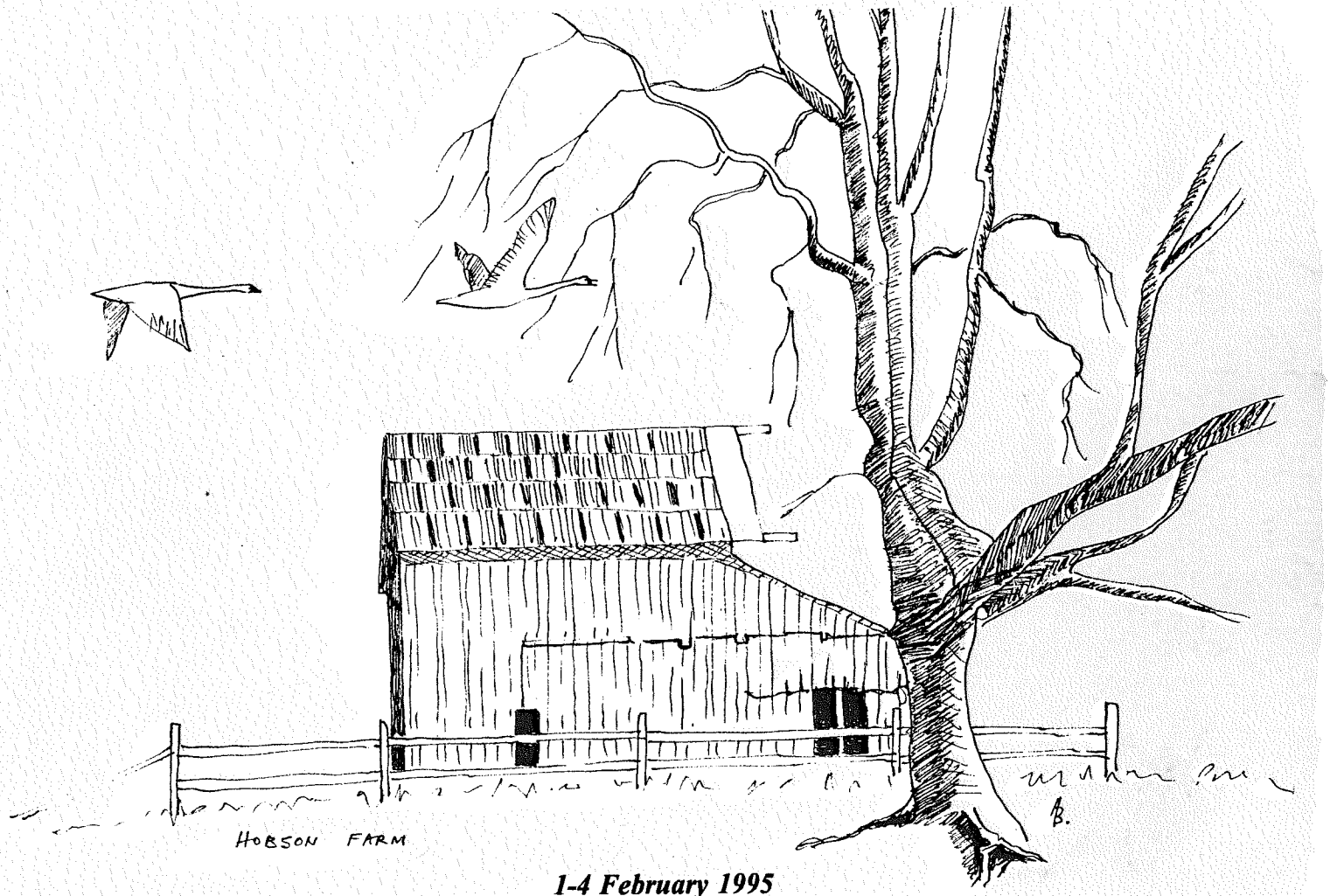
PROCEEDINGS AND PAPERS OF THE FIFTEENTH TRUMPETER SWAN SOCIETY CONFERENCE

Trumpeter Swans: A Vision for the 21st Century

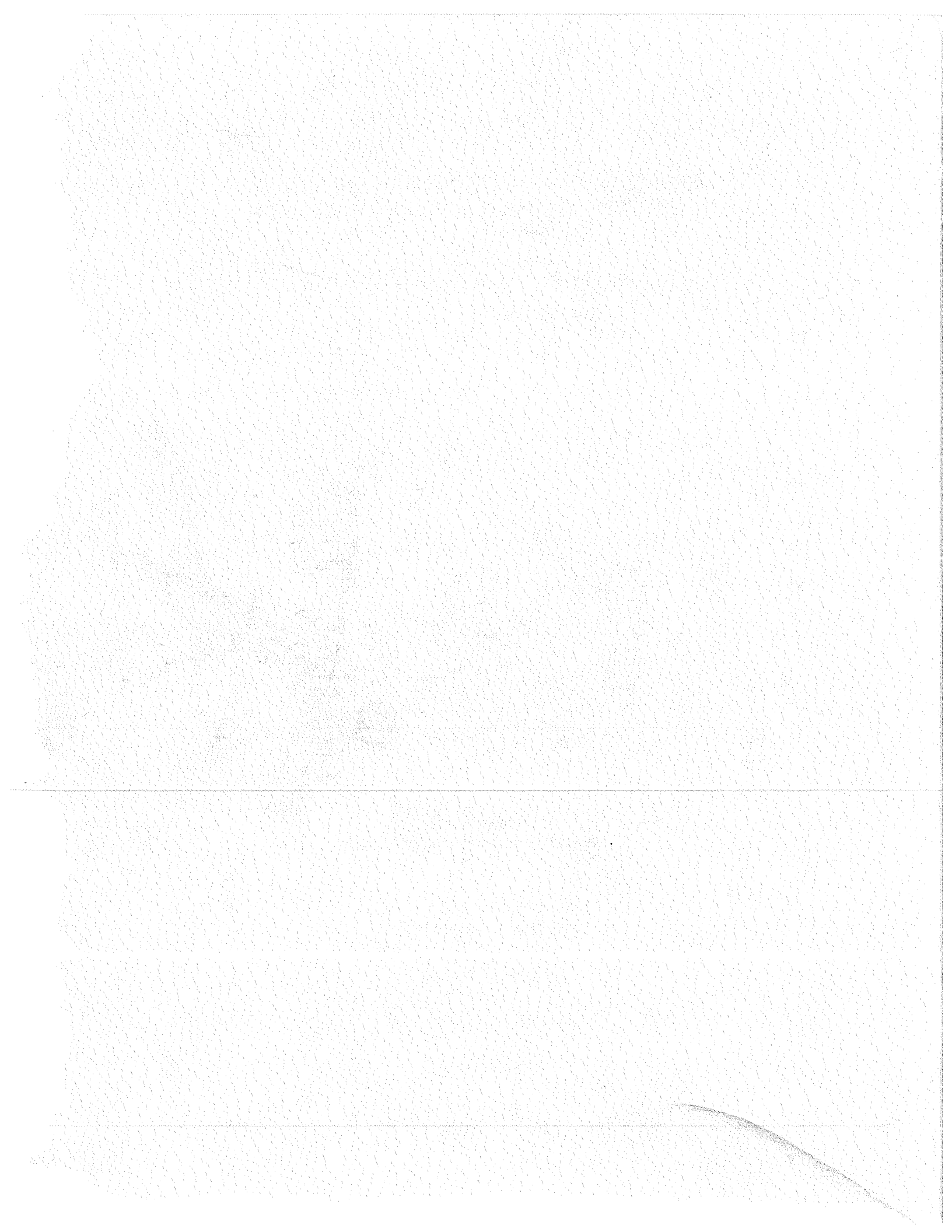


1-4 February 1995
Mount Vernon, Washington

Madeleine H. Linck
Donna C. Compton

Editors

Washington Department of FISH and WILDLIFE



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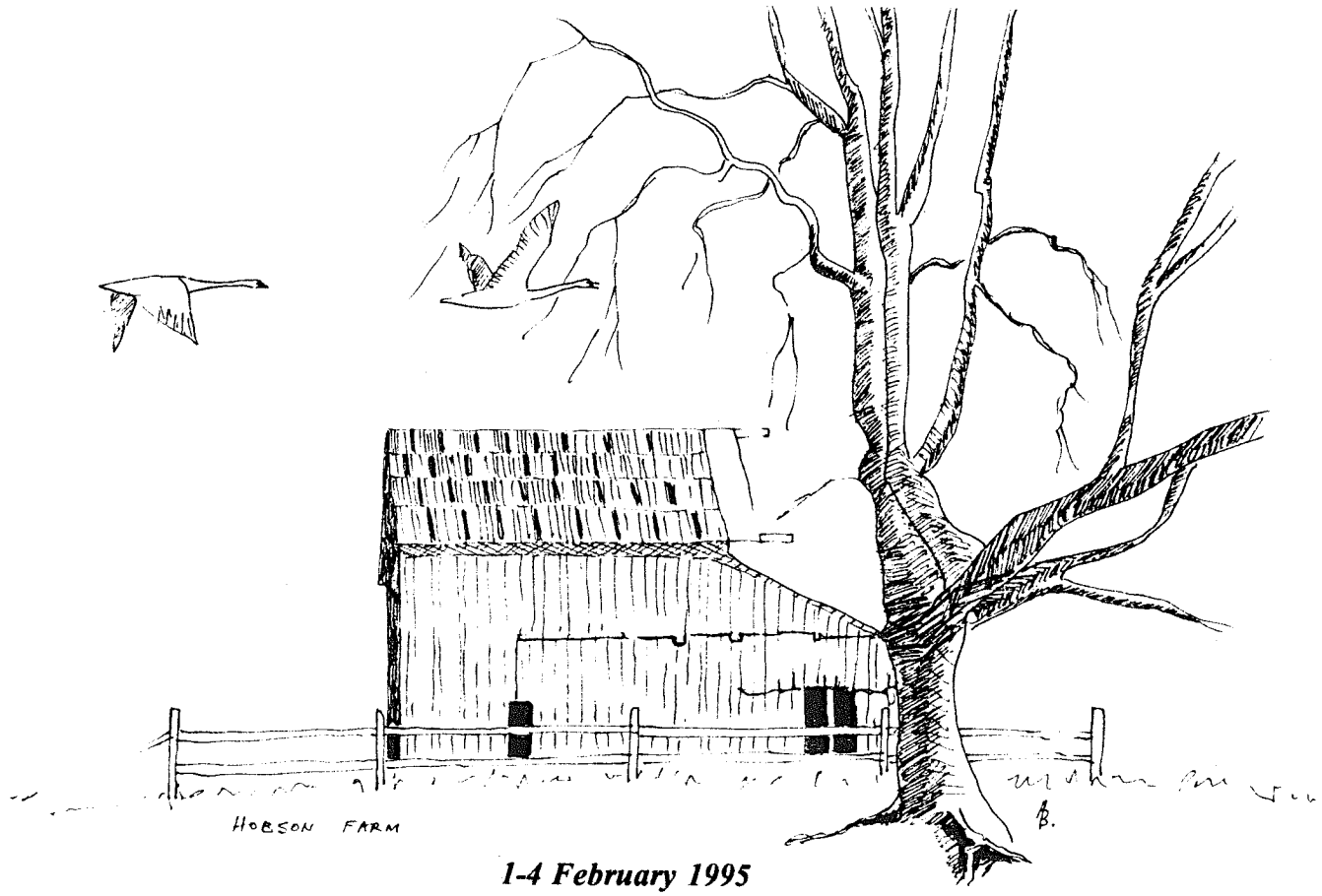

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Artwork courtesy of Dr. Alan Burr, Comox, British Columbia.

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PREFACE

The Fifteenth Trumpeter Swan Society Conference brought us to the beautiful Skagit Valley of Washington State to consider our progress in Trumpeter Swan restoration and contemplate our vision for their future. So much has changed during the Society's nearly three decades of efforts. The Trumpeters have done much on their own - increasing in number, adapting to new habitat opportunities. Much has occurred as a direct result of management efforts; from Ontario to California, Trumpeters are returning to marshes where their call was silenced over a century ago.

