic range and current territory sizes, it is reasonable to assume that more than 10,000 once occupied North America. The population was reduced to an estimated 1400 individuals by 1860. In the early 20th century, the population reached an all-time low of just 14 adults. As of winter 2008, the wild Canadian population had 270 individuals, including 39 young of the year. The introduced Florida population had 30 individuals, while the other introduced population in the eastern United States had 88 individuals. The wild Canadian population increased by 40% in the 10-year period between 1998 and 2008. Overall average population growth of adults for this population has averaged 4.85% per year over the past 36 years (3 generations), which corresponds to an overall increase of 450%.

Limiting factors and threats

The breeding range in Wood Buffalo National Park is restricted. Habitat quality, and thus, food resources, is an important factor affecting reproduction on the breeding grounds. Along with perils faced during migration, factors affecting the wintering grounds in Texas appear to be more limiting than factors affecting the breeding range. The concentration of Whooping Cranes in Texas makes them vulnerable to catastrophic events such as hurricanes or chemical spillage.

Special significance of the species

The Whooping Crane has been described as a flagship species of North American wildlife conservation, symbolizing endangered species worldwide. They are also charismatic birds that have attracted attention from people of all backgrounds and ages.

Existing protection

COSEWIC designated Whooping Cranes as Endangered in November 2000, and this species is currently listed as Endangered on Schedule 1 of the *Species at Risk Act*. They are protected in Canada under the *Migratory Birds Convention Act*, *National Parks Act, Canada Wildlife Act, Species at Risk Act,* as well as by provincial/territorial wildlife acts. This species is also protected in the United States by the *Migratory Bird Treaty Act* and the U.S. *Endangered Species Act*.

TECHNICAL SUMMARY

Grus americana
Whooping Crane Grue blanche
Range of occurrence in Canada: NWT, AB (breeding), SK, MB (migration)

Demographic Information

Generation time	~12 yrs
Is there an observed or projected decline in number of mature individuals?	No
Estimated percent of continuing decline in total number of mature individuals within 10 years or 3 generations	Not applicable
Observed percent change in total number of mature individuals over the last 10 years, or 3 generations. The adult AWBP population increased by 40% in the 10-year period between 1998 and 2008. Overall average population growth of adults for this population has averaged 4.85% per year over the past 36 years or 3 generations, which corresponds to an overall increase of 450%.	450% increase
Projected or suspected percent change in total number of mature individuals over the next 10 years or 3 generations.	Unknown
Observed, estimated, inferred, or suspected percent change in total number of mature individuals over any 10 years, or 3 generations period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased?	Not applicable
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence Based upon a minimum convex polygon for the Canadian breeding population.	3340 km²
Index of area of occupancy (IAO) The biological area of occupancy (AO) of the Canadian breeding population is based upon nesting territory estimates ranging from 3.2 km^2 to 12 km^2 and 72 territorial pairs in 2008. IAO based upon a 2 x 2 km grid was not calculated. [About 900 km^2 of wintering habitat exists in the Aransas National Wildlife Refuge and surrounding lands in Texas (CWS & USFWS 2007).]	230 to 864 km²
Is the total population severely fragmented? Excludes two artificially derived wild breeding populations in the U.S.	No (not the Canadian population)
Number of "locations" as defined by threat WBNP is treated as a single location exposed to the same threats (excludes captive populations and artificially-derived breeding populations in the U.S.)	One
Is there an observed decline in extent of occurrence?	No
Is there an observed decline in index of area of occupancy?	No
Is there an observed decline in number of populations?	No
Is there an observed decline in number of locations?	No
Is there an observed decline in area, extent and/or quality of habitat?	Yes (wintering habitat)
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations (as defined by threat)?	No
Are there extreme fluctuations in extent of occurrence?	No

Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each population)

Population	**N Mature Individuals**
Aransas/Wood Buffalo Canadian population in winter 2008-09 (excluding U.S. populations in Florida and Wisconsin)	231
Total (Canada; breeding adults)	**231**

Quantitative Analysis

Probability of extinction in the wild for the AWBP is <1% within 100 years, assuming no degradation of environmental variables (Mirande *et al.* 1997; Tischendorf 2003; Environment Canada 2007).	<1% probability

Threats (actual or imminent, to populations or habitats)

The Canadian population of this species is particularly vulnerable on its sole wintering grounds in Texas, where Whooping Cranes are threatened by continued habitat loss from human development, sea level rise, erosion of habitat, reduction of freshwater inflows, increased human disturbance, reductions in key food resources, and risk of catastrophic events such as hurricanes, severe droughts, and chemical spills. The risk of catastrophic events (e.g. severe weather, drought, fire) is also present on the sole Canadian breeding grounds.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? USA: Endangered. The only potential source populations are derived from translocated breeding stock that have been established in one location in Florida (a non-migratory population of ca. 30 individuals) and Wisconsin (a migratory population of ca. 80+ individuals)	
Is immigration known or possible?	No, not from natural sources
Would immigrants be adapted to survive in Canada?	Yes, for captive-bred birds
Is there sufficient habitat for immigrants in Canada?	Yes, in WBNP, but resources are limited in winter range (ANWR)
Is rescue from outside populations likely?	No, not without translocation of birds of captive-origin

Current Status

COSEWIC: Endangered (April 2010)

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Endangered	B1ab(iii); D1

Reasons for designation:

Canada is home to 100% of the naturally occurring global breeding population of this species. Although never common, its population dipped to only 14 adult birds early in the last century, at which point the species was at the brink of extinction. Conservation efforts in Canada and the U.S. not only rescued the remnant population from extinction, but later resulted in population increases. To help ensure persistence of the species, efforts to establish wild flocks of captive-bred individuals outside Canada have been underway for several decades. Nevertheless, Canada's breeding population is still very small and is confined to a limited breeding area and only one wintering location. This situation exposes it to catastrophic natural events (e.g. droughts, hurricanes) and a variety of ongoing anthropogenic threats (e.g. loss and degradation of coastal wetland habitats on the wintering grounds, oil spills in coastal areas, and collisions with power lines and structures during migration). Last, because of delayed sexual maturity and a naturally low annual reproductive output, this species has an inherently weak capacity to rebound from pressures that reduce survivorship or reproductive success.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Does not meet criterion; population has significantly increased.
Criterion B (Small Distribution Range and Decline or Fluctuation): Meets Endangered B1ab(iii). EO is <5000 km² (3340 km²); the species occurs in only one location; and there is observed, inferred and projected decline in the quality of wintering habitat owing to a combination of droughts and a series of anthropogenic threats.
Criterion C (Small and Declining Number of Mature Individuals): Does not meet criterion. Population size is <2500 mature individuals but numbers have been increasing significantly in recent decades, and there are no extreme fluctuations.
Criterion D (Very Small or Restricted Total Population): Meets Endangered D1 criterion; population size (231 adults) is <250 mature individuals.
Criterion E (Quantitative Analysis): Does not meet criterion. Analysis of the demographics of the Wood Buffalo National Park population suggests that extinction risk is <1% over the next 100 years, assuming no further degradation of environmental variables.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2010)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

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SPECIES INFORMATION

Name and classification

Class: Aves
Order: Gruiformes
Family: Gruidae
Genus: *Grus*
Species: *americana*
English common name: Whooping Crane
French common name: Grue blanche d'Amérique

The name Whooping Crane refers to the adult cranes' unison call vocalization or guard call, a loud single-note vocalization. DNA analysis by Love and Deininger (1992) has suggested that the closest relative to the Whooping Crane is the Common Crane (*G. grus*) found in Eurasia. The Sandhill Crane (*G. canadensis*) is the only other crane that is native to North America.

Morphological description

Whooping Cranes are the tallest birds in North America, with males reaching 1.5 m in height. They are about 12-20 cm taller than the Sandhill Crane. Males are slightly larger than females; males have an average body weight of 7.3 kg versus 6.4 kg for females (CWS & USFWS 2007).

