



The Future of Trumpeter Swans in Yellowstone National Park

Final Report Summarizing Expert Workshop, April 26-27, 2011

Natural Resource Technical Report NPS/XXXX/NRTR—20XX/XXX



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ON THE COVER

Trumpeter Swans flying over Yellowstone National Park
Photograph by: Douglas W. Smith, Yellowstone National Park

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Executive Summary

Trumpeter swans (*Cygnus buccinator*) were first documented in Yellowstone National Park (YNP) in 1919 and were considered the last population of trumpeter swans (henceforth swans) in the continental United States. The population increased through the middle part of the 20th century, but decreased thereafter with the steepest decrease from the early 1990s through the present. In 2010, only five swans were resident in YNP and there has been no swan reproduction for two years. As a result, the resident swan population in YNP is in danger of extirpation.

Staff from YNP organized a two-day workshop with swan and wetlands experts on April 26-27, 2011 to assess possible causes for the decrease in swan abundance and to recommend management actions. Some possible reasons for the decrease were human disturbance, swan management outside YNP, habitat change, and predation. None of these potential reasons were favored and all could be interacting with each other. Potential management actions include greater protection from human disturbance (trail and campsite closures), augmentation of the swan population (reintroduction), habitat modification (artificial nest structures), or further research to better direct management actions. Workshop participants emphasized the need to act quickly because if resident swans are extirpated in YNP it will be more difficult to restore them. Therefore, this report identifies short- and long-term management recommendations.

Workshop Objectives

This report is a summary of the information provided at the swan workshop. It starts with background information on swan population trends over time in YNP, the greater Yellowstone region, and the entire Rocky Mountain flyway. We examine possible contributing factors for these population trends that can be related to management practices. Recommendations suggested by the experts follow, and are divided into recommendations specific to YNP, recommendations for regional management actions, and recommendations for further study.

Overview of Conclusions and Recommendations

The main conclusions from the workshop were as follows:

- Trumpeter swans are an iconic species with an important history in YNP, and efforts should be made to protect them and educate people about them.
- There were two differing opinions about managing swans in the park. One opinion was that we need to understand and address the factors contributing to the decrease of swans in YNP before augmenting the population. The second opinion was that we should augment the population with cygnets now, while there are still several swans in the park, because the success rate will be higher assisting established pairs than trying to introduce swans after all the residents are gone and swans have no fidelity to the area.
- The trend of decreasing swan abundance in YNP is consistent with a regional trend throughout the core area for swans in the greater Yellowstone area (i.e., YNP, Grand Teton National Park, Red Rocks Lakes National Wildlife Refuge, and surrounding area); therefore, a coordinated regional effort is needed to reverse this trend.

- Conversely, swan numbers are increasing in the area adjacent to the population core (called the expansion area) and the rest of the flyway. It is unknown why the greater Yellowstone core region is experiencing a decrease in swans and how this will affect the population as a whole.
- Recommended short-term management actions:
 - Increase monitoring efforts on the remaining swans in YNP.
 - Coordinate with the Ranger Division and other park staff about closing specific areas to human activity where swans are nesting.
 - Monitor the lone swan on the Madison River near 7-mile bridge and introduce up to three swans as possible mates. (This bird has been present and alone for three years after the previous mate died.)
 - Monitor the pair of swans at Riddle Lake and, if the nest is about to flood, rescue the eggs for captive rearing or graft captive cygnets to the wild pair.
 - Monitor the Grebe Lake pair and consider cygnet grafting in the case of a failed nest attempt.
 - Install artificial floating nest platforms away from the shore at Grebe Lake, East Tern Lake, and 7-mile bridge in autumn 2011.
 - Non-invasively obtain genetic samples from all swans in YNP.
- Recommended long-term actions:
 - Enhance regional coordination of swan research and management.
 - Mark birds to assess connectivity between areas and survival of swans in the area.
 - Continue to monitor swan activity in YNP and institute necessary area closures.
 - Add artificial nest platforms to other suitable sites.
 - Continue population augmentation as necessary.
 - As necessary, close areas to humans to protect swans.

Acknowledgments

This report is dedicated to George Melendez Wright (1904-1936), the first National Park Service Chief of Wildlife, for his efforts to conserve Trumpeter Swans in Yellowstone National Park and throughout the United States.

This report is a result of presentations, discussions, and input from the following experts:

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Background

At the turn of the 20th century, trumpeter swans (*Cygnus buccinators*) were nearly extirpated in North America due to hunting (Banko 1960), except for a pair of nesting swans found in YNP in 1919 (Skinner 1920). In 1922, “about 15” swans were documented in Red Rock Lakes, and by 1932 summer surveys found 57 adults and 12 cygnets in the greater Yellowstone region. These were the only swans known to exist (Banko 1960), though unrecorded flocks existed in Canada and Alaska (Mitchell 2010). This led to the designation of Red Rock Lakes National Wildlife Refuge in 1935, specifically to protect trumpeter swans.

During the 1930s to the mid-1950s, YNP and the surrounding region was a stronghold for trumpeter swans. In fact, the Interior population of swans in the mid-western United States was created by the re-location of swans from Red Rock Lakes National Wildlife Refuge. Between 1938 and 1983, 208 adults, 323 cygnets, and 160 eggs were removed from Red Rock Lakes to captive breeders and zoos, and to establish other flocks (Gale *et al.* 1987).

Trumpeter swans are categorized into several populations based on the flyways, even though these flocks are not genetically distinct (Figure 1). Once conservation measures were enacted, these populations responded with steadily increasing numbers (Figure 2). The Rocky Mountain population consists of a Canadian flock that breeds in Canada but overwinters in United States and a Tri-state flock (Montana, Idaho, and Wyoming) that breeds and winters in the greater Yellowstone region.

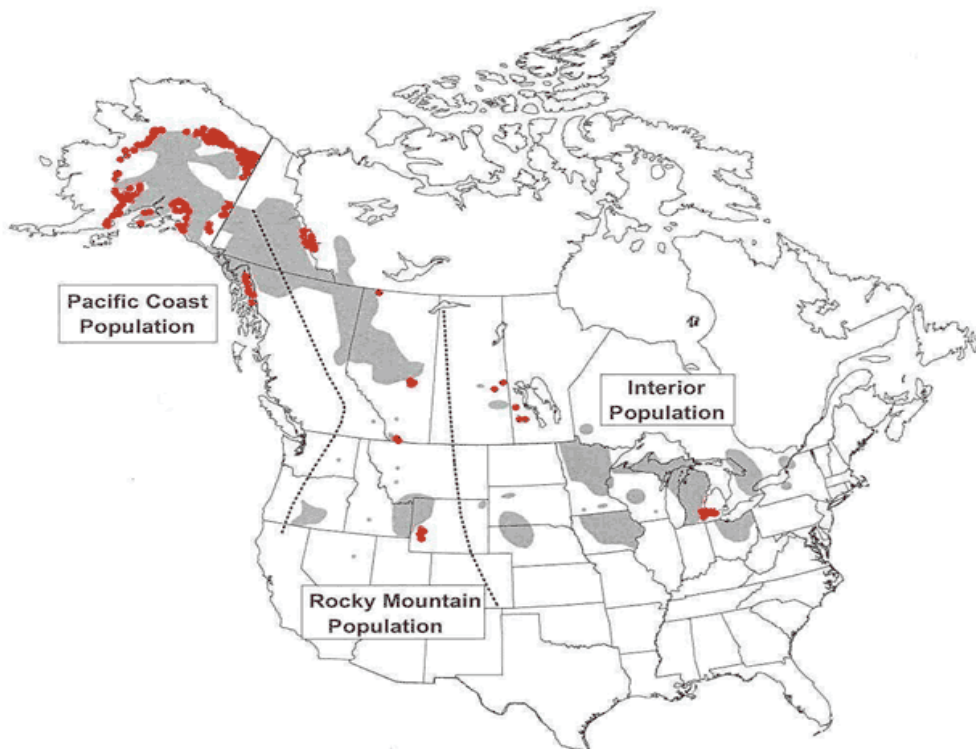


Figure 1. Map of trumpeter swan Populations in North America. Red indicates expansion areas.