Much of the Trumpeter's future success now hinges on rebuilding long-broken migration traditions to diverse winter habitats, repairing the extensive damage that was done long ago to their distribution and movement patterns. As they disperse, we seek ways to create new agricultural winter food sources, using techniques that also benefit farmers and help protect open land. We, and the swans have come a long way from the wilderness -there is no turning back.

Speakers focused on a wide array of topics including an overview of population status, trends, and management issues. We wrestled once again with the very difficult issue of how to manage Tundra Swan hunting in areas where Trumpeters may occur. Our painful deliberations and hard work were not in vain. The Society's comments and recommendations, formed at the 15th Conference, strongly influenced the regulations subsequently adopted by the USFWS, and helped develop a swan hunt framework that recognizes the very different population status and management needs of two look-a-like species.

Private landowners and farmers explained their exciting achievements and vision for creating winter habitat for swans. We examined the potential for Trumpeters to migrate once again through the Midwest. We turned our attention to their potential to return to historic California wintering grounds, in partnership with private landowners. We discussed possible hazards, and the great potential benefits. We explored several opportunities for creative public and private partnerships, while we recognized the need for many more.

We peered into the future, glimpsing populations that may once again nearly span the continent, the specter of high winter mortality for swans that remain bottlenecked in unsuitable Rocky Mountain habitats, and the very difficult process of rebuilding migrations. We shared the vision of a resilient and adaptable creature, which with our continued efforts will return in future decades to much of its historic range, living hope that we can undo at least some of the environmental damage of the past.

Ruth Shea
Vice President

ACKNOWLEDGMENTS

The Fifteenth Trumpeter Swan Society Conference was co-sponsored by The Trumpeter Swan Society, Washington State Swan Working Group (WSSWG), Washington State Department of Fish and Wildlife and the U.S. Fish and Wildlife Service. We wish to thank all those who participated in the Conference by presenting papers or by taking part in the panel discussions. Enthusiastic support from various agencies and the strong personal interest in Trumpeter Swan conservation by all attendees assured the success of the Conference.

I want to thank all those who put so much effort into the organization and delivery of the Conference. The Conference would not have happened without the dedication of the members of the WSSWG and citizens in the local community of the Skagit Valley including, but not limited to, Paul Anderson, Paul Fischbach, David Grimwood MD, Mark Halgren, Henry Hanson, Courtney Ide, Lucy Krakowiak, Rick Larson and students from his class, Alan Merritt, Chris Merritt, John Munn, Marc & Carrie Olson, Leo Roozen of the Washington Bulb Company, Rich Royston, Dick and Ruth Sheldon, Mary Sinker, Terry Stevens, Edith Swan, Taylor United, John Walker, and Weigardt and Sons, Inc.

A special thank you goes to the Washington Secretary of State Ralph Munro for serving as Honorary Chairman, assisting at all our functions and strongly supporting swan work in the Pacific Northwest.

The fundraiser auction was very successful, again, thanks to the hard work of several dedicated volunteers. Many others provided invaluable assistance on auction night to keep things running smoothly including at the end with the bomb scare and evacuation of the building. Thanks also goes to all the artists and galleries that contributed their works to help further the efforts of the Society. Special thanks to Johnny Walker and Courtney Ide of the Washington Duck Hunters who provided assistance and coordination of the auction, to Sea Wind Gallery for its creative framing and to auctioneer Frederic "Fritz" Reid of Ducks Unlimited.

Ruth Shea was responsible for the program organization, arranging for speakers and insuring that the sessions ran on time. Ruth did a tremendous job putting together a cohesive program with a vision for the future.

The Oregon Chapter of The Wildlife Society donated funds towards the preparation of this proceedings. The Washington Department of Fish and Wildlife, via the strong support of Don Kraege, printed the document. Without the generous support of both the above organizations, the information contained in this book would not be in print.

The Board of Directors, myself included, and the swans express our thanks to all the dedicated participants and donors.

Martha Jordan
Conference Chair
Board Member, The Trumpeter Swan Society

The editors wish to thank all the authors who produced such excellent papers. The papers were minimally edited and, for the most part, appear as submitted.

Madeleine H. Linck
Donna C. Compton
Editors

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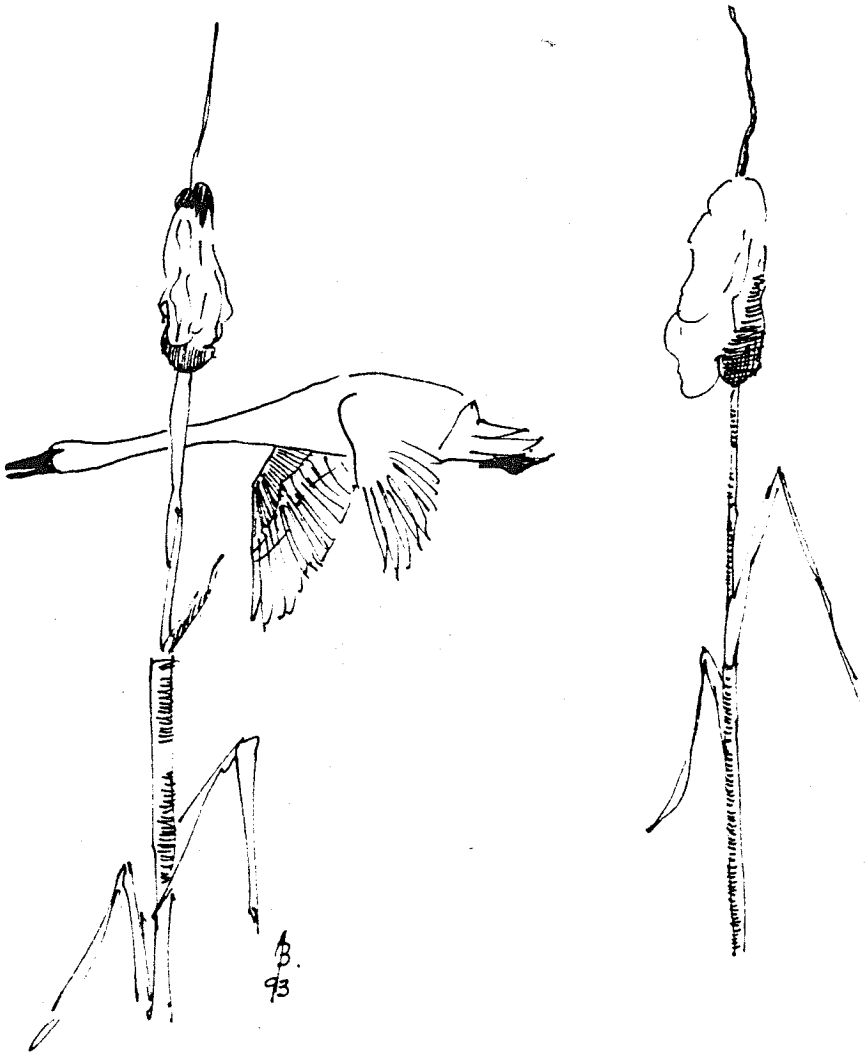
NORTH AMERICAN SWAN POPULATIONS: STATUS, TRENDS AND MANAGEMENT ISSUES



PACIFIC COAST POPULATION - STATUS, TRENDS, AND MANAGEMENT ISSUES

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ABSTRACT

Surveys, population trends, and management issues contained in the recent Pacific Flyway Management Plan for the Pacific Coast Population of Trumpeter Swans were summarized to give an overview of population management on the wintering grounds. Rangewide and area-specific management issues were outlined to provide information on factors affecting the wintering population.

INTRODUCTION

The Pacific Coast Population (PCP) of Trumpeter Swans breeds primarily in Alaska and winters from Alaska south to Oregon and possibly California, but mainly in British Columbia and Washington. The majority of population occurs mainly in coastal areas west of the Cascade Range, but also extends partially into interior British Columbia (Figure 1).

The Pacific Flyway Management Plan for the PCP of Trumpeter Swans was approved by the Pacific Flyway Council in 1993 (Pacific Flyway Study Committee 1993). This plan outlines management issues, potential solutions, and implementation responsibilities for this expanding population.

POPULATION STATUS AND TRENDS

As stated by Bruce Conant, U. S. Fish and Wildlife Service (USFWS), the current population of Pacific Coast Trumpeter Swans is 13,337, as measured by comprehensive summer surveys in Alaska in 1990. Based on breeding ground surveys, the population grew by an estimated 7 percent each year during the period 1980-90.

Concurrent with the increase on the breeding grounds, wintering areas have also seen a dramatic increase in the number of Trumpeters. Currently, British Columbia winters the majority of Pacific Coast Trumpeters, followed by Washington, Oregon, and Alaska (Figure 2). The largest increases have occurred in British Columbia, followed by Washington and Oregon (Figures 3 and 4). Specific areas which have increased the most during the 1980-90 period include Vancouver Island, the Fraser Valley, the British Columbia mainland coast and Queen Charlotte Islands, and the Skagit Delta area of Washington (Figure 5). In addition to growth of flocks in many traditional areas, Trumpeters have also expanded into new wintering sites in the Pacific Northwest. A major objective of the PCP Management Plan is to allow wider distribution of the population through natural range expansion rather than transplants.

RANGEWIDE MANAGEMENT ISSUES

Management issues for the PCP vary somewhat among wintering areas, but some are common rangewide. These issues are primarily information needs, to improve our overall understanding of PCP population dynamics:

1. Relationships between winter and summer use areas.
2. Fidelity of individuals to winter and summer use areas.
3. Seasonal habitat requirements and shifts in use areas.
4. Factors affecting survival, recruitment, and pioneering.
5. Unknown wintering locations for 3,800 Trumpeters.

Issues 1 and 2 above relate to distribution questions which are being partially addressed by ongoing marking programs in Alaska, Yukon, and Northwest Territories. However, additional exploratory marking is warranted in these areas, to further delineate wintering affinities. Active collar observation programs are in place in most traditional wintering areas, and collar reports are regularly investigated from new wintering sites. The Pacific Flyway Study Committee has

recommended a review of all ongoing PCP Trumpeter marking programs in 1995 to determine additional marking needs for the PCP.

Issue 3 has been partially addressed by wintering studies completed in the Comox, British Columbia, and Skagit Delta, Washington, areas and ongoing work on the Olympic Peninsula, Washington, to examine carrying capacity, shifts in use areas, and other habitat components for wintering areas. However, specific habitat information from new use sites is still needed.

Issue 4 includes factors affecting overwinter survival and pioneering. These factors will be discussed under the next topic, Specific Management Issues.

Issue 5 is still a mystery to many involved in swan management. In both 1980 and 1990, the summer survey in Alaska recorded approximately 3,800 more Trumpeters than the winter surveys of the same population (Figure 3). This apparent disparity may mean that some important wintering areas are not being surveyed, Trumpeters are being mistaken for Tundra Swans, or movement is occurring between survey areas and between survey periods. Washington and Oregon conduct comprehensive surveys of Trumpeters in cooperation with USFWS and The Trumpeter Swan Society (TTSS) each year following the summer survey.

SPECIFIC MANAGEMENT ISSUES

There are many other management issues related to PCP Trumpeters which have varying degrees of importance in the wintering areas. These factors ultimately influence overwinter survival, habitat quality, and habitat availability.

Habitat Conversions

Given recent Trumpeter population trends, it is apparent that the carrying capacity has not been attained in many wintering areas. However, a factor that threatens to limit the potential for increase of swans is the loss of agricultural land to residential and commercial development. In Washington, many counties with existing or potential swan use, including Skagit and Snohomish Counties have some of the fastest human population growth rates in the state (Figure 6). Agricultural fields in several areas have been lost to urban sprawl. In addition, changes in agricultural practices have also resulted in loss of particular wintering habitats. In the lower Columbia River region of Washington and Oregon, some agricultural fields are now being converted to hybrid cottonwood plantations (for paper pulp production), reducing potential winter habitat.