Adult Whooping Cranes have a white plumage, with the exception of black primaries that are only visible when the wings are outstretched. The crown is featherless and dark red in colour, and the base of the bill is pink. There is a dark grey-black, wedge-shaped patch on the nape, and dark black feathers on the malar region. The long legs and bill are black or greyish-black. Juvenile plumage is a combination of greyish-white and reddish-cinnamon until four months old, when white feathers appear on the neck and back. During the first winter, juveniles begin to develop distinct adult colours, including dark red skin on the crown and malar regions. By the end of their second summer, juveniles have adult plumage.

Whooping Cranes share portions of their range with several similar-looking species. These include Snow Goose (*Chen caerulescens*) and American White Pelican (*Pelecanus erythrorhynchos*), both of which have white plumage with black primaries, but have short necks and legs and entirely different bill morphology. Egrets and swans also have white plumage but do not have black primaries. Swans have short black legs that do not extend noticeably in flight and although the egret's long black legs trail in flight, they fly with their necks folded on their shoulders. Whooping Cranes in flight have distinctive black wing tips and fly with their long legs and necks stretched out. Sandhill Cranes are similar to Whooping Cranes, but are slightly smaller and have grey plumage often stained with a rusty colour.

Genetic description

The Whooping Crane population reached a bottleneck in 1938, with only 14 surviving adults in the Aransas-Wood Buffalo Population (AWBP). Mitochondrial DNA collected before and after the population bottleneck showed a 66% reduction in haploptypes (Glenn *et al.* 1999). The most common haplotype today was the rarest haplotype at the time of the bottleneck. Genetic diversity of the Whooping Cranes is much less than that of other cranes, including the Mississippi subspecies of Sandhill Crane, which experienced a similar genetic bottleneck (Dessauer *et al.* 1992). While 87% of the genetic variability present after the bottleneck was still present in the wild in 1990, only 33% of the genetic material present prior to the bottleneck is present in today's population of Whooping Cranes, which was derived from 6-8 birds (Mirande *et al.* 1993; Glenn *et al.* 1999).

Population viability analyses have been conducted by Mirande *et al.* (1997), Brook *et al.* (1999), and Tischendorf (2003) to determine minimum viable population size, or the number of individuals needed to yield a high probability that the population will survive over a given amount of time (Primack 1993). To prevent continued loss of genetic material, the AWBP must increase to a population size where the loss of genetic diversity will be offset by the creation of new alleles (CWS & USFWS 2007). If attempts fail to establish both the introduced Florida and Eastern Migratory Population, then the international recovery team has set a target of a minimum population of 1000 individuals (250 breeding pairs) in the AWBP (CWS & USFWS 2007).

Designatable units

All Whooping Cranes currently breeding in Canada are contained within a small, single geographic region. There are no subspecies. Hence, one designatable unit is considered in this report. Although several reintroduced populations now exist, they are all presently confined to the United States, and hence are not part of the designatable unit under consideration. As such, this assessment deals only with the wild migratory population, the Canadian range of which includes Northwest Territories and Alberta (breeding), and Saskatchewan and Manitoba (migratory stopover). The species also occurs as a vagrant in other parts of Canada (e.g., Yukon, Ontario).

Although the range map depicted in Figure 1 appears to show that the current Wood Buffalo National Park breeding population is widely disjunct from the species' historical range in the prairies, the historical record is poor. It is quite possible that the Whooping Crane's original breeding range in the prairies extended north into Wood Buffalo National Park and environs. Hence, there is insufficient evidence for considering more than one historic designatable unit in Canada.

DISTRIBUTION

Global range

Whooping Cranes occur only in North America, in both Canada and the United States. Historically, the main nesting areas were in the prairie regions, ranging from northeastern North Dakota, northwestern Minnesota, northwestern Iowa, to central Illinois in the south and extending north into southern Manitoba and Saskatchewan, east central Alberta, and southeastern Northwest Territories (Allen 1952; see Figure 1).

Wintering grounds were formerly located in tall grass prairies in southwest Louisiana, on the Gulf Coast of Texas, and in northeastern Mexico (Allen 1952). Two main migratory pathways were used by the Whooping Cranes, one of which was between the United States nesting areas and the wintering grounds in Louisiana. The second was between the nesting areas located in the prairie provinces in Canada and the Northwest Territories, and the wintering grounds in Texas and Mexico (Allen 1952; see Figure 1).

Additional locations that have been used historically or pre-historically by Whooping Cranes (at least during migration) include areas along the Atlantic Coast – in South Carolina, New Jersey, Georgia and Florida. Whooping Cranes were also recorded in the interior United States, in Kansas, Missouri, Arkansas, Kentucky and Alabama (CWS & USFWS 2007).

Currently, the North American range of the Whooping Crane is much smaller than historically. The only self-sustaining migratory population, the Aransas-Wood Buffalo Population (AWBP), has breeding grounds on the Alberta/Northwest Territories border in Wood Buffalo National Park (WBNP; CWS & USFWS 2007). Wintering grounds for this population are in the Aransas National Wildlife Refuge (ANWR) along the Gulf of Mexico, in southern Texas. The migratory route extends through the central United States, specifically Montana, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma and Texas. In Canada, the cranes migrate through Alberta, Saskatchewan and western Manitoba. The main migration corridor between the Canadian breeding grounds and the Texas wintering grounds is only about 320 km wide (CWS & USFWS 2007).

Two additional non-self-sustaining populations exist in the United States, originally established through the collection of eggs from Canada. A non-migratory population resides in Florida, referred to as the Florida Population (FP), first introduced in 1993 (Nesbitt *et al.* 1997). The Florida Population is found on the Kissimmee Prairie, south of Orlando in habitat that is mainly grasslands and freshwater marsh. In November 2008, the Florida Fish and Wildlife Conservation Commission decided to terminate the release of captive-bred cranes in Florida, and to invest project resources elsewhere. This decision was made based on the recommendation of the multi-agency International Whooping Crane Recovery Team (Tom Stehn, ANWR, pers. comm.). Additional information on the introduced populations is provided in the appendices of this report.

The second reintroduced population is a migratory population that exists in the midwestern and southern United States, referred to as the Eastern Migratory Population, which migrates between Wisconsin and Florida. This population was reintroduced starting in 2001 and birds have migrated annually between winter and summer grounds. Currently, juvenile birds are either led south by an ultra-light aircraft or migrate with other birds through direct autumn release (Tom Stehn, ANWR, pers. comm.). In the former instance, juvenile birds are led south in their first fall via an ultra-light aircraft. These birds then migrate north on their own in the spring. In addition, through direct autumn releases, captive-bred immature birds are introduced in the fall into the wild population and follow older cranes to wintering grounds. In the spring, these birds migrate north with the founder population.