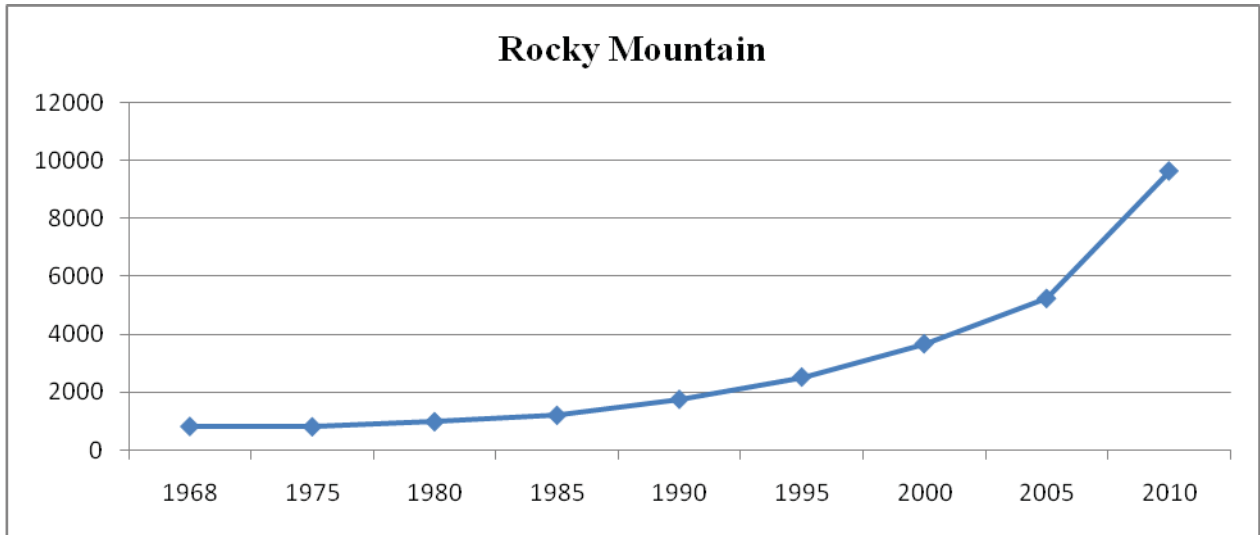
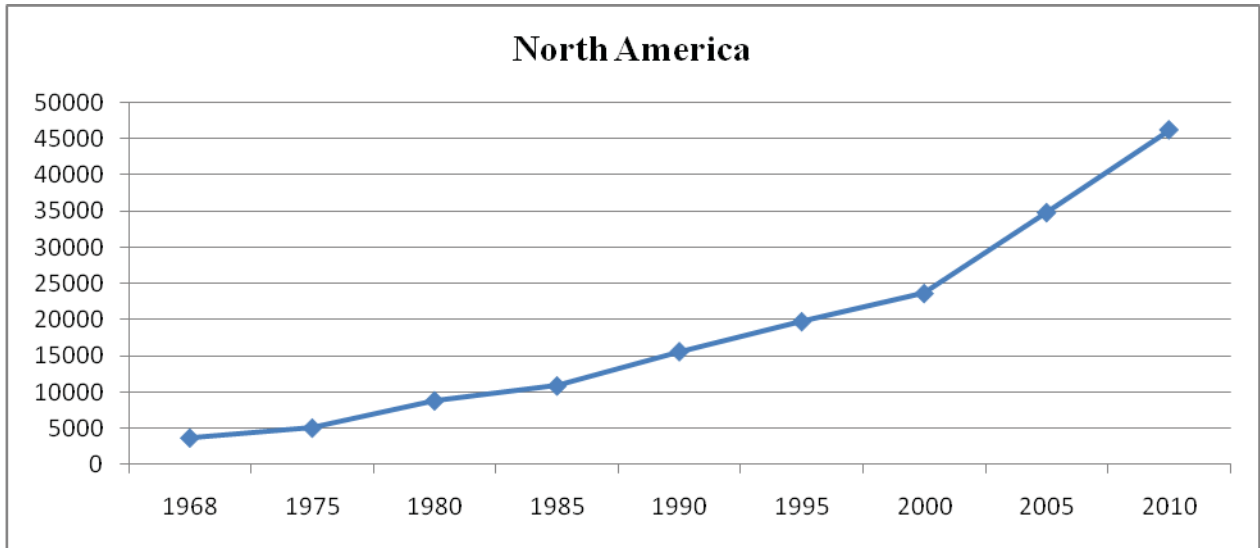


Figure 2. Estimated population size for the North America population of trumpeter swans (top) and the Rocky Mountain flock (bottom; Trost 2011).

Population Trends in Yellowstone National Park

George Melendez Wright, the first Chief of the Wildlife Division in the National Park Service, led efforts that saved trumpeter swans in the lower 48 states. He launched a public campaign to end the shooting of swans in the region surrounding YNP, which threatened to eliminate them. Wright also persuaded Ding Darling and President Roosevelt to establish a refuge at Red Rock

Lakes to halt the illegal shooting of swans and protect nesting habitat. Further, Wright launched a series of key studies of trumpeter swans in the region (Banko 1960, Thompson 1981).

Following the protocols developed by Wright, the National Park Service continued studies of nesting trumpeter swans in the greater Yellowstone region between 1936 and 1941 (Childs 1934, Barrows 1936, 1937, 1938; Oberhansley 1938, Condon 1941). During this time, cygnet production and swan abundance within the park were strong. Between 1931 and 1940, the number of nests per year ranged from 3 to 13, producing in total 69 nests that reared 123 cygnets (average 1.8 cygnets per active nest). The cygnets produced per year ranged from 2 to 29 and abundance ranged from a low of 14 adults in 1931 to a high of 51 adults in 1939 (Condon 1941). There was a strong tradition of nesting in Yellowstone lakes and high fidelity to nest sites (Table 1).

Table 1. Lakes with nesting activity in Yellowstone National Park during 1931-1940 (Shea 2011).

Lake	Years with Nest	Cygnets per Nest Attempt (average)
Trumpeter	10	30/10 (3.0)
Tern	7	20/7 (3.9)
Heart	6	12/6 (2.0)
Riddle	6	11/6 (1.8)
Shoshone	5	11/5 (2.2)
Swan	5	7/5 (1.4)
Beach Springs	4	9/4 (2.3)
Geode	4	7/4 (1.8)
Grebe	2	5/2 (2.5)
Lewis	2	3/2 (1.5)
Madison Junction	2	1/2 (0.5)
Crescent Hill Pond	4	0/0 (0)

Starting in the early 1960s, however, cygnet production in YNP decreased (Table 2). Between 1930 and 2010, a total of 486 cygnets fledged, and 388 (80%) of them were produced from the best 12 lakes (Table 3). This trend continued into the 1970s when nesting pairs decreased from 18 in 1977-78 (Table 4) to about 6 by 1984 (Gale *et al.* 1987). During this time, the clutch size was the lowest of any population studied in North America, with a mean size of 3.9 (range of 2-6, n = 35). This was down from a mean of 5.3 between 1919 and 1933 and suggested an increase in nutritional stress or adverse genetic effects due to small population size. Cygnet survival was only about 10 percent (Shea 1979). Swans in the park typically exhibited low clutch size, poor hatch rates, and weaker, smaller cygnets that died soon after hatch. By the autumn survey in 1983, nesting territories in YNP had decreased from 21 to less than 10, and adults had decreased from 51 in 1977 to 29 in 1983.

Table 2. Decrease in cygnet production in Yellowstone National Park during 1930-2010 (Shea 2011).

	Adults Mean (range)	Cygnets fledged Mean (range)	Broods fledged Mean (range)
1930s	29.4 (14-47)	11.8 (2-29)	3.7 (1-8)
1940s	44.1 (39-54)	12.9 (8-21)	4.8 (3-6)
1950s	56.9 (44-62)	13.3 (9-23)	4.9 (3-7)
1960s	56.7 (44-69)	6.1 (2-12)	3.0 (2-4)
1970s	44.3 (30-52)	3.4 (1-4)	2.4 (1-5)
1980s	33.3 (24-49)	5.8 (0-12)	1.9 (1-4)
1990s	24.7 (18-32)	2.1 (0-3)	0.9 (0-2)
2000s	14.3 (4-22)	2.0 (0-7)	0.7 (0-2)
2010	4	0	0

Table 3. Cygnets fledged from the most productive lakes in Yellowstone National Park during 1930-2010 (Shea 2011).

Site	Last Cygnet	1930-59	1960-89	1990-2010
Trumpeter	1995	38	0	2
Madison Junction	1962	35	1	0
Geode	1963	35	1	0
Grebe	1952	35	1	0
Tern	1988	34	12	0
Riddle	2008	32	22	20
Robinson	1998	16	2	6
Shoshone	1962	14	3	0
Heart	1961	12	2	0
Beach Springs	1990	12	5	2
Swan	1966	10	7	0
7-Mile Bridge	1994	0	5	24
TOTAL		273	61	54

Table 4. Nesting success for trumpeter swans using 21 different territories in Yellowstone National Park during 1977-79 (Shea 1979).

	1977	1978	1979	Total
Occupied Territories	20	20	20	60
Active nests	16	18	16	50
Successful nests (%)	11 (69%)	5 (28%)	9 (56%)	25 (50%)
Cygnets hatched	35	12	19	61
Cygnets fledged	7	2	3	12
Broods fledged	4	2	2	8

During Shea’s surveys (1979), predation was an occasional, but unimportant mortality source for the population. Instead, observations suggested human disturbance was a contributing factor to lower nesting rates. Shea (1979) suggested that three swan territories in the park were no longer suitable, and others were in jeopardy of being lost, due to human disturbance. These disturbed territories showed reduced nesting effort—a lower rate of occupancy and fewer nest attempts when occupied. Shea (1979) also found that nests were often close to shore due to scarcity of islands or robust emergent vegetation and, as a result, the impact of disturbance may have been greater. Though a number of studies have looked at nest success and disturbance factors (see Figure 3, for an example), the relative importance of disturbance or predation varies.

