2011 Management Plan for High Plains Trumpeter Swan Flock

INTRODUCTION

History and Background

Trumpeter swans were once widespread in parts of North America (Fig. 1) with their historic breeding range extending from the Bering Sea, across Canada to the Atlantic Coast, and south to the Midwest United States (Banko 1960). Early records of trumpeter swans in the Midwest come from explorers such as Lewis and Clark and fur traders. Trumpeter swans nested in the Sandhills of South Dakota and Nebraska, but by the early 1900's few swans remained. Only three records of nests were noted between 1912 and 1960, and all were in the Sandhills (Central Flyway Council 1998). Because these birds historically occurred in the Sandhills and much of the wetland habitat was still relatively intact in the mid-1900's, biologists believed this area seemed well suited for the reintroduction of swans. The U.S. Fish and Wildlife Service (Service) began to reintroduce swans into the interior United States at Lacreek National Wildlife Refuge (NWR) when 57 cygnets were transported from Red Rock Lakes between 1960 and 1962 (Monnie 1966, Refuge files). The Refuge kept these cygnets in holding facilities for 3 years before releasing them on the Refuge, and ultimately released seventeen 3-year-old birds (i.e., birds of breeding age) on Lacreek NWR from 1963 to 1966. Lacreek was the focal area for nesting and wintering swans, but soon the swans pioneered into other parts of South Dakota and eventually into Nebraska, where they began nesting at Valentine NWR in 1969. By 1977, the Lacreek flock increased to 200 birds, and by 1978 banded birds began moving southward into Missouri. The "Lacreek Flock" ultimately established nesting territories in northeastern Wyoming, western South Dakota, and Nebraska (Fig. 2).

In 1982 State, Federal, and private cooperators drafted the original management plan for these restoration birds, entitled *Management Plan for Lacreek Trumpeter Swans* (Lacreek National Wildlife Refuge 1982). At that time, the Central Flyway Council recognized the flock had a limited range, but also knew that this range would continue to expand as the numbers of swans increased. As the numbers and range of these birds grew, and as additional reintroductions of trumpeter swans occurred in other areas of the Midwest (e.g., Minnesota, Michigan, Ontario), the original plan for the Lacreek Flock was absorbed into a more comprehensive plan for this large group of restoration birds (*Mississippi and Central Flyway Management Plan for the Interior Population of Trumpeter Swans* [Ad hoc Drafting Committee for the Interior Population of Trumpeter Swans 1998]). Descendants of the original Lacreek birds were termed the High Plains Flock (HPF), in accordance with their expansion into areas beyond the Refuge.

The HPF has continued to increase (Table 1), creating the need to reevaluate the original goals, objectives, and strategies for this flock. This plan incorporates objectives stated in the North American Waterfowl Management Plan: Strategic Guidance (U.S. Fish and Wildlife Service et al. 2004) and is intended to be a component of the management plan

for the Interior Population of Trumpeter Swans (Ad hoc Drafting Committee for the Interior Population of Trumpeter Swans 1998). This plan identifies the current abundance and distribution of the HPF, specifies the goal and objectives for the HPF, and identifies strategies that need to be conducted by federal, state, and private organizations to address management issues.

Abundance and Distribution

Summer

The HPF is monitored twice annually using aerial and ground techniques. The Service conducts a production aerial cruise survey in late summer to determine abundance, production and distribution. A fixed-wing aircraft is flown at low speeds (104 to 139 knots) and elevations (183 to 244 m AGL) along a predetermined route while an observer(s) counts and classifies swans. These aerial counts are not corrected for birds present but not seen by the aerial crew. The adult and subadult birds are counted as singles, pairs, or groups and are termed "white birds." All gray birds are counted as cygnets. Each location is determined with GPS and the waypoints are saved.

The HPF has continued to grow, and the average annual growth rate was 4.9% during 1990-2010 (Fig. 3). The estimated total that presently comprises the HPF was just over 500 birds. Additionally, 66 broods were produced in 2010, the highest thus far (Table 1). The majority of these swans (89%) were located in the Sandhills and mostly in western Nebraska. Areas in Wyoming and South Dakota combined contained 50 swans.

