

Recovery Strategy for the Whooping Crane (*Grus americana*) in Canada

Whooping Crane



2007



Environment
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About the *Species at Risk Act* Recovery Strategy Series

What is the *Species at Risk Act* (SARA)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003, and one of its purposes is “*to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity.*”

What is recovery?

In the context of species at risk conservation, **recovery** is the process by which the decline of an endangered, threatened or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of the species’ persistence in the wild. A species will be considered **recovered** when its long-term persistence in the wild has been secured.

What is a recovery strategy?

A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets goals and objectives and identifies the main areas of activities to be undertaken. Detailed planning is done at the action plan stage.

Recovery strategy development is a commitment of all provinces and territories and of three federal agencies — Environment Canada, Parks Canada Agency, and Fisheries and Oceans Canada — under the Accord for the Protection of Species at Risk. Sections 37–46 of SARA (www.sararegistry.gc.ca/the_act/default_e.cfm) outline both the required content and the process for developing recovery strategies published in this series.

Depending on the status of the species and when it was assessed, a recovery strategy has to be developed within one to two years after the species is added to the List of Wildlife Species at Risk. Three to four years is allowed for those species that were automatically listed when SARA came into force.

What’s next?

In most cases, one or more action plans will be developed to define and guide implementation of the recovery strategy. Nevertheless, directions set in the recovery strategy are sufficient to begin involving communities, land users, and conservationists in recovery implementation. Cost-effective measures to prevent the reduction or loss of the species should not be postponed for lack of full scientific certainty.

The series

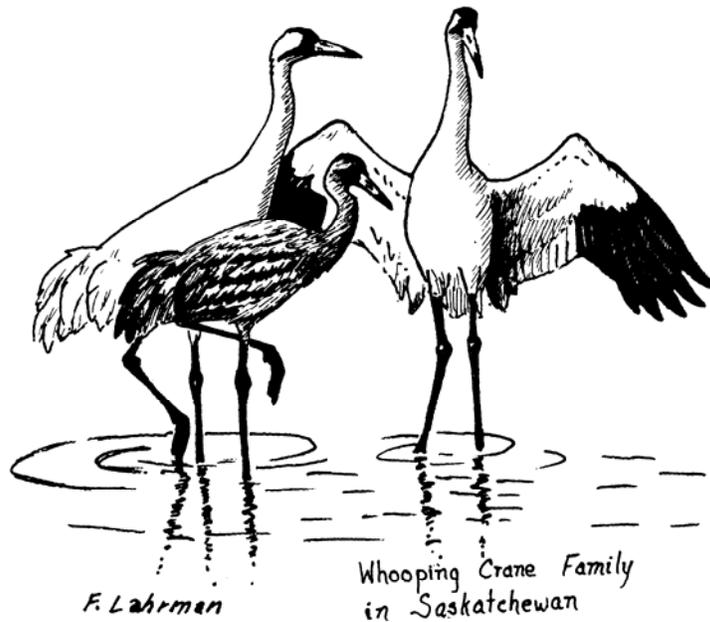
This series presents the recovery strategies prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as strategies are updated.

To learn more

To learn more about the *Species at Risk Act* and recovery initiatives, please consult the SARA Public Registry (www.sararegistry.gc.ca/) and the Web site of the Recovery Secretariat (www.speciesatrisk.gc.ca/recovery/).

Recovery Strategy for the Whooping Crane (*Grus americana*) in Canada

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The recovery strategy for the Whooping Crane is part of a larger document, “International Recovery Plan for the Whooping Crane (*Grus americana*) (Revised),” available in English only, which has been approved/endorsed by the International Whooping Crane Recovery Team.

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DECLARATION

This recovery strategy has been prepared in cooperation with the jurisdictions responsible for the Whooping Crane. Environment Canada has reviewed and accepts this document as its recovery strategy for the Whooping Crane, as required under the *Species at Risk Act*. This recovery strategy also constitutes advice to other jurisdictions and organizations that may be involved in recovering the species.

The goals, objectives and recovery approaches identified in the strategy are based on the best existing knowledge and are subject to modifications resulting from new findings and revised objectives.

This recovery strategy will be the basis for one or more action plans that will provide details on specific recovery measures to be taken to support conservation and recovery of the species. The Minister of the Environment will report on progress within five years.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Environment Canada or any other jurisdiction alone. In the spirit of the Accord for the Protection of Species at Risk, the Minister of the Environment invites all responsible jurisdictions and Canadians to join Environment Canada in supporting and implementing this strategy for the benefit of the Whooping Crane and Canadian society as a whole.

RESPONSIBLE JURISDICTIONS

Environment Canada (Prairie and Northern Region)
Parks Canada Agency
Alberta
Manitoba
Northwest Territories
Saskatchewan

AUTHORS

This strategy was prepared by Brian Johns and Tom Stehn, with assistance from Renee Franken.

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STRATEGIC ENVIRONMENTAL ASSESSMENT

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts on non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below.

This recovery strategy will clearly benefit the environment by promoting the recovery of the Whooping Crane. The potential for the strategy to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects. The reader should refer to the following sections of the document in particular: 1.7 Needs of the Whooping Crane; 1.8 Threats; 2.1 Recovery Feasibility; and 2.8 Critical Habitat.

RESIDENCE

SARA defines residence as: *a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating* [Subsection 2(1)].

Residence descriptions, or the rationale for why the residence concept does not apply to a given species, are posted on the SARA public registry: www.sararegistry.gc.ca/plans/residence_e.cfm

PREFACE

The Whooping Crane is a migratory bird protected under the *Migratory Birds Convention Act, 1994* and is under the management jurisdiction of the federal government. The Whooping Crane was listed as endangered under the *Species at Risk Act* (SARA) in June 2003. SARA (Section 37) requires the competent minister to prepare recovery strategies for listed extirpated, endangered, or threatened species. The strategy meets SARA requirements in terms of content and process (Sections 39–41).

The recovery program for the Whooping Crane is an excellent example of international cooperation to save a species. Cooperative recovery actions between Canada and the United States are outlined in a Memorandum of Understanding on the Conservation of the Whooping Crane, approved in 1985 and updated at five-year intervals. An International Recovery Plan was developed in 2006 by a joint Canada/United States Recovery Team (Canadian Wildlife Service and U.S. Fish and Wildlife Service 2006). The joint plan was appropriate because conservation and management of the species in both countries are essential to the Whooping Crane's recovery. The Canadian recovery strategy has been excerpted from the International Recovery Plan for the Whooping Crane and approved/endorsed by the International Whooping Crane Recovery Team.