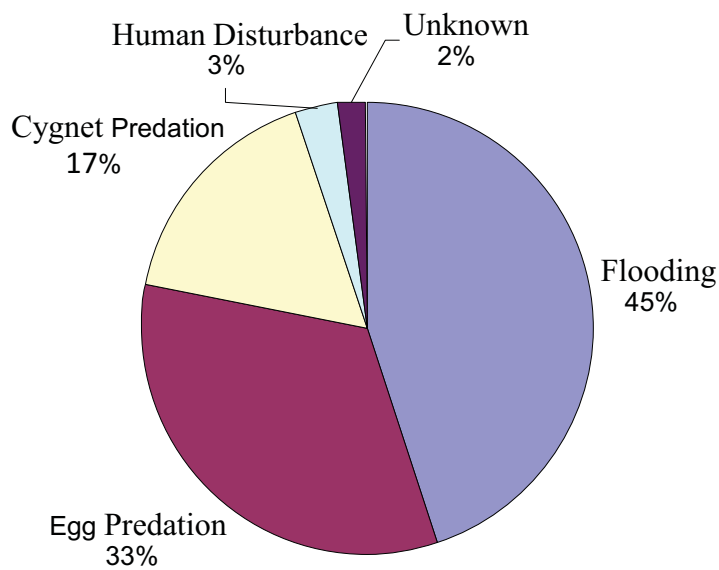


Figure 3. Disturbance factors associated with a lack of fledging success for trumpeter swans in Yellowstone National Park (Proffitt et al. 2010).

Numbers of trumpeter swans in YNP have decreased substantially (Figure 4). In 2010, there were only five resident swans in YNP—a nesting pair at Riddle Lake; a territorial (non-nesting) pair at Grebe Lake; and an individual female at 7-mile bridge. What is happening in YNP is symptomatic of the decrease in the entire core area of the greater Yellowstone region.

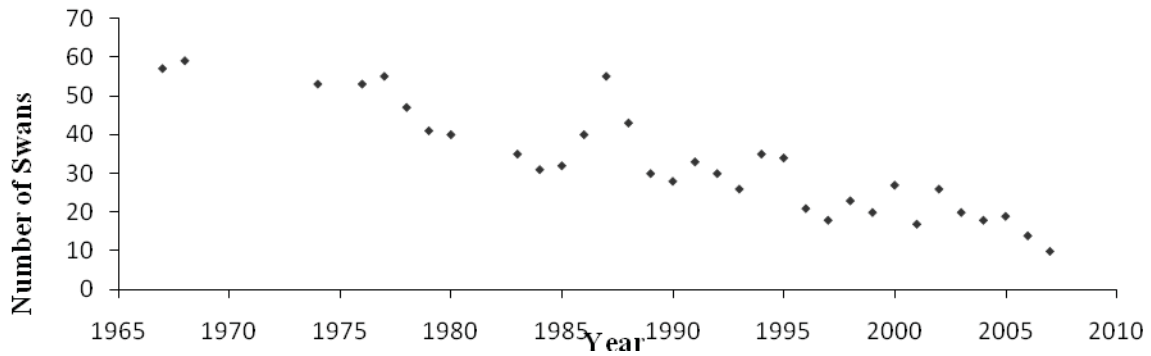


Figure 4. Abundance of adult, resident trumpeter swans in Yellowstone National Park (Proffitt et al. 2009).



Nesting swans at Grebe Lake
PHOTO CREDIT: Doug Smith

Population Trends in the Greater Yellowstone Region

The “core” area within the Rocky Mountain population of Trumpeter Swans is considered the greater Yellowstone Region comprised of Yellowstone National Park, Red Rock Lakes National Wildlife Refuge, and several other key strongholds (Figure 5). The Tri-State area consists of Montana, Idaho, and Wyoming and those sites outside the “core” area that are considered “expansion areas” for swans (Figure 6).

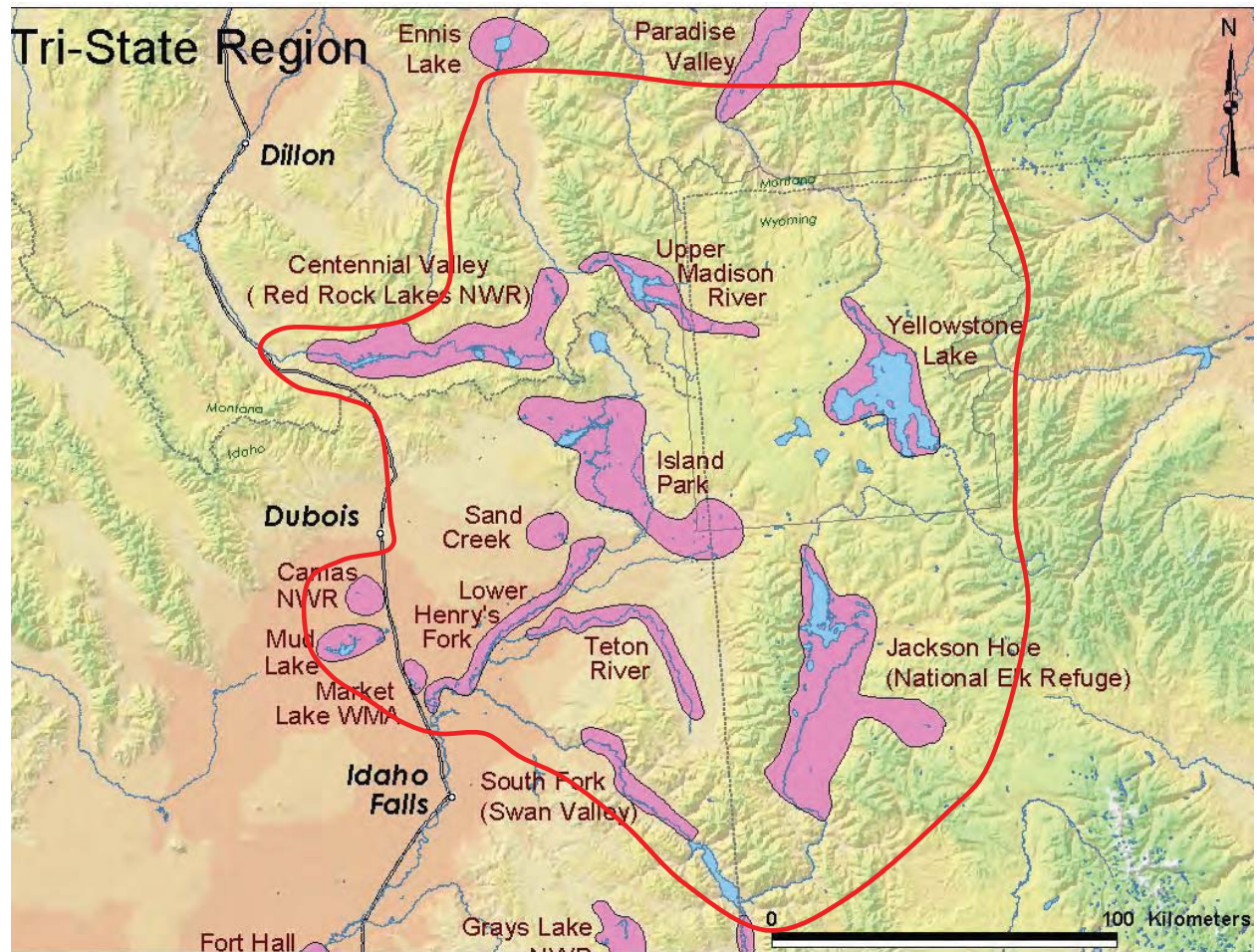


Figure 5. Within the Tri-State Region, the area outlined in red is considered the “core” area of the Rocky Mountain flock of Trumpeter Swans, also known as the greater Yellowstone region.

