

SPECIES ASSESSMENT FOR THE WHOOPING CRANE (*GRUS AMERICANA*) IN WYOMING

prepared by

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Introduction

The federally Endangered whooping crane (*Grus americana*) is snowy white and stands almost 1.5 m tall, with an adult wingspan of 2m. Black wingtips are visible in flight, as are the long neck and legs extended beyond the tail. In the breeding season "whoopers" are usually found as singles or pairs. During migration they can be found as singles or small groups up to 6-7 birds. Family groups of 3 birds (pair of adults and single young) are also observed.

The whooping crane occurs exclusively in North America. Historically breeding range stretched from Alberta across the northeastern Great Plains to the southern end of Lake Michigan. Historic wintering grounds included the highlands of northern Mexico, the Texas gulf coast, and portions of the Atlantic coast. Non-migratory populations occurred in Louisiana and possibly other areas of the southeastern U.S. The species declined rapidly in the late 1800s and early 1900s as a result of hunting, collecting, and widespread conversion of habitat to agriculture and urban centers. By 1940 only one self-sustaining flock remained.

As of winter 2003-2004 the adult whooping crane population numbered 312 in the wild and 114 in captivity. In the wild the species exists in three separate populations: the Aransas-Wood Buffalo population; a migratory population in Florida (winter) and Wisconsin (breeding); and an experimental non-migratory population in central Florida. An experimental, cross-fostered (whooping crane chicks raised by free-ranging sandhill cranes [*G. canadensis*]) population in the Rocky Mountains of the U.S. persisted for some years in the late 20th century, but no longer supports any whooping cranes. In addition to the wild populations, whooping cranes are maintained in captivity at eight locations.

Natural History

The whooping crane is the rarest of the world's 15 crane species. The species' historic decline, near extinction, and gradual recovery is among the best known and documented cases in the annals of conservation. Over the last 50 years a combination of strict legal protection, habitat preservation, and continuous international cooperation between Canada and the United States has allowed the only remaining wild population to increase steadily from a historic low of just 15 known individuals in 1940-41 to several hundred at present.

Morphological Description

The below descriptions are compiled from Dorn and Dorn (1990), U.S. Geological Survey (1997), Sibley (2000), and Nebraska Game and Parks Commission (2002). Whooping cranes are the tallest bird in North America. Adult males stand 1.5 m tall, weigh up to 7.5 kg, and have wingspan up to 2.5m. Males are larger than females; adult females weigh about 6.4 kg. Despite their size cranes are rather fast in flight, averaging about 45 km/ hour.

Adult plumage is snowy white (Figure 1) with black wingtips that are visible only when the wings are extended. The neck is long, the bill is long, dark and pointed, and the legs are long, thin and black. A patch of red-black, bristly feathers lies on the top and back of the head. Black feathers on the side of the head below the yellow eye look like a long dark moustache. The whooping crane is the only large white bird with black wingtips that flies with neck straight out in front and legs trailing far behind (Figure 2). It also is the only one that walks or stands on long thin legs and does not swim.

Plumage of juveniles is a rusty or cinnamon-brown color. At about 4 months of age white feathers begin to appear on the neck and back. Young in their first fall migration usually have a

brown head and neck and a mixture of brown and white on the body. Plumage is predominantly white by the following spring.

Several birds may be casually misidentified as whooping cranes. Sandhill cranes are smaller than whooping cranes with primarily gray plumage, but sometimes appear large and whitish in bright sunlight. Their gray primaries and secondaries are evident when the wings are extended in flight. Snow geese (*Chen caerulescens*) and white pelicans (*Pelecanus erythrorhynchos*) are white with black wingtips, but are much smaller than whooping cranes and have short legs that do not extend beyond the tail in flight. Also, snow geese have rapid wing beats and often occur in large flocks; white pelicans fly with the neck folded. Wood storks (*Mycteria americana*) are white with black wing edges, but are much smaller than whooping cranes with all-dark heads and proportionally longer and heavier bills. Adult tundra (*Cygnus columbianus*), trumpeter (*C. buccinator*) and mute (*C. olor*) swans lack the black wing feathers and fly without the legs extending beyond the tail.

Taxonomy and Distribution

Taxonomy

Analyses of DNA suggest that *G. americana*, *G. grus*, *G. monachus*, and *G. nigicollis* form a monophyletic lineage apart from *G. japonicus* (Krajewski and Fetzner 1994). The closest living relative of *G. americana* may be *G. grus* (Love and Deininger 1992). Interestingly, the other North American crane, *G. canadensis*, does not appear to be closely related to *G. americana* or any of its allies (Krajewski and Fetzner 1994). Remaining populations of whooping cranes exhibit low mtDNA diversity, and may in fact have only a single mtDNA haplotype (Snowbank and Krajewski 1995).

Historic Distribution

The whooping crane occurs exclusively in North America and was likely never very common, even historically. The total population prior to 1870, when European settlement began to have a significant impact on the species and its habitats, has been estimated at 500 - 1400 (Allen 1952, Banks 1978, Lewis 1995). The principal historic breeding range stretched across central North America from central Alberta through southern Saskatchewan and Manitoba, northeastern North Dakota, western Minnesota, southern Wisconsin, northern Iowa, and northern Illinois (Allen 1952) (Figure 3).