In the late 1940s, government agencies in Canada and the United States began actively sharing data and expertise to prevent the extinction of the Whooping Crane. Recovery actions have included protecting breeding and wintering areas, monitoring population dynamics, establishing captive breeding flocks, developing reintroduction techniques, and reintroducing migratory and non-migratory populations. For a detailed account of actions under way or already completed, the reader should refer to Appendix C in the International Recovery Plan.

Recovery of the Whooping Crane is implemented by the Canadian Wildlife Service, Parks Canada Agency, U.S. Fish and Wildlife Service, U.S. Geological Survey Biological Resources Division, provincial wildlife agencies, and state wildlife agencies, with the support of non-profit organizations and private individuals (Lewis 1991). The Audubon Species Survival Center, Calgary Zoo, International Crane Foundation, National Audubon Society, National Fish and Wildlife Foundation, Operation Migration Inc., San Antonio Zoo, World Wildlife Fund, and Whooping Crane Conservation Association are among the groups that have been or currently are active in aiding recovery.

Parks Canada Agency and the Canadian Wildlife Service have met with and consulted Aboriginal and Métis groups who may rely on traditional use of the land regarding this strategy, including the critical habitat designation of the Whooping Crane nesting area within Wood Buffalo National Park. Additional consultations will take place regarding recovery activities including the potential for critical habitat designation outside of Wood Buffalo National Park.

EXECUTIVE SUMMARY

1. Whooping Cranes occur only in North America. They currently exist in the wild at three locations and in captivity at seven sites. The total wild population was estimated at 344 in March 2007, including 237 individuals in the Aransas–Wood Buffalo Population (AWBP), 45 captive-raised and released individuals in the Florida Population (FP), and 62 individuals in the eastern United States that migrate between Wisconsin and Florida. The captive population consisted of 145 birds in March 2007.
2. In Canada, critical habitat includes the marshes located in the northeastern corner of Wood Buffalo National Park. There are ongoing studies and consultation to identify additional critical habitat that may be necessary for the recovery of the Whooping Crane, including staging areas in Canada. In the United States, critical habitat has been designated at five locations: 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.
3. Historic population declines resulted from habitat destruction, shooting, and displacement by human activities. Current threats include limited genetic diversity within the population, loss and degradation of migration stopover habitat, construction of additional power lines, degradation of coastal habitat, and potential chemical spills on the wintering grounds in Texas.
4. The overall recovery goal is to protect, restore, and manage the species to be self-sustaining in the wild in North America, allowing initially for redesignation to threatened status and, ultimately, removal from the list of threatened and endangered species. The long-term recovery goal is to establish 1000 Whooping Cranes in North America by 2035.
5. The principal strategy of the Whooping Crane recovery program is to augment and increase the wild population by reducing threats and establishing two additional and discrete populations. Offspring from the captive breeding population will be released into the wild to establish these populations. Production by released birds and their offspring will ultimately result in self-sustaining wild populations. The continued growth of the AWBP and the two additional populations will also stem the loss of genetic diversity.
6. The effective population size (N_e) for Whooping Cranes needed in the wild to ensure species survival is unknown; however, the following criteria must be met prior to redesignation (downlisting) of the Whooping Crane from endangered to threatened: (1) establish a minimum of 40 productive pairs in the AWBP and a minimum of 25 productive pairs occurring in self-sustaining populations at each of two other discrete locations; if only one introduced population becomes self-sustaining, then the AWBP must remain above 400 individuals; if the two reintroduced populations fail to become self-sustaining, then the AWBP needs to remain above 1000 individuals, and (2) maintain a minimum of 153 Whooping Cranes in captivity (21 productive pairs).

7. The short-term objectives to meet the recovery goal are to (1) increase the AWBP to 240 individuals and 70 productive pairs by 2010; (2) increase the captive populations to 45 breeding pairs by 2010; (3) establish two additional wild populations by participating in the international effort to increase the FP to 100 individuals and 10 productive pairs by 2010, and establishing an eastern migratory population containing 80 adults by 2010; (4) analyze banding data and determine the N_e/N ratio for the AWBP; and (5) promote education on Whooping Crane recovery through innovative media technologies.

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1. BACKGROUND

1.1 Species Assessment Information from COSEWIC

Date of Assessment: November 2000

Common Name: Whooping Crane

Scientific Name: *Grus americana*

COSEWIC Status: Endangered

Reason for Designation: This globally endangered species occurs in very small numbers in a very restricted breeding range within a portion of Wood Buffalo National Park and adjacent area. Human activity and resource development are potential threats to the population, primarily during migration.

Canadian Occurrence: Alberta, Northwest Territories

COSEWIC Status History: Designated Endangered in April 1978. Status re-examined and confirmed in November 2000. Last assessment based on an update status report.

1.2 Introduction

The Whooping Crane is a flagship species in the North American wildlife conservation movement and symbolizes the struggle for survival that characterizes many endangered species worldwide. It is a large, distinctive, and photogenic bird, popular with the public and the media, and is often used to illustrate endangered species literature.

Once numbering in the several thousands, the Whooping Crane approached the brink of extinction in the 1940s, when only 21 Whooping Cranes remained in the world. Luckily, these large majestic birds were saved from extinction, and by March 2007, the Canadian migratory Whooping Crane population grew to 237 birds. While on the precarious road to recovery, Whooping Cranes remain listed as an endangered species in Canada and the United States. Historically, population declines were caused by shooting and destruction of nesting habitat in the prairies as a result of agricultural development. Today, the Whooping Crane remains an endangered species because of its low population numbers, slow reproductive potential due to delayed sexual maturity and limited recruitment into the population, a hazardous migration route traversed twice annually, and many human pressures on the wintering grounds. Current threats to the wild cranes include collisions with human made objects such as power lines, shooting, predators, disease, habitat destruction, severe weather, and a loss of two-thirds of the original genetic diversity. Threats to the captive cranes include disease, accidents, and limited genetic diversity.

1.3 Description of the Species

The Whooping Crane is the tallest North American bird, with males approaching 1.5 m when standing erect. Males are generally larger than females, weighing an average of 7.3 kg; captive females average 6.4 kg. Whooping Cranes are sexually monomorphic (Walkinshaw 1973); however, the guard call vocalization and components of the unison call are sexually distinct (Archibald 1975; Carlson 1991), as are some behavioural postures.



Figure 1. Adult plumage of the Whooping Crane.

Adult plumage is snowy white except for black wing-tips and black and red on the crown and around the bill (Figure 1). The long bill is a dark olive-grey, which becomes lighter during breeding season. Legs and feet are grey-black. Juvenile plumage is a reddish-cinnamon colour. At 120 days of age, white feathers begin to appear on the neck and back of juveniles, and the juvenile plumage is replaced through the winter months. Rusty juvenile plumage remains on the head and upper neck in the winter/spring (Stephenson 1971), with adult plumage becoming complete late in their second summer.