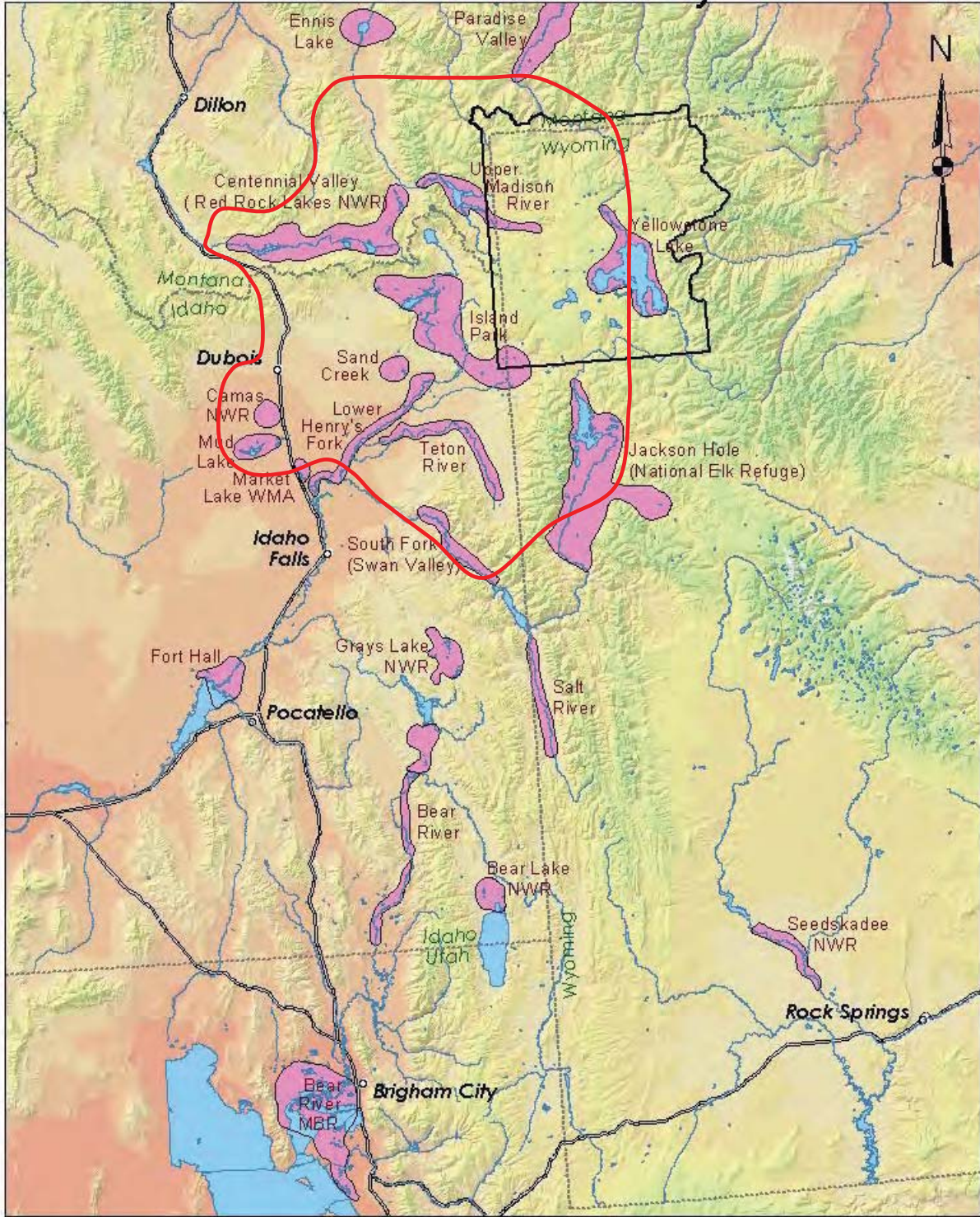


Figure 6. Another map of the Tri-State Region showing the “core” area outlined in red, and other sites (shaded) considered as “expansion areas” for Trumpeter Swans.

Similar to the trends within YNP, the 1930s through the 1950s were peak years for trumpeter swans in the greater Yellowstone region, with YNP being an important contributor to the population (Table 5). Nesting swans increased to over 100 adults in 1939, 200 adults by 1944, 300 adults by 1949, and 550 adults in 1954 (U.S. Fish and Wildlife Service, unpublished data).

Table 5. Peak counts of trumpeter swans in the core area of the greater Yellowstone region during 1932-1934.

	Nesting pairs	Breeders	Non- breeders	Adults	Cygnets
Yellowstone National Park	8	16	13	29	17
Red Rock Lakes/ Centennial Valley	7	14	6	20	26
Henry's Lake, Idaho	3	6	7	13	5
Wyoming	1	2	1	3	1
Total	19	38	27	65	49

There was high cygnet mortality during the 1960s and 1970s, possibly due to managed water levels in the reservoirs and a series of spring flood events. Also, adult swans experienced a 22% decrease in numbers between 1964 and 1968. Shea (1979) found cygnet production in the park and the surrounding region was below the level necessary for self-replacement, and concluded that if this trend continued, the regional population would decrease. In the early 1980s, Red Rock Lakes National Wildlife Refuge experienced extremely low production (<5 cygnets fledged in 1980, 1982, and 1984) and a further decrease in regional adult numbers occurred. In response to this trend, Wyoming marked and studied resident swans between 1982 and 1986, and began a 20-year effort to expand their distribution in western Wyoming (Lockman *et al.* 1987). These expansion efforts were successful and, swans are currently increasing in numbers in this expansion area (Figure 7). Indeed, the rate of increase in abundance for swans in the western Wyoming expansion area has outpaced the rates of increase in expansion areas in Montana and Idaho (Figure 8).



PHOTO CREDIT: Doug Smith

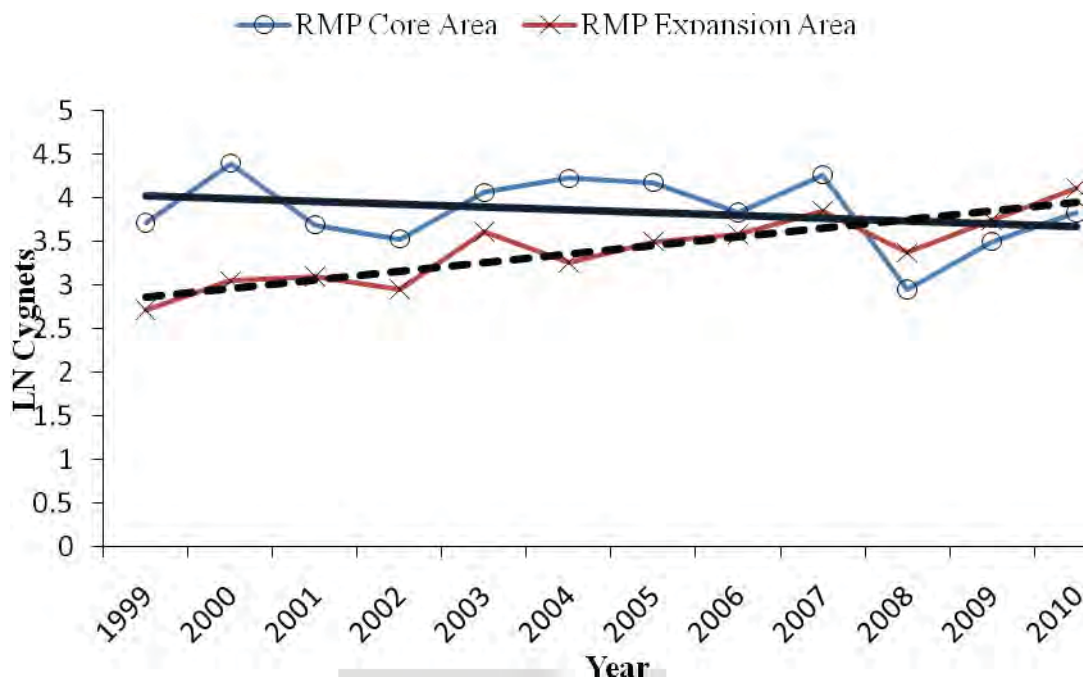


Figure 7. Recent trends in cygnet production in the Rocky Mountain population (RMP) “core” area in comparison to the expansion area in western Wyoming where active habitat restoration and population augmentation has taken place (Olsen 2011).

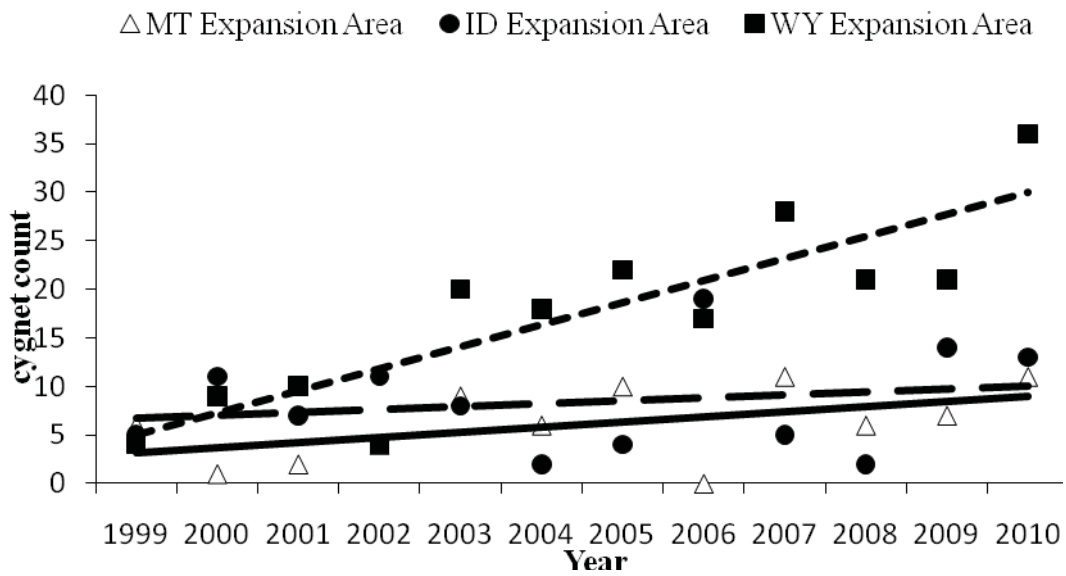


Figure 8. Recent trends in cygnet production in expansion areas in the Tri-state area of Montana (MT), Idaho (ID), and Wyoming (WY) (Olsen 2011).

While the cygnet production is low in the core area of the greater Yellowstone region compared to the expansion areas, there has also been a recent increase in wintering swans in the core area. Midwinter surveys in 1994 found in excess of 2,000 swans wintering in the core area. This number increased to 3,000 by 1999 and 4,000 by 2005. This led to speculation about the impacts of migratory trumpeter swans from Canada on the habitat and behavior of resident swans, though Proffitt *et al.* (2009) concluded that there was no significant effect.