Historic wintering grounds included southwestern Louisiana, the Gulf Coast of Texas, interior west Texas, the highlands of northern Mexico, and Atlantic coastal areas of New Jersey, Delaware, South Carolina, and Georgia (Allen 1952, Howell and Webb 1995). Non-migratory populations were found in coastal Louisiana and possibly in other portions of the southeastern U.S. (Nesbitt 1982, Gomez 1992, USDI Fish and Wildlife Service 1994).

The species' range shrank rapidly in the second half of the 19th century; by the 1890s breeding birds were extirpated from the U.S. (Allen 1952, McNulty 1966). Nesting in the aspen parklands of Canada was last observed in 1929, with unconfirmed reports continuing into the early 1930s (Hjertaas 1994).

By the late 1930s only two breeding populations remained: a remnant non-migratory population around White Lake in southwestern Louisiana, and a migratory population that wintered in coastal Texas but whose breeding grounds were unknown at that time. Birds in the Louisiana population last nested in 1939; a hurricane in August 1940 reduced this population from 13 to 6 individuals. The last member of this flock was taken into captivity in 1950.

Current Distribution

Wild whooping cranes currently exist in 3 populations: Wood Buffalo/ Aransas; Florida non-migratory; Wisconsin-Florida migratory. An experimental population in the Rocky Mountains was recently extirpated.

Wood Buffalo/ Aransas

The main population (and also the only indigenous, non-reintroduced population) breeds in northern Wood Buffalo National Park near Fort Smith, Northwest Territories, and migrates 2700 mi south to wintering areas in and around the Aransas National Wildlife Refuge on the gulf coast of Texas (Figure 4).

The population reached a low of 15 birds in the winter of 1941-42, and hovered between 20-30 individuals over the next two decades (Boyce 1987, USDI Fish and Wildlife Service 1994). Efforts to locate the flock's breeding grounds intensified following World War II. Evidence of breeding was first reported in 1954, when several adults and pre-fledged juveniles were observed in Wood Buffalo National Park. Researchers located nests the following year (Allen 1956). The inaccessibility of the breeding grounds, protection of the wintering grounds, and extensive public education campaigns has contributed to the population's increase. Since 1967 biologists have removed single eggs from two-egg clutch nests of the population, using these eggs in establishing captive and experimental wild populations (Erickson 1976, Kuyt 1993).

The 2700mi migration route generally cuts across northeastern Alberta and southwestern Saskatchewan, through northeastern Montana, the western half of North Dakota, central South Dakota, Nebraska and Oklahoma and east-central Texas (Figure 2-3). It narrows to only about 140mi wide in Nebraska, with critical stopover sites on the Platte River near the towns of North Platte, Kearney, and Grand Island (Nebraska Game and Parks 2002).

In February 2004 194 whooping cranes were counted on the wintering ground in coastal Texas. Whooping crane production surveys carried out in June 2004 documented a record number of 66 chicks hatched from 54 nests, surpassing the previous high of 58 chicks produced in 1997. Productivity was excellent with 85% of the nests producing one or two offspring; 20 nests hatched twins, 26 hatched singles, and 8 hatched no offspring.

Florida nonmigratory

A second population, established via experimental reintroduction, occurs in the Kissimmee Prairie of south-central Florida. Since 1993 over 135 captive-reared whooping cranes have been released there (Meine and Archibald 1996). Although high mortality from predation by bobcats (*Lynx rufus*) was experienced initially, modification of rearing techniques and relocation of release sites reduced this problem. This population is non-migratory, which helps avoid hazards such as power line collision and lack of suitable stopover areas.

In 1996 two adults established a breeding territory from which they excluded locally abundant sandhill cranes, and in which they built several nests. The first eggs laid by free-ranging whooping cranes in this population were documented in 2000, and the first chicks to be hatched were documented in 2001. Neither chick survived, although one was raised almost to fledging before being lost to a predator.

In 2001 this population supported 75 individuals. In February 2004 it supported 82 - 64 adults (including 17 breeding pairs) and 18 juveniles (16 from captivity, 2 fledged in the wild).

Wisconsin - Florida migratory

In 2001, in an effort to establish another migratory population, 10 young whooping cranes were lead by ultralight aircraft from Wisconsin's Necedah National Wildlife Refuge 1200mi south

to Florida's Chassahowitzka National Wildlife Refuge (Operation Migration 2002). Plans called for the same procedure to be used for four more years or until a self-sustaining flock of migrating whooping cranes is established. The recovery goal was 25 nesting pairs. As of winter 2003 – 2004 this population supported 36 whooping cranes that migrate along a well-defined corridor between Wisconsin and Florida (Stehn 2004). Survival of these whooping cranes, after completion of their first fall migration, has been about 92%.