Whooping Cranes are a long-lived species. Current estimates suggest a maximum longevity in the wild of at least 30 years (Mirande et al. 1993). Captive individuals live 35–40 years (Moody 1931; McNulty 1966).

1.4 Current Distribution

Whooping Cranes occur only in North America (Figure 2). They currently exist in the wild at three locations and in captivity at seven sites. The wild populations include (1) a non-migratory flock at and surrounding Kissimmee Prairie, central Florida; (2) a migratory flock established in 2001, located between central Wisconsin and the central Gulf Coast of Florida; and (3) the migratory Aransas–Wood Buffalo Population (AWBP), which nests in Canada and winters in the United States.

The AWBP is the only wild population that occurs in Canada. It breeds in and adjacent to Wood Buffalo National Park and migrates through Alberta, Saskatchewan, and, occasionally, Manitoba, staging in Saskatchewan during the fall. In the United States, the cranes migrate through the central Great Plains and winter on the central Gulf Coast of Texas at Aransas National Wildlife Refuge and vicinity. Subadult cranes have summered at various locations throughout the migration corridor and north of the breeding grounds.

Captive Whooping Cranes are maintained at Patuxent Wildlife Research Center, Laurel, Maryland; International Crane Foundation, Baraboo, Wisconsin; Calgary Zoo, Calgary, Alberta; Audubon Species Survival Center, Belle Chasse, Louisiana; San Antonio Zoo, San Antonio, Texas; New Orleans Zoo, New Orleans, Louisiana; and Lowry Park Zoo, Tampa, Florida.



Figure 2. Former and current breeding and wintering areas of the Whooping Crane (adapted from Meine and Archibald 1996). ICF = International Crane Foundation; NWR = National Wildlife Refuge.

1.5 Current Abundance

In March 2007, the total wild population was estimated at 344. This included 237 individuals in the only self-sustaining population, the AWBP, 45 captive-raised individuals released in an effort to establish a non-migratory FP, and 62 individuals introduced to the eastern United States that migrate between Wisconsin and Florida.

In March 2007, the total captive population consisted of 145 birds, with annual production from the Calgary Zoo, International Crane Foundation, Patuxent Wildlife Research Center, and San Antonio Zoo. The total population of wild and captive birds was 489.

1.6 Population Trends

The Whooping Crane has a long-term recruitment rate of 13.9%, the highest of any North American crane population (Drewien et al. 1995). The AWBP is increasing at an annual rate of more than 4%. The growth of the AWBP up to the year 2000 seems to have resulted primarily from a decline in the mortality rate rather than an increase in recruitment. Prior to 1970, annual mortality averaged 12.1%, although it has since dropped to 7.7%; overall mortality averages 9.8% per year. During this time, recruitment also declined from the pre-1970 average of 15.9% to 11.3% per year.

It is difficult to predict the future population size given the large variation in annual growth rates for any given year. However, over the next 100 years, it is highly probable that the AWBP will continue to grow, and the probability of extinction of the population is less than 1% (Mirande et al. 1997; Tischendorf 2003), assuming that current environmental conditions do not deteriorate. For a more detailed discussion of population viability assessment, the reader should refer to the International Recovery Plan (Canadian Wildlife Service and U.S. Fish and Wildlife Service 2006).

1.7 Needs of the Whooping Crane

1.7.1 Breeding Habitat

Whooping Cranes formerly bred in isolated marshes on the prairies and in aspen parkland. There are six primary nesting areas within and adjacent to Wood Buffalo National Park; between the headwaters of the Nyarling, Sass, Klewi and Little Buffalo rivers (Figure 3). The area is poorly drained and interspersed with numerous potholes. Wetlands vary considerably in size, shape, and depth, and most possess soft marl bottoms (Timoney et al. 1997). The wetlands are separated by narrow ridges, which support an overstorey of white spruce (*Picea glauca*), black spruce (*P. mariana*), tamarack (*Larix laricina*), and willows (*Salix* spp.) and an understorey of dwarf birch (*Betula glandulosa*), Labrador tea (*Ledum groenlandicum*), bearberry (*Arctostaphylos uva-ursi*), and several species of lichen, underlain by sphagnum moss (Novakowski 1966). Bulrush (*Scirpus validus*¹) is the dominant emergent in the potholes used for nesting, although cattail

¹Now known as *Schoenoplectus tabernaemontani* (K.C. Gmel.) Palla



Figure 3. Breeding area of the Aransas–Wood Buffalo Population, Wood Buffalo National Park.

(*Typha* sp.), sedge (*Carex aquatilis*), musk-grass (*Chara* sp.), and other aquatic plants are common (Allen 1956; Novakowski 1965, 1966; Kuyt 1976a, 1976b, 1981). Nest sites are located primarily in shallow diatom ponds that contain bulrush (Timoney 1999).

1.7.2 Migration Habitat

Whooping Cranes use a variety of habitats during migration (Howe 1987, 1989; Lingle 1987; Lingle et al. 1991; Johns et al. 1997). The majority of roosting wetlands are less than 4 ha (75%) and within 1 km of a suitable feeding site (Johns et al. 1997). More than 40% of the roosting

wetlands are smaller than 0.5 ha (Johns et al. 1997). Cropland accounts for 70% of the feeding sites of non-family birds, whereas wetlands account for 67% of the feeding sites of family groups (Howe 1987).

The most suitable stopover habitat appears to be wetland mosaics (Johns et al. 1997; Richert et al. 2000). Whooping Cranes used primarily shallow, seasonally and semipermanently flooded palustrine wetlands for roosting and various cropland sites and emergent wetlands for feeding (Johns et al. 1997; Austin and Richert 2001). Whooping Cranes also use riverine habitats during migration through Saskatchewan and Nebraska, where they roost on submerged sandbars in wide unobstructed channels, isolated from human disturbance (Armbruster 1990; B. Johns pers. comm.).

Spring migration typically begins between March 25 and April 15, with the last birds usually leaving the wintering grounds by May 1. Spring migration is completed in 2–4 weeks on average.

Autumn migration normally begins in mid-September, with most birds arriving on the wintering grounds between late October and mid-November. Their first stop often occurs in northeastern Alberta or northwestern Saskatchewan. Most of the cranes remain for 2–4 weeks in a region between Meadow Lake, Swift Current, Estevan, and the Quill Lakes, Saskatchewan, where they feed on waste grain in barley and wheat stubble fields and roost in the many wetlands (Johns 1992). Some of these wetlands include Midnight Lake, Witchehan Lake, Blaine Lakes, Radisson Lake, Buffer Lake, Muskiki Lake, Quill Lakes, Kutawagan Lake, Luck Lake, Creelman Marsh, and wetlands near Tribune and Bromhead. Riverine areas include the South Saskatchewan River and its sandbars between Outlook and Saskatoon and the North Saskatchewan River between the Maymont and Petrofka bridges.

