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# AN UPDATE ON MORTALITY OF FLEDGED WHOOPING CRANES IN THE ARANSAS/ WOOD BUFFALO POPULATION

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**Abstract:** From winter 1950 through spring 2011, 6,364 whooping cranes (*Grus americana*) overwintered at Aransas National Wildlife Refuge, or rarely, elsewhere. Documented winter losses amounted to 105 birds dead or disappeared. About 20% of total losses occurred in the wintering area, where birds spend 5 to 6 months of the year including a few birds that over-summer. Losses of white-plumaged whooping cranes on the summering area in Canada appear to be low with only 3 instances documented. The most significant losses seem to occur in migration and may comprise over 80% of the annual mortality. Migration involves only 17-20% of the annual cycle but is a period when losses are high because birds are exposed to new hazards as they travel through mostly unfamiliar environments. This paper updates a similar account by Lewis et al. (1992) by adding mortality records of the Aransas/Wood Buffalo population (AWBP) from 1987 through 2010 with information on 50 recovered carcasses.

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**Key words:** Aransas/Wood Buffalo, *Grus americana*, mortality, whooping crane.

Understanding mortality factors of a wildlife population is potentially important for effective management. Several authors have reported on aspects of mortality in whooping cranes (*Grus americana*) of the Aransas/Wood Buffalo population (AWBP). Kuyt (1981) noted that most chick mortality usually occurs during the first 2 weeks of life. Kuyt et al. (1981) and Hunt et al. (1987) described predation of individual juveniles, one of which had avian tuberculosis. In this article we add 24 years of data to update the account by Lewis et al. (1992), which summarized mortality of the AWBP from 1950 to 1987.

### METHODS

The winter whooping crane census at Aransas National Wildlife Refuge (NWR) and nearby areas in coastal Texas began in 1938 and has continued through the present (CWS and USFWS 2007). However, aerial counts were infrequent during World War II. Beginning in 1950, after birds first started arriving (mid-October to mid-December) and in spring (mid-March through end of April) as they departed northward, aerial monitoring was generally conducted weekly, weather permitting (Aransas NWR, unpublished data). Mid-winter censuses were conducted 1 or 2 times per month. Starting in 2006, number of census flights done each winter was reduced to 9-12 with emphasis placed on determining the peak flock size.

Since 1966, flights to estimate numbers of nesting pairs in the Canadian nesting grounds have occurred in May. Additionally, searches in June were conducted during 1976-2009 to determine number of young hatched, and in August/September during 1981-1984 and 1997-2011 to determine the number of fledged juveniles. In recent years, up to 25 hours of aerial surveys conducted over 4-5 days in June have counted up to 82% of the flock. A census of the entire breeding area in Wood Buffalo National Park (WBNP) and adjacent areas has never been attempted because the area occupied by whooping cranes, particularly by subadults, is too extensive.

We believe the fall censuses provide a nearly complete count of the arriving wintering population and the spring censuses provide a reasonable estimate of the population alive when spring migration begins. However, the death of subadult cranes at Aransas NWR is difficult to determine because subadult groupings and use areas are variable and carcasses are rarely found. Therefore, the spring estimate is less accurate. Winter mortality estimates are based on the number of dead cranes found plus those recognizable birds that disappeared from Aransas NWR during winter. The estimates of birds initiating spring migration are based on winter mortality estimates minus those birds which remained in Texas coastal habitats throughout summer. To calculate April through November losses of adults and subadults which had migrated in a particular year, the peak number of white-plumaged cranes in Texas in early winter was subtracted from the previous year's combined total of cranes migrating northward and

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surviving cranes summering in Texas.

Records of AWBP carcasses recovered were compiled from the Aransas NWR files. A few birds that had been observed with life-threatening injuries such as a broken leg and which subsequently disappeared without a carcass being found were included. The data set used started in 1950 when regular winter flights were begun at Aransas NWR.