Winter

Waterfowl surveys are conducted each January by federal and state agencies in South Dakota and Nebraska, and these surveys enumerate trumpeter swans. During the 2004 midwinter waterfowl surveys, 529 swans were counted in the High Plains (Fig. 4). The difference between the summer and winter counts varies from year to year, but on average the difference seems minimal, with winter counts being slightly higher than summer counts ($\mathcal{O} = 52 \pm 15$ birds; 1980-2010). This difference may be due to HPF birds expanding to areas outside the survey route in the summer but inhabiting areas within the boundaries of the winter survey, movement of birds from Canada or other restoration areas into the winter survey area, or both.

As many as 489 swans have been observed at Lacreek NWR in early winter months, but that number can drop to as few as 14 birds when prolonged subzero temperatures leave little open water on the Refuge. During that time, most move to more southerly locations such as the Snake and North Loup Rivers (Nebraska Game and Parks Commission [NGPC], unpublished memo). In 2010, 7 of the trumpeter swans counted during the midwinter survey were in the Lacreek area, and the remaining 543 wintered in Nebraska (Refuge files). Refuge staff believe that Lacreek NWR will continue to support swans in the winter, but that the role of the Refuge may evolve to function primarily as a migratory and staging location. Small numbers of birds have migrated as far south as Missouri,

Kansas, and Oklahoma (Ad hoc Drafting Committee for the Interior Population of Trumpeter Swans 1998, Quivira NWR staff, personal communication), and movement to potential wintering locations may increase with an increase in population.

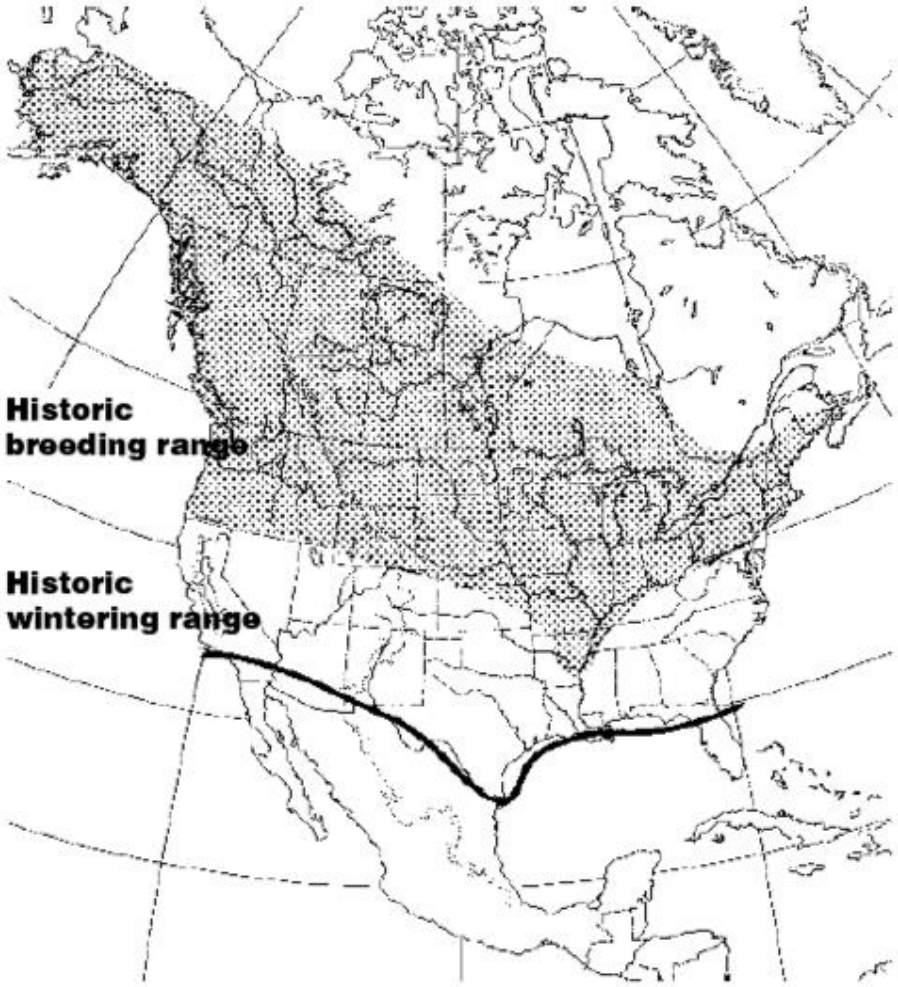

Figure 1. Historic breeding and wintering range of the trumpeter swan (Mattesen et al. 1995).

Figure 2. Contemporary distribution of trumpeter swans in the United States and Canada with the High Plans Flock circled in red (Moser 2006).