To counter decreasing habitat trends, the Pacific Coast Joint Venture has been actively securing and enhancing waterfowl habitat. Washington Department of Fish and Wildlife (WDFW) recently received a grant to preserve and enhance an important swan use site on Debays Slough in the Skagit Delta. Another program to leave standing grain for wintering waterfowl ("Barley for Birds") has provided winter food for numerous Trumpeters in the Skagit Delta.

All agencies are active in reviewing permit applications for development which may impact swan habitat. WDFW and TTSS are currently working to incorporate winter swan data into a Geographic Information System to be used in county planning efforts and designation of sensitive environmental areas. The recent management plan for Trumpeter Swans in the Skagit area will also influence land use decisions.

Depredation

Depredation has been a significant issue in the Comox, British Columbia, area, although recent hazing efforts have been effective in reducing impacts on fields. This population appears to have levelled off at approximately 1,200 birds during the past few years.

Crop depredation by Trumpeter Swans is not a significant issue in Washington or Oregon, but may become so as the swan population continues to expand. Landowners tired of dealing with Canada Goose depredation in the Lower Columbia region may become less tolerant of waterfowl using their fields as the swan population continues to grow. In general, swans in these states are currently welcomed on most agricultural areas.

Disturbance

Residential developments are encroaching on several critical resting and feeding areas used by swans, increasing disturbance. In addition, amateur photographers and birders regularly flush swans

from preferred resting and feeding areas during critical use periods. Agencies and TTSS are working to educate appreciative users on the effects of these activities on swan habitat use.

Disease/Lead Shot

Aspergillosis and lead poisoning continue to be a problem in particular Trumpeter Swan wintering areas. Steel shot is required for waterfowl hunting in Washington, Oregon, and in the vicinity of Vancouver and Victoria, British Columbia, but lead shot is still available in pond sediments in certain locations.

Shooting

Accidental and malicious shooting are a concern throughout the wintering areas. As Trumpeters expand into new areas, misidentification problems become more common. Increased educational and enforcement problems are needed in many areas.

Collisions

Collisions with powerlines and structures continue to be a mortality factor, particularly with birds moving into new wintering sites. Coastal weather conditions contribute to the frequency of collisions in this region.

Mute Swans

Mute Swans have the potential to compete with native waterfowl, and are removed from the wild in Washington and Oregon. In Washington, Mutes are listed as a Deleterious Species, along with walking catfish, piranhas, and a wide range of unwanted exotics.

SUMMARY AND CONCLUSIONS

The PCP of Trumpeter Swans in the Pacific Northwest continues to increase in many traditional winter habitats and to expand into new wintering habitats. Additional effort is needed to summarize existing banding data, protect and enhance additional habitats to counteract habitat losses, and provide additional information about Trumpeter Swans to wildlife user groups and the general public.

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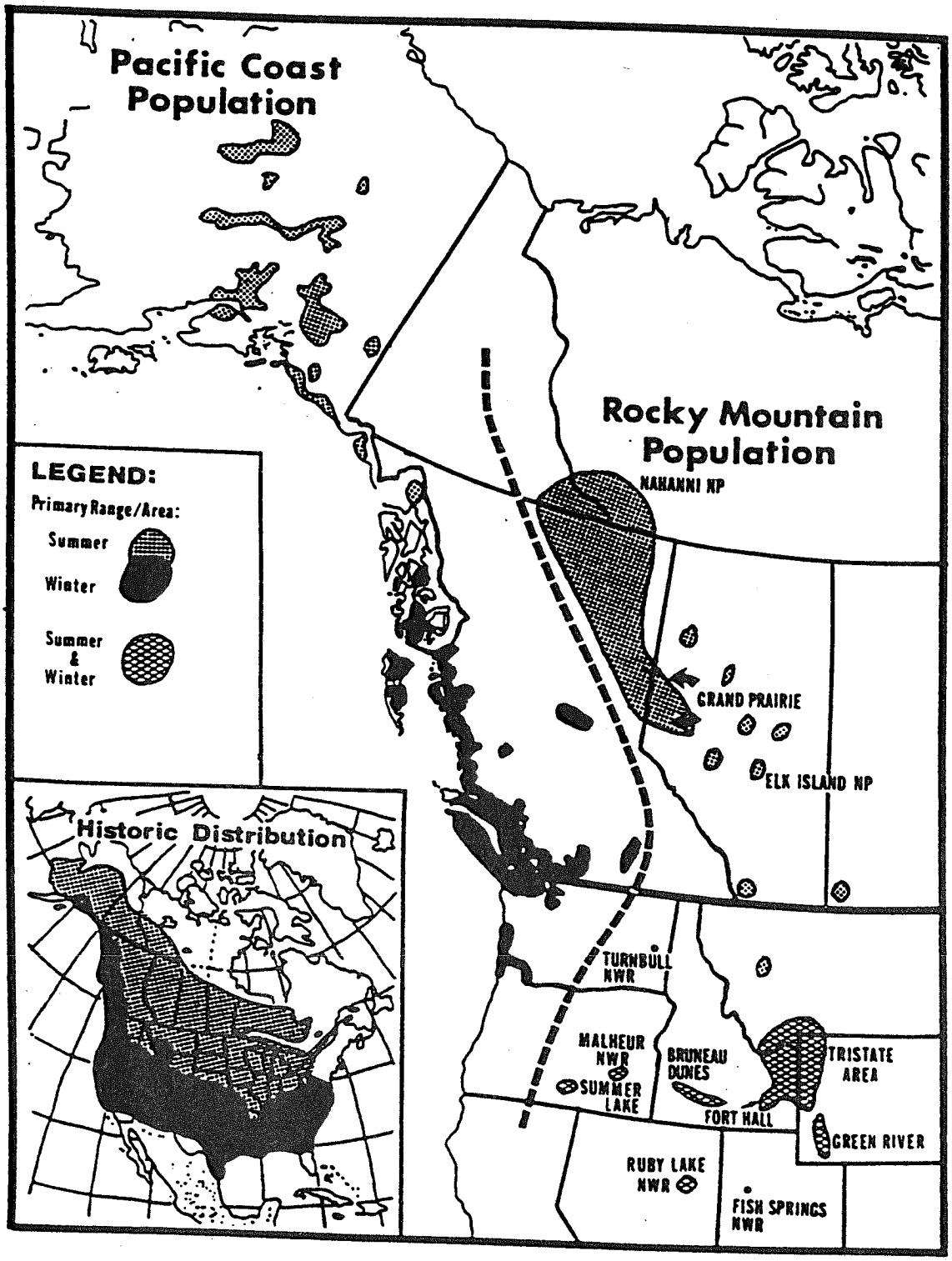

Figure 1. Probable historic distribution of trumpeter swans (after Bellrose [1979] with modifications of southern limit after Rogers and Hammer [no date] and of the northeastern limit after Lumsden [1984]) and present distribution of the Pacific Coast and Rocky Mountain Populations.

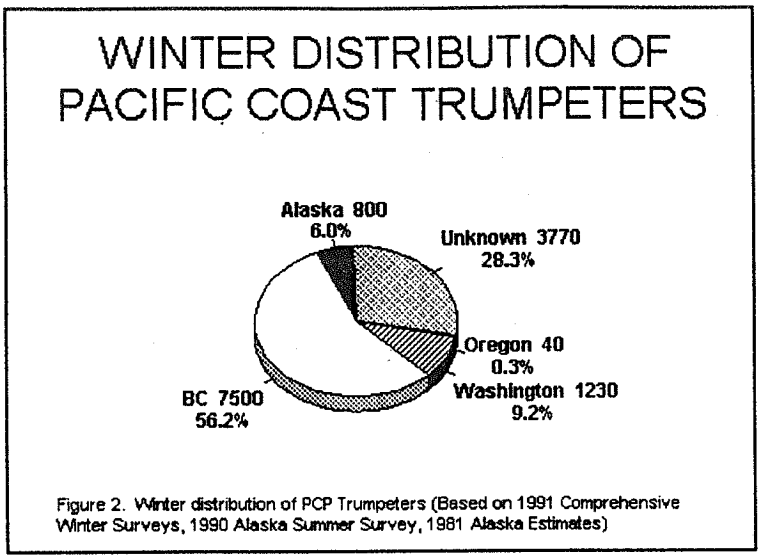

Figure 2. Winter distribution of PCP Trumpeters (Based on 1991 Comprehensive Winter Surveys, 1990 Alaska Summer Survey, 1981 Alaska Estimates)

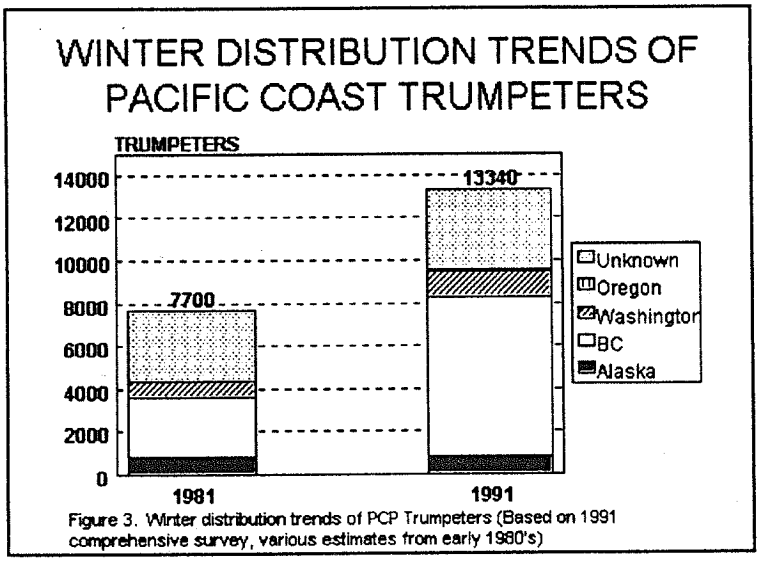

Figure 3. Winter distribution trends of PCP Trumpeters (Based on 1991 comprehensive survey, various estimates from early 1980's)

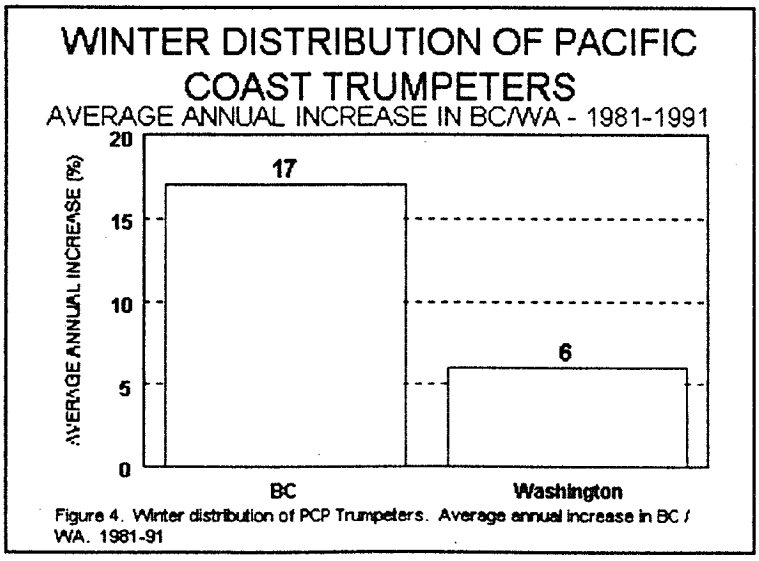

Figure 4. Winter distribution of PCP Trumpeters. Average annual increase in BC / WA. 1981-91

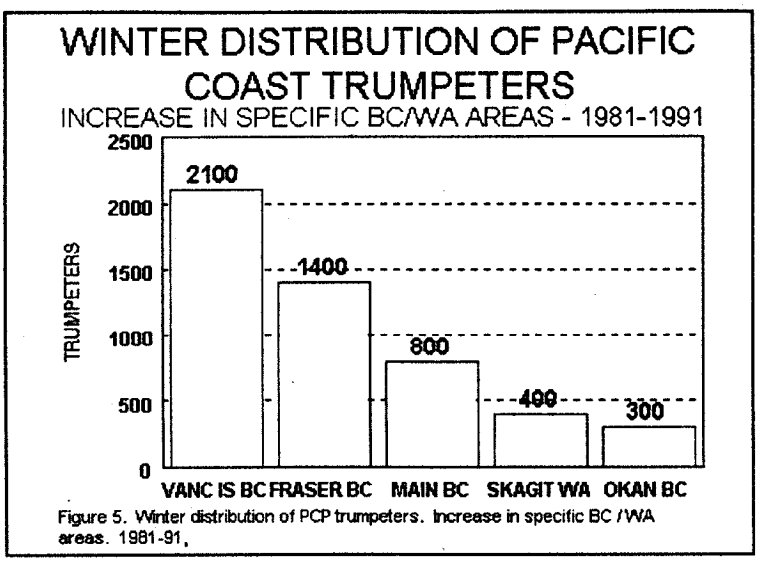

Figure 5. Winter distribution of PCP trumpeters. Increase in specific BC /WA areas. 1981-91.