1.7.3 Wintering Habitat

About 9000 ha of salt flats on the Aransas National Wildlife Refuge and adjacent islands comprise the principal wintering grounds for the AWBP breeding population. Marshes are dominated by saltgrass (*Distichlis spicata*), saltwort (*Batis maritima*), smooth cordgrass (*Spartina alterniflora*), glasswort (*Salicornia* sp.), and sea ox-eye (*Borrchia frutescens*). Inland margins of the flats are dominated by gulf cordgrass (*Spartina spartinae*). Interior portions of the refuge are gently rolling and sandy and are characterized by oak brush, grassland, swales, and ponds. Typical plants include live oak (*Quercus virginiana*), redbay (*Persea borbonia*), and bluestem (*Andropogon* sp.) (Stevenson and Griffith 1946; Allen 1952; Labuda and Butts 1979).

1.7.4 Diet

Whooping Cranes are omnivorous (Walkinshaw 1973), and summer foods include large nymphal or larval forms of insects (Anisoptera: *Aeshna* spp. and *Libellula* spp.; and Dytiscidae: *Graphoderus occidentalis*, *Acilius semisulcatus*, *Rhantus binotatus*, and *Dytiscus alaskanus*), snails (*Probythinella lacustris*), minnows (*Culea inconstans*, *Phoxinus eos*, *Margariscus margarita*, *Phoxinus neogaeus*, and *Pimephales promelas*), seeds (*Potamogeton* and *Myriophyllum*), frogs (*Rana sylvatica*, *Acris crepitans*, and possibly *Bufo hemiophrys*), and

rodents (*Clethrionomys rutilus* and several others) (Allen 1956; Novakowski 1966; Bergeson et al. 2001a; Bergeson 2004). Foods utilized during migration are poorly documented but include frogs, fish, plant tubers, crayfish, insects, and agricultural grains. The greatest proportion of feeding time during migration is spent in harvested grain fields (Johns et al. 1997). The crane's winter diet consists predominantly of animal foods, especially blue crabs (*Callinectes sapidus*), clams (*Tagelus plebius*, *Ensis minor*, *Rangia cuneata*, *Cyrtopleura costata*, *Phacoides pectinata*, *Macoma constricta*), and the fruit of wolfberry (*Lycium carolinianum*) (Allen 1952; Uhler and Locke 1970; Blankinship 1976, 1987; Hunt and Slack 1987; Chavez-Ramirez 1996).

1.8 Threats

1.8.1 Habitat Loss and Degradation

Human population growth in North America has resulted in alteration and destruction of Whooping Crane habitat. Conversion of wetlands and prairie for hay and grain production made much of the historical nesting habitat unsuitable for Whooping Cranes. Disruptive and destructive practices included draining, fencing, cultivation, and the human activities associated with these actions. Settlement of the midcontinent and coastal prairies and associated disturbance, in addition to alteration of habitat, may have interfered with continued use of prairie and wetlands by breeding Whooping Cranes. The extensive drainage of wetlands in the prairie pothole region of Canada and the United States also resulted in a tremendous loss of migration habitat available to Whooping Cranes. In the United States, upstream reservoir construction and water diversions for agriculture and human use have reduced inflows into coastal waters used by Whooping Cranes.

1.8.2 Loss of Genetic Diversity

As a consequence of the 1941 population bottleneck, the current population is derived from an estimated six to eight founders, with a loss of 66% of all genetic material (Mirande et al. 1993; Glenn et al. 1999). The continued loss of genetic material may lead to inbreeding depression and declining productivity (Jimenez et al. 1994; Frankham 1995; Lacy 1997; Brook et al. 2002; Woodworth et al. 2002). A detailed discussion of genetic issues is presented in the International Recovery Plan.

1.8.3 Disturbance

Whooping Cranes are sensitive to disturbance on both breeding and wintering grounds. Some disturbances, such as egg transfer and banding programs, are necessary to implement recovery and are tolerable for short intervals. However, unnecessary disturbances should be avoided, as they may cause birds to leave an area. There is no public access to most of the Whooping Crane nesting habitat; however, access to portions of the Whooping Crane winter habitat is available. Cranes are somewhat tolerant of people in carefully operated boats and land vehicles (Mabie et al. 1989); this is evidenced by the lack of concern that cranes show for barges that travel along the Gulf Intracoastal Waterway. Airboats, low-altitude aircraft, and especially helicopters are more disturbing, and cranes are particularly sensitive to humans on foot (Lewis and Slack 1992; T.E. Lewis pers. comm.; B. Johns pers. comm.). Crane displacement results in short-term or

long-term loss of habitat use and social disruption of the flock, limits the ability to obtain food resources, and thus impacts fitness (T.E. Lewis pers. comm.).

1.8.4 Collisions with Power Lines

Collisions with power lines are a substantial cause of Whooping Crane mortality in migration (Brown et al. 1987; Lewis et al. 1992). Collisions with power lines are known to have accounted for the deaths or serious injury of at least 36 Whooping Cranes since 1956. Guy wires associated with telecommunication towers (radio, television, cellular, and microwave) are another threat. Tests of line marking devices, using Sandhill Cranes (*Grus canadensis*) as surrogate research species, have identified techniques effective in reducing collisions by up to 61% (Morkill 1990; Morkill and Anderson 1991, 1993; Brown and Drewien 1995). Techniques currently recommended include marking lines in areas frequently used by cranes and avoiding placement of new line corridors around wetlands or other crane use areas.

1.8.5 Chemical Spills

The only self-sustaining wild Whooping Crane population remains vulnerable to the potential of contaminant spills. The risk on the breeding range or during migration is minimal; however, the greatest concern is in the Gulf Intracoastal Waterway on the Texas coast. Numerous oil and gas wells and connecting pipelines are located in bay and upland sites near the cranes' winter habitat, and many barges carrying dangerous, toxic chemicals travel the Gulf Intracoastal Waterway daily through Whooping Crane winter habitat. A spill or leak of these substances could contaminate or kill the cranes' food supply or poison the cranes (Robertson et al. 1993).

1.8.6 Disease and Parasites

Little is known about the importance of diseases or parasites as mortality factors for wild Whooping Cranes. Loss of wetlands has concentrated birds, thereby increasing the risk of disease transmission. Although wild Whooping Cranes are presumably susceptible to a variety of infectious and toxicological diseases (including tuberculosis), evidence of disease-related mortality is infrequently documented.