Recently extirpated Rocky Mountain

In 1975 the USDI Fish and Wildlife Service and Canadian Wildlife Service attempted to establish another migratory flock in the Rocky Mountains via cross-fostering. Whooping crane eggs (produced mostly by the Wood Buffalo/ Aransas population) were gathered and placed in the nests of sandhill cranes at Grays Lake National Wildlife Refuge in southeastern Idaho. The eggs hatched, young whooping cranes were raised by adult sandhill cranes, and the whooping cranes migrated with the sandhill crane flock to wintering grounds at Bosque del Apache National Wildlife Refuge in New Mexico. However, none of the whooping cranes raised in this manner paired with other whooping cranes for breeding.

This experimental population peaked at 33 birds in 1984-85. No eggs were added after 1989, and the number of whooping cranes steadily declined in subsequent years. In 1999 one sandhill X whooping crane hybrid was observed in the flock; at this time only 4 whooping cranes remained in the population. By summer 2001 only 2 whooping cranes remained, and by 2004 all whooping cranes had died (M. Fisher, Grays Lake National Wildlife Refuge, personal communication; Stehn 2004).

Habitat Requirements

Remaining whooping cranes continue to breed in ancestral breeding areas, and use ancestral migration routes and wintering grounds. Over the last 50 years there has been little natural range or population expansion; however, no evidence suggests that this is due to lack of habitat. Thousands of acres of unoccupied and apparently suitable habitat is available adjacent to existing occupied habitat. This discussion will focus primarily on the Wood Buffalo/ Aransas population, with some discussion of the recently-extirpated Rocky Mountain experimental population. Habitat in these areas is assumed to be more similar to habitat in the Wyoming region than to habitat used by the Midwestern and Florida populations.

Breeding Habitat

In general whooping cranes breed in large marshes and extensive mosaics of wetlands mixed with upland patches and small ridges. Breeding habitat within Wood Buffalo National Park is poorly drained wetlands at the headwaters of the Nyarling, Sass, Klewi, and Little Buffalo rivers. Average annual precipitation is about 33 cm. The area is interspersed with numerous shallow-water wetlands of various sizes, shapes, and depths; whooping cranes apparently favor wetlands with pH 7.6 - 8.3. Bulrush (*Scirpus validus*) is the dominant emergent in the potholes used for nesting, although cattail (*Typha* spp.), sedge (*Carex aquatilis*), musk-grass (*Chara* spp.), and other aquatic plants are common (Lewis 1995). These wetlands are separated by narrow ridges dominated by white spruce (*Picea glauca*), black spruce (*P. mariana*), tamarack (*Larix laricina*), and willows (*Salix* spp.), with understories of dwarf birch (*Betula glandulosa*), Labrador tea (*Ledum groenlandicum*), and bear berry (*Arctostaphylos uva-ursi*).

Habitat used during the breeding season by the cross-fostered Rocky Mountain population at Grays Lake, Idaho, was an extensive marsh surrounded by agricultural fields. Interestingly, some adult female whooping cranes tended to disperse away from adult males and all sandhill cranes at this wetland site, apparently preferring to summer in higher meadows (M. Fisher, Grays Lake National Wildlife Refuge, personal communication). This suggests a possibly greater affinity for upland meadows by whooping cranes relative to sandhill cranes.

Breeding habitat in Florida is open saw-palmetto (*Serenoa repens*) prairie interspersed with shallow lakes and wetlands.

Migration Habitat

The Aransas/Wood Buffalo population appears to be somewhat flexible in habitat use during migration (Howe 1989, Kuyt 1992). Radio-telemetered cranes from this population feed in a variety of croplands, and roost in a variety of freshwater wetlands, during migration.

When whooping cranes persisted in the Rocky Mountain experimental population they often stopped-over with sandhill cranes in the upper Green River valley of Wyoming (see Figure 5). The upper Rio Grande River valley in the San Luis Valley of southern Colorado (especially the National Wildlife Refuge complex near the city of Alamosa) also regularly supported migrating whooping cranes. These areas are generally similar: high elevation, open river valleys dominated by sagebrush steppe and grassland, with some agricultural fields and extensive wetlands.

Wintering Habitat

The Wood Buffalo/ Aransas population spends most of the winter in brackish bays, estuarine marshes, and tidal flats along the coast of southern Texas (Allen 1952, Stehn and Johnson 1987). These areas are dominated by salt grass (*Distichlis spicata*), smooth cordgrass (*Spartina*

alterniflora), glasswort (*Salicornia* spp.), 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, characterized by oak brush, grassland, swales, and ponds. Typical plants include live oak (*Quercus virginiana*), redbay (*Persea borbornia*), and bluestem (*Adropogon* spp.) (Stevenson and Griffith 1946, Allen 1952, Labuda and Butts 1979).

The Rocky Mountain population wintered along the middle Rio Grande River valley, primarily at Bosque del Apache National Wildlife Refuge in New Mexico. While on the refuge whooping cranes roosted on the Rio Grande River itself or on the managed wetlands interspersed among cottonwood (*Populus* spp.) woodlands; they fed in adjacent wetlands, pastures, and fields of corn and alfalfa.

Area Requirements

Nesting territories vary from 1.3 - 47.1 km² (Kuyt 1976). Adult males are the primary defenders of territories, nests, and family groups; adult females also perform some defense. Whooping cranes are aggressive towards other whooping cranes as well as other large waterfowl and predators trespassing into nesting territories.