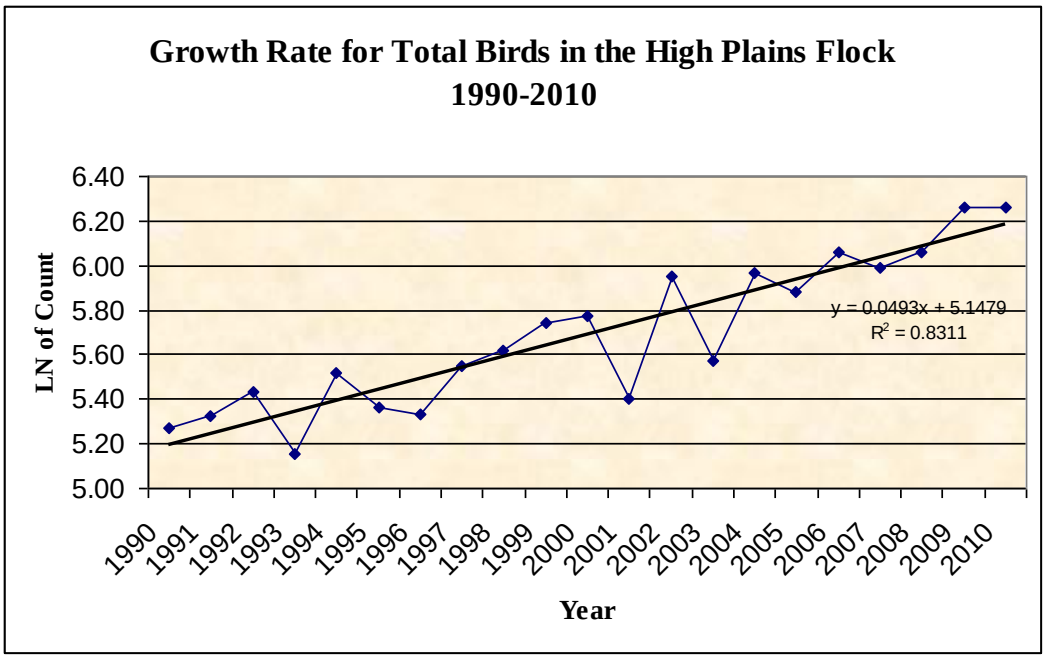

Figure 3. Growth rate of the HPF derived from the natural log of swans counted during fall production surveys from 1990 to 2010. The growth rate = 4.9% per year ($P < 0.001$).

Table 1. Breeding performance of HPF from 1980 to 2010.

Year	White Birds	Cygnets	Total	Pairs	Broods
1980	120	44	164	28	18
1981	104	54	158	30	16
1982	no data	no data	no data	no data	no data
1983	no data	no data	no data	no data	no data
1984	116	65	181	42	28
1985	95	63	158	40	22
1986	103	74	177	41	21
1987	110	81	191	34	23
1988	no data	no data	no data	no data	no data
1989	152	79	231	51	30
1990	127	68	195	41	22
1991	117	89	206	44	24
1992	126	102	228	48	30
1993	115	58	173	42	21
1994	164	85	249	54	32
1995	168	46	214	48	17
1996	129	78	207	52	22
1997	171	86	257	51	29
1998	184	114	298	62	32
1999	206	105	311	69	36
2000	235	86	321	56	28
2001	177	45	222	68	18
2002	264	121	385	67	38
2003	213	51	264	54	26
2004	284	107	391	100	40
2005	284	74	358	96	29

Table 1. Continued.

Year	White Birds	Cygnets	Total	Pairs	Broods
2006	360	67	427	124	20
2007	321	77	398	97	33
2008	314	115	429	113	43
2009	352	171	523	131	63
2010	350	174	524	121	66