## RESULTS

The total of maximum annual winter counts indicates that 6,364 whooping cranes overwintered at Aransas, or rarely elsewhere, from 1950 to 2010 (Table 1). Ninety-eight percent of these cranes survived to migrate northward in spring. Twenty-six birds stayed at Aransas NWR in summer, 3 of which died while summering (Table 1). Winter losses amounted to 105 birds during the 61-year period. The remains of 16 cranes were found in winter, and 89 others disappeared and are presumed to have died in winter. Carcasses recovered included 9 white-plumaged birds and 7 juveniles. Deaths of the 16 recovered individuals are believed due to a combination of disease and/or predation (7), shooting (2), trauma (1), and unknown (6). Juveniles that died often separated from their parents for unknown reasons several days before they died—abnormal behavior believed indicative of disease. Diseases identified were avian tuberculosis and an unknown herpes virus. One case of avian predation was documented, with talon marks consistent with a great horned owl (*Bubo virginianus*) found during necropsy. Other predation was caused by bobcat (*Lynx rufus*), coyote (*Canis latrans*), and American alligator (*Alligator mississippiensis*), but disease was also believed to be involved in at least 3 of those instances. The last known shooting loss during winter occurred in the 1988 winter when a waterfowl hunter shot an adult female near San Jose Island.

Four hundred and thirty-six adults and subadults alive in March at the start of the spring migration disappeared or were found dead from April to November 1950-2010, including 3 over-summering birds which died at Aransas NWR (Table 1). Carcasses were recovered for 29 (6.7%) of the 436 white-plumaged birds that had disappeared between spring and fall. Additionally, 5 juveniles were found dead during fall migration. The most common causes of mortality were collision with power lines and shooting (Figure 1). We also have documentation of an individual colliding with a fence while crossing a small

wetland, one being caught in a muskrat trap, one that may have had a heart muscle disease, and one that was hit by a military tanker aircraft taking off from Minot, North Dakota, in June. One of the instances categorized as trauma was from collision with a blunt object where the internal organs were shattered. That bird presumably was either hit by an airplane or died in flight and fell to the ground with great force.

Of the 546 total losses of fledged cranes during 1950-2010, 50 carcasses (9.2%) were recovered, or in a few instances, birds with severe injuries were observed prior to their disappearance that provided clues as to source of mortality (Table 2). Of the 546 losses, 19.8% occurred at Aransas during the 5-6 months the whooping cranes annually spent on the wintering grounds, or in 3 instances birds that over-summered at Aransas. Remains of birds that died were more frequently found at Aransas (18.5%) than during migration or on the nesting grounds (6.8%).

Flights in summer at WBNP indicate that summer (May-Sep) losses of adults and subadults are infrequent in the Park; only 3 carcasses have been found there since 1966. This includes 1 radioed adult found dead in WBNP in summer 2011 that was not included in the 1950-2010 data set. One juvenile (named CANUS) with an injured wing was captured and subsequently survived in captivity for 38 years.

## DISCUSSION

Information on when mortality occurs for the AWBP changed very little when 23 years of data (1988-2010) were added to the account by Lewis et al. (1992). Winter losses occurred at about the same rate as that reported in the Lewis paper. Losses north of Aransas NWR when birds are migrating or on the nesting grounds ( $n = 433$ ) were 80.0% of total mortality, similar to the 81% reported by Lewis et al. (1992). It is probable that mortality on the nesting grounds is underestimated since observations of cranes in the Park are made only during infrequent flights. The general public has no probability of observing cranes in the Park as it remains for the most part impenetrable wilderness. Thus, the probability of recovering a carcass is lower on breeding areas than during migration or winter. One of 4 radioed carcasses recovered disappeared while on the summering area. With only 3 carcasses ever recovered in WBNP compared to 28 in migration, it appears that most of the April to November mortality occurs during migration.