ROCKY MOUNTAIN POPULATION OF TRUMPETER SWANS: STATUS, TRENDS, PROBLEMS, OUTLOOK

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ABSTRACT

Survey data, technical literature and unpublished reports were reviewed to describe the population status and trends of the Interior Canada and Tristate Subpopulations (TSP) of the Rocky Mountain Population (RMP) of Trumpeter Swans. While the overall population is increasing, significant problems remain with the TSP. Management activities during the 1994-95 winter season are discussed. Seventy-two swans from Harriman State Park were captured. Sixty-two were transplanted to Summer Lake, Oregon, and the remainder moved to the Fort Hall Indian Reservation. Current management problems such as overcrowding, disease potential on the winter range, and the need to develop migratory patterns leading to winter habitat farther south in the flyway are discussed. Some potential solutions with regard to relieving overcrowding and establishing suitable migratory patterns outside the Tristate Area are reviewed.

INTRODUCTION

Trumpeter Swans are divided into various populations, based on geographic distribution and affinity (for restored flocks). The RMP is comprised of Trumpeter flocks found in inland western North America (Figure 1).

The RMP is comprised of two subpopulations. The Interior Canada Subpopulation (ICSP) is composed of flocks in Alberta, Saskatchewan, eastern British Columbia, Yukon and Northwest Territories. The TSP is composed of flocks in Montana, Idaho, Wyoming, Utah, Oregon, Nevada and eastern Washington. Flocks in the latter three states are restoration flocks established with swans from Red Rock Lakes National Wildlife Refuge (NWR), Montana (Figure 2). Coordination of the management for these three restoration flocks was assigned to the RMP Technical Subcommittee on Trumpeter Swans in May 1990. They had been assigned to the Pacific Coast Population (PCP) Subcommittee since 1984 (Mitchell and Shandruk 1991).

Management responsibilities are divided among state and provincial wildlife agencies, the U.S. Fish and Wildlife Service (USFWS) and the Canadian Wildlife Service (CWS). While various agencies have their own management goals, objectives, and programs, all are generally coordinated under the North American Trumpeter Swan Management Plan (Anonymous 1984), through the Pacific Flyway Council, and its several technical and study subcommittees.

In this paper we provide a review of the population status and trends of the Interior Canada and TSP of the RMP, review the 1994-95 winter program, review major problems facing these subpopulations, and discuss several possible solutions.

Populations status and trends: RMP

Overall, the RMP continues to grow at a significant rate, with a mean annual productivity of approximately 19 percent. The 1995 Midwinter Survey, which provides an census of the population, revealed a total of 2,812 swans of which 707 or 25.1 percent were cygnets (Gomez 1995). This compares to a total of 2,526 counted in 1994, of which 644 or 25.5 percent were cygnets. The period of sustained growth documented since the early 1970's continues (Figures 3 and 4) (Niethammer 1994).

This overall growth is due to the ICSP. When comparisons are made between data from the Mid-winter Survey which attempts to census the entire population, and the Tristate Survey, which attempts to census the Tristate segment of the population (Figure 5), it is apparent the Tristate segment has been roughly stable.

Between 1954-93 Tristate flocks averaged 532 swans (441 adults and 91 cygnets) with 17 percent recruitment in September (Shea 1994). In September 1994, the combined Tristate flocks, including Oregon and Nevada, numbered 454 (302 adults, 152 cygnets). The Montana, Idaho, Wyoming flock contained 369 swans (239 adults, 130 cygnets) (Gomez 1994).

Winter management activities, 1994-95

Objectives for the winter program were to:

1. Capture and transplant 60 swans from Harriman State Park (HSP) to Summer Lake, Oregon.
2. Haze swans from HSP and other specified sites in the Tristate Region.
3. Investigate the use of a helicopter for hazing swans.
4. Monitor swan movements in the Tristate Region, Utah, Nevada, and California.

The fall was characterized by mild temperatures and a relatively slow arrival of Trumpeter Swans into the Tristate Region. Some southward movement of swans was reported early with movement of birds onto the Henry's Fork downstream of Ashton, and reports of birds from Utah and Colorado.

Trumpeters from Canada began arriving about 21 October. A total of 62 Trumpeter Swans was captured during two capture efforts in November at HSP and translocated to Summer Lake, Oregon. The group was composed of 36 cygnets, 17 adults, and 9 yearlings. Additionally, 10 swans, (6 adults and 4 cygnets), captured at HSP on 30 December were released at Fort Hall Indian Reservation as part of an opportunistic capture/hazing effort.

Hazing started on 17 November and continued on a sporadic basis until 30 December 1994. Hazing was conducted primarily by ultra-light aircraft until mid-December when the aircraft was grounded because of liability concerns. This aircraft was extremely successful at scaring birds out of target areas. Hazed birds tended to stay out of target areas for about 7-10 days after hazing. The technique was also very cost effective.

Hazing with a helicopter was initiated on 14 December for 3 days. Efforts at hazing with this aircraft did not demonstrate much success at moving birds out of the target area. The lateness of the season may have been the principal factor in the lack of success.

Overall, hazing efforts appeared to have been successful at moving Trumpeter Swans. An aerial survey flown on 10 December which covered the Tristate Region counted 2,276 swans. Compared with a similar survey done at approximately the same time in 1993, there were 300 less swans in Island Park, 100 less in Yellowstone, 50 more in Jackson, and 364 more swans on the Henry's Fork from Ashton to its junction with the South Fork.

Management problems

Several key management concerns occupy the attention of swan managers.

Increasing numbers of swans are continuing to occupy declining Tristate winter habitats with limited capacity. Although some evidence suggests that small numbers of swans are wintering south of the Tristate Region (Mitchell and Shandruk 1991) and some swans are shifting to new wintering habitats outside the Yellowstone/Island Park area, such as at the Fort Hall Indian Reservation and on the Henry's Fork below Ashton. However, most swans are still wintering in habitats that will fail to provide adequate food in a severe winter.

Large concentrations of birds occupying marginal habitats in severe winter conditions greatly increase the chances of a disease outbreak. Additionally, swans continue to impact the ecology of the Henry's Fork River which impacts future wintering opportunity and a world class trout fishery.

A more southerly migration and wintering distribution is needed for RMP swans. While there is some evidence to suggest that hazing efforts in recent years is having some effect on discouraging swans from wintering in the traditional Tristate wintering areas, there are still large numbers of birds utilizing marginal habitats which places them at risk during a severe winter.

The recent string of mild winters has allowed many swans to survive in marginal winter habitat, but the potential remains high for significant losses of swans.

SOLUTIONS

Following are several potential solutions:

Develop a program to transplant Trumpeters south into portions of Utah, Nevada, and eventually California.

After nearly 5 years of effort, it is apparent that the eventual success of encouraging southward migration of Rocky Mountain Trumpeters depends on the transplant of birds into historic migration and wintering habitats. This may be accomplished by the continued transplant of immature swans into potential wintering areas.

Develop security areas at key migration and wintering sites to encourage Trumpeters to adopt new habitats.

The success of any transplant program for Trumpeter Swans is heavily dependent on providing security from major disturbance at key migration and wintering sites. Trumpeter Swans appear to be highly sensitive to various forms of disturbance from hunting and other recreational activities (Lockman et al. 1987) The establishment of key security areas is critical to the success of any effort to provide for a southward migration of Rocky Mountain Trumpeters.

Continue to discourage large numbers of Trumpeter Swans from wintering in the Tristate Region.

Approximately 1,000 swans could winter in the Tristate Region without impacting habitats for themselves and other species. Efforts to discourage winter use of the area through hazing of key areas, a moratorium on supplemental feeding, pond drawdown in the Centennial Valley, and capture efforts must be continued.

These efforts will likely show results over a range of time from 5 to 15 years if not longer, but represent an important factor in the total effort to encourage swans to migrate southward. Preliminary efforts are under way to develop a 5-year agreement which addresses these potential solutions in a concrete way.

The principal factors in this plan are the transplant of swans into migration and wintering areas south of Idaho, the continuance of Tundra Swan hunting in Montana, Utah, and Nevada, the legalization of what amounts the accidental take of Trumpeter Swans during Tundra Swan hunts with quotas to protect the overall Trumpeter population, and increased monitoring. In addition, the use of sanctuary areas in and adjacent to hunting areas would be developed in a few key locations.

CONCLUSION

The current problems which face the Rocky Mountain population of Trumpeter Swans are not going to disappear without significant efforts, compromises, and finding new ways of doing business on the part of government agencies and swan enthusiasts alike.

We see the current situation as a test case which is being closely monitored by the other Flyways. This effort, if successful, could become a model for the development of migratory Trumpeter Swan populations nationwide.

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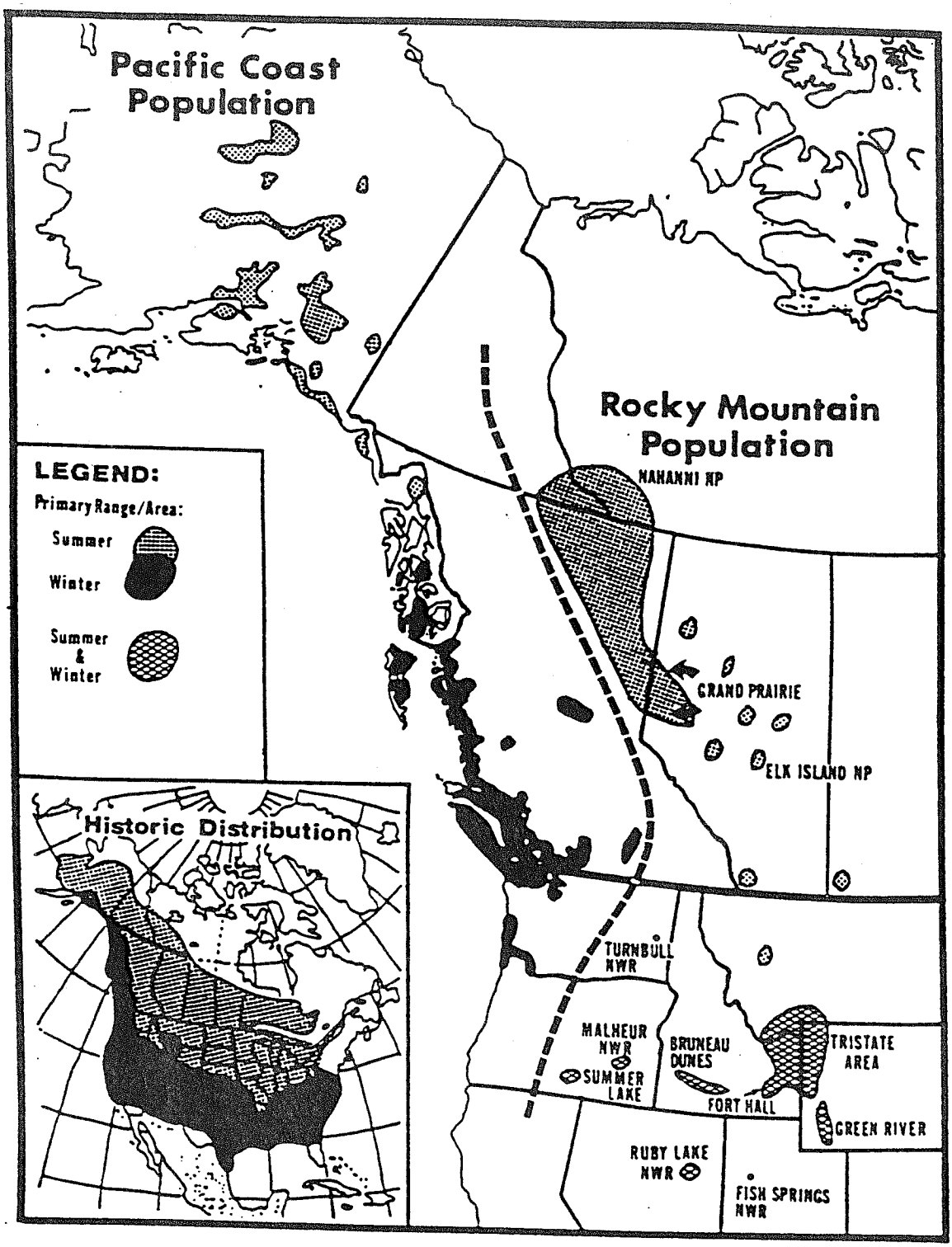

Figure 1. Probable historic distribution of trumpeter swans (after Bellrose [1979] with modifications of southern limit after Rogers and Hammer [no date] and of the northeastern limit after Lumsden [1984]) and present distribution of the Pacific Coast and Rocky Mountain Populations.