1.8.7 Predation

Adult Whooping Cranes are generally not susceptible to predation unless they are weakened by disease or injury or when flightless during feather moult. Eggs and chicks, however, are susceptible to predation (Bergeson et al. 2001b). Potential predators in Wood Buffalo National Park include Black Bear (*Ursus americanus*), Wolverine (*Gulo gulo luscus*), Gray Wolf (*Canis lupus*), Red Fox (*Vulpes fulva*), Mink (*Mustela vison*), Lynx (*Lynx canadensis*), and Common Raven (*Corvus corax*). The overall impact of predation on AWBP recruitment remains uncertain, but predation may be a factor in the 10-year cycle in Whooping Crane recruitment (Boyce et al. 2005).

Bobcats (*Lynx rufus*) and American Alligators (*Alligator mississippiensis*) are significant predators to reintroduced Whooping Cranes in Florida. Predation rates are significant in Florida but appear to be very low in Texas, where wild cranes spend more time in coastal wetlands.

1.8.8 Shooting

Hunting was one of the primary historical reasons for the Whooping Crane's decline. Enactment of protective legislation coincided with a decline in human-caused mortality. Although hunting Whooping Cranes is no longer legal, occasional shootings occur (Lewis et al. 1992).

1.8.9 Other Threats and Limiting Factors

Other potential threats, such as collisions with aircraft, pesticides, red tide, severe weather, climate change, life history, and food availability/sibling aggression, have been addressed in the International Recovery Plan. While these are considered to be potential limiting factors, none appears to be a primary threat to the species' survival.

1.9 Information Needs

1.9.1 Survey Requirements

- Continue aerial population surveys on nesting and wintering areas.
- Identify unoccupied potential nesting and wintering habitat to identify limitations on population growth.
- Continue water level surveys in Wood Buffalo National Park to fully understand ecological changes and their impact on population trends.
- Conduct prey abundance surveys in Wood Buffalo National Park to fully understand ecological changes and their impact on population trends.
- Continue surveys of coastal water salinity levels, freshwater inflows, and crane food resources at Aransas to identify ecological trends.
- Monitor migration activities to ensure the safety of the cranes, and evaluate changes in conditions faced by migrating birds.

1.9.2 Biological/Ecological Research Requirements

- Continue to identify and address causes of mortality in wild and captive cranes.
- Perform frequent monitoring (including radio-tracking or satellite tracking) of the birds to detect losses and causes of mortality.
- Acquire further understanding of migration stopover habitat to refine the effectiveness of habitat augmentation and management on the Platte River and elsewhere.
- Refine methods to create marsh wintering habitat with dredged sediments to ensure long-term benefits to Whooping Cranes.
- Refine techniques for disease prevention in captive birds (including West Nile vaccination and effective tuberculosis test), pairing and promotion of early breeding, genetic management, nutrition of captive birds, and behavioural training to promote wildness in birds destined for release.

- Refine reintroduction techniques for establishing a second migratory population to promote appropriate migratory behaviour and survival.
- Develop faecal corticosterone test to compare levels of stress associated with various management techniques in captivity.

1.9.3 Threat Clarification Research Requirements

Research needed to clarify threats was previously identified in the “Threats” section (section 1.8). Some examples include research on:

- the impact of reduced freshwater inflows at Aransas;
- causes of mortality in reintroduced populations; and
- techniques to separate family lines, which will preserve and increase the genetic diversity of the flock.

2. RECOVERY

2.1 Recovery Feasibility

The goal of this recovery strategy is to protect, restore, and manage Whooping Cranes to be self-sustaining in the wild and to downlist the species from endangered to threatened under the Canadian *Species at Risk Act* and the U.S. *Endangered Species Act*, ultimately setting the stage for delisting. Specific strategies are identified and, if implemented, should achieve that goal. The Whooping Crane may never be abundant, based on the past history of this species, its low reproductive rate, and threats to habitat required for breeding, migration, and wintering. Preserving this species will require the interest and concern of an informed public. Based on overall habitat availability, a positive growth rate, and success in captive breeding, the recovery potential of the species is high.

The inherent capacity of Whooping Cranes to rebound demographically is low due to delayed sexual maturity (age 3–4 years) and a low reproductive rate (two eggs in the annual nesting attempt, with only one chick typically fledging). However, breeding experience and longevity somewhat compensate for their low reproductive rate.

The present nesting habitat at Wood Buffalo National Park may not be as productive as the historical nesting wetlands in the prairie grasslands (B. Johns pers. comm.). However, Wood Buffalo National Park provides suitable protected nesting habitats that have supported population recovery from 3 or 4 nesting pairs in 1941 to 62 nesting pairs in 2006. Sufficient migratory stopover habitat is available to support the present population and numbers likely to be attained in the near future. Winter habitats at Aransas are currently sufficient to support at least 500 individuals (T. Stehn pers. comm.).

Threat factors have been alleviated to a degree sufficient to allow an average annual growth of 4.5% for the last half century in the AWBP. The cooperative protection plans implemented by provincial, state, and federal agencies are believed to have reduced losses due to shooting and

disease (Lewis 1992). Some power lines have been marked to increase visibility and help reduce Whooping Crane mortality, a technique shown to reduce Sandhill Crane collisions with power lines (Morkill 1990; Morkill and Anderson 1991; Brown and Drewien 1995). Erosion losses of critical winter habitat along the Gulf Intracoastal Waterway have been reduced significantly through the use of concrete matting (Zang et al. 1993; Evans and Stehn 1997). Dredged material has been used to create additional winter habitat (Evans and Stehn 1997).

Four captive flocks are producing offspring, and captive production has been sufficient to provide over 262 birds for the non-migratory reintroduction experiment in Florida since 1993. Another reintroduction using captive-produced young was started in 2001 in the eastern United States, with Wisconsin as the nesting area and western Florida as the wintering site.

There are no unique conflicts or logistical difficulties to achieving recovery that can be identified at the present time. There will, however, continue to be challenges of the type that impede new research and recovery techniques.

2.2 Recovery Goal

The overall recovery goal for the Whooping Crane is to protect, restore, and manage the species to be self-sustaining in the wild, no longer requiring the protections of the *Species at Risk Act* and the U.S. *Endangered Species Act*. The long-term recovery goal is to establish 1000 Whooping Cranes in North America by 2035.

Following successful implementation of this strategy, redesignation (downlisting) to threatened status would be recommended. Delisting criteria are not established in this strategy because a) the effective population size needed to ensure long-term survival of the species is not well established; and b) new threats are expected to arise before downlisting is achieved.