**Table 1. Flock size and mortality of the Aransas/Wood Buffalo whooping crane population, 1950-2010.**

Winter beginning	White plumaged	Juvenile	Total	Winter losses	Migrating in spring	Number over-summering at Aransas	Over-summer mortality	Total mortality at ANWR	Subadult and adult mortality Apr-Nov	Total recovered carcasses <sup>a</sup>	Total annual mortality Nov-Nov
1950	26	5	31	1	29	1	1	2	9	1	11
1951	20	5	25	2	23			2	4	4	6
1952	19	2	21		21			0	0	0	0
1953	21	3	24		24			0	3	0	3
1954	21	0	21		21			0	1	1	1
1955	20	8	28	1	26	1		1	5	1	6
1956	22	2	24		21	3	1	1	1	1	2
1957	22	4	26		26			0	3	0	3
1958	23	9	32		32			0	1	0	1
1959	31	2	33		31	2		0	3	0	3
1960	30	6	36		36			0	2	0	2
1961	34	5	39	1	38			1	6	1	7
1962	32	0	32	4	28			4	2	0	6
1963	26	7	33	1	32			1	0	1	1
1964	32	10	42		42			0	6	1	6
1965	36	8	44		44			0	6	0	6
1966	38	5	43		43			0	4	0	4
1967	39	9	48	1	47			1	3	2	4
1968	44	6	50		50			0	2	0	2
1969	48	8	56		56			0	5	0	5
1970	51	6	57	1	56			1	2	0	3
1971	54	5	59	1	58			1	12	0	13
1972	46	5	51	1	50			1	3	0	4
1973	47	2	49	1	47	1		1	1	0	2
1974	47	2	49		49			0	0	0	0
1975	49	8	57		57			0	0	0	0
1976	57	12	69		69			0	8	1	8
1977	61	10	71	1	70			1	2	0	3
1978	68	7	75	1	74			1	4	0	5
1979	70	6	76		76			0	4	0	4
1980	72	6	78	1	76	1		1	6	1	7
1981	71	2	73		73			0	6	2	6
1982	67	6	73	2	70	1		2	3	3	5
1983	68	7	75		75			0	4	1	4
1984	71	15	86	2	84			2	3	1	5
1985	81	16	97	1	96			1	7	1	8
1986	89	21	110	1	109			1	0	0	1
1987	109	25	134	3	129	2		3	12	1	15
1988	119	19	138	6	131	1	1	7	5	3	12
1989	126	20	146	4	141	1		4	9	1	13
1990	133	13	146	11	134	1		11	11	2	22
1991	124	8	132	1	131			1	10	1	11
1992	121	15	136		136			0	9	1	9
1993	127	16	143	7	136			7	11	1	18
1994	125	8	133		131	2		0	3	0	3
1995	130	28	158	1	155	2		1	13	1	14
1996	144	16	160		160			0	8	1	8
1997	152	30	182	1	181			1	16	1	17
1998	165	18	183		183			0	12	0	12
1999	171	17	188	1	186	1		1	16	0	17
2000	171	9	180	6	174			6	13	1	19
2001	161	15	176	2	174			2	5	1	7
2002	169	16	185	1	184			1	15	1	16
2003	169	25	194	1	193			1	10	3	11

**Table 1. Continued.**

Winter beginning	White plumaged	Juvenile	Total	Winter losses	Migrating in spring	Number over-summering at Aransas	Over-summer mortality	Total mortality at ANWR	Subadult and adult mortality Apr-Nov	Total recovered carcasses <sup>a</sup>	Total annual mortality Nov-Nov
2004	183	34	217	2	214	1		2	25	2	27
2005	190	30	220	6	211	3		6	22	0	28
2006	192	45	237		237			0	10	2	10
2007	227	39	266		266			0	34	0	34
2008	232	38	270	23	245	2		23	5	4	28
2009	242	22	264	1	263			1	3	0	4
2010	238	45	283	4	279			4	25	0	29
<b>Totals</b>	5573	791	6364	105	6233	26	3	108	433	50	541

<sup>a</sup> In a few instances, the carcass was not recovered but mortality was deduced from disappearance of an injured crane.