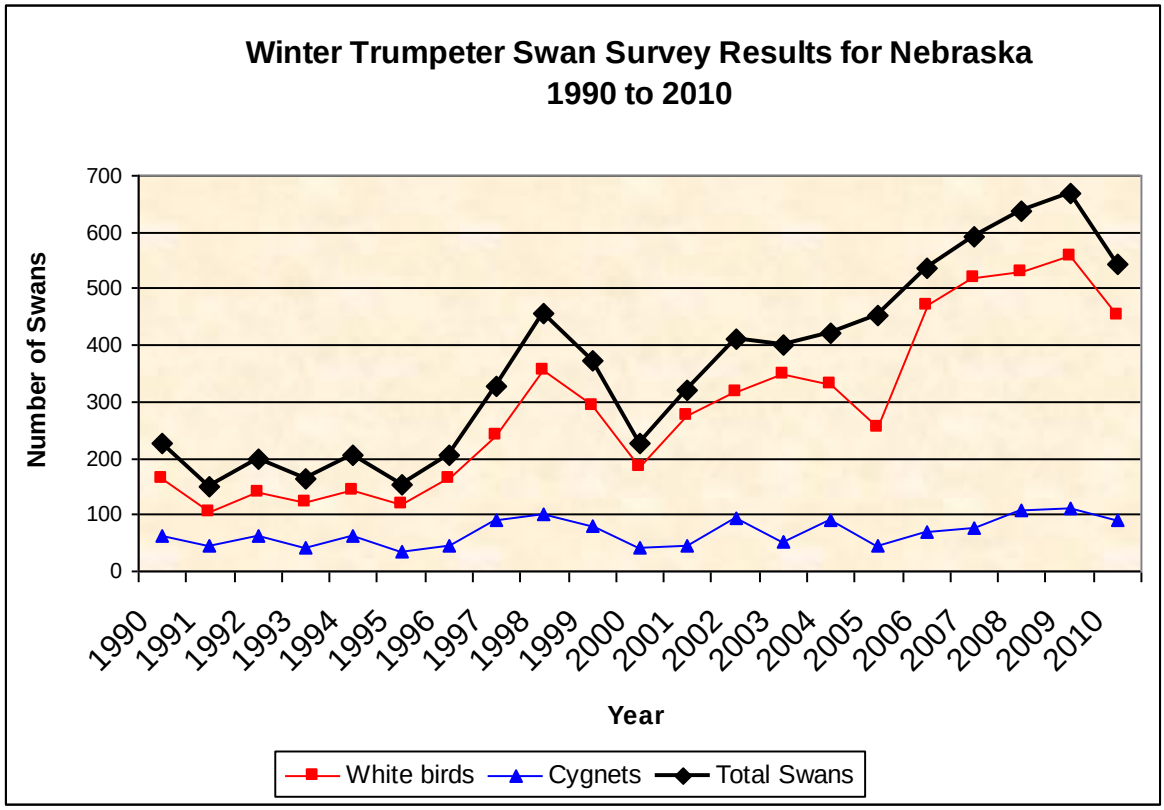

Figure 4. Midwinter trumpeter swan survey results for the High Plain Flock, 1990 to 2010. The year reflects the results that correspond to the most recent fall survey (i.e., the winter 1995 count was actually derived from the January 1996 survey).

Table 2. Counts of trumpeter swans observed during the winter survey.

Year	White birds	Cygnets	Total
1980	140	56	196
1981	172	58	230
1982	167	48	215
1983	206	57	263
1984	190	47	237
1985	144	43	187
1986	166	63	229
1987	182	86	268
1988	169	78	247
1989	221	61	282
1990	164	61	225
1991	105	45	150
1992	138	62	200
1993	122	42	164
1994	144	61	205
1995	118	34	152
1996	163	44	207
1997	239	89	328
1998	354	101	455
1999	294	80	374
2000	185	42	227
2001	274	45	319
2002	318	94	412
2003	350	51	401
2004	332	91	423
2005	255	44	454
2006	470	68	538
2007	518	75	593
2008	531	108	639
2009	556	113	669
2010	453	90	543

GOAL AND OBJECTIVES

Purpose

This plan was drafted to direct management of the High Plains trumpeter swan flock to meet the goals and objectives of the Service and its partners.

Goals and Objectives

Goal

Maintain and perpetuate a self-sustaining, migratory flock of trumpeter swans in the High Plains.

Objectives

1. Maintain a dispersed population consisting of at least 500 total birds counted during the production survey and 50 successful breeding pairs.

2. Identify and monitor nesting, migration, and wintering locations to ensure these habitats support bird abundances consistent with the population goals for this flock.

3. To provide wintering habitat among 10 different locations in Nebraska and South Dakota for up to 600 trumpeter swans.

4. Reduce known mortality factors within the current range of the HPF and investigate factors that could limit expansion within its historical range.

MANAGEMENT ISSUES AND STRATEGIES

1. Maintain a dispersed population consisting of at least 500 total birds counted during the fall production survey and 50 successful breeding pairs.