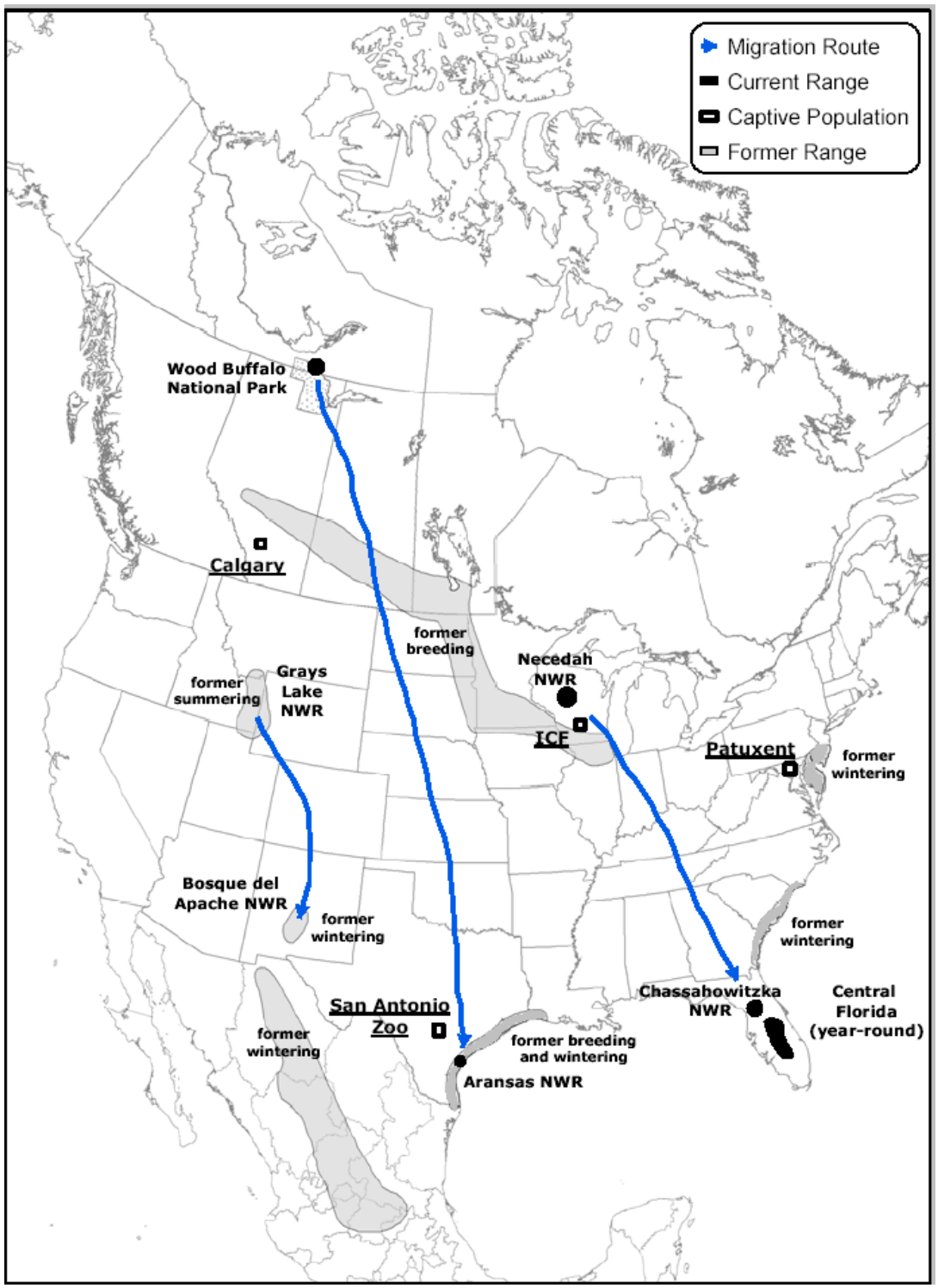

Figure 1. Former and current breeding and wintering areas of the Whooping Crane (adapted from Meine and Archibald 1996, as illustrated by Environment Canada 2007). Captive populations (including two adults on display at the Calgary Zoo) are denoted by open squares. ICF = International Crane Foundation; NWR = National Wildlife Refuge.

A small experimental population of Whooping Cranes existed in the Rocky Mountains for the latter part of the 20th century. Eggs were introduced into Sandhill Crane nests between 1975 and 1988. The resulting cross-fostered birds failed to breed and the population steadily declined. In 2002, this population became extirpated (CWS & USFWS 2007). No additional birds have been reintroduced to the area.

The United States is home to 100% of the Whooping Crane wintering population. Considering all three wild Whooping Crane populations, the United States is home to 17% of the global breeding population and Canada is home to 83% (Brian Johns, CWS, pers. comm.). Considering only the AWBP, Canada is home to 100% of the wild breeding population.

Canadian range

Breeding:

Only the AWBP has breeding grounds in Canada, located in the Boreal Plains ecozone. The majority of the breeding habitat is located within Wood Buffalo National Park (WBNP), specifically around the northern Alberta and southern Northwest Territories border in the vicinity of the Klewi, Sass, Nyarling and Little Buffalo rivers (Figure 2). Currently, there are six nesting areas defined by relatively close clusters of breeding pairs, some of which are separated by areas of unused, but potentially suitable, breeding habitat. Four of these areas (Klewi, Sass, Alberta, Nyarling) occur solely within the park; one is located on the northwestern park boundary (North Nyarling); and one is adjacent to the northeastern park boundary (Lobstick). These nesting clusters can be considered to represent a single breeding location, because a) they fall within a more or less contiguous belt of suitable breeding habitat, b) birds do occur in between the clusters, and c) all the birds are exposed to the same landscape-level threats and limiting factors (e.g., fire, drought, predation by carnivores).

In 1954, when the breeding grounds were discovered in WBNP, birds were nesting along the Sass River (Allen 1954). Soon after, they began to occupy territory along the Klewi River, with the first nests being found in 1967. The Nyarling, Alberta, Sass-Klewi, and Lobstick nesting areas were occupied next, between 1970 and 1982 (Brian Johns, CWS, pers. comm.). The last area to be used by cranes was North Nyarling. All areas have shown annual growth in number of nesting territories (Brian Johns, CWS, pers. comm.), as new breeding pairs nest in unoccupied areas adjacent to those used by breeding cranes (Kuyt 1978; Johns 1998). Potential expansion of the breeding range within Canada is large, because thousands of hectares (196,286 ha) of suitable habitat (nesting probability of 0.70 or higher) exists within and adjacent to WBNP (Olson and Olson 2003).

Figure 2. Map of current Whooping Crane nesting clusters in and around Wood Buffalo National Park (from Environment Canada 2007). The nesting areas are rather contiguous and effectively represent a single location.

The extent of occurrence (EO) of the Whooping Crane in Canada is 3340 km^2, based upon a minimum convex polygon on the breeding grounds. Multiple surveys of breeding cranes have occurred each summer since 1965 (Brian Johns, CWS, pers. comm.), allowing for an accurate assessment of average territory size of each breeding pair. In the early 2000s, the total area used by breeding cranes was determined to be 315 km^2 (Olson and Olson 2003). Currently, with nesting territory estimates ranging from 3.2 km^2 to 12 km^2 and the current number of nesting pairs at 72 (Brian Johns, CWS, pers. comm.), the biological area of occupancy (AO) would range from 230 km^2 to 864 km^2. An index of area of occupancy (IAO) based on a 2 x 2 km grid was not calculated, in part because of the large range in territory size.

Migration

Migratory habitat for the AWBP extends through Alberta, Saskatchewan and Manitoba, as discussed in the **Distribution** section.

HABITAT

Habitat requirements

AWBP Breeding

Whooping Cranes nest in a unique wetland complex located in WBNP, characterized by ponds with extremely soft substrate. These ponds are relatively small and fed by groundwater, though they can become interconnected during spring flooding of rivers in the area. Generally speaking, there is little terrestrial vegetation; however, ponds can be separated by narrow ridges populated by Black Spruce (*Picea mariana*), White Spruce (*P. glauca*), Tamarack (*Larix laricina*), Labrador Tea (*Ledum groenlandicum*), and sphagnum moss (*Sphagnum* spp.), among other terrestrial plants. Aquatic plants, such as Soft-stemmed Bulrush (*Schoenoplectus tabernaemontani*), Water Sedge (*Carex aquatilis*), cattail (*Typha* spp.), are common (Allen 1956), but generally restricted to fringes of the ponds (Timoney *et al.* 1997).

Areas in the WBNP wetland complex have a substantial amount of open water, creating long sight lines for the cranes, which facilitates easy detection of predators (Timoney *et al.* 1997). Bulrush is the preferred nesting material, but cattail and sedge are often present at the nest site (Timoney *et al.* 1997). Potential nesting areas are somewhat patchy, separated by sections with a greater amount of terrestrial vegetation than that found in occupied breeding habitat.

AWBP Non-breeding

During migration, the AWBP uses a variety of wetlands and croplands along the migration corridor, feeding largely on aquatic organisms and waste grains. Whooping Cranes favour temporary and seasonal wetlands in spring, and prefer semi-permanent and permanent wetlands in fall (Johns *et al.* 1997). Howe (1989) found that 70% of feeding sites used by non-family groups were croplands, while 67% of feeding sites used by families were wetlands. Family groups appear to use more heavily-vegetated wetlands than non-family groups. More densely vegetated wetlands may decrease predation on young inexperienced birds. Juveniles allocated 25% more time to foraging than parents; hence, roosting wetlands are likely important feeding sites for young and may provide a relatively high protein diet required by growing juveniles. Although large wetlands are used by migrating cranes, 41% of roosting wetlands were <0.5 ha, of which 15% were <0.1 ha. Cranes favoured roosting and feeding sites that were within 1 km of each other (Howe 1989; Johns *et al.* 1997).