2.3 International Strategy for Recovery

The principal strategy of the International Recovery Plan for the Whooping Crane is to augment and increase the wild population by reducing threats and establishing two additional and discrete populations. Offspring from the captive breeding population will be released into the wild to establish the populations. Production by released birds and their offspring will ultimately result in self-sustaining wild populations. The continued growth of the AWBP and two additional populations will also curtail the loss of genetic diversity.

2.4 Recovery Criteria

Whooping cranes are listed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2005). The cranes are listed under status criteria D1: very small population (IUCN 2001). This recovery strategy sets forth two criteria that, when attained, will ensure healthy, self-sustaining populations of Whooping Cranes in North America, such that the species is no longer in danger of extinction and can be redesignated as threatened in both Canada and the United States. The numerical goals for population size and stability can be achieved only if threats to the species' existence are sufficiently reduced or removed.

The following criteria must be met prior to redesignation (downlisting) of the Whooping Crane from endangered to threatened:

1. **Maintain a minimum of 40 productive pairs in the AWBP and establish a minimum of 25 productive pairs occurring in self-sustaining populations at each of two other discrete locations.** A productive pair is defined as a pair that nests regularly and has fledged offspring. Population numbers would have to exceed 200 adults in the AWBP and 100 adults in each of the Florida non-migratory population and the eastern migratory population. Numerical objectives are based on a population viability assessment of what is needed to maintain genetic material for the population. All three populations must be self-sustaining for a decade at the designated levels before downlisting would be considered. Recovery actions may result in migratory and non-migratory populations as occurred historically in North America. **If only one reintroduced population becomes self-sustaining, then the AWBP must remain above 400 individuals (i.e. 100 productive pairs) and the new population must remain above 120 individuals (i.e. 30 productive pairs), both populations must be self-sustaining for a decade. If reintroduced populations do not become self-sustaining, then the AWBP must remain above 1000 individuals for a decade (i.e., 250 productive pairs).** These higher numbers are needed because the AWBP currently has a very limited range in both summer and winter and could be severely impacted by a catastrophic event.
2. **Maintain a minimum of 153 Whooping Cranes in captivity (21 productive pairs) as a safeguard to ensure the long-term survival of the species.** Genetic analysis demonstrates that these numbers can maintain 90% of the genetic material of the species for 100 years (Jones and Lacy 2003).

2.5 Recovery Objectives

Objective 1: Continue to build the AWBP. The short-term recovery objective of 40 productive pairs in the AWBP for 10 consecutive years has been met. To reach the long-term recovery goal of 1000 birds in North America by the year 2035, the AWBP needs to increase to 240 individuals and 70 productive pairs by 2010.

- Objective 2: Develop and maintain captive populations.** Increase the captive populations to 45 breeding pairs by 2010.
- Objective 3: Establish two additional wild populations** by participating in the international effort to increase the FP to 100 individuals and 10 productive pairs by 2010 and establishing an eastern migratory population containing 80 adults by 2010.
- Objective 4: Determine the effective population size (N_e) for species survival.** Analyze banding data and determine the N_e/N ratio for the AWBP.
- Objective 5: Maintain and expand information/education programs.** Promote education on Whooping Crane recovery through innovative media technologies.

2.6 Research and Management Activities Needed

This section provides a general description of the research and management activities needed to meet the objectives. Action plan(s) will contain more detailed information on the actions and the implementation schedule. For more information on actions already completed or under way, the reader should refer to Appendix C in the International Recovery Plan.

1. Continue to build the AWBP. Increase the AWBP to 240 individuals and 70 productive pairs by 2010 (Priority 1).

This will be achieved by reducing mortality and removing habitat constraints that might limit population recovery. The nesting and winter habitats appear to have the potential to support substantially more than the 58 nesting pairs and the associated subadults and young-of-the-year present in 2005 (Johns 1998; Tom Stehn pers. comm.).

Activities will include:

- monitoring population numbers, including annual recruitment and mortality;
- monitoring movements in migration;
- reducing mortality through management actions;
- restricting detrimental human activities; and
- identifying, protecting, managing, and creating habitat.

2. Develop and maintain captive populations. Increase the captive populations to 45 breeding pairs by 2010 (Priority 1).

Maintain 45 breeding pairs of Whooping Cranes at Patuxent Wildlife Research Center (15), International Crane Foundation (12), Calgary Zoo (10), Audubon Species Survival Center (5), and San Antonio Zoo (3). This will be achieved by examining the genetics of productive pairs in captivity and optimizing the production of Whooping Cranes in captivity using known methods.

Activities to achieve this objective include:

- developing more sensitive measures of genetic diversity;
- increasing the number of captive breeders;
- refining avicultural methods and productivity; and
- maintaining captive facilities.

3. Establish two additional wild populations (Priority 2).

Continue research to identify appropriate reintroduction sites and improve reintroduction techniques. Protect and manage habitat of reintroduced populations. The U.S. Fish and Wildlife Service and the Canadian Wildlife Service should coordinate their research and management efforts to establish at least two discrete, self-sustaining populations, each consisting of a minimum of 25 nesting pairs by the year 2035. By 2010, the FP should have 100 individuals and 10 pairs, and the eastern migratory population should have 80 adults. As long as they meet recovery criteria, these new populations can be either migratory or non-migratory. Plans call for all releases to be in the eastern United States (Florida non-migratory population and eastern migratory population), at least through 2010.

Activities to meet this objective will include:

- improving release techniques;
- evaluating and selecting release sites;
- establishing a non-migratory population; and
- establishing a migratory population.

4. Determine the effective population size (N_e) for species survival (Priority 3).

Continue to use genetic information to determine N_e and revise recovery criteria as warranted. This N_e will be based on advances in conservation biology, population viability theory, and on-the-ground recovery progress with other endangered species.

5. Maintain and expand information/education programs (Priority 3).

Implement information and education programs to further recovery of the Whooping Crane. Issue press releases for December population counts at Aransas National Wildlife Refuge, spring departure from Aransas National Wildlife Refuge, spring arrival in Saskatchewan, requests for reports of migration sightings, number of nesting pairs in Wood Buffalo National Park, number of chicks surviving to autumn in and near Wood Buffalo National Park, autumn arrival in Saskatchewan and other provinces, and similar significant events for the FP and eastern migratory population. Provide outreach opportunistically at meetings and festivals.

Activities to meet this objective will include:

- developing media products; and
- providing viewing opportunities.

2.7 Broad Strategies to Address Threats

2.7.1 Habitat Loss and Degradation

Habitat destruction and curtailment of the species' range will be addressed through population and habitat monitoring on the breeding, migration, and wintering grounds; reduction of collision and disease mortality; public education to prevent accidental shooting; habitat protection and management; and monitoring and regulation of specific threats and impacts, such as chemical spills, coastal erosion, dredging, changing salinity from water withdrawal, and changes in in-stream flows. Establishment of two additional wild populations will also address this threat through augmentation of the current population and expansion of Whooping Crane range in historical habitats. Development and maintenance of a captive population will provide protection against extinction in the wild and produce birds for reintroduction to the wild.