On wintering grounds pairs and family groups occupy and defend small and discrete territories, but appear somewhat more tolerant of conspecifics. Winter territory size apparently declines as density increases; it averaged 117 ha (about 1km²) in the 1980s (Stehn and Johnson 1987). Subadults and unpaired adults form small flocks and use areas outside occupied territories, usually near territories where they spent their first winter with a family group (Blankinship 1976, Bishop and Blankinship 1982).

Reproduction and Survivorship

Breeding Behavior

Whooping cranes mate for life, but birds will pair with different individuals following the death of a mate (Blankenship 1976, Stehn 1992). Pair formation begins at 2 to 3 years of age (Kuyt 1981) and can be a lengthy process, developing over 1 to 3 winters from associations in subadult flocks on wintering grounds (Bishop 1984). As a pair forms the birds continuously engage in social and maintenance activities involving dancing and vocalization. In early spring adult pairs display elaborate courtship rituals of bobbing, weaving, jumping, and calling with their mates. Three year-old birds occasionally nest, but average age of first egg production is >4 years.

Breeding Phenology

In early spring, while still on the wintering grounds, pairs engage in courtship dances and vocalizations. These rituals intensify until the start of migration in mid-March.

Migration can take 2-6 six weeks. Whooping cranes migrate in the daytime and make regular stops for the night to feed and rest. Some stopovers last only one night, others up to 4 weeks. Whooping cranes migrate as individuals, pairs, family groups or small flocks of up to 11 birds; breeding pairs stay in close association throughout migration.

Breeding pairs first arrive in Wood Buffalo National Park during late April, when pairs quickly establish nesting territories. Nest building occurs shortly after territory establishment, and eggs are laid in late April to mid May.

Females lay two large eggs; both adults incubate the eggs for about 1 month. Few eggs are lost to predators, due mostly to the vigilance and aggression of the adults. The reddish-orange

young hatch in late May and early June. The 2 eggs hatch at different times, and the second chick is often pushed out of the nest or starved.

Chicks can swim as soon as they hatch, and are capable of sustained flight at the age of 80 to 100 days. By late September - early October the young birds are ready to migrate. The Wood Buffalo/ Aransas population usually forms staging flocks in Saskatchewan for 1-5 weeks prior to migration. Here the birds fatten up on waste barley and wheat in stubble fields, and roost during the night in nearby wetlands.

Fecundity and Survivorship

Whooping cranes survive up to 24 years in the wild. Three year-old birds occasionally nest, but average age of first egg production is >4 years. A pair typically lays and hatches 2 eggs, but only one chick survives to fledging.

Population Demographics

Limiting Factors

There have probably never been huge numbers of whooping cranes. The pre-settlement population has been variously estimated at around 1,500 birds. The population declined rapidly from 1870 to 1900 due to over-harvest and loss of breeding grounds, primarily as prairie wetlands and coastal marshes were drained and converted to agriculture or urban centers.

It is generally accepted that suitable but unoccupied breeding grounds are still available for population expansion. The loss and degradation of winter habitat may have been the major cause of the historic decline, and scarcity of suitable winter habitat is probably the main constraint on population expansion today. Aransas National Wildlife Refuge may be able to sustain only about

200 wintering cranes; it is difficult to enlarge the refuge because it is surrounded by concentrated human development. Furthermore, it is vulnerable to petroleum spills (the Aransas range lies along one of the busiest oil transport corridors in the world).

Currently, wild populations are so small that mortality from accidents (e.g., power line collisions, misidentification by hunters) and stochastic events (e.g., wildfires or summer freezes on breeding grounds), which are easily absorbed by larger populations, can have a large effect on long-term viability.

Population Dynamics

Whooping cranes exhibit a classic K-selected life history: long-lived, low annual reproductive output, and high survival of fledged chicks. This strategy is ill-suited for rapid population growth, range expansion, or fast recovery from periodic mortality events.

Human-mediated establishment of new populations (e.g., Florida nonmigratory population, Wisconsin-Florida migratory population) and active augmentation of existing populations are crucial if whooping cranes are to achieve recovery levels. Captive breeding programs are essential to these efforts. The first captive flock was established ca. 1967. There are now 114 individuals in 8 captive populations in facilities across North America (Stehn 2004).

Genetic Concerns

There is increasing evidence of genetic problems in captive whooping cranes; it is likely that the same problems exist in wild populations (Lewis 2003). Some pairs produce infertile eggs, and others produce chicks with notable heart defects, scoliosis, and leg deformities. All remaining whooping cranes exhibit very low mtDNA diversity, and may in fact have only a single mtDNA haplotype (Snowbank and Krajewski 1995). It is reasonable to attribute these problems to a

genetic bottleneck in the 1940s, when only 14 or 15 whooping cranes were known alive.

Managers are currently designing and implementing strategies that will retain the maximum possible genetic diversity in the captive population (Stehn 2004).