The Lacreek management plan and the current management plan for the Interior Population of trumpeter swans specify an objective of 500 swans for the HPF. The abundance of swans from the September 2010 survey was 524. Also, 66 pairs nested successfully in 2010, and fledged an average of 2.7 cygnets per pair. The growth rate for the HPF is 4.9% annually based on data from 1990 to 2010. The number of swans counted this year is the highest on record for the HPF and this was attributed to an increase in breeding pairs and the number of swans in groups. All the production parameters for this flock increased, including the number of breeding pairs and average brood size. Also the number of breeding pairs outnumbered the non-breeding pairs, which is usually not the case. The increase in total birds could be credited not only to the number of reproductively active pairs, but also wetland habitat quality. A swan may take up to four years to become reproductively active and in 2004 a relatively high number of cygnets were produced (107), so many of these birds likely became reproductively mature two years ago. Recent precipitation levels have maintained habitat quality and provided many areas for breeding that may have been limited during the drought conditions. During the dry period many of the highest quality wetlands were likely occupied by established pairs that nest at these locations year after year. Thus, wetlands that provided marginal breeding habitat for newly established pairs during the drought may now be adequate for production.

Provided habitat conditions remain favorable and no major stochastic event occurs, abundances of swans likely will fluctuate between 350 and 500 total birds, based on trend data and the current growth rate. If these conditions are not met, the population may drop below management objectives. Work is continuing on historic abundance data and habitats to determine if swans tend to inhabit ponds with particular characteristics or surrounding landscapes. In the future, this data may be used to provide a better biological rationale for establishing abundance objectives.

Strategies

The Service and the NGPC will continue to monitor the abundance, distribution, and production of the HPF annually during both fall and winter. The Service will organize and conduct the fall surveys, which will be completed during late summer before swans leave breeding grounds. Lacreek NWR staff will estimate abundance and distribution using aerial observations along an established cruise survey route. Refuge staff members will contact other wildlife resource agencies prior to the survey so that they may conduct ground counts where needed. Lacreek NWR staff will produce a report detailing the results of the fall survey, provide the report for public review, and distribute it to interested stakeholders. The Service and NGPC will coordinate winter survey efforts and jointly assess abundance and distribution of wintering trumpeter swans. NGPC will provide a summary report detailing the results of the winter survey for public review. All

reports will be posted to the Service's Mountain-Prairie Region website (http://www.fws.gov/mountain-prairie/species/birds/trumpeterswan/high_plains_population.htm).

As this population grows, so does the probability that the flock might expand beyond its current distribution. Therefore, managers will assess the whether the survey routes are sufficient to estimate the flock status (i.e., determine whether swans are breeding or wintering just beyond the established route that are not being counted). When reports of swans outside the survey area are received, the respective agency will investigate and verify the sighting. If sightings are valid, these areas will be included during the 5-year North American Trumpeter Swan range wide survey to determine if there are significant birds in other portions of the range. Stakeholders in the management plan will then make a decision on whether to change aerial survey routes based on new information. Conversely, if an area that once contained swans is devoid of swans for 5 consecutive years, managers may consider eliminating that portion of the survey.

2. Identify and monitor nesting, migration, and wintering locations to ensure these habitats will support abundance goals for the High Plains Flock.

The wetlands, streams, and rivers in the Sandhills provide all the requisites for trumpeter swans: (1) a consistent water source, (2) plentiful food resources, (3) open water areas in the winter, and (4) limited disturbance (Shea 1979, Maj 1983, Henson and Grant 1991, Squires et al. 1992, Pelizza 2001). Currently, 92.5% of the swan nests occur in Nebraska, with very few nests recorded in South Dakota or Wyoming. Current habitat conditions at nesting areas appear to be adequate for maintaining or increasing abundance of swans (S. Comeau, Lacreek NWR, personal observation). The Sandhills provide a consistent water supply and subaquatic vegetation (SAV), but habitat is reduced during times of drought. Additionally, because much of the nesting area is remote and privately owned, the resulting isolation and protection greatly reduces disturbance. Managers believe that swans will continue to pioneer additional areas in Nebraska and perhaps South Dakota, based on swan observations east of the current production survey route (M. Vrtiska NGPC, personal communication). Continued cooperation between wildlife resources agencies and private landowners is essential to reaching the population goal.