**Table 2. Documented mortalities of the Aransas/Wood Buffalo whooping crane flock, 1950-2010.**

Year	Date	Period	Location <sup>a</sup>	Age <sup>b</sup>	Recovered	Cause of death	Comments
1950	Sep	Summer	Burgentine Lake, ANWR	A	Yes	Unknown	“Mac” had been captured in Louisiana and released at ANWR in spring 1950.
1951	Aug	Summer	N. Mullet Bay, ANWR	A	Yes	Unknown	Carcass much decayed
1951	Nov	Winter	Ratama Mill, ANWR	A	Yes	Shot	Shattered joint between femur and tibiotarsus, assumed shot on migration, died at San Antonio Zoo
1951	Dec	Winter	W. St. Charles, ANWR	A	Yes	Trauma	Unknown, missing 1 foot, leg broken at tibiotarsus
1952	Oct	Fall migration	Sharon, Kans.	A	Yes	Unknown	Had dislocated wing, died en route to San Antonio Zoo
1952	Nov	Fall migration	Regina, Sask.	Chick	Yes	Trauma	Injured wing, broken leg, lung congestion; died
1955	Fall	Fall migration	Sioux Falls, S.D.	WP		Shot	Snow goose hunter (McNulty 1966)
1956	May	Spring migration	Lampass City, Tex.	SA	Yes	Power line	Broken wing tip
1957	Oct	Fall migration	Ketchum, Okla.	WP	No	Trauma	Crippled bird seen, then disappeared
1961	Dec	Winter	Matagorda Island, ANWR		No	Unknown	Ranch foreman discovered carcass (McNulty 1966)
1964	Mar	Winter	ANWR		Yes	Unknown	Bones, feathers, and skin recovered; was 1 of twin chicks; lab detected minute traces of DDT
1965	Nov	Fall migration	Rawlins Cty., Kans.	SA	Yes	Power line	Distribution (3 wire)
1968	Jan	Winter	ANWR	A	Yes	Shot	Shot by goose hunter
1968	Apr	Spring migration	Russell Cty., Kans.	A	Yes	Power line	Distribution (3 wire)
1977	Apr-May	Spring migration	Sask.	A	No	Muskrat trap	Unconfirmed mortality of death in trap
1981	11 Oct	Fall migration	Glaslyn, Sask.	Chick	Yes	Power line	Distribution (1 wire, 9 m), picked up, died later due to injuries
1982	Jun	Spring migration	Minton, S.D.		Yes	Aircraft	Feathers identified on military tanker aircraft
1982	Oct	Fall migration	Oglesby, Tex.	A	Yes	Power line	Distribution (4 wire, <8 m)
1983	Jan	Winter	ANWR	Chick	Yes	Disease, predated	Found dead on M.I. <sup>a</sup> , assumed avian tuberculosis (TB) and predation (radioed)

**Table 2. Continued.**

Year	Date	Period	Location <sup>a</sup>	Age <sup>b</sup>	Recovered	Cause of death	Comments
1983	Jan	Winter	ANWR	Chick	Yes	Disease, predated	Separated, disease similar to avian TB, predated by a coyote (radioed)
1983	May	Spring migration	Edam, Sask.	SA	No	Possibly disease	Unknown, observed by farmer for 1 week, died, possibly disease
1984	Oct	Fall migration	Linton, N.D.	A	Yes	Power line	Male with multiple fractures in wing, captured but later died Jan 1985, aspergillosis, and partial paralysis from running into captive fence during handling
1984	Nov	Winter	ANWR	SA	Yes	Neck trauma	Probable avian predation (radioed)
1986	24 May	Summer	WBNP	A	Yes	Unknown	Male found dead at the nest
1988	Oct	Fall migration	St. Paul, Nebr.	A	Yes	Power line	Distribution (2 wire, 11 m)
1989	Apr	Winter	ANWR	SA	Yes	Avian TB	Avian tuberculosis
1989	3 Jan	Winter	ANWR	A	Yes	Shot	Mistaken for snow goose on San Jose Island
1989	Oct	Fall migration	Nebr.	SA	Yes	Power line	Flew into 2-wire transmission line, found dead
1990	19 Apr	Spring migration	Leoville, Sask.	A	No	Shot	Hunter observed with crane in back of truck at gas station; not convicted because he was "unknowingly" in possession of an endangered species
1991	Apr	Spring migration	Bend, Tex.	A	Yes	Shot	Shot
1991	Jun	Summer	WBNP	WP	Yes	Unknown	Unknown due to decay, not submitted for necropsy
1992	Jan	Winter	ANWR	A	Yes	Unknown	Pile of feathers in burn area
1993	Dec	Winter	ANWR	Chick	Yes	Bobcat predation	Bobcat predation
1996	Mar	Winter	ANWR	Chick	Yes	Disease, predation	Probably not bobcat
1997	Oct	Fall migration	Zelma, Sask.	Chick	Yes	Power line	Dead under a 14.4-kV power line for 1 week
1998	Nov	Fall migration	Quivira NWR, Kans.	A	No	Broken leg	Last seen with broken leg, mate appeared at ANWR without her
2001	Jan	Winter	ANWR	SA	Yes	Unknown	Skull and feathers found
2002	Apr	Spring Migration	De Leon, Tex.	A	Yes	Power line	Power line strike
2003	Nov	Fall Migration	Dallas, Tex.	A	Yes	Shot	Shot
2004	Nov	Fall Migration	Quivira NWR, Kans.	SA	Yes	Shot	Had a leg amputated, died in captivity 9 Nov
2004	Nov	Fall Migration	Quivira NWR, Kans.	SA	Yes	Shot	Second bird had a fractured humerus repaired, died due to complications mid-Nov
2004	Nov	Fall migration	Quivira NWR, Kans.	SA	No	Shot	Shot at, red spot seen on breast, not captured, stayed in area and was last observed in Dec; assumed mortality
2005	Dec	Fall migration	Mo.	Chick	Yes	Bacterium	Bacterium obstructing the larynx
2007	7 Apr	Spring migration	N.D.	A	Yes	Collision	Collision with a blunt object
2007	8 Oct	Fall migration	Sask.	Chick	Yes	Unknown	Scavenged carcass, could not be recovered until spring due to snow cover
2008	Dec	Winter	ANWR	WP	Yes	Starvation, knee	Injured knee and starvation
2009	Jan	Winter	ANWR	Chick	Yes	Predation	Herpes virus and emaciation underlying factors
2009	Feb	Winter	ANWR	Chick	Yes	Disease, predation	Separated, possibly diseased; predation near dugout
2009	Mar	Winter	ANWR	WP	Yes	Unknown	Pile of feathers