Food Habits

Whooping cranes are omnivorous. On breeding grounds they feed primarily on mollusks, crustaceans, aquatic insects, minnows, frogs, and snakes (Allen 1956, Novakowski 1966). Diet during migration is mostly frogs, fish, plant tubers, crayfish, insects, and waste grains in harvested fields. In winter whooping cranes feed primarily on crabs and clams. They will occasionally wander into upland areas flooded by rain to feed on acorns, snails, mice, voles, crayfish, grasshoppers, and snakes (Bishop and Blankinship 1982, Hunt 1987).

Foraging Strategy and Flexibility

Whooping cranes forage in soil, water, and vegetation in a variety of contexts; wetland margins, harvested grain fields, pastures, and burned fields are common foraging settings. Foraging is primarily done by visual searching and probing with the long bill. Large food items such as crabs, frogs, or snakes are often stabbed with the bill, then swallowed.

Conservation

Conservation Status

Federal Endangered Species Act

In 1967 the whooping crane was designated as Endangered under the U.S. Endangered Species Act. This designation still holds without modification for the Wood Buffalo/ Aransas population. In 1993 the Florida nonmigratory population was designated “Endangered - experimental

nonessential” (Federal Register 22 January 1993). In 1997 the Rocky Mountain population was similarly designated “Endangered - experimental nonessential” (Federal Register 21 July 1997); this designation is presumed no longer relevant due to the loss of this population. Finally, in 2001 the Wisconsin-Florida migratory population was designated “Endangered - experimental nonessential” (Federal Register 9 March 2001).

All whooping cranes are legally protected at the international level under the Migratory Bird Treaty Act (1916) and the Convention on International Trade in Endangered Species (1975). At the national level, additional legal protection is provided by the U. S. Migratory Bird Treaty Act (1918), the Canadian National Parks Act (1930), the Canada Wildlife Act (1972), and the Canadian Migratory Birds Convention Act (1994). Although the species no longer occurs in Mexico, it is legally protected there.

USDI Bureau of Land Management

The whooping crane does not appear on USDI Bureau of Land Management (BLM) Sensitive Species lists. By design, these lists do not include species already designated as formally Threatened or Endangered; i.e., the BLM defers to the more legally-restrictive designation.

USDA Forest Service

Similar to the BLM, the USDA Forest Service (USFS) does not list the whooping crane as Sensitive due to the precedence of the formal Endangered designation.

State Wildlife Agencies

The whooping crane is listed as Endangered by South Dakota, Kansas, Oklahoma, Nebraska, and Northwest Territories; it is a state-level “species of special concern” in Florida. It receives no special state-level status in Wyoming.

Heritage Ranks and Wyoming Contribution Rank

The whooping crane has been assigned a rank of **G1/ SAB/ S1N** by the Wyoming Natural Diversity Database (WYNDD, University of Wyoming; Keinath et al. 2003). The **G1** rank indicates an extremely high probability of rangewide extinction, which is appropriate for a species with a total combined wild and captive population numbering <500; **SAB** indicates that the species essentially occurs only accidentally in Wyoming during the breeding season; **S1N** indicates that the species is at extreme risk of extinction from Wyoming during the non-breeding season, referring to the migratory period only since no birds winter in the state. With the recent extirpation of the Rocky Mountain experimental population, the latter 2 ranks may soon be revised to **SX** to reflect the total extirpation from the state.

The Wyoming Contribution rank for whooping cranes is **Low**. This is based on a ranking system developed by WYNDD (Keinath and Beauvais 2003) that measures the contribution of Wyoming populations of a taxon to the rangewide persistence of that taxon, and considers several factors. For the whooping crane, the **Low** rank is a consequence of the extremely low probability that the species occurs in Wyoming at this time; i.e., Wyoming populations of the species essentially do not exist, let alone contribute anything to rangewide persistence.

Biological Conservation Issues

Abundance in Wyoming

As of the winter of 2003-2004, the worldwide population of whooping cranes was 431 birds (312 wild, 114 captive; Stehn 2004). None of these occurred in Wyoming. The bulk of reported whooping crane observations in Wyoming are from the western half of the state (Figure 5), and all but one of these was recorded between 1979 and 1992. The only observation in the eastern part of

the state was of a migrating bird near Torrington in 1950 (Wyoming Natural Diversity Database, University of Wyoming, unpublished data).

Essentially all western Wyoming whooping crane observations were of cross-fostered birds migrating with sandhill cranes in the recently-exirpated Rocky Mountain experimental population.

Trends in Wyoming

It is difficult to assess the historical abundance of whooping cranes in Wyoming, although it is reasonable to conclude that no birds ever wintered in the state, nesting birds were probably rare, and migrating birds probably occasionally stopped-over. Currently, no whooping crane is known to occur at any time in Wyoming; some could potentially migrate through eastern Wyoming due to its proximity to the main flyway for Wood Buffalo/ Aransas populations. The vast majority of whooping cranes ever documented in Wyoming were from the recently extirpated Rocky Mountain experimental population.

Range Context in Wyoming

Wyoming does not support any winter range for whooping cranes, and historically formed only a small part of the extreme periphery of the species' breeding range. Wyoming's role in supporting whooping cranes was in supplying stopover sites during migration; this is the only substantial role the state can play in the species' recovery. Wyoming's ability to support migrating whooping cranes depends on expansion of current populations, which in turn depends on proper management of distant breeding and (especially) wintering ranges and probable aggressive establishment and augmentation of new management populations.