About 900 km^2 of wintering habitat exists in the Aransas National Wildlife Refuge and surrounding lands on the Texas Gulf Coast (CWS & USFWS 2007). The area consists of estuarine marshes dominated by Salt Grass (*Distichlis spicata*), Saltwort (*Batis maritima*), Smooth Cordgrass (*Spartina alterniflora*), glasswort (*Salicornia* spp.,) and Sea ox-eye (*Borrichia frutescens*), and salt flats dominated by Gulf Cordgrass (*Spartina spartinae*). Oak (*Quercus virginiana*), Redbay (*Persea borbonia*) and bluestem (*Andropogon* spp.) characterize upland areas that are managed for cranes and other wildlife (Allen 1952; Labuda and Butts 1979).

Captive-bred Florida and Eastern Migratory Populations

The resident Florida Population is found mainly on the Kissimmee Prairie, south of Orlando, and surrounding areas (CWS & USFWS 2007). The Kissimmee Prairie consists of a 5000 km^2 area of shallow marshes, lakes, and flat, open Saw-palmetto (*Serenoa repens*) prairie. This region is surrounded by a wide variety of private and publicly owned ranches and wetlands.

The Eastern Migratory Population summers on and near the Necedah National Wildlife Refuge in Wisconsin. Birds that are led south by ultra-light aircraft winter in salt marshes at the Chassahowitzka and St. Marks National Wildlife Refuges on the Gulf Coast of Florida (CWS & USFWS 2007) during their first winter and then usually select alternate freshwater habitats in subsequent years.

Habitat trends

Loss of isolated wetland habitat required for breeding is likely a primary reason why the AWBP does not currently breed south of WBNP. Recolonization of remnant breeding habitat in these areas is unlikely because of high disturbance levels from humans and loss of isolated habitat. However, a Whooping Crane habitat mapping project conducted by Olson and Olson (2003) identified 1963 km^2 of potentially suitable nesting habitat within and adjacent to WBNP (2064 km^2 total, including summer habitat for non-breeding cranes; see Figure 2). This estimate has increased from a core habitat size of 625 km^2 in the 1970s (Gollop 1978). While the suitable habitat encompasses a large area, only 10.4% of the potential nesting habitat is used by breeding cranes (Olson and Olson 2003). Furthermore, the Nyarling River wetland complex has the largest expanse of contiguous habitat (548 km^2), the vast majority of which is located outside of WBNP boundaries (Olson and Olson 2003). Calculations based on average nesting areas ranging from 3.2 km^2 to 12.0 km^2 (see area of occupancy discussed in the **Distribution** section) suggest that the potentially suitable area could provide habitat for 107-472 breeding pairs of Whooping Cranes (Olson and Olson 2003). Because only about 10% of suitable breeding habitat is currently used by Whooping Cranes, lack of suitable nesting habitat is likely not a limiting factor for continued growth of the AWBP within the immediate area that is currently occupied.

There is general consensus that the inability of WBNP Whooping Cranes to further expand their breeding grounds may be influenced by the extent and conditions on their wintering grounds in Texas (USFWS 1994; Lewis 1995; Johns 1998).

There is ongoing loss and degradation of coastal wetland habitat on the Texas wintering grounds owing to development, erosion, water diversions, and increased salinity (CWS & USFWS 2007; see **Limiting Factors and Threats**). Habitat along the migration corridor is also being degraded through the proliferation of power lines and tall structures (e.g., telecommunication towers; Environment Canada 2007).

Habitat protection/Ownership

In 1922, Wood Buffalo National Park, an expansive (4.2 million ha) area of sub-arctic boreal forest and muskeg, was established for the protection of the herds of wood bison that inhabited the park at the time. Coincidentally, though not realized until the 1950s, the entire remaining nesting grounds of the Whooping Crane were also included in this area. The nesting area is designated by Parks Canada as a Zone 1 Special Preservation Area to which no access is allowed between April 15 and October 31, except for park staff and scientists. Zone 1 habitat has been designated as critical breeding habitat for the Whooping Crane (Government Notices Section of the Canada Gazette, Part 1, November 29, 2008). The park was also designated a World Heritage Site in 1983 by the United Nations Educational, Scientific and Cultural Organization (UNESCO), which identifies it as a place of exceptional universal value, deserving of protection for the benefit of all humanity. The International Union for the Conservation of Nature (IUCN) designated the Whooping Crane nesting area in WBNP as a Wetland of International Importance under the Ramsar Convention in 1982.

As discussed in the **Habitat Requirements** section, a large portion of potential breeding habitat exists north of WBNP along the Nyarling River, outside of Parks Canada jurisdiction (Olson and Olson 2003). While this habitat could be threatened by a variety of activities, steps necessary to identify critical habitat for the Whooping Crane have been outlined in the Recovery Strategy (Environment Canada 2007) and will be more thoroughly examined in the Action Plan currently in preparation (L. Craig-Moore pers. comm. 2010).

Johns *et al.* (1997) found that 85% of Whooping Crane staging sites used during migration were on private land, illustrating the importance of cooperation between private landowners and wildlife managers in protecting feeding and staging sites for migrating cranes. Some major wetlands along the Whooping Crane's migration corridor are also protected, such as Last Mountain Lake National Wildlife Area (also a Ramsar site) and Luck Lake Heritage Marsh, both of which lie within fall staging areas in Saskatchewan.

Identification and potential protection of other important Whooping Crane staging sites in this region via the Important Bird Areas (IBA) initiative is currently in progress. The IBA program in Canada was initiated in 1996, along with parallel programs in the United States and Mexico. The goal of the program is to identify and protect a worldwide network of sites necessary to ensure the long-term viability of naturally occurring bird populations. Sites designated as Whooping Crane IBAs (as of 2001) include WBNP nesting areas near Fort Smith, NWT and in the Alberta portion of the park, and several sites in Saskatchewan that are known to be used by migrating Whooping Cranes. These include Blaine Lakes, Buffer Lake, Last Mountain Lake (north end), Luck Lake, Midnight Lake, Quill Lakes, Radisson Lake, and Rice Lake (Bird Studies Canada and Nature Canada 2009). However, IBAs afford no special legal protection per se.

In the United States, five sites have been designated as critical habitat (CWS & USFWS 2007). This includes Cheyenne Bottoms State Waterfowl Management Area, Kansas; Quivira National Wildlife Refuge, Kansas; the Platte River bottoms between Lexington and Denman, Nebraska; Salt Plains National Wildlife Refuge, Oklahoma; and Aransas National Wildlife Refuge and vicinity, Texas.

BIOLOGY

Whooping Crane biologists from the Canadian Wildlife Service and U.S. Fish and Wildlife Service have been monitoring the AWBP on the breeding and wintering grounds for the past 20-25 years. Much of the population information below was obtained from them. Recently, work has been conducted in the breeding grounds to better determine food sources (Bergeson *et al.* 2001a; Sotiropoulos 2002; Classen 2008).

Life cycle and reproduction

The Whooping Crane is a long-lived species, with life span estimates ranging from 22-24 years (Binkley and Milner 1983) to 30 years (Mirande *et al.* 1993). Sexual maturity can be reached as early as age three (Kuyt and Goossen 1987; Brian Johns CWS pers. comm. *in* CWS & USFWS 2007), but the average age for sexual reproduction is five (Kuyt and Goossen 1987).

Not all birds nest each year (George Gee, pers. comm. *in* CWS & USFWS 2007). Nesting begins upon late-April arrival in WBNP; clutch initiation occurs shortly thereafter, usually complete by mid-May. The eggs are incubated for 30-35 days (Kuyt 1981). Perennially monogamous pairs lay two eggs per clutch but rarely fledge more than a single young (only 7% of nests fledge more than 1 young; Brian Johns, CWS, pers. comm.). Both parents share parental duties. Due to the length of the chick-rearing period (90 days to fledging), only one brood is raised per season.