Suitable breeding habitat currently unoccupied and areas important for migration will be identified using satellite imagery and historical use data. Protection of these sites will occur through cooperative agreements, existing legislation, and/or purchase.

Through consultation and management, stream flows should be maintained to continue productivity of bay systems used by wintering Whooping Cranes. Freshwater ponds will be maintained and new ponds will be created on wintering grounds to ensure a supply of fresh water for the cranes and to optimize distribution of upland use by cranes. Human activities on upland areas need to be controlled to minimize disturbance to cranes at freshwater sources.

2.7.2 Loss of Genetic Diversity

The loss of genetic diversity can be overcome only as population numbers increase to the level where the creation of new alleles through mutation will offset past, current, and future losses in genetic diversity. The managers of the captive population should make annual analyses of the genetics and demographics of captive populations. Frozen semen banks should be maintained to prevent loss of founder lines, and the number of captive breeders should be increased.

2.7.3 Disturbance

To protect cranes from disturbance, human activities should be monitored, regulated, and/or prohibited wherever they have the potential to cause problems for the cranes. For example, construction periods should be restricted to times when cranes are absent, and the altitude of aircraft over nesting and wintering areas should be regulated.

2.7.4 Collisions with Power Lines

To address the threat of power lines, actions will be developed to minimize losses, such as increasing the visibility of structures or lines.

2.7.5 Chemical Spills

Environment Canada, Fisheries and Oceans Canada, and the equivalent provincial/territorial agencies share lead responsibility for spill response within their respective jurisdictions. Parks Canada Agency is the lead for situations within Wood Buffalo National Park. In the United States, the U.S. Coast Guard has the lead responsibility for spill response and containment, and the U.S. Fish and Wildlife Service has response plans for the Gulf of Mexico (U.S. Fish and Wildlife Service 1979) and specifically for Aransas National Wildlife Refuge (Robertson et al. 1993). Appropriate agencies will be encouraged to inspect oil and gas facilities.

2.7.6 Disease and Parasites

To address the threat of disease and parasites, methods of disease prevention, detection, and treatment will be developed. In captive centres, research should be conducted on diagnosis and treatment of cranes to ensure flock health. As well, routine health practices will be monitored at captive facilities.

2.7.7 Predation

Predator control is not considered an appropriate management technique within Canadian national parks. Efforts must be taken to reduce predation where practical, especially in the reintroduced populations. This will be done by determining mortality factors, measuring impacts, and carrying out strategies to reduce losses. In addition, release techniques will be developed to identify methods for teaching predator avoidance to birds.

2.7.8 Shooting

Continued education and enforcement will be needed to ensure that hunting does not present a threat to the Whooping Crane.

2.8 Critical Habitat

Critical habitat is defined in the *Species at Risk Act* as “the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species’ critical habitat in a recovery strategy or in an action plan for the species” (Subsection 2(1)). In this recovery strategy we identify areas of critical habitat on the breeding grounds within Wood Buffalo National Park previously described under Wood Buffalo National Park Game Regulations.

2.8.1 Breeding Grounds

The Canadian Wildlife Service has been monitoring Whooping Crane nesting activity in Canada since 1954. The majority of currently occupied breeding territories (91%) are located within Wood Buffalo National Park. Whooping Cranes are slow to pioneer new areas, and most (76%) of the pairs establish territories within 20 km of their natal area (Johns et al. 2005).

Boreal marsh complexes that meet the requirements outlined in Timoney (1999) can be deemed as essential for Whooping Cranes to establish territories, build nests, and raise their young. Timoney (1999) describes nesting wetlands as visually open patchy wetland complexes containing semi-permanent and permanent wetlands with water depths averaging 25 cm; this diverse mosaic of wetlands contains a high proportion of bulrush marsh associated with mixed marsh (sedge and cattail), shrubby marsh (willow and birch) and diatomaceous ponds with bulrush. The quantity of suitable habitat identified as the whooping crane nesting area within the boundaries of Wood Buffalo National Park appears to be sufficient to support a growing population of Whooping Cranes (Olson and Olson Planning & Design Consultants Inc. 2003; Tischendorf 2003).

Critical habitat identified in this recovery strategy is therefore:

Boreal marsh complexes surrounded by a 100 meter riparian management zone (Thorpe 2005) in that portion of the northeast corner of Wood Buffalo National Park that meet the requirements outlined in Timoney (1999) within the whooping crane nesting area as described in SCHEDULE I - Wood Buffalo National Park Game Regulations SOR/78-830 (see below).

“The whooping crane nesting area lies within the following boundaries:

PART A

Commencing at a point one mile west on Northwest Territories Highway No. 5 from the crossing of said highway across the Little Buffalo River and 180 metres north of the edge of the cleared right-of-way of said highway, thence in a north westerly direction parallel to said highway to a point 180 metres east of the centre of the main channel of the Nyarling River; thence in a north easterly direction parallel to the centre of the main channel of the Nyarling River to its intersection with a line drawn 180 metres west of and parallel to the centre of the main channel of the Little Buffalo River; thence in a south easterly direction parallel to and 180 metres west of the centre of the main channel of the Little Buffalo River to the centre of the main channel of Seton Creek; thence in a south westerly direction following the centre of the main channel of Seton Creek to a point due North of the commencement point; thence due South to the commencement point.

PART B

Commencing at a point due south of the most south easterly corner of the whooping crane nesting area described in Part A of this Schedule and 180 metres south of the edge of the cleared right-of-way of the Northwest Territory Highway No. 5; thence in a north westerly direction parallel to the said highway to a point due north of the most northerly extension of Sass Lake and 180 metres south of the cleared right-of-way of the said highway; thence due south to the most northerly extension of Sass Lake; thence in a south easterly direction along the shore of Sass Lake to the most easterly extension of Sass Lake, thence in a south easterly direction to a point 180 metres north of the centre line of the tributary of the Little Buffalo River; thence in a north easterly direction parallel to the centre line of the said tributary and 180 metres north of the said centre line to a point 180 metres west of the centre line of the Little Buffalo River; thence in a north westerly direction parallel to the centre line of the Little Buffalo River and 180 metres west to the commencement point.”

Activities likely to result in destruction of breeding critical habitat

Destruction of critical habitat for the Whooping Crane in Canada is any alteration to the topography, geology, soil conditions, vegetation, chemical composition of air or water, surface water or groundwater hydrology and microclimate of such a magnitude, intensity, or duration that significantly reduces the capacity of the critical habitat to contribute to the survival or recovery of this species.