Outside of the Nebraska Sandhills, the remainder of habitat used by swans during the non-breeding season is on Lacreek NWR. Most of the wetlands on the Refuge have water control structures that allow the manipulation of water levels. The manipulation of water levels to mimic wet-dry hydrologic cycles is one tool used by wetland managers to influence vegetative productivity, composition, and structure (Kadlec 1962, Frederickson and Taylor 1982). The continuance of static water levels can create anaerobic conditions that limit decomposition and nutrient cycling (Brinson et al. 1981). High, static water levels can also influence the growth of SAV by limiting light penetration and allows water temperatures to remain cool. Water level manipulations can create hemi-marsh habitats that can provide open water areas that may contain SAV and shallow-water areas that may provide emergent food resource and cover for many wetland-dependent species (Weller and Frederickson 1974, Murkin et al. 1997).

Lacreek NWR has used water levels manipulations to increase wetland plant diversity and nutrient cycling and promote the growth of SAV. Wetlands that were once dominated by cattail and bulrush in emergent zones are now interspersed with species such as arrowhead (*Sagitarria ssp*.), beggarticks (*Bidens spp*.), and wild rice (*Zizania aquatica*). Arrowhead is carbohydrate-rich and especially important to swans in the winter and spring, and beggarticks contains high amounts protein (Paullin 1973, Squires 1991, Eaggars and Reed 1997). Additionally, species such as waterweed (*Elodea canadensis)* and sago (*Potamogeton pectinatus)* have become established in open water areas after drawdowns; both provide important food resources for swans (Shea 1979, Hughlett et al. 1984, Mitchell 1994).

Strategies

To determine potential nesting or wintering areas outside the known range, the Service will continue to work with state and tribal wildlife agencies and non-governmental organizations (e.g., The Trumpeter Swan Society, The Nature Conservancy) to document and investigate these locations. The Service and the NGPC will communicate with landowners groups, such as the Nebraska Sandhills Task Force, to aid in the protection and perpetuation of the HPF and their habitats. The majority of the nesting habitat is found on private ranches in the sandhills of Nebraska and South Dakota. Waterfowl managers generally believe that the majority of private landowners support nesting trumpeter swans on their lands and will protect these birds from disturbance during the nesting season. Lacreek NWR staff will make information, such as the current population status or threats to the population, available to private landowners in the sandhills via the station's website and the Sandhills Taskforce.

Survey biologists will evaluate habitat conditions during the fall production surveys and summarize them in annual reports. Any additional habitat areas will be evaluated by the agency with jurisdiction in the area. Lacreek NWR will continue using moist soil management techniques to provide 200 to 300 acres of food resources annually, to include species such as waterweed, *Potamogeton spp*., and arrowhead. The acreage will be determined through mapping with a GPS unit. Management will also be evaluated based on species composition within key wetlands, and will be determined using the Daubenmier technique in 1m x 1m plot at predetermined points throughout the wetland (Appendix B). The management objective is to have at least one wetland meet the criteria below in two of every five years: 1) ≥30% of plant species composition being waterweed, 2) ≥15% being sago pondweed, 3) ≥10% being Richardson's pondweed (*P. richardsonii*), or 4) ≥15% being arrowhead. Percentages will vary temporally depending on stage of wetland succession. For example, sago pondweed may be more prevalent after a complete or partial drawdown, and less prevalent when water levels are higher. Thus, the composition goal for sago pondweed will likely be met two out of every five years, but not every year because of changes in water management.

3. Provide wintering habitat among 10 different locations in Nebraska and South Dakota for up to 600 trumpeter swans.

Open water and adequate food supplies are the main resources needed for winter survival by HP trumpeter swans (Pelizza 2001). Currently, these resources are dispersed throughout the High Plains at several different sites, including Lacreek NWR and the Snake River. Swans will move between these sites in order to find adequate resources for over-winter survival (S. Comeau, Lacreek NWR, personal observation). This movement may result in less pressure on the resources at a single site because large concentrations of swans are limited to brief periods. On Lacreek NWR, the average number of swans in the winter of 2009/2010 was 64 birds, but dropped to 0 when a week-long cold snap occurred and swans moved off the Refuge. However, within a couple of weeks, temperatures and open water increased, as did the number of swans on the Refuge to 262 total birds.