Intrinsic Vulnerability in Wyoming

A variety of factors contribute to a species being intrinsically vulnerable to decline and extinction, including low or variable population density, large area requirements, low fecundity, habitat specificity and site fidelity, and sensitivity to disturbance and habitat alteration. Whooping cranes exhibit all of these characters; clearly, their extremely low population size now outweighs all other factors in pre-disposing the species to extinction.

Extrinsic Threats and Reasons for Decline

The historic decline in whooping cranes was likely primarily due to habitat loss - conversion of prairie wetlands (breeding and migration habitat) to agriculture and, perhaps most importantly, conversion of coastal wetlands (wintering habitat) to agriculture and urban centers. Overharvest for meat and feathers may also have played an important role (Lewis 1995).

Currently, mortality from April - November is 3 times higher than during the winter. Most of this is assumed to occur during migration, when whooping cranes are exposed to a variety of hazards such as collisions with power lines and other obstructions, and mistaken identification by sandhill crane hunters (U.S. Geological Survey 1997). Snow, hailstorms, low temperatures, and drought can handicap navigation and reduce the quality of stopover habitat by reducing food availability and allowing predators to access formerly water-locked roosts over ice or dry land.

The Wood Buffalo/ Aransas population, the only self-sustaining wild population of whooping cranes, is vulnerable to petroleum contamination on its critical wintering grounds (U.S. Geological Survey 1997). Petroleum barge traffic on the adjacent Gulf International Waterway is among the heaviest of any waterway in the world. It is also possible that hurricanes could do great harm to wintering cranes, either directly or by damaging habitat, in both Texas and Florida.

Protected Areas

Much of the critical nesting, migration, and wintering habitat of the Aransas-Wood Buffalo population is contained within protected areas (U.S. Geological Survey 1997). The main nesting grounds are located within Wood Buffalo National Park, and many staging areas and migration stopovers are within federal, state, and provincial wildlife refuges, waterfowl management districts, and other designated conservation areas. In the U.S. migrating whooping cranes utilize approximately twenty national wildlife refuges in eleven states (Lewis 1991). The Aransas National Wildlife Refuge protects the main wintering grounds. The U.S. government and the state of Texas have purchased additional habitat surrounding this refuge, with the assistance of The Nature Conservancy (Doughty 1989). The National Audubon Society has also entered into leasing arrangements on lands adjacent to the refuge.

The recently-extirpated Rocky Mountain population was concentrated at Grays Lake National Wildlife Refuge in the breeding season, Bosque del Apache National Wildlife Refuge in the winter, and several other state and federal refuges during migration.

The Florida nonmigratory population occupies state wildlife management areas and parklands, as well as several large and small private holdings (including lands owned by the National Audubon Society) (Lewis 1995). The Wisconsin-Florida migratory population is centered on Wisconsin's Necedah National Wildlife Refuge (breeding) and Florida's Chassahowitzka National Wildlife Refuge (wintering).

Population Viability Assessment

A population viability assessment workshop for the whooping crane was conducted in August 1991. The workshop included representatives of the U.S. and Canadian Whooping Crane

Recovery Teams as well as several government agencies and private conservation groups. The final report (Mirande et al. 1993) concluded:

- About 87% of the species' pre-1938 genetic diversity persisted as of 1990.
- The captive population retains about 96% of the wild population's genetic diversity.
- The Wood Buffalo/ Aransas population has a low probability (<1%) of extinction over the next 100 years, although temporary declines are likely.
- Assuming no further habitat limitation or damaging inbreeding, the Wood Buffalo/ Aransas population may reach 500 individuals in ca. 27 years and 1000 individuals in ca. 42 years.
- Even if the reproductive and survival rates of the Rocky Mountain population improve, the population is unlikely to become self-sustaining (borne out by subsequent extirpation).
- The Florida nonmigratory population could become self-sustaining if it is augmented by 10- 20 captive-raised birds each year for ten years (1993-2003).
- With improved management the captive population can sustain planned release efforts (borne out by subsequent management efforts).

Conservation Action

Existing and Future Conservation Plans

Recovery activities have been closely coordinated between the U.S. and Canada, and a 1995 MOU on Conservation of the Whooping Crane calls for the preparation of a combined plan and the formation of a single bi-national recovery team.

The U.S. Endangered Species Act provides for the development and implementation of recovery plans for endangered species. These plans are prepared and periodically updated by recovery teams appointed by the U.S. Secretary of the Interior. The U.S. Whooping Crane Recovery Team was appointed in 1976 and the USDI Fish and Wildlife Service published its first

Whooping Crane Recovery Plan in 1980 (USDI Fish and Wildlife Service 1980). The plan was revised twice in 1986 and 1994; the former revision included the Grays Lake cross-fostering program (USDI Fish and Wildlife Service 1986).