Whooping Cranes usually breed in isolated locations, but nests have been recorded as little as 350 m apart in the highest-density nesting areas (Brian Johns, CWS, pers. comm.). Inexperienced pairs nesting far from riparian floodplains appear to move their nest sites closer to these areas in successive years (Kuyt 1993). The overall mortality of Whooping Cranes is 9.9% per year, while juvenile mortality is 26.7% in year one and 9.1% in year two (Brian Johns, CWS, pers. comm.). Generation time has been estimated at 12 years (Mirande *et al.* 1993).

Whooping Cranes are territorial on both the breeding and wintering grounds, with the male crane usually defending the territory. In WBNP, family groups of Whooping Cranes do not socialize with conspecifics; thus breeding territories are usually well defined. Kuyt (1993) found that territory sizes for isolated breeding pairs of cranes varied from 12.0 km^2 to 18.9 km^2, while pairs using more densely-populated regions had territory sizes that ranged from 3.2 km^2 to 4.2 km^2. Of 13 breeding pairs studied, mean home range size was 4.1 km^2.

Kuyt (1981) estimated that 80% of the adult population of cranes breed in a given year at WBNP, with 60% producing young. Between 1976 and 1989, 172 of 234 hatchlings (~73%) reached Aransas on their first trip south. Johns *et al.* (2005) determined that of 134 Whooping Cranes banded as juveniles, 71 reached breeding age and 67 actually nested. Boyce (1987) demonstrated a 10-year periodicity in Whooping Crane populations that is largely driven by changes in juvenile survival, which may be associated with predator cycles (Boyce *et. al.* 2005). There are also wet-dry cycles on the breeding grounds, where fewer young are produced during dry years (Kuyt *et al.* 1992; Lewis 1995). The age structure of the AWBP is currently about 50% breeding adults and 50% subadults (Brian Johns, CWS, pers. comm.).

Predation

Generally, the only time adult Whooping Cranes might be susceptible to predation is when they are flightless while moulting, or weak due to disease or injury (CWS & USFWS 2007). Potential predators of adult birds, eggs and chicks in Canada include Black Bear (*Ursus americanus*), Wolverine (*Gulo gulo*), Gray Wolf (*Canis lupus*), Red Fox (*Vulpes vulpes*), Mink (*Neovison vison*), Canada Lynx (*Lynx canadensis*), Bald Eagle (*Haliaeetus leucocephalus*), Golden Eagle (*Aquila chrysaetos*), and Common Raven (*Corvus corax;* Kuyt 1981a,b; Bergeson *et al.* 2001b). Potential predators in Texas include Bobcat (*Lynx rufus*), Coyote (*Canis latrans*) and American Alligator (*Alligator mississippiensis)*.

Physiology

Ellis *et al.* (1991) describe behaviour mechanisms used by Whooping Cranes to regulate body temperature. These include tucking in legs during flight or standing on one leg during cold weather, adjusting feathers, panting, shivering, and sunbathing. Upon hatching, the insulative properties of the chick's plumage appear to allow sufficient thermoregulation in most conditions (Lewis 1995). However, rain events on the breeding grounds immediately following hatching may result in increased chick mortality (Brian Johns, CWS, pers. comm.).

Dispersal/Migration

Migration between WBNP breeding grounds and wintering grounds at ANWR extends along a direct corridor in a southeasterly direction (see Figure 1). Spring migration from Texas usually begins between late March and mid-April, and can extend until about 1 May. It is usually direct and rapid, taking as little as 10 days for experienced adults (Kuyt 1992). Unlike the fall, there are no traditional spring staging areas. During the period from 1982-84, 43.7% of crane use-days during spring migration were spent at stopovers in Saskatchewan (Howe 1989). Older experienced birds arrive on the breeding grounds first, exhibiting site fidelity to nesting territories they held in previous years (Johns *et al.* 2005).

Juveniles leave Texas with their parents and accompany them on the majority of their northward migration, separating at or near the breeding grounds. Juvenile separation from their parents during spring migration has been documented in Saskatchewan but often does not occur until family groups reach their nesting grounds (Kuyt 1992).

Following chick hatching on the breeding grounds, pedestrian movements of family groups occur entirely within the breeding territory (Kuyt 1976). Chicks grow rapidly and begin sustained flights in mid-August, at which point family groups move farther from the natal territory, but the distance is still minimal (Howe 1989).

Fall migration begins in mid-September, with non-breeding sub-adults leaving WBNP earlier than family groups. The departure of crane groups from the nesting grounds may stimulate neighbouring groups to begin their migration (Lewis 1995). Cranes migrate solo, in family groups, or in small flocks consisting of between three to five birds (Johns 1992). An 85,000-km^2 area of south-central Saskatchewan provides a traditional fall staging area where Whooping Cranes may spend from 1 to 5 weeks. Groups of up to 23 individuals can be found in these areas. From 1982-84, 68.4% of crane-use days during fall migration were spent in Saskatchewan (Howe 1989). Fall migration is often of longer duration than in spring, and may take up to 50 days (Kuyt 1992). Arrival on wintering grounds on the Texas Gulf Coast occurs in late October and mid-November, ending in late December.

Pairs and family groups establish territories during their winter tenure at ANWR. Winter territories appear to be a minimum average size of 202 ha, but can be as small as 101 ha (Stehn and Prieto, in prep.). Sub-adults and unpaired adults form small winter flocks that border existing territories (Blankinship 1976).

Diet

Whooping Cranes are omnivorous throughout the year. Limited information is available on diet on the breeding grounds, but it is known to include a wide variety of insects, minnows and crustaceans. Observations of adult cranes feeding young immediately after hatching showed a diet rich in aquatic invertebrates, most notably dragonfly nymphs (Bergeson *et al.* 2001a). Once young were mobile and feeding on their own, assessment of ponds where cranes were observed feeding showed aquatic communities dominated by forage fish (e.g., minnows and sticklebacks; Sotiropoulos 2002). From these studies it is thought that both fish and invertebrates, such as dragonfly larvae, are important food sources on the breeding grounds (Sotiropoulos 2002; Classen 2008). Food is not thought to be limiting on the breeding grounds; however, a yearly prey-monitoring program has been designed (Classen 2008). The purposes of this program are to both evaluate the relationship between chick survival and prey abundance on the current breeding grounds as well as help to identify other areas in North America suitable for potential reintroduction of captive-bred birds (Classen 2008).

Other food items that are likely important on the breeding grounds include berries, molluscs, frogs, snakes, and small rodents (Allen 1956; Novakowski 1965, 1966). Whooping Cranes are also known to stalk ducklings and a juvenile was observed with a live blackbird in its bill. Observations of an adult feeding on a dead grebe and of a flightless young feeding on a dead juvenile bittern suggest carrion may be opportunistically consumed (Cooch *et al.* 1988).

Staging cranes in south-central Saskatchewan feed largely on waste grains like barley and wheat (Johns *et al.* 1997), as well as tubers, a variety of insects (grasshoppers, crickets), voles (*Microtus* spp.), Deer Mice (*Peromyscus maniculatus*), and snakes (*Thamnophis* spp.). Agricultural lands used by migrating cranes between Saskatchewan and ANWR likely provide a similar diet.

On the Texas wintering grounds, Blankinship (1976) found Blue Crabs (*Callinectes sapidus)* and a variety of clams (*Tagelus plebius, Ensis minor, Rangia cuneata, Cyrtopleura costada, Phacoides pectinata, Macoma constrica*) to be the most important food items. Water level is believed to influence which species are most accessible for capture and consumption. During periods of flooding and high tides, cranes feed mainly on Blue Crabs and Wolfberry (*Lycium carolinianum*) in the tidal flats (Blankinship 1976; Nelson *et al*. 1996). In December and January, when tidal flats typically drain due to lower tides, clams are the main prey. Other items consumed on the wintering grounds include fiddler crabs (*Uca* app.), a variety of shrimp (*Callianassa* spp., *Penaeus* spp., *Cragnon* spp.), crayfish (*Cambarus* spp.), Ear Snails (*Melampus coffeus*) and the roots of Three-square (*Scirpus olneyi*) and cordgrass (*Spartina* spp.). Whooping Cranes on the wintering grounds also feed on Southern Live Oak (*Quercus virginiana*) acorns in adjacent uplands, but croplands are rarely visited (Bishop and Blankinship 1982).