Policy

Trumpeter swans are managed under the authority of the Migratory Bird Treaty Act. The U.S. Fish and Wildlife Service policy is to support restoration of migratory trumpeter swan populations and introduce birds in suitable habitat (expansion areas) in a way that increases connectivity and develops traditions that will not crowd overwintering areas. The Service has not introduced birds into the core area of the greater Yellowstone region because of winter habitat limits, however, their priorities are to augment swans in suitable habitat throughout the region and prevent the extirpation of trumpeter swans in YNP.

MANAGEMENT ISSUES

The exact causes of the decreased abundance of Yellowstone swans are unknown, but several hypotheses were posed for investigation and management attention:

- There may be insufficient food, or insufficient nutritional quality, available within YNP to support successful nesting and fledging.
- The wetland quality in YNP and throughout the region has decreased, and does not provide sufficient conditions to attract nesting pairs—particularly in the numbers needed to sustain the population.
- As the numbers of swans in the region have decreased due to changes in management practices in Red Rock Lakes National Wildlife Refuge and other places, there are fewer swans dispersing into YNP to establish their territories.
- Management changes, the availability and location of winter habitat, and competition with Canadian swans may be inhibiting the establishment of nesting pairs in YNP.
- Because of tradition and high fidelity to nesting sites, YNP may have a flock of swans genetically predisposed to small clutch sizes and weak cygnets.
- Human disturbance and predation preclude successful nesting and fledging at the rate necessary for self-replacement. (Or perhaps YNP swans are genetically predisposed to a behavioral trait of being disturbed more easily, thereby contributing to not establishing nesting sites or being flushed from the nest more easily by disturbance.)
- Swans are expanding to restoration areas and traditions are developing around those sites rather than sites in the Yellowstone region.

Factors that potentially contributed to decrease in swan abundance in YNP are discussed below.

Food Sources

The decrease in swan numbers in the greater Yellowstone core area is potentially due to a shortage in availability or deficiency in quality of food through the year. While some apparently excellent food sources exist, and some birds take advantage of this and show large clutch size and healthy cygnets, it is not clear why more birds do not take advantage of these resources, or why these resources do not exist throughout more of the region.

In YNP, clutch sizes were large and there was no evidence of nutritional stress between 1919 and 1933. More recent data and trends, however, indicate small clutch sizes, low hatch rates, and weak cygnets. Has something about the food source in YNP or the region changed to account for the decline in condition?

There has also been a history of feeding swans (most notably at Red Rock Lakes National Wildlife Refuge between 1936 and 1992). This management practice artificially increased swan numbers and was shown to discourage migration, so the practice was stopped.

More recently, and most prominently in Idaho, swans have become reliant on seed potatoes and grains, particularly in the winter. Throughout North America, swans are increasingly using

agricultural lands for winter feeding. How does this impact their overall nutrition and condition going into the breeding season?

Individual Behavior and Life History

Trumpeter swans are long-lived birds that form monogamous pairs and exhibit a high fidelity to nest sites. They have a strong sense of tradition to established territories, and when that tradition is altered or interrupted, it is difficult to reestablish. Tradition is behavior learned from parents, and it is common to see multiple generations nest in proximity to each other. Establishing traditions through new site selection by sub-adults is critical to expand territory and numbers of nesting pairs.

Individual behavior influences pair formation, establishment of territory, nest site selection, susceptibility to disturbance or individual avoidance tendencies, as well as variation among females in clutch size, egg size, and fledge success. Individual behavior studies would help us understand dispersal patterns and how sub-adults identify new territories.

The greater Yellowstone region has a relatively high proportion of non-breeding adults, but little is known about the demographics and age structure of these birds. Also, energetic studies of individuals would help us understand the needs of individuals in this region compared to areas where swans are thriving.

Genetics are also important to understand individuals in the Yellowstone population compared to the region. Observations have indicated that YNP has traditionally had more white-colored cygnets than typical in the region. Perhaps genetics could partially explain why YNP has smaller clutch size, poor hatch rates, and weak cygnets.

Wintering Habitat

Yellowstone National Park and the greater Yellowstone region in general, provide relatively harsh conditions for over wintering. Birds have not been introduced into this region because of concerns over crowding in the relatively few suitable wintering areas. Agricultural lands have increasingly played a more important role in providing winter habitat and probably account for the population increases outside the greater Yellowstone region in the expansion or restoration areas.

Red Rock Lakes National Wildlife Refuge has a management target of no more than 10 percent of the population wintering at the refuge to prevent crowded conditions and encourage dispersal. This management objective was the primary reason for the decision to stop winter feeding. Active hazing has been a management practice in Harriman State Park in Idaho and has met with mixed results. The impact of Canadian swans on the wintering habitat and condition or behavior of the Rocky Mountain population as a whole is unknown.

Wetlands and Breeding Habitat

Wetlands are critical to improve the quality of breeding habitat. Swans need healthy wetlands for optimum use that includes dynamic hydrology (changing water depths), the interaction of ground water and surface water, the interaction of wetland components (edge, vegetation types, structure, etc.) in a wetlands complex, variation in salinity, and bare mineral soils for best food

production and availability. Most adults forage within a 5 kilometer range from the nest site, so suitable nesting sites must be relatively close to optimum food sources.

Nesting success and cygnet production is highly dependent upon cool, wet summers that allow the persistence of wetlands, and low spring precipitation that limits the impacts of flooding. It is not well understood what wetland characteristics attract sub-adults to establish territories, but nesting success has been shown to be dependent upon fidelity of occupancy or use of traditional nesting sites.

Studies have shown how changes in wetlands have impacted swans. For example in the Henry's Fork, vegetation diversity and structure, and access to food sources has decreased due to increasing water depth. Red Rock Lakes National Wildlife Refuge stopped winter feeding and shifted to a more natural hydrological function to encourage the establishment of and access to natural food sources.

Lakes in YNP are generally not good nesting sites, though nesting success is highly variable. Swans used 29 lakes in the park between 1931 and 1940, but now only two lakes have recent nesting activity. In addition, the trend over recent decades indicates that most nest sites in YNP have been unproductive or produced low fledging rates.

Role of Disturbance

The relative importance of disturbance and predation in nesting success is not known, but clearly they have some level of negative impact. If hens are flushed from the nest, the eggs experience fluctuations in temperature and are exposed to predation. In some areas, disturbed sites have less nest attempts and lower occupancy of nests, though specific behaviors of habitat avoidance are difficult to detect. In addition, flushing behavior or susceptibility to disturbance could be an individual trait and dependent upon the individual as much as the site.

It is not known what kind of cumulative effects human disturbance has created for swans. Between 1929 and 1934, illegal shooting was a problem at Red Rock Lakes National Wildlife Refuge, as was human disturbance in YNP. Also, for years swans have been hazed off crowded wintering grounds in places such as Harriman State Park. Trumpeter swans are also susceptible to incidental take during tundra swan hunts, and this trend is likely to continue or increase.

Predation can be a problem in some areas. Proffitt and her colleagues (2010) indicated that predation in YNP accounted for a loss in 33 percent of the eggs, while 45 percent were lost due to flooding. These factors were the most significant contributions to failed nests.

Restoration

Areas outside the greater Yellowstone region have enjoyed increases in swan numbers, at least in part due to augmentation and introduction of birds. Introduction is showing a lot of success in the expansion and restoration areas of the range, and techniques have greatly improved over the years. The knowledge and ability exist to graft and transplant birds successfully. For example, the Green River wetland restoration project in Wyoming has produced one of the most successful flocks in the region. Between 1994 and 2000, there was a consistent management approach to

augment this population and restore the wetland habitats. This could be a model to “jump start” restoration populations in other suitable locations.

RECOMMENDATIONS

The consensus among experts is that to restore the number of trumpeter swans in YNP (to some objective target), and throughout the historic territory in the greater Yellowstone region, there needs to be a combination of near-term, proactive management actions, and long-term (decades), consistent management attention and commitment. Strategic prioritization should focus on the population core (YNP) and those areas where swans have a long history, or tradition, of use.

An adaptive management approach was recommended to initiate action quickly, monitor and evaluate the response, and adjust management based on additional learning. There was a strong recommendation to support studies to help determine why production of swans in the greater Yellowstone core area does not support increasing numbers. Generally, management recommendations reflect the following range of actions:

- **Passive management.** Start by protecting swans and reduce disturbance by managing human access.
- **Research.** Collect as much data as possible (with the least disturbance as possible) and start to relate information to management actions. Design a research program to systematically compile what already exists (including historic and current datasets, use Partners in Flight monitoring protocols, etc.) and collect new information using a consistent method to increase the body of comparable data. Share experiences with other managers and begin to relate trends in data to management actions.
- **Proactive management.** More proactive management includes a range of actions designed to address perceived limiting factors, such as creating or enhancing habitat, or supplementing or growing food. It is understood that these management actions would need to be consistent with the management agency's mission, and dependent upon the local situation and conditions.
- **Restock.** If restocking is a chosen management action, the reasons for restocking should be clear (biological, political, social—iconic or educational values), and the risks and benefits must be weighed. Techniques have been improved and refined over the years, and reintroduction or grafting can be quite successful. For example, there are ways to select for individuals based on behavior and genetics that can increase the likelihood of success.