<sup>a</sup> ANWR = Aransas National Wildlife Refuge, Cty. = County, M.I. = Matagorda Island, WBNP = Wood Buffalo National Park.<sup>b</sup> A = Adult, SA = Subadult, WP = White-plumaged.



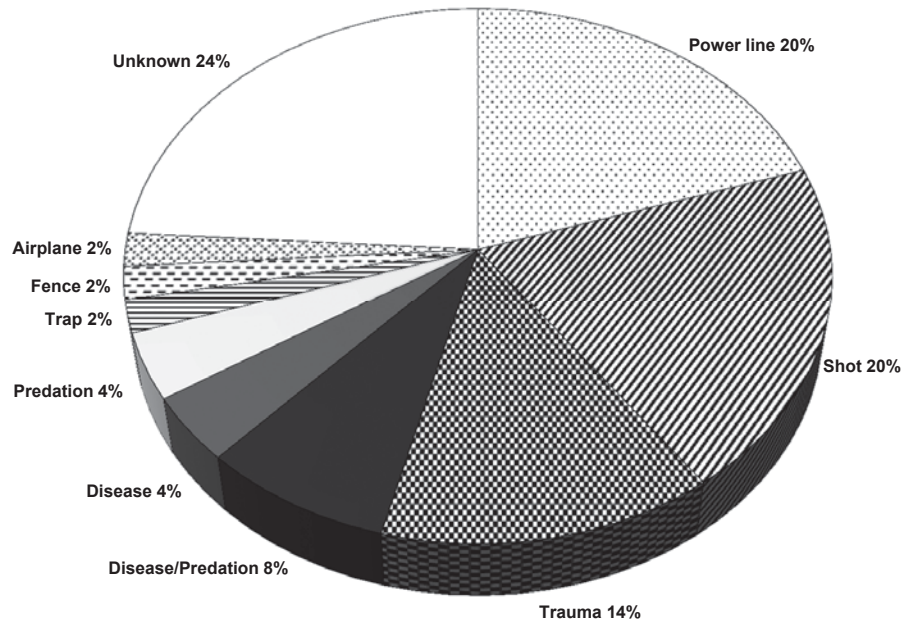


Figure 1. Causes of mortality of 50 carcasses recovered from the Aransas-Wood Buffalo whooping crane flock, 1950-2009.

For an average whooping crane, fall migration takes about 6 weeks, including the staging period in Saskatchewan. Spring migration on average involves about 2-4 weeks. Thus, migration losses occur during a period comprising about 9 weeks (17%) of the annual cycle. Spring and fall migration periods are the periods that should be focused on to further diminish mortality of fledged birds. Such actions are occurring through the Federal-State and Federal-Provincial cooperative plans for protection of whooping cranes (Lewis 1992) and through efforts to diminish collisions with power lines and wind energy developments. However, reducing mortality wherever it occurs benefits the population (CWS and USFWS 2007).

Although the majority of known mortality for the AWBP is split between power lines ( $n = 10$ ), shootings (10), other trauma (7), and disease often linked with predation (6), carcasses are recovered only 9.2% of the time, leaving the causes for about 90% of mortality as speculative. An ongoing satellite radio telemetry study should allow more unbiased information to be collected on causes and timing of mortality. Also, much more intensive monitoring has occurred on introduced whooping cranes where all such birds are radioed prior to reintroduction.