The Canadian Whooping Crane Recovery Team was established in 1987 to define and coordinate recovery activities within Canada. Its first plan was published in 1988 (Cooch et al. 1988) and revised in 1994 (Edwards et al. 1994). The 1994 revision set forth the following strategies:

1. Protect whooping cranes and their habitat in and near Wood Buffalo National Park to maximize the productivity of this population.
2. Protect whooping cranes and their habitat at areas other than Wood Buffalo National Park, including staging areas, migration stopovers, and the main migration corridor.
3. Establish additional wild populations as per the 1995 Canada - U.S. MOU.
4. Establish a captive breeding population in Canada.
5. Continue a comprehensive public relations program to increase awareness and support for the recovery plan.

Wyoming is not included in any recovery plan.

Other conservation actions directed toward the whooping crane include:

- Critical habitat designated at 9 sites in 6 states.
- Special habitat management measures at Aransas National Wildlife Refuge, including: artificial impoundment of freshwater; prescribed burning of uplands to improve cover and enhance food production; halting and mitigating shoreline erosion; and experimental wetland creation using dredge material (Hunt 1987, USDI Fish and Wildlife Service 1994, Lewis 1995).
- A contingency plan for responding to oil spills at Aransas NWR (Robertson et al. 1993).

- Active restoration of roosting habitat along the Platte River (Strom 1987, Currier 1991).
- Utility line marking devices to reduce crane collisions; tests indicate 40-60% reduction in collisions (Morkill and Anderson 1993, Brown and Drewien 1995).
- Habitat enhancement via water management and planting of food crops (Lewis 1995).
- Identification and mapping of suitable, but unoccupied, breeding habitat.

Information Needs

All three free-ranging populations are intensively monitored. The Wood Buffalo/ Aransas population is monitored on breeding grounds by the Canada Wildlife Service (Novakowski 1966, Kuyt 1993), in migration by Canada Wildlife Service and the USDI Fish and Wildlife Service, and on wintering grounds by the USDI Fish and Wildlife Service (Binkley and Miller 1983, Boyce and Miller 1985, Boyce 1987, Nedelman et al. 1987). Continuation of such monitoring will be crucial in informing management and conservation actions targeting species recovery.

Color-banding and radio-telemetry studies conducted since the 1940s have yielded valuable information on many aspects of demography, behavior, mortality sources, and habitat use (Drewien and Bizeau 1981, Drewien et al. 1989, Kuyt 1992). These efforts were first carried out under the Cooperative Whooping Crane Project (Allen 1952, 1956). Since then scientists have built upon this foundation with wide-ranging studies of demographics, genetics, reproductive biology, migration, food habits, environmental threats, behavior, habitat ecology and restoration, captive propagation, health management, and reintroduction. This information has been summarized in several publications, including Walkinshaw (1973), Johnsgard (1983), Doughty (1989), Mirande et al. (1993), USDI Fish and Wildlife Service (1994), and Lewis (1995). Recent research topics include studies of historical summer and breeding records, winter habitat and ecology, breeding range expansion, new reintroduction and release techniques, potential release

sites, the availability of migration habitat, and conservation genetics (e.g., Armbruster 1990, Ellis et al. 1992, Kuyt 1993, Hjertaas 1994, Snowbank 1995).

Past and ongoing studies have provided a wealth of information. The recovery of the species will benefit from all types of studies; those that map habitat available for population expansion, identify habitat features that correlate with reproductive success and survivorship, and address the best protocols for establishing new, and augmenting existing, populations will be most helpful.

Tables and Figures

Figure 1. Photo of Whooping Cranes in adult plumage. Photo from the Nebraska Game and Parks Commission (2002).



Figure 2. Flight silhouettes of cranes and herons; note the outstretched neck and long legs of cranes.

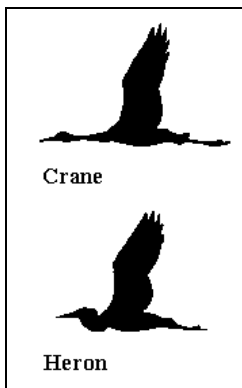


Figure 3. Map of current and former whooping crane migration routes and breeding and wintering grounds (U.S. Geological Survey 1997).

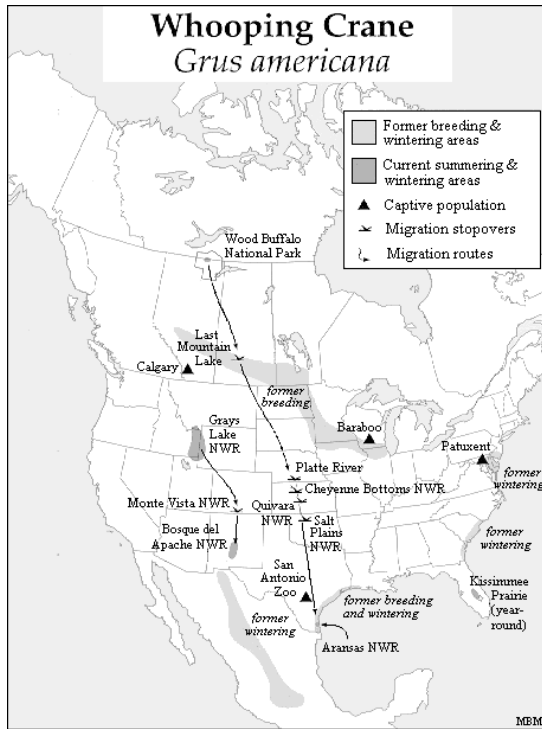


Figure 4. Migration route of the Wood Buffalo/ Aransas population of whooping cranes (*Grus americana*).