Because the decrease in swans is not unique to YNP, but is also occurring in, and dependent on, a larger region, another overall recommendation was that there needs to be greater coordination among resource managers to collect and share information on adaptive management practices, and support research targeted to inform management. Therefore, the following specific recommendations are presented in two sections—those relevant to the greater Yellowstone region and those specific to YNP.

Greater Yellowstone Region

The following recommendations are for coordinated efforts among all interests within the greater Yellowstone region; any of these could also be applied in YNP.

1. Better connect research and management throughout the region through a cooperative learning network to look at swan information at a larger scale. To the extent possible, use existing structures such as the Greater Yellowstone Trumpeter Swan Working Group or opportunities such as the Trumpeter Swan Society meetings to increase coordination and move forward with a collective management and research agenda.
2. Define a “swan management area” and identify appropriate cross-jurisdictional boundaries, coordinate actions, learn from experience (adaptive management), and within that area, create a collaborative research agenda to systematically test hypotheses and inform management action. A research agenda should include:
 - a. Landscape analysis—learn from modifications on the landscape (specifically wetlands); examine assumptions about management; how conditions have changed due to climate, water management, and other factors.
 - b. Identify a research flock (or, ideally, several flocks) to learn about the relationship between female condition and nutrition, annual and year-round food sources, wintering habitat, and individual behaviors, life history, and genetics.
 - c. Collect data whenever possible on clutch size, egg size, fertility, incubation stage, and genetic material from down feathers—use existing protocols and existing databases.
 - d. Collect data and document disturbance factors (use established protocols); raise management concerns as appropriate.
 - e. Collect data on nest success, fledging rates and dates, and adult survival at different sites to compare across the region.
 - f. Band, collar, or otherwise mark birds in the region to better understand dispersal patterns and behaviors.
3. Strategic reintroduction or augmentation of swans that encourages tradition and migratory behavior.
4. Explore restoration of wetlands on private lands in the region, and identify the potential for introducing birds into the region on private lands.

Yellowstone National Park

The park currently has a very small flock, and because of this, there were two differing opinions among the experts:

1. With such a small number of swans, learn about the habitat conditions and reasons for decrease in abundance before initiating efforts to introduce new birds into the area.
2. With such a small number of swans, introduce new birds while you still have some residents to be more successful in establishing tradition (it is much more difficult to introduce swans without resident birds there). At the same time, learn about the habitat conditions and reasons for decrease in abundance, and design research to learn as much as you can from the birds you have.

There was agreement within the group that YNP should do everything to keep swans in the park based on the mission of the park to protect wildlife. Trumpeter swans are an iconic species with high symbolic value and YNP’s high profile birds represent an educational opportunity. Also, the historic role of YNP in recovery of the species is an important story.

There were some generalized recommendations for proactive management actions, including:

1. Participate in regional swan conservation efforts; learn from what is happening in other parts of the region and apply appropriate management actions; take the long view and provide consistent support long-term to swan recovery.
2. Where swans are nesting, or where they are establishing territory and preparing to nest, disturbance from visitors should be minimized by closing access where possible.
3. Wetland dynamics and vegetation surveys should be done in the park and compared to historical records to determine what might be the reasons for the decrease in swan numbers over time, and if management actions could reverse the trend.
4. Collect as much information about the remaining swans in the park as possible.
5. Analyze existing datasets (historic and contemporary) and identify possible management implications related to the health of birds and habitat quality and genetics.



Since there are such a small number of swans in the park, the group provided more specific recommendations based on existing conditions:

1. In fragile sites such as Grebe Lake, where there may be a territorial (non-nesting) pair, close access to the site to protect from human disturbance and collect whatever information possible with minimum disturbance to understand more about why no nesting occurs (e.g., genetics, habitat information, and others). Consider augmentation through grafting cygnets.
2. In sites where there is an individual female (such as 7-mile bridge), grafting a 70-day-old cygnet that could carry a leg band could help augment the population and build tradition around that site. It is also an opportunity to collect as much information about habitat and behavior as possible with minimal disturbance.
3. In sites where there is a nesting pair such as Riddle Lake, there are more management options. A nesting pair creates a good opportunity for grafting to augment the population and create tradition. Eggs laid in the wild can also be hatched under captive birds to more easily observe them, their health, and genetics. In these sites it is important to collect as much information as possible about the habitat and the birds to better understand what is happening and why. Web-linked cameras can be used to monitor the nest to allow for both more information and quick response if you decide to graft. Also, if a nest is about to be flooded, it can be salvaged and the cygnets raised under captive birds for observation, banding, and return to the park.
4. If YNP decides to augment swan population numbers through grafting or introduction of sub-adults, there should be an objective number set.

FUTURE RESEARCH

Trumpeter swans are relatively easy to study, and this region has a long history to draw upon. The interest and efforts within the region can help move conservation efforts forward. The following is a list of research needs identified at the expert workshop. Again, it was emphasized that research should be considered a long-term effort, have frequent feedback into management (adapted management and structured decision making), and systematically investigate hypotheses.

- Landscape analysis of wetlands. Compare historic wetlands (hydrology, vegetation, etc.) to current conditions and identify how conditions have changed in a way that may be influencing swans.
- Wetlands research on food production and bird condition. One hypothesis is that the food sources are insufficient to support adequate body condition for successful fledging in the Yellowstone region. Identify the deficiencies and how to address them. Why do some birds take advantage of good food sources and others do not?
- Research on the structural factors of wetlands conducive to nesting and producing adequate food. Understand variability and persistence in the systems, water levels, interaction between ground water and surface water, food sources and vegetation, and other factors that attract swans to nest.
- Understand individual behavior and life history. Why are there so many non-breeding adults in this region? What is influencing site selection? How can nesting traditions be reestablished in the region? Are there genetic factors influencing individual behavior?
- Population research. What are the criteria for delineating populations? What is the sensitivity/response of the flyway population to variability across sites? How does the Canadian population impact the Rocky Mountain population? Why are swans thriving in restoration and expansion areas in the flyway and not within the core greater Yellowstone region? How do swans move between the different areas within the core area or between the expansion area and the core?

Literature Cited

- Banko, W. E. 1960. The trumpeter swan, its history, habits, and population in the United States. North American Fauna 63. U.S. Department of the Interior, Bureau of Sport Fish and Wildlife, Washington, D.C.
- Barrows, M. 1936. Trumpeter swans of Yellowstone National Park. Summer 1936. Internal Report, National Park Service, Yellowstone National Park.
- Barrows, M. 1937. Trumpeter swans of Yellowstone National Park. Summer 1937. Internal Report, National Park Service, Yellowstone National Park.
- Barrows, M. 1938. Trumpeter swans of Yellowstone National Park. Summer 1938. Internal Report, National Park Service, Yellowstone National Park.
- Childs, F. W. 1934. Trumpeter swans of Yellowstone National Park and adjacent territories. Internal Report, National Park Service, Yellowstone National Park.
- Condon, D. D. 1941. Preliminary report on the trumpeter swan of Yellowstone National Park. Internal Report, National Park Service, Yellowstone National Park.
- Gale, R. S., E. O. Garton, and I. J. Ball. 1987. The history, ecology, and management of the Rocky Mountain population of trumpeter swans. Montana Cooperative Wildlife Research Unit. University of Montana, Missoula.
- Lockman, D. C., R. Wood, H. Burgess, R. Burgess, The Trumpeter Swan Society, and H. Smith. 1987. Progress report: Rocky Mountain trumpeter swan population Wyoming flock, 1982-86. Wyoming Game and Fish Department, Jackson.
- Mitchell, C. D., and M. W. Eichholz. 2010. Trumpeter swan (*Cygnus buccinator*). The birds of North America online at <<http://bna.birds.cornell.edu/bna/species/105>>.
- Oberhansley, F. R. 1938. Trumpeter swan studies. Internal Report, National Park Service, Yellowstone National Park.
- Olsen, D. 2011. Trumpeter Swans in the Greater Yellowstone Ecoregion. Presentation at workshop, April 26-27, 2011.
- Proffitt, K. M., T. P. McEneaney, P. J. White, and R. A. Garrott. 2010. Productivity and fledging success of trumpeter swans in Yellowstone National Park, 1987-2007. *Waterbirds* 33:341-348.
- Proffitt, K. M., T. P. McEneaney, P. J. White, and R. A. Garrott. 2009. Trumpeter swan abundance and growth rates in Yellowstone National Park. *Journal of Wildlife Management* 73:728-736.

- Shea, R. E. 2011. A History of Trumpeter Swans in Yellowstone National Park. Presentation at workshop, April 26-27, 2011.
- Shea, R. E. 1979. Ecology of trumpeter swans in Yellowstone National Park and vicinity. Thesis, University of Montana, Missoula.
- Skinner, M. P. 1920. Trumpeter swan breeding in Yellowstone Park. *Condor* 22:72.
- Thompson, B. 1981. George M. Wright: 1904-1936. *George Wright Forum* 1:1-4.
- Trost, R. 2011. Trumpeter Swans in North America. Presentation at workshop, April 26-27, 2011.
- U.S. Fish and Wildlife Service. 1998. Pacific flyway management plan for the Rocky Mountain population of trumpeter swans. Subcommittee on Rocky Mountain trumpeter swans, Pacific flyway study committee, Portland, Oregon.