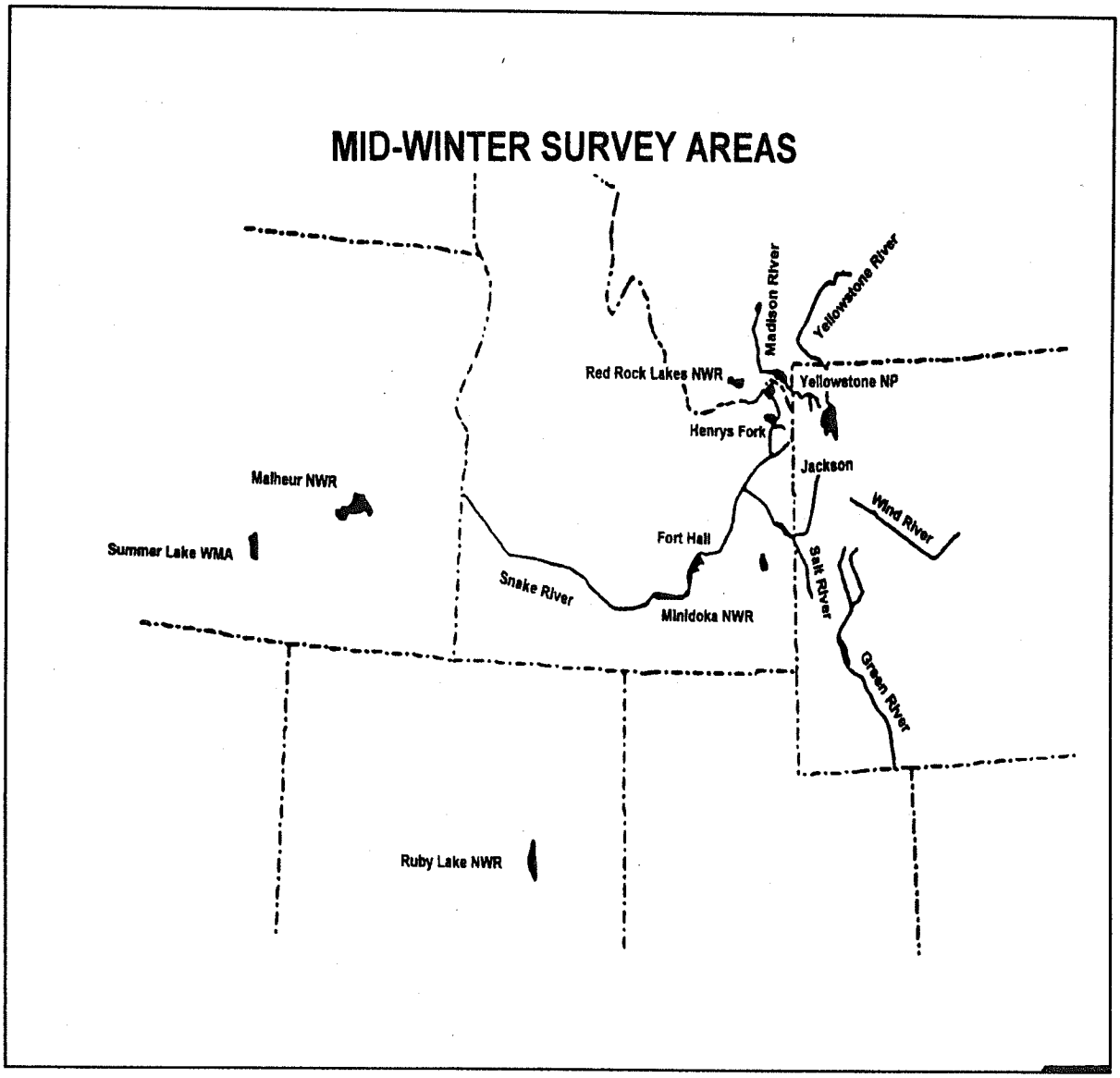

Figure 2. Areas and river segments included in the Mid-Winter Survey.

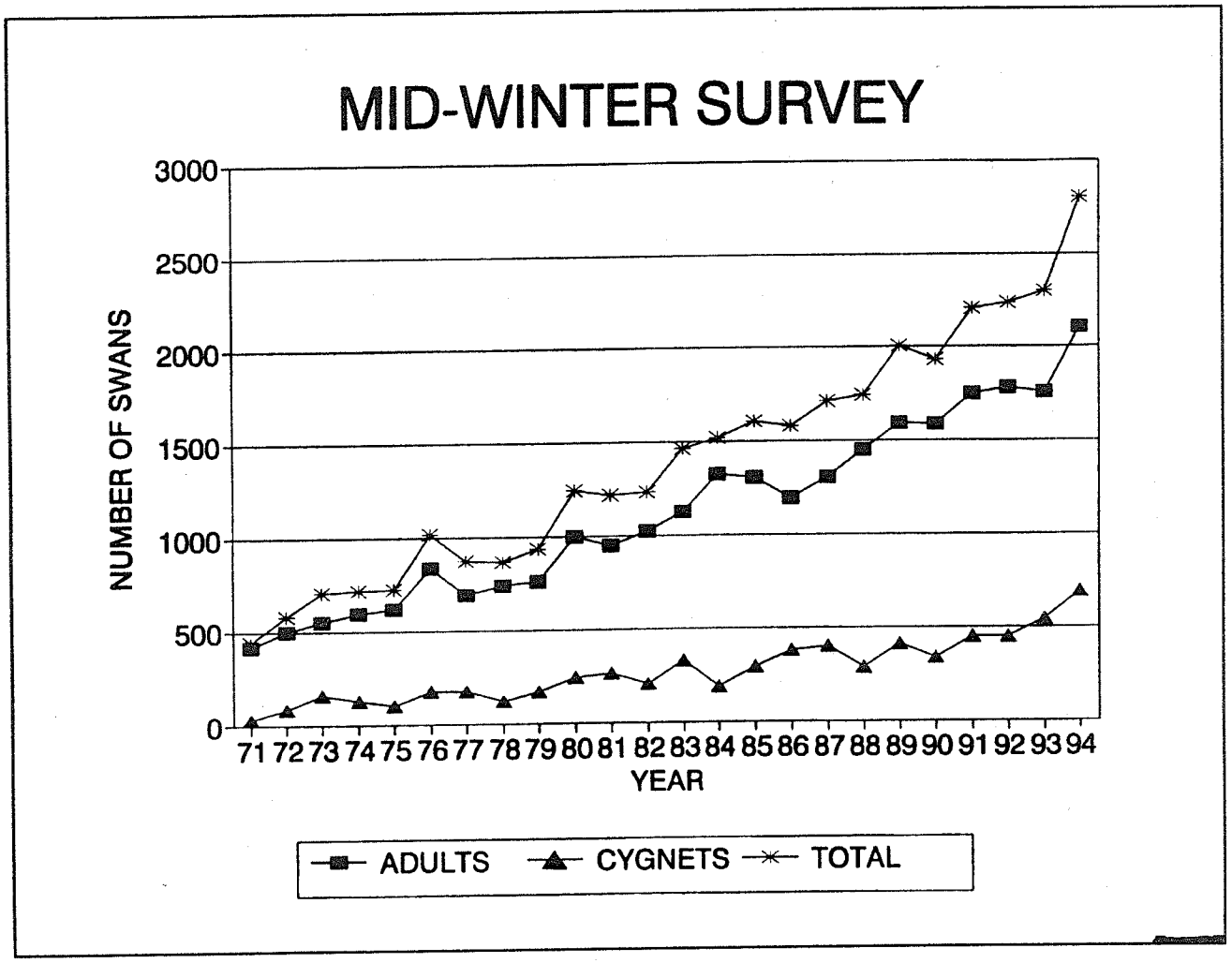

Figure 3. The total number of Trumpeter Swans and the break down by age class counted during Midwinter surveys since 1971. The data have been corrected for year. For example data from the 1995 survey actually represent reproduction from 1994 and are plotted as 1994 data.

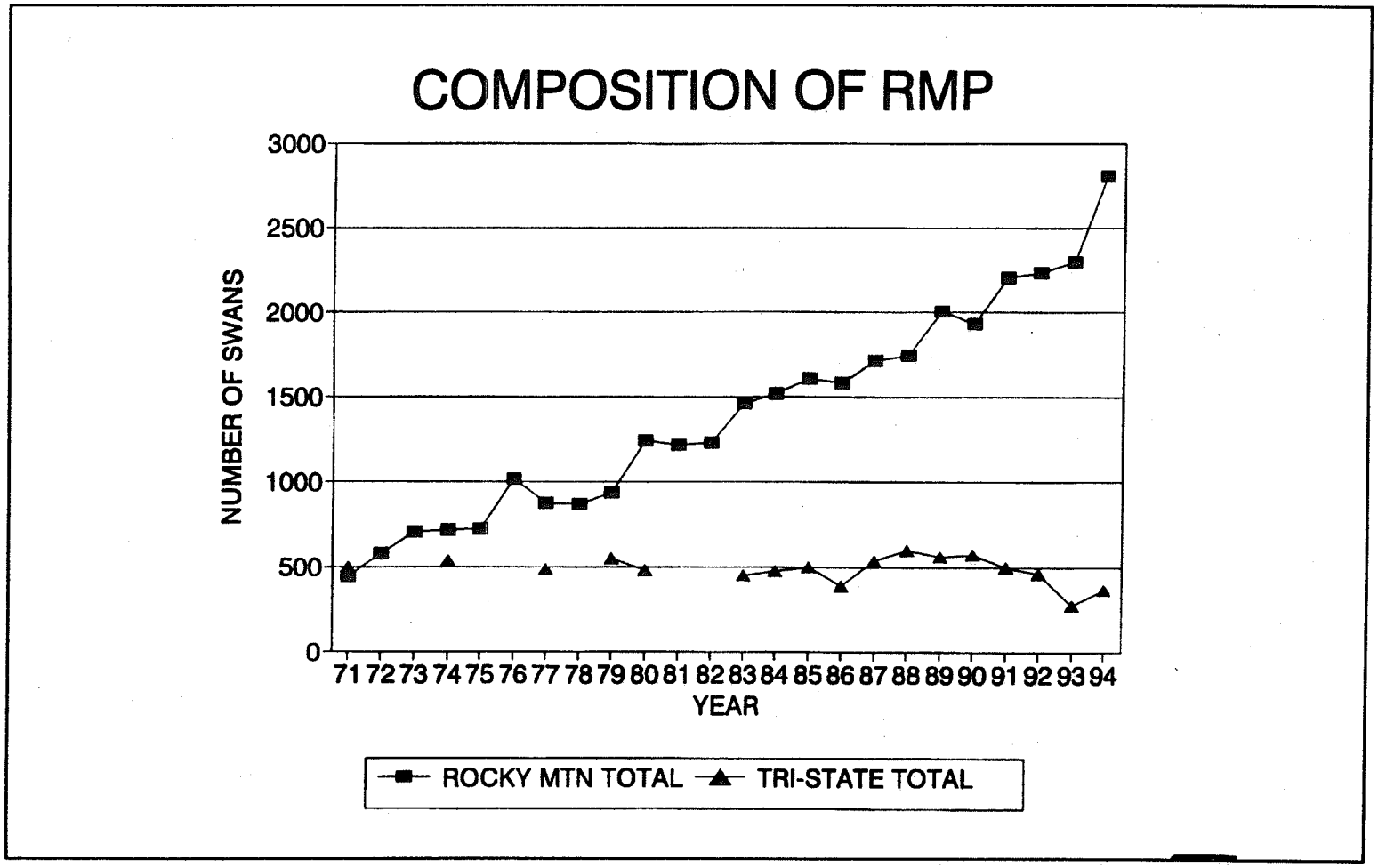

Figure 4. The upper line represents the total number of Trumpeter Swans in the Rocky Mountain Population (data from Midwinter Surveys) and the lower line represents the number of swans in the Tristate Subpopulation (data from Tristate Surveys). The difference represents the number of swans in the Interior Canada Subpopulation. The Midwinter Survey have been corrected for year. For example, data from the Midwinter 1995 survey actually represent reproduction from 1994 and are plotted as 1994 data for comparison with the 1994 Tristate Survey data.