Examples of activities that are likely to result in destruction of critical habitat for breeding include, but are not limited to, radical or lasting alterations to normal hydrological regimes, infrastructure development (e.g. power lines, towers, roads), plus a number of activities related to forestry practices, mining, oil and gas exploration (e.g. application of pesticides, construction of roads, access and resource extraction).

Protection of breeding habitat

Wood Buffalo National Park is protected under the *Canada National Parks Act*. To afford the highest level of protection, the breeding habitat is designated as a Zone 1 Special Preservation area. The Special Preservation designation establishes that there are to be no human made facilities (except Highway 5) within the area, and human access is prohibited from April 15 through October, except for park staff and scientists involved in Whooping Crane research. The breeding grounds are also designated as a Wetland of International Importance by the Ramsar Convention and an Important Bird Area by BirdLife International. Because of these designations, the critical habitat is protected from a number of anthropogenic threats.

2.8.2 Schedule of Studies to Identify Additional Critical Habitat

Identification of additional areas as critical habitat (e.g., unoccupied potential breeding grounds outside of Wood Buffalo National Park and migration staging areas) will be considered following completion of all or part of the schedule of studies below. The identification of additional critical habitat will take place after consultations are completed with landowners and other directly affected parties including numerous aboriginal organizations; to enable consultations, land tenure must be determined. Consultations will also investigate suitable protection options for the critical habitat being considered.

Breeding Habitat

The growth rate of the population may be significantly increased as cranes spread to suitable habitat outside the boundaries of the nesting area as described above (Tischendorf 2003). The Canadian Wildlife Service and Parks Canada have investigated suitable unoccupied nesting habitat within Wood Buffalo National Park and adjacent areas that may be necessary for the recovery of Whooping Cranes (Olson and Olson 2003). This research indicates that expansion of the Aransas/Wood Buffalo Population will likely lead to more breeding of Whooping Cranes outside of the current Whooping Crane nesting area delineated above. In addition, expansion outside of Wood Buffalo National Park, into adjacent, currently unprotected areas of the Northwest Territories (Olson and Olson 2003) is also anticipated. Combined, the amount of

suitable breeding habitat available within the park and the amount of suitable breeding habitat available adjacent to the northeast corner of the park appears to be enough to support a population of upwards of 250 breeding pairs and 1000 individuals, enough to meet recovery goals (Olson and Olson 2003). In recent years Whooping Cranes have begun expanding their breeding range into these new areas. Therefore, protecting all available suitable habitat is required to support the maximum possible growth rate for the Whooping Crane population. These additional areas may be identified as critical habitat in the future pending refinement of the precise areas and boundaries.

Protection of Potential Breeding Critical Habitat

Currently there is no formal protection for wetland habitat adjacent to the northeast corner of the park. This area is under the jurisdiction of the Government of the Northwest Territories, Indian and Northern Affairs Canada and the Salt River First Nation. Consultation with these organizations is required, as well as community consultations with all affected parties to present new critical habitat to be identified and to discuss the best protection options for this habitat (DeWandel 2003). Where appropriate, stewardship opportunities will be investigated with the appropriate land managers (DeWandel 2003). If these additional areas are identified as critical habitat in the future, we would need to protect those areas from the same kinds of activities identified above as being destruction.

Migration Habitat – Saskatchewan Staging Areas

During fall migration Whooping Cranes typically stop in south central Saskatchewan for several days or weeks. The area of Saskatchewan between Meadow Lake, Swift Current, Estevan and the Quill Lakes, can be described as a staging region for Whooping Cranes. The cranes spend their evenings roosting in shallow wetlands, while their days are occupied with feeding in harvested agricultural fields, chiefly wheat and barley fields (Johns et al. 1997). Fall staging wetlands are primarily on private lands (85%) (Johns et al. 1997). Few wetlands are used repeatedly from one year to the next since most staging wetlands are ephemeral and their availability to cranes fluctuates annually due to variations in precipitation. Preferred staging wetlands have the following characteristics: permanently (32%) or semi permanently (53%) flooded; soft mud bottoms (83%); almost any size from less than half a hectare to several thousand hectares; water depths at roost sites average 13 cm (SD 7.5); and roost sites are generally within 2 km of suitable feeding areas (agricultural fields) and are usually over 1 km from human habitation (Johns et al. 1997). Large wetlands with a secure water supply are important as staging sites since they provide refuge when ephemeral wetlands are dry.

Due to the ephemeral nature of most prairie wetlands and their inconsistent use by Whooping Cranes, it is difficult to predict which wetlands may be used by Whooping Cranes at any particular time. However, wetland complexes that meet the criteria listed in Johns et al. (1997) and/or exhibit repeated use by Whooping Cranes may be identified as critical habitat in the future.

Schedule of Studies

- a) Ongoing inventory of birds and habitat areas used (2007-2010).
- b) Define precise areas and boundaries of potential additional critical habitat for breeding in Canada (2008; see above).
- c) Finalize staging site selection criteria and apply criteria to potential critical habitat staging areas (2008; see above).
- d) Review and update critical habitat list (2010).

2.8.3 Critical Habitat – United States

Migration Habitat

In the United States critical migration habitat has been designated at four locations: the Platte River bottoms between Lexington and Denman, Nebraska; Cheyenne Bottoms State Waterfowl Management Area and Quivira National Wildlife Refuge, Kansas; and Salt Plains National Wildlife Refuge, Oklahoma. These locations were designated as critical habitat in 1978 under the authority of the United States *Endangered Species Act* (Fed. Reg. Vol. 43, Number 94, May 15, U.S. Fish and Wildlife Service 1994).

Wintering Grounds

Portions of the Aransas National Wildlife Refuge and vicinity, Texas have been designated as critical habitat for the Whooping Crane in 1978 under the authority of United States *Endangered Species Act* (Fed. Reg. Vol. 43, Number 94, May 15, U.S. Fish and Wildlife Service 1994). Additional information on critical habitat and its protection in the United States can be found in the International Recovery Plan.

2.9 Action Plan Timeline

The Canadian action plan for the Whooping Crane will be completed by June 2008.

2.10 Evaluation of Recovery Activities

The Canada/United States International Whooping Crane Recovery Team continually evaluates recovery activities, their direction, and the methodology used for each. In addition, outside agencies are asked to periodically evaluate various aspects of the recovery program to ensure that recovery activities are consistent with recovery guidelines outlined in the International Recovery Plan for the Whooping Crane, the Recovery Strategy for the Whooping Crane in Canada, and the Canada/U.S. Memorandum of Understanding on the Conservation of the Whooping Crane. These actions are undertaken under the authority of the *Species at Risk Act* (Section 49(d)).

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