Managers of the HPF believe there is adequate winter habitat available in South Dakota and Nebraska to sustain a population of 600 wintering trumpeter swans. Therefore, encouraging swans to move south through direct interventions (e.g., translocating birds) currently are not warranted. However, trumpeter swans seem to be exploring more southerly location on their own and unmarked birds have been seen at Quivira NWR in Kansas and parts of Oklahoma. It is probable that these birds are from the HPF because birds from other portions of the Interior Population range are marked with neck collars. Still, the amount of suitable habitat south of Nebraska is uncertain. There are few locations that could provide the resources for over-wintering swans, but increased human activities could raise the likelihood of mortality through power line collisions (L. Gillette, The Trumpeter Swan Society, personal communication). Additionally, other flocks within the Interior Population (e.g., Minnesota and Wisconsin) are being encouraged to migrate to more southerly locations, and some birds from nesting flocks in Iowa have been actively translocated to Arkansas in an attempt to establish migratory pathways.

Strategies

Swans frequently use streams and rivers in the winter because flowing water maintains open areas and allows the movement of food resources through the system (Pelizza 2001). Various rivers and creeks provide open water during winter, as does as Lacreek NWR when temperatures are moderate. Many of the major pools on the Refuge were created by placing dikes along Lake Creek; thus, these water bodies can function as a stream system. The use of periodic drawdowns will restore/maintain channels and allow deep water areas within pools. In turn, these deeper water areas can remain open and provide habitat for swans on the Refuge. Also, two spring-fed ponds supply additional open water areas on the Refuge. These areas will be closed when swans began to concentrate to reduce stress and allow swans keep water open through use. Currently, trumpeter swans overwinter at seven different locations, and the Refuge believes that these management actions will maintain this number of sites and create additional ones.

Key wintering areas for the HPF include the Snake, Niobrara, North and Middle Loup, North Platte and Calamus rivers, and Birdwood and Blue creeks. The areas of these rivers and creeks where most swans congregate in winter consist of narrow, winding channels with shallow water and contain open water throughout or most of the winter period. Subaquatic vegetation provides food resources for the swans, although most of these areas have adjacent corn fields that may or may not be used by swans. Critical to ensuring future use of these areas by swans includes protecting the natural hydrology of Sandhills streams and monitoring and controlling invasive species. Both of these threats may impact vegetation used by swans in those areas.

Trumpeter swan managers will work with partners (e.g., Great Plains GIS Partnership, Sandhills Taskforce) to identify three additional wintering areas in portions of the Sandhills that currently are not used. If conditions at the seven current sites become degraded to the point that they are not suitable for swans, replacement sites will be identified and managed appropriately.

4. Reduce known mortality factors within the current range of the HPF and investigate factors that could limit expansion within its historical range.

The main mortality issues in this region are related to lead poisoning and collisions with utility poles and fences. Also, icing on neck collars has been observed within this flock, which is thought to contribute to stress during the winter. However, such icing has not been directly related to mortality events in the HPF. Swans are particularly susceptible to lead poisoning which may affect swans as young as 3 weeks old (Mitchell 1994). Lead deposits in the High Plains are generally thought to be the result of pellets deposited from spent shotgun shells and from fishing sinkers. According to a study done by Pelizza (2001), elevated levels of lead were found in 50% of all swans tested during his study, but it is not known exactly where the lead was acquired. Additionally, 12 swans died on Lacreek as a result of lead poisoning from 1979 to 1994 (Lacreek NWR files).

Collisions with power lines and wire fences have been documented in Wyoming, Montana, and Minnesota (Lockman et al. 1987, Gillette 1990, Lockman 1990, S. Comeau, Lacreek NWR, personal observation). Collisions could occur within the High Plains as well, and efforts should be made to reduce the probability of this event where possible.

Strategies

The Service will investigate all swan mortalities on refuges in South Dakota and Nebraska. Carcasses will be submitted to the National Wildlife Health Center in Madison, Wisconsin to determine the cause of death.

Since lead is a known toxin, every effort should be made to reduce lead on public lands utilized by swans. Currently, the use of nontoxic shot is required for waterfowl hunting statewide in South Dakota and Nebraska. Furthermore, nontoxic shot is required for all shotgun hunting of upland game birds and small game on National Wildlife Refuges, State Game Production Areas, and Federal Waterfowl Production Areas. Lacreek NWR

and N G P C will continue to enforce already established bans on lead and pursue additional bans on public lands that swans are known to inhabit, including the use of lead sinkers. Additionally, information will be disseminated to hunters and anglers about the effects of lead on waterfowl when they receive their licenses and through the local media. In 2008, the use of lead sinkers was banned to reduce the amount of lead in wetlands used by swans. To investigate the prevalence of lead persisting on Lacreek NWR, core sampling will occur on the Trout Ponds which is frequently used by anglers.