Appendix A: Trumpeter Swan Timeline (1900-2010)

- 1900 Trumpeter Swans had been eliminated from all but the most remote parts of North America by overharvest and were thought to be near extinction (Banko 1960).
- 1919 Two nesting pairs discovered in Yellowstone National Park proved the species still nested in the lower 48 states (Skinner 1920).
- 1920 20-34 Trumpeters found wintering in Yellowstone NP on Yellowstone, Lewis and Bechler rivers (Banko 1960).
- 1922 “About 15” trumpeters were verified summering in the Red Rock Lake marshes by Sperry (Banko 1960).
- 1929-33 George Melendez Wright, Ben Thompson and Joseph Dixon initiated USNPS studies of Trumpeter Swans in YNP and surrounding areas; documented the importance of nesting habitat at Red Rock Lakes and Henrys Lake and significant annual mortality of Trumpeters from shooting at RRL (Wright 1932, 1934; G. M. Wright’s original field notes).
- 1932 Summer surveys found 57 adults and 12 cygnets in Yellowstone region. 1 adult was also found in June at Bear River NWR, Utah. These were the only known Trumpeters remaining in the lower 48 states (Banko 1960).
- 1933 Henrys Lake dam completed; lake raised (G. M. Wright field notes).
- 1933-35 George Melendez Wright, first Chief of Wildlife Division, USNPS, led efforts that saved the last Trumpeters of the lower 48 states. Wright launched a public campaign to end the shooting of Trumpeters outside of YNP which threatened to eliminate the last swans. Wright persuaded Ding Darling and President Roosevelt to establish a refuge at Red Rock Lakes to halt the illegal shooting and protect nesting habitat, and launched a series of key studies of Trumpeter Swans in the region (Banko 1960, Thompson 1981).
- 1935 April 1935. FDR signed an Executive Order to establish RRLNWR.
- Dec 1935 U.S. Biological Survey began winter feeding of grain at privately owned springheads near the east edge of the newly established RRLNWR to increase winter swan survival and reduce the regular fall migration of Trumpeters to wintering sites outside the valley, where illegal shooting was a problem (Banko 1960, RRLNWR Annual Report 1935).
- 1936 George Wright and Roger Toll, Superintendent of YNP, were killed in a car accident during park surveys in New Mexico. With the death of Wright, wildlife research and

- science-based wildlife management in the USNPS began a highly lamented decline that lasted into the 1960s (Sumner 1983).
- 1936-41 USNPS continued studies of the nesting trumpeters of the Greater Yellowstone region, following the instructions left by Wright. These studies included: Childs 1934, Barrows 1936, 1937, 1938, Oberhansley 1938, Condon 1941.
- 1938 Translocations from RRLNWR to other locations began in an attempt to establish other nesting flocks and later, to provide swans to captive propagators and zoos; 208 adults, 323 cygnets and 160 eggs were removed in 1938-83, before this program ended (Gale *et al.* 1987).
- 1938 Island Park Dam was completed on the Henry's Fork River in Idaho, upstream from Harriman State Park. The reservoir flooded various springfed swan wintering sites and altered winter river conditions downstream from the dam (Banko 1960).
- 1939 Greater Yellowstone nesting trumpeters increased to over 100 adults (USFWS Sept. surveys).
- 1944 Greater Yellowstone nesting trumpeters increased to over 200 adults (USFWS Sept. surveys).
- 1945 First tarsal-banding studies began at RRLNWR. Various marking studies continued in all subsequent decades (Banko 1960).
- 1946 Aerial survey in Canada found 77 adults and 23 cygnets near Grande Prairie, Alberta. This was the only known breeding population in Canada (Banko 1960).
- 1949 Greater Yellowstone nesting trumpeters increased to over 300 adults (USFWS Sept. surveys).
- 1951 Greater Yellowstone nesting trumpeters increased to over 400 adults (USFWS Sept. surveys).
- 1954 Greater Yellowstone nesting trumpeters peak at about 550 adults (USFWS Sept. surveys).
- 1954 Marking studies of Canadian Trumpeters began in Grande Prairie, Alberta and revealed that most wintered in Greater Yellowstone. Additional Canadian trumpeters were marked in Yukon, Northwest Territories, Alberta, and Saskatchewan in subsequent decades (Gale *et al.* 1987).
- 1954-67 The Tristate nesting population attained a peak of about 550 adults in 1954 and 1964. Adult numbers varied between about 360-554 adults in this period, with continuous peaks over 500 in 1964-67 (Gale *et al.* 1987).

- 1958 First surveys of aquatic vegetation were conducted at Harriman State Park, subsequent surveys occurred in 1977, 1979-80, 1986 and most years between 1989-99 (Shea 1999).
- 1959-77 The only known Canadian flock, in the Grande Prairie region, showed no expansion and remained stable at about 70-100 adults (Gale *et al.* 1987).
- 1960 *The Trumpeter Swan* by Winston Banko was published.
- early 1960s Cygnet production in YNP declines to levels inadequate for breeding pair replacement (Shea 1979).
- 1960s–70s High cygnet mortality and the 22% decline of Greater Yellowstone adults from 554 in 1964 to 431 in 1968 triggered management concerns (Gale *et al.* 1987).
- 1967 Changes in water management increased winter flows and available habitat in the Henrys Fork below Island Park Dam. (Gale *et al.* 1987).
- 1969 First attempt to terminate winter feeding at RRLNWR resulted in substantial mortality, attempt aborted (Gale *et al.* 1987).
- 1974 First evidence of increase in Canadian nesting population shown by midwinter surveys(Gale *et al.* 1987).
- 1976-79 MS study R. Shea – The Ecology of Trumpeter Swans in Yellowstone National Park and Vicinity; concluded cygnet production in YNP and vicinity was below level necessary for self-replacement and population would decline if this continued.
- 1977 The Railroad Ranch on the Henrys Fork River in Island Park was gifted to the State of Idaho to become Harriman State Park and a sanctuary for wintering swans and other waterfowl (Gale *et al.* 1987).
- 1979-80 USFWS Madison Wildlife Health lab study of cygnet mortality in YNP—Ruth E Shea.
- Early 1980s Extremely low production at RRLNWR (≤ 5 cygnets fledged in 1980, 1982 and 1984) and a further decline in regional adult numbers triggered great management concern for the continued viability of the Greater Yellowstone nesting population. The decline of adults centered at RRLNWR and also impacted Yellowstone NP. YNP nesting pairs declined from 18 in 1977-78 to about 6 by 1984 (Gale *et al.* 1987).
- 1982-86 Wyoming marked and studied resident Trumpeters and began a 20+ year effort to expand their distribution in western Wyoming (Lockman et al. 1987).
- 1984-87 USFWS sponsored a 3-year review of all historic and current data pertaining to the Rocky Mountain Population of Trumpeter Swans to examine possible reasons for the

- productivity declines centered at Red Rock Lakes NWR and to recommend management changes. *History, Ecology, and Management of the Rocky Mountain Population of Trumpeter Swans*, R. Shea Gale, E. O. Garton, and I. J. Ball with assistance from most RMP managers and researchers from the 1950s-1980s.
- 1986 Greater Yellowstone nesting trumpeters had declined to about 330 adults while Canadian Trumpeters wintering in Greater Yellowstone had increased to about 1,200 (Gale *et al.* 1987)
- 1988 Efforts to expand nesting to Grays Lake NWR in southeast Idaho through translocations of swans from RRLNWR began (Shea and Drewien 1999).
- Feb. 1989 Months of low flows from Island Park dam and a severe February storm led to the deaths of about 100 swans in Island Park, Idaho, and threatened the survival of additional hundreds when most habitat north of Idaho Falls froze. Emergency winter water flows were released from Island Park Dam to thaw the Henrys Fork's thick ice and reduce further mortality. Mortality was low among resident swans using supplemental feed at RRLNWR (Shea and Drewien 1999).
- Apr. 1989 Idaho Chapter of the Wildlife Society filed a petition to list the Rocky Mountain Population of Trumpeter Swans as threatened (Shea and Drewien 1999).
- Winter 1989-90 Record numbers of Canadian Trumpeters and high concentrations of geese and ducks concentrated within Harriman State Park during a mild winter with low river flows and habitat reduced elsewhere by drought. Normally abundant aquatic vegetation was totally denuded by March and 800+ swans congregated at the RRLNWR feeding ponds and exhausted the grain supply (Shea 1999, Shea and Drewien 1999).
- Apr. 1990 USFWS ruled that listing of RMP was not warranted because FWS had launched a program to solve the winter vulnerability problems by annual purchase of winter water flows to keep the Henrys Fork from freezing and by initiating a greatly expanded long-term program to disperse swans from the Harriman/Red Rock Lakes area and rebuild migrations to other less severe wintering areas (Shea and Drewien 1999).
- 1990-1995 1,279 Trumpeters translocated in winter from Harriman State Park (1,102) and RRLNWR (177) to more southerly potential new wintering areas (Shea and Drewien 1999).
- 1992-93 Winter feeding was terminated at RRLNWR; accompanied by efforts to translocate and haze swans from the area (Shea and Drewien 1999).
- 1994 Trumpeters wintering in core Greater Yellowstone exceed 2,000 (USFWS Midwinter survey).
- 1999 Trumpeters wintering in core Greater Yellowstone exceed 3,000 (USFWS Midwinter survey).