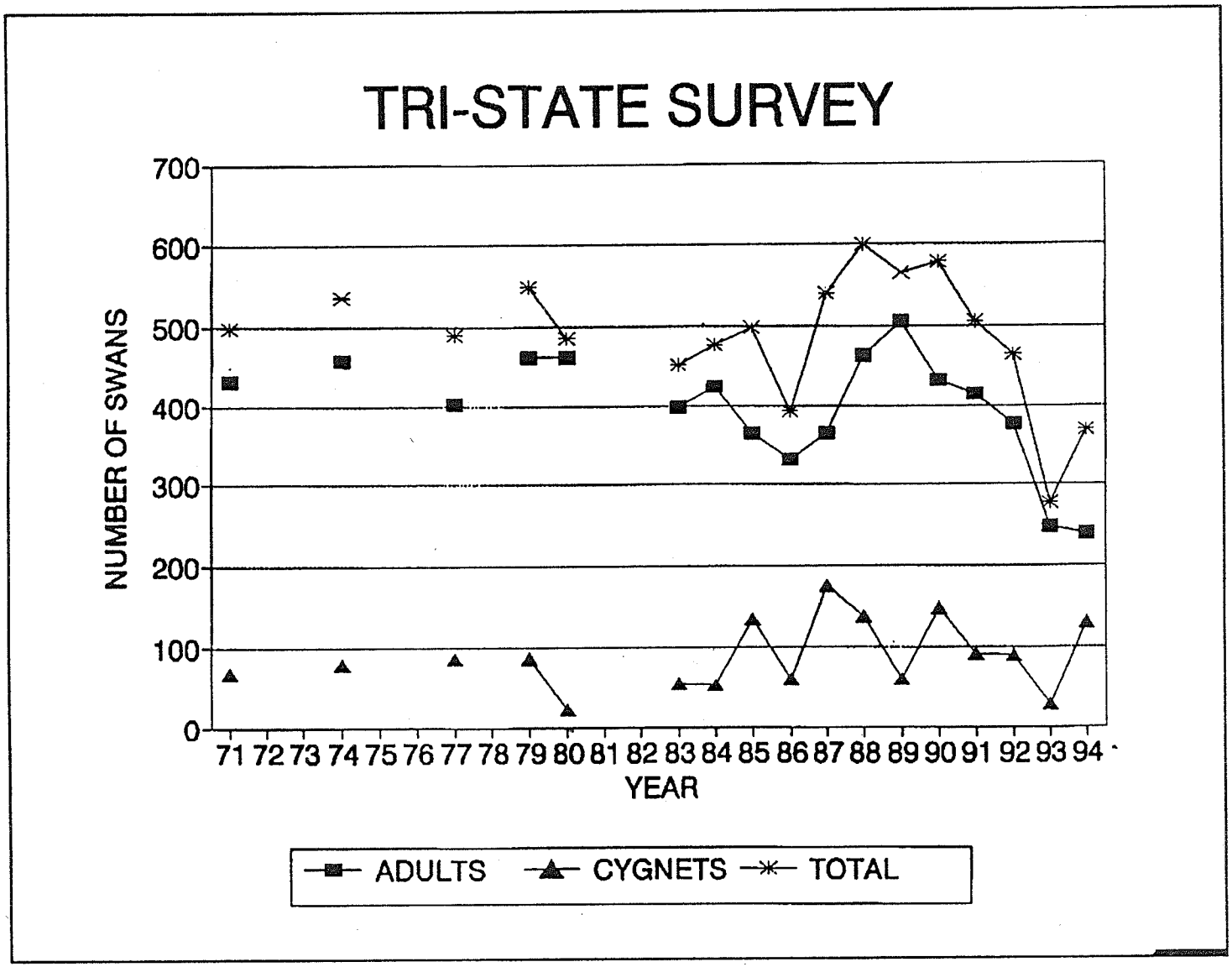

Figure 5. Number of Trumpeter Swans by age class counted on Tristate Surveys since 1971. Restoration flocks from Nevada, Oregon, and Washington were included in the survey since 1991.

INTERIOR POPULATION STATUS REPORT, HIGHLIGHTS AND TRENDS, DECEMBER 1994

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INTRODUCTION

Trumpeter Swans were completely extirpated from east of the Tristate Region (Montana, Wyoming and Idaho), across all of North America around the turn of the 20th century (Figure 1). All of the Trumpeter Swans present in the Interior Population are a result of restoration projects (Figure 2). It all began with a project at Delta Waterfowl Research Station in Manitoba. In 1954, the research station received 12 Trumpeter Swans from Grande Prairie, Alberta, and Red Rock Lakes National Wildlife Refuge in Montana (Batt 1976). A captive breeding program at the Station produced many swans that were then transferred to sanctuaries, parks and zoos (Jones 1974). In 1972, the Station made a limited attempt to establish Trumpeters on Delta Marsh as a wild flock. Eleven swans were released that year and four additional cygnets were released in 1973. The project at Delta was ultimately unsuccessful. By 1975, all of the birds had disappeared (Batt 1976).

Another restoration effort began at Lacreek National Wildlife Refuge (NWR) in South Dakota, in 1960. Since that beginning, six other restoration projects have joined in the effort to bring the Trumpeter back to the center of the continent as a self-sustaining, migratory population (Figure 2). This paper will describe the condition of the restoration flocks (now considered the Interior Population), as of December 1994. It will only briefly describe the restoration techniques, and will not evaluate winter migration strategies or recommend the next steps needed to ensure the success of the Interior Population (IP). This description is intended to set the stage for Larry Gillette's paper on migration strategies for the IP elsewhere in this publication.

BRIEF PROJECT SUMMARIES

The release locations for each of the seven projects, the years of active releases, and the numbers of birds released in each area, as of December 1994, are given in Figures 3 and 4. Each project has proceeded along an individual course and the methods used have had a different effect on the flock totals each year. Figure 3 maps the counties in which releases were made and gives the year(s) of those releases. The far left column of Figure 4 indicates total numbers of birds released per project. The left column in the second graph of Figure 4 depicts the numbers of birds released prior to 1985. For Lacreek NWR, those were the only birds released. For Hennepin Parks, those, plus the larger releases in 1985-87, were the foundation for the current numbers of free flyers. For the remaining five projects, releases have been more recent.

The Delta Waterfowl Research Station project will not be discussed beyond the introduction in this paper. The birds released at Delta had completely disappeared 20 years ago, and it is assumed that that project has not contributed any wild birds to the current flocks in the Midwest (North American Management Plan 1984).

Essentially, the restoration attempt for the IP of Trumpeter Swans began with the Lacreek NWR project in 1960 (Fjetland 1974). Fifty-seven cygnets were transferred from Red Rock Lakes NWR to Lacreek NWR. Of those, 34 were eventually released to the wild. Their progeny now form the High Plains flock of approximately 249 birds (as of December 1994) that has dispersed throughout western South Dakota, Nebraska and into eastern Wyoming (Kraft 1994b). Since the releases in the early 1960's, management on the Refuge has been limited to supplying open water and feed on the Refuge for wintering birds, conducting summer aerial surveys throughout the High Plains to determine summer distribution and productivity and midwinter counts at Lacreek. The birds have done the rest. Total flock size has increased slowly or perhaps stabilized, ranging from a low of 158 (1985) to a high of 249 (1994) over the past 15 years (Kraft 1994b).

Hennepin Parks, a natural resource based park system, located 30 miles west of Minneapolis/St. Paul in Minnesota, began its restoration in 1966, with plans to do a project similar to that of Lacreek NWR. Forty Trumpeters were obtained from Red Rock Lakes NWR and released over the next few years, but most of them disappeared or died within a short time. With failure likely, the project was dramatically altered, and all remaining birds were taken into captivity to participate in a captive breeding program

for the next few years (Weaver 1974). Beginning again with small releases from captivity in 1979, the project has since released 153 birds from Hennepin Parks property. In 1994, there were 95 birds associated with the Hennepin Parks project (Hennepin Parks files).

The Minnesota Department of Natural Resources (MN DNR) began a restoration in the early 1980's designed to complement that of Hennepin Parks in the state. Eggs were obtained from the Alaska breeding range, hatched and raised to 2 years-of-age. Large releases of these captive-raised birds in northwestern Minnesota began in 1987 and ended in 1994 after releasing 215 birds (Kittelson 1994). The 1994 total for the MN DNR flock was 200.

With the MN DNR releases, the genetic segregation of the Alaska and Red Rock Lakes NWR stock (source of the Lacreek and Hennepin Parks birds) was broken. At the time, there still remained some question as to whether or not the genetics of the two populations should be mixed. But the sources for eggs, cygnets or subadult birds were so limited by genetics and economics, that the source in Alaska was determined to be the most reasonable option for success. (Joyce Marsolais of McMaster University in Ontario, gave a paper on the limitations of our genetic pools in our restoration flocks. She also documented a genetic difference between Red Rock Lakes-source and Alaska-source birds. However, no definitive conclusions could be reached at this stage in her research.)

Continuing the idea of releasing large numbers of young birds over a condensed period of time, the Wisconsin project began with egg collections in Alaska. Since 1988, the Wisconsin Department of Natural Resources (WI DNR) has been releasing Trumpeters from several sites throughout the state (Hartman and Mossman 1993). By December 1994, 227 birds had been released from captivity (Lisa Hartman, pers. comm.) with plans to continue large releases through 1996 and possibly beyond (Matteson et. al. 1986). Total flock size in December 1994 was estimated at 115 (Lisa Hartman, pers. comm.).

Again, using eggs collected in Alaska, the Michigan Department of Natural Resources (MI DNR) made releases of 32 or more Trumpeter Swans from captive rearing programs for 3 years, 1991-93 (Joe Johnson, pers. comm.). Two primary release sites were used, one in the Upper Peninsula at Seney NWR, and the second in the southwestern corner of the Lower Peninsula near Kalamazoo. In the 3 years, 134 birds were released (Joe Johnson and Karen Charleston, pers. comm.). There are no plans for future large releases, unless the current flocks are unable to sustain themselves.

Ontario began its restoration effort in 1982, largely due to the efforts of Harry Lumsden. Through a variety of methods, 79 Trumpeters have been released in the Toronto, and Midland, Ontario, areas (Harry Lumsden, pers. comm.). Surrounded by Great Lakes on three sides, the birds have not wandered far. They have been year-round residents in the release areas, although some short migrations to the Lake Ontario waterfront have occurred. Occasional winter sightings of Trumpeters in Pennsylvania and upstate New York are attributed to the Ontario release project (Lumsden 1995).