Management agencies should inform utility companies of their responsibility to minimize collisions in accordance with the Migratory Bird Treaty Act, and cooperate with them to develop and implement plans and techniques (e.g., alternative placement of powerlines, effective line-markers and marking strategies). Most nesting and wintering areas have been identified and mapped by wildlife managers as well as power lines by utility companies; this information can be combined to prioritize areas for line modifications. For example, power lines on a small section of land on Lacreek NWR were buried to decrease the probability of collisions occurring with all migratory birds and another section was retrofitted after several hawks and an eagle were electrocuted.

Management agencies should not conduct neck collaring activities unless specific and quantifiable information available only by using neck collars is needed for the management of this flock. The accretion of ice on neck collars has been documented at Lacreek, Red Rock Lakes, and Seedskadee NWRs and is suspected to contribute to the mortality of birds at Lacreek.

CONSULTATION AND COORDINATION

Lacreek NWR and NGPC will continue to manage for trumpeter swans within the High Plains, but as this flock expands additional agencies and organizations will have an important role in the management of swans in the Central Flyway. Some of those partners include:

Trumpeter Swan Society
Oglala Sioux Tribe
U.S. Geological Survey
U.S. Fish and Wildlife Service Private Lands Program
Sandhills Taskforce
Great Plains GIS Partnership
Rosebud Sioux Tribe
Nebraska Natural Legacy Project
U.S. Fish and Wildlife Service, R6, Migratory Birds and State Programs

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Appendix A. Summary results from the fall production survey of the High Plains Flock of trumpeter swans 1989 to 2010.

Year	White Birds	Cygnets	Pairs	Broods	Production Rate	Total
1989	152	79	51	30	0.52	231
1990	127	68	41	22	0.54	195
1991	117	89	44	24	0.76	206
1992	126	102	48	30	0.81	228
1993	115	58	42	21	0.50	173
1994	164	85	54	32	0.52	249
1995	168	46	48	17	0.27	214
1996	129	78	52	22	0.60	207
1997	171	86	51	29	0.50	257
1998	184	91	62	32	0.49	275
1999	206	105	69	36	0.51	311
2000	235	86	56	28	0.37	321
2001	177	45	68	18	0.25	222
2002	264	121	67	38	0.46	385
2003	213	51	54	26	0.24	264
2004	284	107	100	40	0.38	391
2005	284	74	96	29	0.26	358
2006	360	67	124	20	0.19	427
2007	321	77	97	33	0.24	398
2008	314	115	113	43	0.37	429
2009	352	171	131	63	0.49	523
2010	350	174	121	66	0.50	524
Average	**219**	**90**	**72.23**	**31.77**	**0.44**	**309**
SE	**17.42**	**7.06**	**6.31**	**2.30**	**0.16**	**22.01**

Appendix B. Results of the submerged aquatic vegetation survey in Pool 5, Lacreek NWR, 2004-2010.

Species	2004 % Composition	2006 % Composition	2008 % Composition	2010 % Composition
arrowhead	<1*	1	3	0
wild celery	15	3	13	1
sago	26	3	0	0
coontail	<1*	4	16	54
Richardson's pondweed	16	22	1	<1*
duckweed spp.	2	2	9	1
floating-leaf pondweed	6	28	19	22
milfoil	0	1	0	0
Elodea (waterweed)	0	0	14	18
bladderwort	0	0	5	0
wild rice	0	0	6	2
bushy pondweed	0	0	6	0
open water	33	36	7	1

* Indicates it was observed in the wetland and recorded in cover but was less than 1 so the species composition calculation was 0.

Appendix C. Results of the submerged aquatic vegetation survey in Pool 6, Lacreek NWR, 2004-2010.

Species	2004 % Composition	2006 % Composition	2008 % Composition	2010 % Composition
wild celery	12	7	0	8
sago	3	7	0	0
coontail	5	7	16	33
Richardson's pondweed	0	0	7	0
duckweed spp.	0	1	12	<1*
floating-leaf pondweed	<1*	1	19	21
longleaf pondweed	<1*	0	0	0
Elodea (waterweed)	0	28	23	15
wild rice	0	17	17	0
arrowhead	0	0	<1*	0
widgeon grass	0	0	0	2
bladderwort	0	0	0	1
bushy pondweed	5	0	0	3
open water	75	34	7	17

* Indicates it was observed in the wetland and recorded in cover but was less than 1 so the species composition calculation was 0.