- 2000 Biodiversity Legal Foundation and Fund for Animals petition USFWS to list the Greater Yellowstone nesting population as a threatened Distinct Population Segment (Federal Register Vol. 68, No. 18 /Tuesday, January 28, 2003).
- 2001 Fund for Animals, Biodiversity Legal Foundation and others sued USFWS for various actions related to lack of response to the listing petition and authorization of a quota harvest of Trumpeter Swans in the Pacific Flyway. Suit was resolved in 2003. Discussion of the complex issues can be found in Appendix 6 of the Pacific Flyway Management Plan for RMP Trumpeter Swans, 2008.
- 2001-05 Winter capture of 376 cygnets at Harriman SP with half translocated to SE Idaho and half (control group) released at capture site (Kilpatrick 2006).
- 2003 USFWS rules nesting swans of Greater Yellowstone are not a Distinct Population Segment and should not be listed as threatened or endangered (Federal Register Vol. 68, No. 18 /Tuesday, January 28, 2003).
- 2005 Trumpeters wintering in core Greater Yellowstone exceed 4,000 (USFWS Midwinter survey).
- 2009 Proffitt *et al.*: Analysis of Trumpeter Swan abundance and growth rates in YNP; analysis covered data from 1967-2007.

References

- Banko, W. E. 1960. The Trumpeter Swan. North American Fauna 63. USFWS, Washington, D.C. 214pp.
- Barrows, M. 1936. Trumpeter Swans of Yellowstone National Park. Summer 1936. USNPS, YNP internal report. 7pp.
- Barrows, M. 1937. Trumpeter Swans of Yellowstone National Park. Summer 1937. USNPS, YNP internal report. 9pp.
- Barrows, M. 1938. Trumpeter Swans of Yellowstone National Park. Summer 1938. USNPS, YNP internal report. 8pp.
- Childs, F. W. 1934. Trumpeter Swans of Yellowstone National Park and Adjacent Territories. USNPS, YNP internal report. 8pp.
- Condon, D. D. 1941. Preliminary Report on the Trumpeter Swan of Yellowstone National Park. 35pp.

- Federal Register 2003. Department of the Interior, Fish and Wildlife Service, Endangered and Threatened Wildlife and Plants; 90-Day Finding for a Petition to List the Tri-State Area Flock of Trumpeter Swans as Threatened. Vol. 68, No. 18 /Tuesday, January 28, 2003)
- Gale, R. S., E. O. Garton, and I. J. Ball. 1987. The History , Ecology, and Management of the Rocky Mountain Population of Trumpeter Swans. , Montana Coop. Wildl. Res. Unit. U. of Montana, Missoula. 314 pp.
- Lockman, D. C., R. Wood, H. burgess, R. Burgess, The Trumpeter Swan Society and H. Smith. 1987. Progress report Rocky Mountain trumpeter swan population Wyoming flock. 1982-86. WGFD, Jackson, WY
- Oberhansley, F. R. 1938. Trumpeter Swan Studies. USNPS, YNP internal report. 15 pp.
- Proffitt, K. M., T. P. McEneaney, P.J. White, and R. A. Garrott. 2009. Trumpeter Swan Abundance and Growth Rates in Yellowstone National Park. The Journal of Wildlife Management 73(5):728-736.
- Shea, R. E. 1979. Ecology of Trumpeter Swan in Yellowstone National Park and Vicinity. M.S. Thesis. U. of Montana, Missoula. 132pp.
- Shea, R. E. 1980. Causes of Pre-fledging Mortality of Trumpeter Swans. Report prepared for the USFWS Health Lab, Madison, WI and USNPS, YNP. 31pp
- Shea, R. E. 1999. Assessment of aquatic macrophytes at Harriman State Park, Idaho, October 1999. Unpub. report. Henrys Fork Foundation, Ashton, ID
- Shea, R. E. and R. C. Drewien. 1999. Evaluation of efforts to redistribute the Rocky Mountain Population of Trumpeter Swans, 1986-97. Unpub. rept. Printed by USFWS, MBMO, Portland, OR.
- Skinner, M. P. 1920. Trumpeter Swan Breeding in Yellowstone Park. The Condor, Vol. 22(2):72.
- Sumner, Lowell. 1983. Biological research and management in the National Park Service: A history. The George Wright Forum 3(4): 3-27.
- Thompson, B. 1981. George M. Wright, 1904-1936. The George Wright Forum 1(1):1-4.
- USFWS 1972-2010. Midwinter Surveys of the Rocky Mountain Population of Trumpeter Swans.
- Wright, George M., J. S Dixon; and B. H. Thompson. 1933. A Preliminary Survey of Faunal Relations in National Parks. Fauna Series No. 1. Washington, DC: Government Printing Office, 1933.

Wright, George M. and Ben H. Thompson. 1935. Wildlife Management in the National Parks
Fauna Series No. 2. Washington, DC: Government Printing Office.

Appendix B: Expert Workshop Agenda

The Future of Trumpeter Swans in Yellowstone National Park: An Experts Workshop

AGENDA

April 26-27, 2011
Holiday Inn, Bozeman, Montana

Purpose: The purpose of this workshop is to bring together experts to discuss Trumpeter Swan population decline in Yellowstone National Park, explore the possible causes including habitat changes, and to develop management recommendations. As a result of this workshop, a report will be produced that will inform management direction at Yellowstone National Park.

Tuesday, April 26

The purpose of the first day is to focus on Trumpeter Swan biology: Why have populations declined in Yellowstone National Park? What are the factors impacting swans throughout the region?

- 8:30 a **Welcome**
Doug Smith, Senior Wildlife Biologist, Yellowstone National Park
- 8:50 a **Getting Started**
Nina Chambers, Sonoran Institute
- 9:00a **Introductions**
- 9:30 a **A History of Trumpeter Swans in Yellowstone**
Ruth Shea, The Trumpeter Swan Society
- 10:30 a BREAK
- 10:45 a **Population Status and Trends—Panel Presentations**
Historical Population Dynamics
Oz Garton, University of Idaho
- Population Dynamics in Yellowstone National Park
Kelly Proffitt, Montana Department of Fish, Wildlife and Parks
- Update of Swan Populations in the Greater Yellowstone Area
Susan Patla, Wyoming Game and Fish Department

Regional Perspective
Dave Olson, U.S. Fish and Wildlife Service

- 12 noon LUNCH
Speaker: Erin Towler, *Incorporating climate information in natural resource management: A case study on Lewis's Woodpecker nest survival past, present, and future*
- 1:30 p **Swan Population Status and Research at Red Rock Lakes National Wildlife Refuge**
Kyle Cutting, Red Rock Lakes National Wildlife Refuge
- 2:30 p BREAK
- 2:45 p **Habitat Conditions and Swans—Panel Presentations**
Habitat Conditions in Yellowstone National Park
Laura Cockrell and Robert Frederick, Eastern Kentucky University
- Habitat Conditions in the Three-state Region (Wyoming, Idaho, and Montana)
Adonia Henry, Scaup and Willet LLC
- 3:15 p DISCUSSION
What are the insights from these presentations? What have we learned? Where are the gaps in knowledge?
- 5:00 p Wrap up and adjourn

Wednesday, April 27

The purpose of the second day is to focus on management options. Based on what we learned and discussed the first day about declining Trumpeter Swan populations in Yellowstone, and the contributing factors, what should they do about it?

- 8:30 a **Overview for the Day**
Nina Chambers, Sonoran Institute
- 8:45 a **The Intersection of Biology and Management**
Carl Mitchell, retired U.S. Fish and Wildlife Service and National Park Service
- 9:15 a **Trumpeter Swan Management Policy and Practice—Panel Presentations**
Trumpeter Swans: A Continental Perspective
Bob Trost, Migratory Bird Management Office, U.S. Fish and Wildlife Service
- National Park Service Policies, Mandates and Management
Steve Iobst, Deputy Superintendent, Yellowstone National Park

- 9:45 a BREAK
- 10:00 a **A Range of Management Options: Experience from the Field—Panel**
Jeff Black, Humboldt State University
Rob Caravallo, Idaho Department of Fish and Game
Robert Frederick, Eastern Kentucky University
Leigh Frederickson, WETMES
Keith Hobson, Harriman State Park
Sammy King, Louisiana State University
Bill Long, Wyoming Wetlands Society
Mary Maj, U.S. Forest Service
Jay Rotella, Montana State University
Jeff Snyder, Western Oregon University
Rick Sodja, U.S. Geological Survey Northern Rocky Mountain Science Center
- 12 noon LUNCH
- 1:30 p **Framing the Management Options and Decisions**
Doug Smith, Senior Wildlife Biologist, Yellowstone National Park
- 2:00 p DISCUSSION
- 4:00 p Wrap up and adjourn

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS XXXXXX, August 2011

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U.S. Department of the Interior



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