Interspecific interactions

Whooping Cranes do not directly compete with any other bird species for breeding territories or wintering habitat. On the wintering grounds, there is competition from humans harvesting crabs (Edwards *et al.* 1994).

Adaptability

Whooping Cranes are able to withstand minimal human disturbance on the breeding grounds and at nest sites, evident by the success of egg collection from 1966-1996 (discussed below; Brian Johns, CWS, pers. comm.). However, in the late 1800s and early 1900s, this species' inability to adapt to increased disturbance (i.e., shooting, egg collection, wetland draining) in areas used for breeding was likely a major factor in the extirpation of prairie and aspen parkland populations (Brian Johns, CWS, pers. comm.). The current breeding grounds in WBNP are isolated and relatively undisturbed by humans.

On the wintering grounds, it is generally thought that Whooping Cranes are less wary and more tolerant of human disturbances (e.g. from barge traffic along the Gulf Intracoastal Waterway and from eco-tourist boats) than on the breeding grounds.

Whooping Cranes are known to adapt to varying water levels that affect prey availability on the wintering grounds (Blankinship 1976). Although they are omnivorous, the importance of Blue Crab in the winter diet of the Whooping Crane suggests that factors affecting crab populations may have major consequences for cranes (Johns 1998). Food shortages on the wintering grounds can seriously impact nesting effort in WBNP (Chavez-Ramirez 1996). No information is available on the effects of drought on the food supply in the breeding grounds. Low young production during dry years suggests it is likely affected by wet-dry climatic periodicity (Kuyt *et al.* 1992).

POPULATION SIZE AND TRENDS

The AWBP is monitored several times annually in both the breeding and wintering grounds by CWS and USFWS. As such, an accurate population size is determined in mid-December each year. The Florida and Eastern Migratory populations are closely monitored as well, thus accurate sizes of these populations, while not entirely relevant to Canada, are also known.

The Whooping Crane was never a common species, and its population was reduced to an estimated 1400 individuals by 1860 (Allen 1952). About 90% of the population disappeared between 1870 and 1900 due to the encroachment of civilization on its breeding grounds south of WBNP. Wintering sites on the east coast of the United States disappeared around this time as well, due to greatly increasing human populations and subsequent drainage of marsh habitats (COSEWIC 2000). In the early 20th century, the population reached an all-time low of only 14 known adults.

The concentration of Whooping Cranes in the vicinity of ANWR in winter allows wildlife agencies to accurately determine population levels and annual trends. Breeding grounds censuses are less reliable because of the vastness of WBNP and the fact that subadult birds may summer elsewhere and/or move around a lot in the local region (Johns *et al.* 2008). The total population of wild Whooping Cranes in winter 2008-09 was 388 individuals (270 in the AWBP, 88 in the EMP, and 30 in the FP). Along with 151 individuals in captivity, the overall population was about 540 individuals (see Appendices 1 to 4).

In WBNP in 2008, there were 72 territorial pairs that nested at least once (Brian Johns, CWS, pers. comm.), a number that compares closely with the number of winter adult territories in Texas.

Although slight decreases in the AWBP occasionally occur, likely owing to a 10-year cycle in recruitment that has been linked to predation by carnivores (Boyce *et al.* 2005), the population has been mostly increasing since intensive population monitoring was initiated in 1938 (see Figure 3 and Appendix 2). Beginning in 1977, the core breeding area expanded south into the Alberta portion of WBNP, representing the first Alberta breeding record in 63 years (Kuyt 1978). Eight pairs bred in this newly pioneered Alberta region in 1997 (Johns 1998). In 2008, 13 pairs bred in the area but due to its proximity to the AB/NWT border, only 9 pairs were located in Alberta (Brian Johns, CWS, pers. comm.).

The adult AWBP population increased by 40% in the 10-year period between 1998 and 2008. Overall average population growth of adults for this population has averaged 4.85% per year over the past 36 years or 3 generations, which corresponds to an overall increase of 450% (see Figure 3).

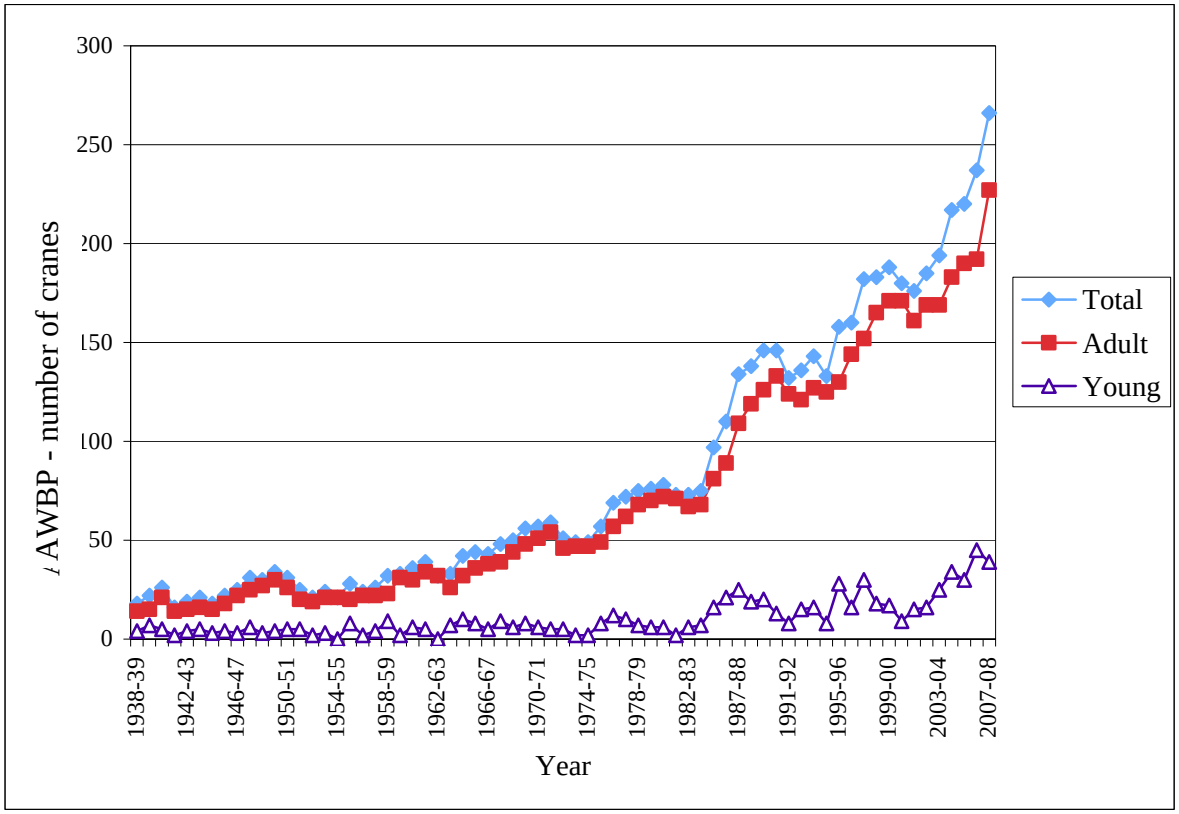

Figure 3. Composition of the Aransas-Wood Buffalo Whooping Crane population (AWBP), based on annual winter surveys (1938-2008).

LIMITING FACTORS AND THREATS

The occupied area in WBNP is small. Apparently suitable breeding habitat in other areas of the park and in adjacent areas is presently unoccupied (Olson and Olson 2003).

Lewis (1995) identified habitat quality and food resources (especially on the wintering grounds) as the most important factors regulating Whooping Crane numbers. The importance of Blue Crab in the winter diet of the Whooping Crane suggests that factors affecting crab populations may have major consequences for cranes (Johns 1998). Food shortages on the wintering grounds can seriously impact nesting effort in WBNP (Chavez-Ramirez 1996). Poor chick production and low survival have also been linked to drought conditions on the breeding grounds (Kuyt *et al.* 1992), but Boyce *et al.* (2005) did not find a significant relationship.