From the carcasses recovered, the causes of mortality seem different during winter at Aransas compared with the rest of the year. This makes sense

since there is little opportunity, with a few exceptions, for collisions with power lines or trauma during the 6 months the birds reside in the coastal salt marsh. Shootings may occur anywhere except in WBNP where human/crane interactions are practically non-existent. Predation on healthy fledged birds seems to be minimal. However, the impact of disease on the flock needs to be investigated further.

Cole et al. (2009) conducted postmortem evaluations on 17 reintroduced migratory whooping cranes in eastern North America from 2001 to 2006. Causes of death included predation ( $n = 8$ ), trauma (2), capture myopathy (1), and unknown (6). The primary predator was found to be bobcat. Limited roosting habitat or behavior of the naïve captive-raised birds were likely prime factors in predation events. The 2 trauma events were gunshot and power line collision. Infectious disease was not detected in their limited sample.

Predation by bobcats was the primary cause of mortality in nonmigratory whooping cranes in Florida. Whooping cranes were particularly vulnerable during their 44-day flightless molt that occurred every 2-4 years in summer (Spalding et al. 2011). In the early years of the project, juvenile whooping cranes without exposure to roosting ponds in captivity had much higher rates of predation than birds raised in later years with water exposure (Gee et al. 2001). Poor habitat selection (Nesbitt et al. 1997) or limited availability of roosting

habitat was found in a majority of the predation events (Cole et al. 2009). Immaturity, lack of predator avoidance training in captivity, and inappropriate habitat selection may put captive-raised cranes at greater risk than wild-raised birds (Spalding et al. 2011). In contrast, predation, except where linked with disease, seems to be relatively uncommon in AWBP whooping cranes. Some mortality in Florida was associated with human activities (crane leg fractured by a golf ball, fishing line wrapped around feet, suspected collision with vehicles) (Folk et al. 2001). Postmortem findings of nonmigratory whooping cranes in Florida include case reports of lead and zinc toxicosis associated with pen construction (Spalding et al. 1997), avian cholera, eastern equine encephalitis, infectious bursal disease, and aspergillosis (Spalding et al. 2004), mycobacteriosis, parasite infections (Spalding 2003), avian tuberculosis and salmonellosis (Stroud et al. 1986), and disseminated visceral coccidiosis (Novilla and Carpenter 2004).

Known causes of mortality in Florida whooping cranes, listed in order from most common to least common, were bobcat predation, power line collision, alligator predation, disease, gunshot, leg fracture, and cattle (Spalding et al. 2011), though the category of missing birds was larger than any other category. Mortality factors for the Florida nonmigratory and eastern migratory flocks seem similar (M. Spalding, University of Florida, unpublished data), with predation mortality of 47% in the migratory flock and 58% for the nonmigratory population (Cole et al. 2009). Traumatic injury accounted for 12% of the mortality in the eastern migratory flock and 7.5% in the Florida nonmigratory flock (Cole et al. 2009).

Causes of death of 24 Rocky Mountain cross-fostered whooping cranes was compiled from necropsy reports (N. Thomas, National Wildlife Health Center, unpublished data). In order of most common to least common, power line and fence collisions ( $n = 11$ ), disease (4), predation (2), injuries related to capture (2), vehicle collisions (1), and poison (1) were documented. Predation included coyote and golden eagle (*Aquila chrysaetos*) (Windingstad et al. 1981). Diseases included avian tuberculosis and avian cholera (Snyder et al. 1991). Notable was the high incidence of avian tuberculosis (20.8%) compared with much lower rates reported in sandhill cranes (*Grus canadensis*) (0.6%) and waterfowl (0.3%). Rocky Mountain whooping cranes were exposed to large concentrations of geese and sandhill cranes on wintering areas and suffered food

shortages as crops grown for the birds were depleted, leading to higher incidence of disease.

Whooping cranes are more susceptible to collision with power lines (Stehn and Wassenich 2008) than sandhill cranes (Brown et al. 1987). Power line mortalities have been documented in all reintroduced whooping crane populations as well as the AWBP, with 49 documented fatal collisions in North America (T. Stehn, U.S. Fish and Wildlife Service, unpublished data). Power lines collisions were the greatest (39.0%) known cause of mortality for fledged whooping cranes in the introduced Rocky Mountain population (Brown et al. 1987). In Florida, males were significantly more vulnerable to power line collisions than females (Spalding et al. 2011).

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