The Iowa Department of Natural Resources (IA DNR) will begin releasing Trumpeters in northwestern Iowa in 1995 (Zenner 1993). Concurrently, the MN DNR plans to release Trumpeters across the border in southwestern Minnesota in a cooperative effort with the Iowa project.

The Missouri Department of Conservation worked with Lacreek NWR on a migration restoration project from 1982 to 1986. Trumpeters were translocated from Lacreek NWR to Mingo NWR in southeastern Missouri in hopes that the birds would winter in Mingo and return to the Lacreek area to breed (Smith 1988a). Of the 25 Trumpeters released at Mingo, four were known to have survived beyond 1986 and stayed on at Mingo year-round. They did not establish a migration tradition (Smith 1988b). As of 1991, all Trumpeters had died or disappeared from the Mingo/Lacreek experiment.

Future plans include the possibility of Ohio starting a restoration project in 1995. Many of the states to the south of the restorations as well as the provinces to the north have become involved with Trumpeters as sightings in their state or province have dictated. Nearly 900 (868) Trumpeters have now been released in the Midwest. It is clear from the map in Figure 3 and the graph in Figure 8, that although these restoration projects span great distances and have occurred over a number of decades, the framework is now in place to restore an Interior Population of Trumpeter Swans. Figure 4 shows the peak of releases in 1990 and 1991 in Minnesota and the subsequent shift to the east to major release efforts in Wisconsin and Michigan. As Trumpeters venture into

new areas both for summer and winter, the IP is becoming a reality.

PROGRESS TOWARD POPULATION GOALS

It is important to compare the restoration goals of each of the individual projects (Figure 5) to the current status, to determine how close we are to achieving our objectives. Occasionally, the primary goal of a project was to achieve a specific number of breeding pairs rather than a total number of birds. For the sake of discussion, an estimate of how many birds would be required to achieve this type of breeding pair goal has been calculated using the ratios from the Lacreek flock (Kraft 1994a). The numbers are very much estimates, as fluctuations in all factors of breeding success and life as a swan, cause great variability in the ratio of total numbers to numbers of breeding pairs.

150 approximates 15 nesting pairs.
200 approximates 20 nesting pairs.
250 approximates 30 nesting pairs.

The total numbers given are considered minimums to attain a consistent minimum number of breeding pairs. Also, these numbers would be only applicable to a flock with a "normalized" age-class structure of wild, swan-raised birds, not a flock of largely very young birds with the majority having been captively raised. It will take a number of years for the restorations that have only just released large numbers of young birds to become "normalized".

The Lacreek NWR/High Plains flock goal of 500 Trumpeters, 300 migratory and 200 residents (USFWS 1982) has been half achieved (Figure 5). Based on the comparison between winter and summer surveys, Refuge Manager Rolf Kraft believes that approximately 200 are year-round residents and 50 are summer residents only, going somewhere other than Lacreek NWR for the winter (Kraft 1994b). Because the vast majority of the Lacreek flock is unmarked, they are many times not even identifiable to species in states to the south. Documentation of the occurrence of a migration exists by the comparison of summer versus winter counts and in the numbers of reports of unmarked Trumpeters or swans (species unknown) in states to the south of Nebraska during the winter months (Figure 6). Achievement of the second half of the goal, to establish a migratory flock of 300 birds, will require strategies as yet undeveloped and the cooperation and participation of biologists in states to the south.

The Hennepin Parks project has been a slow, but steady release and management effort. There have never been large numbers of birds released in any one spring; but small numbers of birds have been released over a long period of time. It has also been slow to be successful. However, the age-class structure is considered "normalized".

The MN DNR has been able to release large numbers of birds quickly, and, with the exception of 1992, has had steady and quick increases in flock numbers (Steve Kittelson, pers. comm.). The age-class structure in 1994 is now mature enough to suppport good reproduction. There will not be any more large releases in northwestern Minnesota. Small releases (12-15 birds) will take place in southwestern Minnesota beginning in 1995.

The combined goals of the MN DNR and Hennepin Parks restorations are for 30 nesting pairs of Trumpeters and a total of at least 250 birds (Henderson 1985 and Hennepin Parks files). Estimates as of December 1994, were 270 birds with 20 nesting pairs. It appears, that to attain 30 breeding pairs, it may be necessary to have nearer to 300 birds. The total number of birds in the combined flock was above the stated goal, primarily due to continued releases by the MN DNR and Hennepin Parks. Both Minnesota flocks are now mature and at the highest numbers ever. The future should bring strong reproduction and steadily increasing numbers. Additional releases, at least in the two primary release sites of Minnesota, northwestern Minnesota and Hennepin County, should be unnecessary. The 250- or 300-bird level will have to be maintained without additional releases, to be successful.

The WI DNR project is in many ways at the same place as the MN DNR project was in 1992. There are still several large releases to come, and the majority of the flock is very young, annual mortality is high and wild production is low. The WI DNR goal stated only that there would be 20 nesting, migratory pairs (Matteson et. al. 1986). This translates to about 200 birds in the flock. With 115 Trumpeters in the flock in 1994, the project is over halfway to the 200 mark. There were 10 nesting pairs in Wisconsin in 1994. Continued releases will help keep numbers up until natural production can take over as the flock matures.

The Michigan project has completed its releases. The birds in the flock are still quite young the oldest possible bird being 6 years of age. The distribution

is scattered throughout the state with small numbers present in each area (Joe Johnson and Karen Charleston, pers. comm.). The project is on "wait and see" mode. Where mates are lost, replacements may be supplied from captive stock, but otherwise, no additional releases will be made.

The Michigan project is hoping to reach 30 nesting pairs divided between the Upper and Lower Peninsulas (Michigan DNR). It is estimated that that will necessitate a total flock size of 250-300 birds, perhaps closer to 300 because of the great distance between the two portions of the flock. In 1994, there were 108 birds and nine nests (Joe Johnson, pers. comm.).

Ontario's project has been similar to that of Hennepin Parks in that small numbers of Trumpeters have been released over several years. Because the Ontario project is relatively isolated from the other projects by distance and the Great Lakes, the project cannot expect much interaction with the other restoration projects. (For example, it is unlikely that a lost mate will be replaced by a Michigan bird, or that swans migrating from Ontario will be decoyed into safe wintering sites by WI DNR wintering birds.) Total flock size in Ontario was 36 in 1994 ranging in and around Midland and Toronto and there was one wild nest.
Iowa's goal is to achieve 15 nesting pairs which translates to a minimum of 150 birds in a mature flock (Zenner 1993).

Considered separately, with the exception of Lacreek's goal of 500 birds, each of the project goals are possibly too low to attain self-sustaining separate flocks. However, with the current mixing of birds from Minnesota, Hennepin Parks, Wisconsin and soon Iowa, perhaps the combined numbers and goals will achieve the minimum population size needed to be self-sustaining. Excluding Ontario for the reason that it could be a very long time before the flocks in the U. S. are contiguous with the Ontario birds, the total population goal was 1,300 birds including 150 nesting pairs. In December 1994, there were approximately 800 birds including 107 pairs (an unknown number of them actually nested and raised young). We are well on our way to achieving our breeding population goals.

SUMMER/FALL DISTRIBUTION AND PRODUCTION

The fall 1994 distribution of Interior Population Trumpeters can be seen in Figure 7. Of particular interest are the 34 birds in Saskatchewan in the Porcupine Provincial Forest (Rhys Beaulieu, pers. comm.), thought to have originated in Lacreek NWR, and the three birds recently discovered in the Kenora District of western Ontario, thought to have originated from the MN DNR releases (Harry Lumsden, pers. comm.). Plans for 1995 include continued close monitoring of the Porcupine Forest birds, and a thorough summer survey of the Kenora District. The Cypress Hills, Saskatchewan, flock, discovered in the early 1900's, has dwindled to only one bird.

Overall, we are at an all time high for this century, at over 800 birds collectively. The age-class structure should be coming into maturity and good production in the next few years. The dramatic increase that the total numbers graph (Figure 8) indicates has been artificially induced by the large numbers of birds released from captivity. Releases will no longer be a significant factor in Michigan, Minnesota, or Hennepin Parks. Iowa and Wisconsin will continue to release large numbers for a few more years and Ontario will continue to release small numbers of birds for an undetermined period of time. It bodes well that a population of greater than 800 birds has been achieved from releases of nearly 900 Trumpeters over a wide frame of time and space (Figure 4).

The importance of Figure 8 is in the appearance of the Lacreek flock as bedrock. Although the Lacreek birds have not pioneered eastward to mix with the other restoration project birds, the potential is there. It should be recognized that an unmarked bird from Lacreek that disperses to Minnesota, Wisconsin or Michigan could not be identified as such. At least one marked bird from Lacreek (marked) has intermingled with birds from Wisconsin and Michigan and is currently spending its winters in Wisconsin and summers in the Upper Peninsula of Michigan. Since Lacreek has not released any additional birds since the early 1960's and has been a relatively isolated flock from the other restoration flocks for 30 years, it is therefore, self-sustaining. The appearance of bedrock is accurate.

Figure 9 gives the number of wild fledged cygnets per restoration per year. Total recruitment per year can be determined by adding totals released from captivity (Figure 4) to totals produced in the wild per year

(Figure 9). Total recruitment for 1994 was 329. This is fully 40 percent of the total population, indicating clearly how young and inexperienced the population is.

Comparison of Figures 4 and 9 with Figure 8 gives the true picture of the large numbers of swans that have been lost over the years. To focus on a small portion of the picture, in 1984, there were 181 Trumpeters in the Lacreek flock. At least 700 High Plains cygnets have flown with their parents since 1985, and the flock numbered 249 in December 1994. Assuming relative isolation from the other restoration projects, it has taken over 700 cygnets to increase the flock size by 68 (Kraft 1994b). Annual mortality for the Lacreek flock has ranged from 26-35 percent. Annual mortality for the IP has ranged from 16-35 percent. (An average was not calculated due to discrepancies in the data.)

The growth curve of Figure 8 has been artificially induced by the addition of birds from captivity in all cases except Lacreek. To determine what annual recruitment must be to maintain or slightly increase total flock size, data from the Lacreek flock was used. Annual recruitment averaging 41 percent will produce growth similar to that of the Lacreek flock, assuming similar mortality factors. To maintain the growth rate shown in Figure 8 (including releases from captivity), it would be necessary to attain 54 percent annual recruitment. Therefore, annual recruitment between 41-54 percent should produce a steady increase in total flock numbers. To date, average annual recruitment, excluding releases from captivity, has been 33 percent with a range of 20-45 percent.

If average annual recruitment must be 41 percent to achieve a growth curve similar to Lacreek's, it appears that the restorations will fail at 33 percent. However, many of the flocks have not yet matured, and releases from captivity are continuing. As the flocks mature, and establish successful breeding traditions, annual recruitment will increase. Whether it will increase sufficiently to overcome the wide range of mortality factors is unknown.

WINTER DISTRIBUTION

Winter distribution seems to be the stumbling block for all of our Trumpeter Swan populations continent-wide. Although objectives for each of the IP flocks includes facilitating migration to suitable wintering sites, no plans have been made for the process. Lacreek NWR in South Dakota, Hennepin Parks, Fergus Falls and Monticello in Minnesota and the waterfront between Toronto and Burlington in Ontario, have become major winter concentration sites (Figure 10), due to naturally occurring open water, supplemental food sources, and/or human created open water. At each of these sites, white birds decoy other white birds in. Only Lacreek has a planned feeding station established for the winter, which attracts the majority of the High Plains flock. Hennepin Parks maintains winter refuges for captive birds with a steady supply of food and open water. Some of the free fliers choose to stay there for the winter. Monticello and the Toronto/Burlington waterfront are sites where feeding swans in the winter has become a popular pastime for the local residents.

A nuclear power plant on the Mississippi River near Monticello, Minnesota, discharges warm water year-round, keeping the river open for about 10 miles through town and beyond. Except in the most extreme conditions, the river is wide open all winter. There are a number of people feeding waterfowl along this stretch of river. One resident feeds 100-150 pounds of shelled corn per day beginning at 11 a.m., every day. Many swans from Hennepin Parks and from MN DNR releases, have been attracted to the site. The site provides everything they need for the winter; good security, minimal disturbance, few mortality factors, available unrelated adults for original and replacement mates, consistent open water and plenty of food.