Perils faced during migration largely include strikes with powerlines (Kuyt 1992; Lewis 1995); guy lines at telecommunications towers pose another threat (Environment Canada 2007). Factors affecting the wintering grounds at ANWR appear to be more limiting than factors affecting the breeding range at WBNP. The security of the food base in this wintering area is a concern. In 1994, after a winter of low Blue Crab populations, the number of subsequent nesting attempts in WBNP dropped from 43, in 1993, to only 28 (Johns 1998).

The concentration of Whooping Cranes in the vicinity of ANWR makes them particularly vulnerable to catastrophic events such as hurricanes or chemical spillage.

One of the major concerns on the wintering grounds has focused around the Gulf Intracoastal Waterway (GIW), which extends from Carrabelle, FL to Brownsville, TX, to protect boats from wind and high seas. Construction of this waterway in the early 1940s caused some initial loss of wetland habitat. Moreover, 15% of Whooping Crane wintering habitat has been lost since the early 1940s due to erosion from boat traffic along the GIW. It is estimated that 1.6 ha of wintering habitat per year is lost. The US Army Corps of Engineers began installing concrete slabs along portions of the GIW to reduce erosion (Halpern 1992), but this was not completed until 2002.

The heavy barge traffic along the GIW is composed largely of petrochemical products. Relatively small chemical spills have occurred in this region in the past and there is potential for catastrophic spills in the future. Such spills can negatively affect water quality and crane food supplies.

Both natural drought conditions and diversion of the San Antonio and Guadalupe rivers are also major threats to wintering Whooping Cranes (Brian Johns, CWS, pers. comm.), and can seriously impact nesting effort in Canada (Chavez-Ramirez 1996). Without the major freshwater inflow these rivers provide to the bay ecosystems where the Whooping Cranes winter, the salt marsh becomes too saline and unsuitable for drinking. Not only are the cranes forced to fly inland to find fresh water, but the availability of their food sources in the bay may also change as a result of increased salinity (Brian Johns, CWS, pers. comm. 2009). Drought conditions during winter 2008-09 are believed to have had detrimental impacts on the Whooping Crane population (Brian Johns, CWS, pers. comm.).

Although hurricanes occur at ANWR, the hurricane season is generally complete by the time the cranes arrive in November. Nevertheless, severe weather can have devastating affects. A hurricane in 1940 was believed to be a factor in the deaths of 7 of the remaining 13 Whooping Cranes in the Louisiana flock, which led to the extirpation of this population in 1948 (CWS & USFWS 2007). In 2006, a lightening strike during a severe thunderstorm in Chassahowitzka NWR killed 17 birds from the Eastern Migratory Population (EMP) that were in a pen (Tom Stehn, ANWR, pers. comm.).

In winter, increasing amounts of boat traffic through the ANWR area is a source of human disturbance. In addition, ongoing coastal development is bringing people into closer contact with the cranes, and human reductions of freshwater inflows into Whooping Crane wintering habitat could reduce Blue Crab numbers (Tom Stehn, ANWR, pers. comm.).

Hunting and shooting contributed to Whooping Crane declines up to about 1920 (Lewis 1995). Some Whooping Cranes are still shot inadvertently or as deliberate acts of vandalism (CWS & USFWS 2007). The most recent case concerns an adult from the Wisconsin introduced population that was shot in Indiana in fall 2009.

There is little human disturbance on the breeding grounds because there is no public access to the breeding area between April and September, except for park staff and scientists. Subsistence hunting, fishing and trapping still occurs in WBNP by local Aboriginal groups. These activities are considered an important part of the park's cultural history, but they take place outside the breeding season and are not considered to be a threat to nesting Whooping Cranes.

SPECIAL SIGNIFICANCE OF THE SPECIES

The world's only naturally occurring population of Whooping Cranes breeds in Canada. It is a relict population of a once more-widespread species. The Whooping Crane has been described as the flagship species of the North American wildlife conservation movement, symbolizing endangered species worldwide. Whooping Cranes are a major tourist attraction in staging areas in southern Saskatchewan, and at their wintering grounds in the U.S. Lewis (1995) reported that an estimated 70,000-80,000 people visit Aransas each year, mostly in winter, to view the cranes. In winter 1990-91, Whooping Crane tour boats alone took in $340,000 (USD) from approximately 17,000 patrons. Eco-tourism contributes an estimated $6 million/year (USD) of gross economic benefits to the local economy of Rockport, TX. Much of this revenue is derived from the viewing of Whooping Cranes.

No Aboriginal Traditional Knowledge is currently available for this species.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

The Whooping Crane is protected in Canada under the *Migratory Birds Convention Act* (1994). This legislation prohibits the possession or sale of migratory birds and their nests, and activities that are harmful to migratory birds, their eggs, or their nests, except as permitted under the *Migratory Bird Regulations*. This species also receives legal protection in the United States and Mexico under similar legislation. Whooping Cranes are also protected in Canada under the *National Parks Act, Canada Wildlife Act, Species at Risk Act (Endangered Schedule 1)*, as well as by provincial/territorial wildlife acts. This species is also protected in the United States by the *Endangered Species Act* of 1973.

The Whooping Crane was originally designated as Endangered in 1978 by the Committee on the Status of Endangered Wildlife in Canada (Gollop 1978; COSEWIC 2000), and the status was re-examined and confirmed in November 2000. The Nature Conservancy has given this species a G1 ranking, which is defined as very rare and may be especially vulnerable to extirpation. The Whooping Crane is also designated as endangered by the Manitoba Department of Natural Resources and Saskatchewan Environment and Resource Management. The Manitoba Conservation Data Centre and the Saskatchewan Conservation Data Centre assign the Whooping Crane an S1 ranking, which is defined as extremely rare and critically imperiled. The IUCN status is Endangered.

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BIOGRAPHICAL SUMMARY OF REPORT WRITER

Marie-Claire Classen completed her Bachelor of Science in Environmental Science from the University of British Columbia in 2003. In 2008, she completed her Master of Science in Environmental Biology and Ecology from the University of Alberta. Her M.Sc. project was to develop a prey-monitoring program for the Whooping Crane breeding grounds in Wood Buffalo National Park, Canada. She currently works as an environmental consultant in the field of aquatic ecology. As a former graduate student, and now as a consultant, she has experience writing both academic and technical reports. She has had a lifelong interest in natural sciences and ecology.

Appendix 1. Wild and captive population data for the Whooping Crane in North America in December 2008, based upon information provided by Brian Johns (CWS) and Tom Stehn (USFWS).

a) Wild Populations in North America

Location	Adult	Young	Total	Adult Pairs
Aransas/Wood Buffalo	227	39	270[A]	72
Florida non-migratory	30[B]	0	30[B]	8
Wisconsin/Florida migratory	68	20[C]	88	11
Total in the Wild	325	59	389	91

[A] The 270 cranes above is the estimated flock size at the end of spring 2008. Forty-one chicks fledged from a record 66 nests in 2008. Chicks hatched in 2008 are not added to the count until they reach Aransas in late fall.

[B] This number reflects the 26 birds regularly monitored in Florida plus 4 additional cranes believed to be alive in unknown locations. No chicks fledged in the wild in 2008.