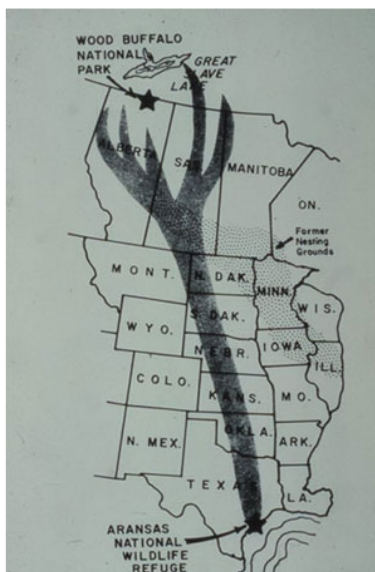
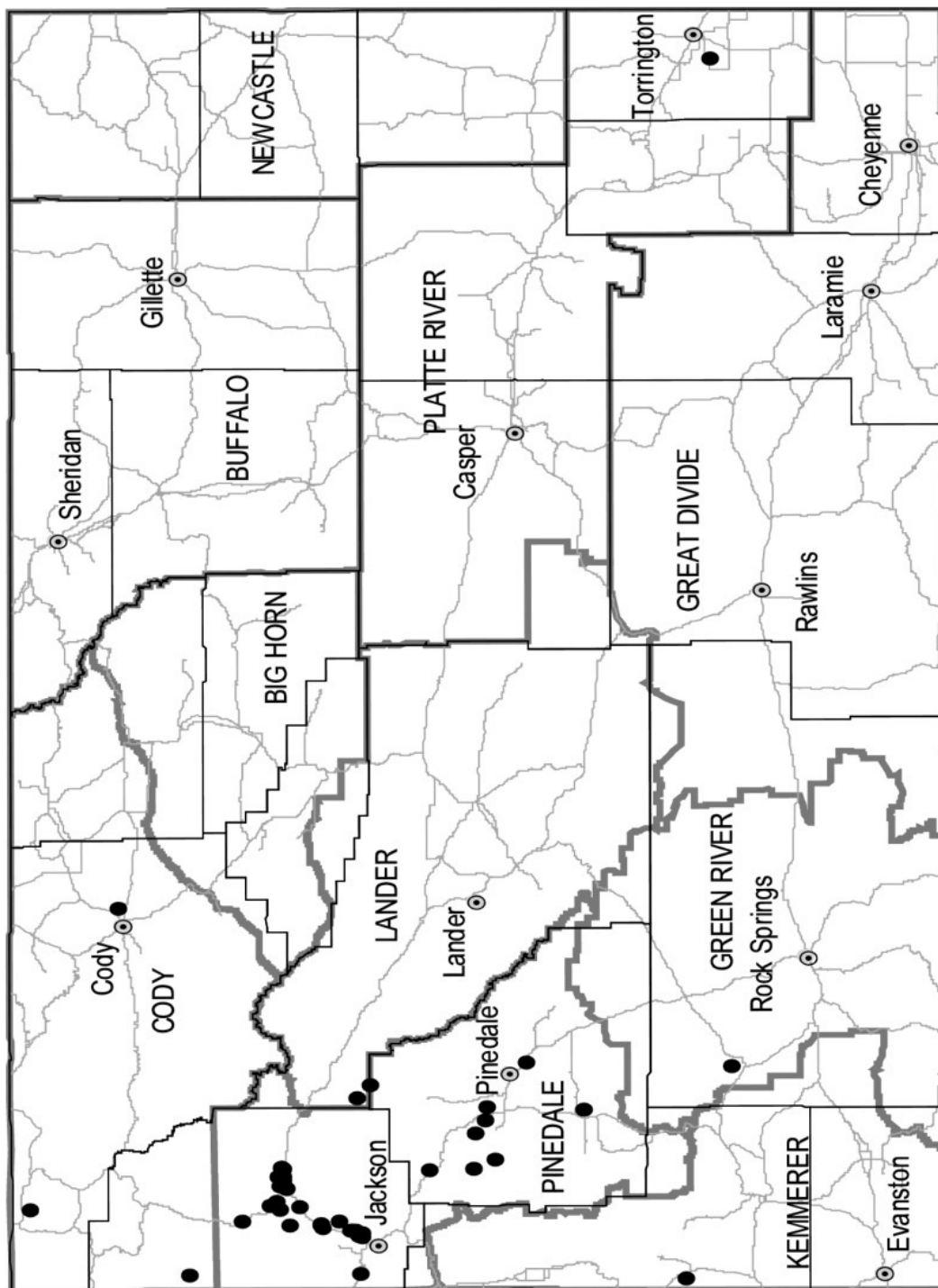


Figure 5. Documented observations of whooping cranes (black dots) in Wyoming (Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming).



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