[C] The 5 Whooping Crane breeding facilities (Patuxent Wildlife Research Center, International Crane Foundation, Calgary Zoo, San Antonio Zoo, and Species Survival Center in New Orleans) either provided eggs or hatched and raised chicks in 2008. Four eggs came from abandoned wild nests in Wisconsin and successfully hatched at Patuxent. Twenty-one chicks were raised for the release programs in central Wisconsin (14 ultralight, 7 direct autumn release). One direct autumn release chick was killed by a predator on November 6, 2008 at Necedah NWR.

b) Captive Populations in North America (including 5 breeding centres and 6 display facilities)

Location	Adult	Young[E]	Total	Breeding Pairs
Patuxent WRC, Maryland	62	3	65	13
International Crane Foundation, WI	32	0	32	11
Devonian Wildlife Conservation Centre, Calgary, Alberta	24	0	24	6
Species Survival Center, Louisiana	12	0	12	1
Calgary Zoo, Alberta	2	0	2	0
New Orleans Zoo, Louisiana	2	0	2	0
San Antonio Zoo, Texas	7	0	7	1
Homosassa Springs Wildlife State Park, Florida	2	0	2	0
Lowry Park Zoo, Tampa, Florida	1	0	1	0
Jacksonville Zoo, Florida	2	0	2	0
Milwaukee County Zoo, Wisconsin	1	1	2	0
Total in Captivity	147	4	151	32

[E] Three of these young are genetic holdbacks and will remain in captivity as future breeding stock. The table does not reflect captive young that have entered reintroduction programs in 2008.

Appendix 2. Composition of Canada's wild Aransas-Wood Buffalo Population (AWBP) Whooping Crane flock, based on annual winter counts from 1938-2008.

Year	Adult	Young	Total	Year	Adult	Young	Total
1938-39	14	4	18	1973-74	47	2	49
1939-40	15	7	22	1974-75	47	2	49
1940-41	21	5	26	1975-76	49	8	57
1941-42	14	2	16	1976-77	57	12	69
1942-43	15	4	19	1977-78	62	10	72
1943-44	16	5	21	1978-79	68	7	75
1944-45	15	3	18	1979-80	70	6	76
1945-46	18	4	22	1980-81	72	6	78
1946-47	22	3	25	1981-82	71	2	73
1947-48	25	6	31	1982-83	67	6	73
1948-49	27	3	30	1983-84	68	7	75
1949-50	30	4	34	1984-85	71	15	86
1950-51	26	5	31	1985-86	81	16	97
1951-52	20	5	25	1986-87	89	21	110
1952-53	19	2	21	1987-88	109	25	134
1953-54	21	3	24	1988-89	119	19	138
1954-55	21	0	21	1989-90	126	20	146
1955-56	20	8	28	1990-91	133	13	146
1956-57	22	2	24	1991-92	124	8	132
1957-58	22	4	26	1992-93	121	15	136
1958-59	23	9	32	1993-94	127	16	143
1959-60	31	2	33	1994-95	125	8	133
1960-61	30	6	36	1995-96	130	28	158
1961-62	34	5	39	1996-97	140	19	159
1962-63	32	0	32	1997-98	152	30	182
1963-64	26	7	33	1998-99	165	19	183
1964-65	32	10	42	1999-00	171	17	188
1965-66	36	8	44	2000-01	171	9	180
1966-67	38	5	43	2001-02	161	15	176
1967-68	39	9	48	2002-03	169	16	185
1968-69	44	6	50	2003-04	169	25	194
1969-70	48	8	56	2004-05	183	34	217
1970-71	51	6	57	2005-06	190	30	220
1971-72	54	5	59	2006-07	192	45	237
1972-73	46	5	51	2007-08	227	39	266
				2008-09	231	39	270

Appendix 3. Composition of the Eastern Migratory Whooping Crane Flock, 2001-2008.

Year	Adult	Young	Total
2001-02	5		5
2002-03	21		21
2003-04	36		36
2004-05	47		47
2005-06	64		64
2006-07	58	1	59
2007-08	88		88

Appendix 4. Composition of the resident Florida Whooping Crane flock, 1993-2008.

Year	Adult	Young	Total
1993-94	8		8
1994-95	16		16
1995-96	25		25
1996-97	56		56
1997-98	60		60
1998-99	57		57
1999-00	65		65
2000-01	82		82
2001-02	86		86
2002-03	84	1	85
2003-04	85	2	87
2004-05	70	1	71
2005-06	59	0	59
2006-07	41	4	41
2007-08	30	0	30

Appendix 5. Relevant recovery efforts for Whooping Cranes in North America.

The Canadian Wildlife Service and the United States Fish and Wildlife Service have cooperated in attempts to recover this species for many years. The overall goal of the 2007 Recovery Strategy for the Whooping Crane in Canada and International Recovery Plan for the Whooping Crane is to protect the crane and its habitat so that the population can reach a stable level, at which point it can be downlisted to threatened status (Environment Canada 2007; CWS & USFWS 2007). This will require protecting and enhancing habitat to allow the AWBP to reach stability, establishing self-sustaining wild flocks that are isolated from the AWBP, and maintaining a captive breeding flock.

To meet the goal of downlisting the Whooping Crane, the Recovery Strategy and the International Recovery Plan outline downlisting criteria and objectives, as well as recovery actions required to meet the objectives (Environment Canada 2007; CWS & USFWS 2007).

Objective 1:

Establish and maintain self-sustaining populations of Whooping Cranes in the wild that are genetically stable and resilient to stochastic environmental events.

Criterion 1: A minimum population of 160 individuals (40 breeding pairs) in the AWBP for 10 years, and 100 individuals (25 breeding pairs) in each of the Florida and Eastern Migratory populations. If attempts to establish the Florida or Eastern Migratory Population (or both) fail, one of the following two criteria must be met for downlisting to occur.

Criterion 1A: A minimum population of 400 individuals (100 breeding pairs) in the AWBP for 10 years, and 120 individuals (30 breeding pairs) in one of the two introduced populations

Criterion 1B: A minimum population of 1000 individuals (250 breeding pairs) in the AWBP.

Objective 2:

Maintain a genetically stable captive population to ensure against extinction of the species.

Criterion 2: Maintain 153 Whooping Cranes in captivity (21 breeding pairs). Genetic analysis suggests that 90% of the genetic material of the species can be maintained for 100 years at this population size (Jones and Lacy 2003).

Delisting criteria are not identified in the Recovery Strategy or the International Recovery Plan at this time (Environment Canada 2007; CWS & USFWS 2007). The delayed sexual maturity, low reproductive rate and endangered status make it difficult to establish delisting criteria with a high level of confidence. Furthermore, downlisting will likely not occur until 2035; information required for delisting will be obtained closer to meeting the goal of downlisting to threatened status (Environment Canada 2007; CWS & USFWS 2007).

Between 1967 and 1996, 453 Whooping Crane eggs were removed from nests in WBNP for captive rearing, used in cross-fostering experiments with Sandhill Cranes, and used in ultralight aircraft experiments for reintroducing flocks.

Although both Sandhill and Whooping cranes typically lay two eggs per clutch, it is rare for more than a single young to fledge. Opinions on the effects of egg removal on Whooping Crane recruitment vary. Ellis and Gee (2001) stated that removal of one egg from the nest results in an increase in number of young produced in the wild. Conversely, Cannon *et al.* (2001) argued that juvenile recruitment into the AWBP population was significantly greater during years of no egg collection. Further investigation showed that egg removal may actually increase the probability of nest success under certain conditions (Boyce *et al.* 2005), but is counter-balanced by the loss of the opportunity for pairs to fledge two young. Regardless, the egg removal program helped to develop captive flocks, support the reintroduction of the FP and EMP, and reduce the variance in AWBP reproductive success. There are no current plans, however, to conduct egg removal again.

Five captive flocks, established for propagation and support of reintroduction programs, are managed by the U.S. Fish and Wildlife Service (USFWS), U.S. Geological Survey, and the Canadian Wildlife Service (CWS). The first was established in 1966 at Patuxent Wildlife Research Center, Maryland. A second flock was established at the International Crane Foundation (ICF) at Baraboo, Wisconsin, and a third flock was established at the Devonian Wildlife Conservation Centre (DWCC) in Calgary, Alberta. The fourth propagation program was established at the San Antonio Zoo (SAZ) in Texas, and the fifth was established at the Freeport McMoran Audubon Species Survival Centre (SSC) in Louisianna. As of November 2008, the Patuxent flock had 65 birds, the ICF flock had 32 birds, and the DWCC flock had 24 birds. The SSC had 12 birds and the SAZ had seven birds. Various other zoos and state parks are home to captive birds as well (Appendix 1; Tom Stehn, ANWR, pers. comm.).