Because of the excellent conditions, the tradition of wintering in Monticello has been growing steadily. In 1987-88 there were 15 Trumpeters using the site. Numbers have increased from 15 to about 115 in 1994-95. In the 8 years of steadily increasing use, repeated use by individual swans has occurred frequently. Nine identifiable birds have been at the site at least 4 consecutive years and four have been there every year since 1987 (Hennepin Parks files). The number of cygnets has increased as the total number of birds present has increased. In 1987, cygnets were 7 percent of the total numbers of birds. In 1988, cygnets comprised 25 percent of the total numbers, and in 1994, 38 percent of the total. The total number of cygnets brought to Monticello over the 8 years is 719, 42 in 1994 (Hennepin Parks files). These statistics represent several things: the maturation of the MN DNR flock, good production in 1994 over the whole state due to good weather during the nesting season and high water levels, good production of the individuals using Monticello, and a successful wintering tradition being established.

The large number of unmarked, unidentifiable birds using Monticello is very frustrating to us swan managers, although indicative of good survival of unmarked young. Over the years, 73 identifiable individuals have used Monticello, 33 from the MN DNR project, and 38 from the Hennepin Parks project and two from Wisconsin. In 1994, 37 individuals at Monticello were marked, 96 of the 115 total were identifiable by association, and only about 20 birds were unmarked and completely unassociated with marked individuals (Sheila Lawrence, pers. comm.). But when the families leave in the spring and the cygnets disassociate from the adults, most (80) of the unmarked birds will become indistinguishable from each other. A lot of valuable information about survivorship and tradition establishment is lost by having so few birds marked.

Figures 6 and 11 are attempts to illustrate winter movements to the south. Figure 6 depicts 11 years of sightings, with symbols indicating origin of marked birds seen at the site. Unmarked birds are shown with *. Each symbol represents at least one sighting of one positively identified Trumpeter Swan at one site, once in the last 11 years. In many cases, the symbol actually represents numerous locations within the county, and varying numbers of birds over several years. (The Trumpeter Swan Society office in Minnesota has been attempting to keep a full record of winter Trumpeter sightings in the states south of the Interior Population restoration states.) Figure 11 is an attempt to break out more information per county, and to depict only the more recent winter siting information. Repetition of area use in recent years is available from this illustration, but identification of individual movements is still lacking. Within the outlined counties, there is a year and the highest number of birds seen within that county during that winter. Perhaps the most remarkable thing about these maps is the huge gaps in the information. However, we consider ourselves lucky that we have as much information as we do considering the huge expanses, the large number of unmarked birds (which are seldom reported), and the relative difficulty for the observer to get a sighting to the "right" agency person.

If we assume that the majority of the unmarked sightings (*, Figure 6), are likely from the large reservoir of unmarked birds in the High Plains, it appears that Trumpeters have been dispersing from the High Plains to the south and east for a number of years in a fan-shaped dispersal pattern. It is interesting to note that the pattern of unmarked birds sighted stops abruptly near the Texas border. There also has not been much information coming out of Colorado or Utah of unmarked Trumpeters in the winter.

Figure 6 also shows the significance of central and southern Illinois for the Wisconsin birds, and illustrates the wide ranging of the Wisconsin birds as they search for adequate wintering sites.

The Michigan birds released in the Lower Peninsula have been spending the winters in Michigan, either disappearing within the Mute Swan population for the winter, or finding open water in southern Michigan (Joe Johnson, pers. comm.). Nothing is known about the Upper Peninsula birds wintering sites. For the first time in 1994-95, one Michigan family group has gone out-of-state for the winter. They are wintering in central Missouri on Lake-of-the-Ozarks.

A migration tradition is being established between Minnesota and Oklahoma. A pair of marked birds has traveled from Buffalo, Minnesota, to the Tulsa, Oklahoma, area every winter for the last 6 years (Hennepin Parks files). They leave Minnesota with their cygnets in early November, travel through western Missouri, into eastern Kansas and then into Oklahoma to arrive in late November at a private ranch west of Tulsa. The landowner on the ranch is ready and waiting for them with food and protection from disturbance. Each year that they've made the trip they've lost a cygnet or two enroute, but the adults have migrated successfully. In the winter of 1994-95, several additional birds joined the family group at the ranch. At least one of the extra unmarked birds was familiar with the feeding system and may have been a subadult from a previous years' brood (Janine Kyler, pers. comm.). Also, there were reports of additional swans in waters beyond the ranch perimeter which the landowner was never able to confirm. It is likely that the number of birds wintering in the area will begin to climb as the offspring of the pair become more numerous and begin breeding.

Both MN DNR- and WI DNR-marked birds have gone south for at least 4 years and quite a bit of repetition in area usage has been documented (Figures 6 and 11). However, there are major gaps in the information because of lost markers, unmarked subadults, and inconsistent observation effort at each location every year. The data as it is, is very difficult to interpret. There have been decreasing numbers of reports of Minnesota-marked birds to the south of

Minnesota (Steve Kittelson, pers. comm.). It may be that the MN DNR birds are going south in fewer numbers because of the decoying effect of the wintering sites at Monticello and Fergus Falls in Minnesota. It may also be that the number of unmarked birds has significantly increased, and because of that, sightings cannot be attributed to a specific project. The WI DNR has made huge efforts to keep their birds fully marked, and therefore has much more information about the wintering locations of their birds. The Wisconsin-origin birds seem to follow the Mississippi River and other major riverways in their wanderings to the south. They have also been known to spend the entire winter on waterways in the north where human structures such as lock and dam systems create open water.

It appears that Trumpeters will attempt to spend the winter as far north as possible, rather than venturing to warmer climes in search of food and open water. This behavior may be a product of lack of guidance and tradition, availability of adequate resources (however artificial) in the north, lack of good wintering sites to the south, or lead poisoning killing off many of those that would otherwise have been successful migrators. On the other hand, it may be a successful wintering strategy devised in adaptation to the human-altered environment. Project goals dictate that we manage to promote migration to southern wintering areas that can support swans without human-supplied food or open water. Eventually there will be a migration tradition established between breeding and wintering grounds. We, as managers, have decided that that will be better for the swans. However, we have not determined how we will accomplish it.

CONCLUSION

There will be an IP Management Plan for Trumpeter Swans written for flyway approval in 1996. It will include Trumpeter Swan management plans for the Central and Mississippi Flyway Trumpeters, but exclude consideration of Atlantic Flyway issues.

The current population numbers 806 birds. There were 107 pairs in 1994, but the number that actually nested is unknown. Two hundred and thirty nine cygnets were produced by these wild pairs, comprising 30 percent of the total population. Five hundred and forty three or 67 percent of the population wintered at six northern sites or areas (Ontario, Michigan, Lacreek NWR and Hennepin Parks, Monticello, and Fergus Falls, in Minnesota) in the winter of 1994/95. This figure includes all of the Michigan and Ontario birds plus those sites in Figure 10 that have a established wintering tradition.

Hennepin Parks, Ontario, WI DNR, IA DNR, and possibly Ohio will continue to release captive bred birds for several years to come. Average annual growth of the population has been approximately 13 percent including releases from captivity. The Lacreek NWR flock (without releases from captivity) has increased an average of 3 percent over the last 10 years. Projections through the year 2000 using these figures should put the population somewhere between 950 (3%) and 1,500 (13%) Trumpeters.

The remaining breaks in summer distribution visible in Figures 2 and 7 will soon be bridged. Birds from Minnesota and Wisconsin are intermingling freely. There is adequate habitat available within those gap areas. The stage is set for success. The Interior Population Management Plan will ensure it.

ACKNOWLEDGMENTS

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Francine Feeney volunteered many hours to create the figures in this paper. I am sure that her work will be useful for many future papers as well as in this one.

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Figure 1. Historic range of the Trumpeter Swan. Compiled from the studies of Philip Rogers, Don Hammer, Harold Burgess, Harry Lumsden, Frank Bellrose and Ralph Palmer (Matteson, et.al. 1995).

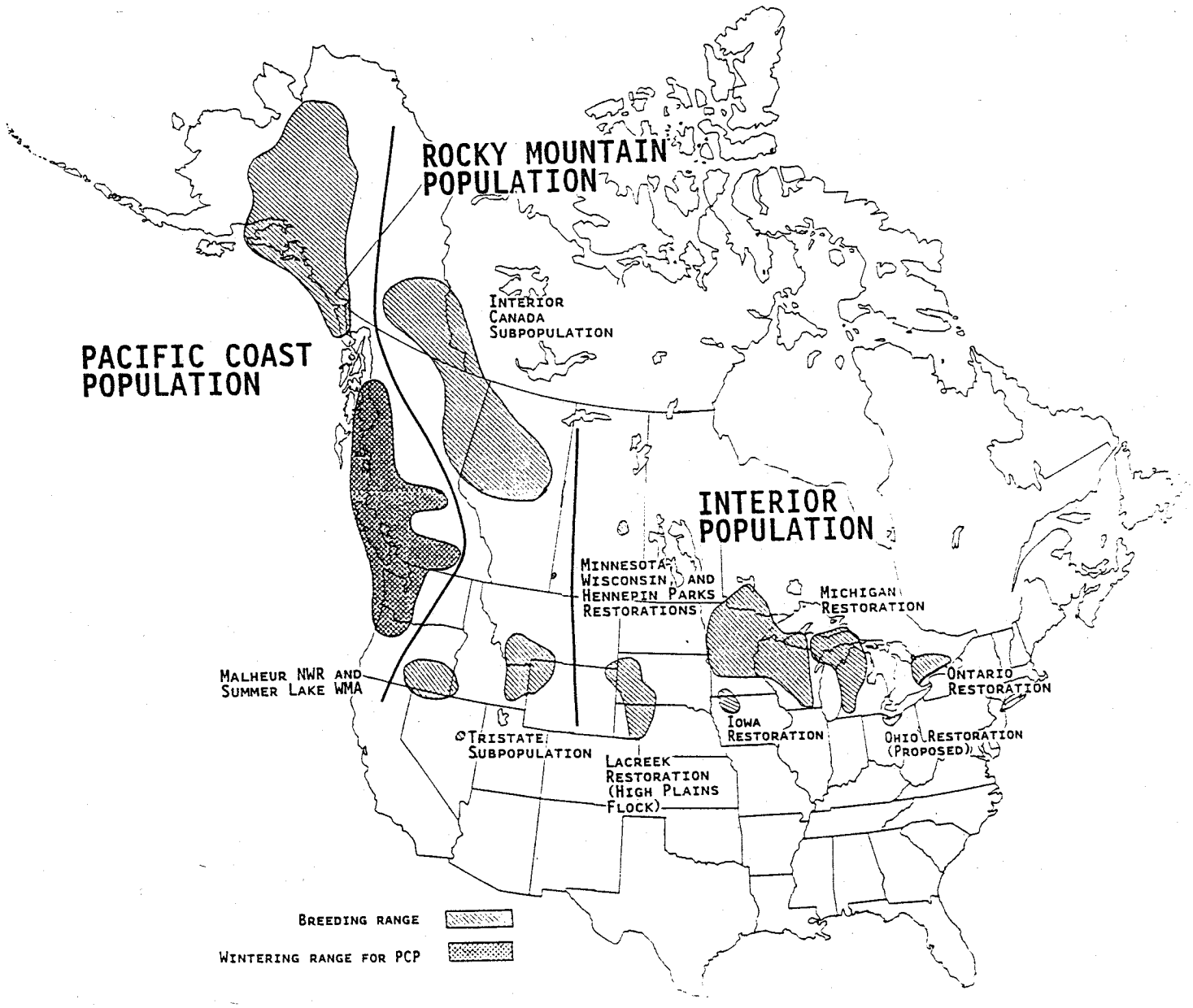


Figure 2. Populations of Trumpeter Swans (modified from Gillette and Shea 1995).

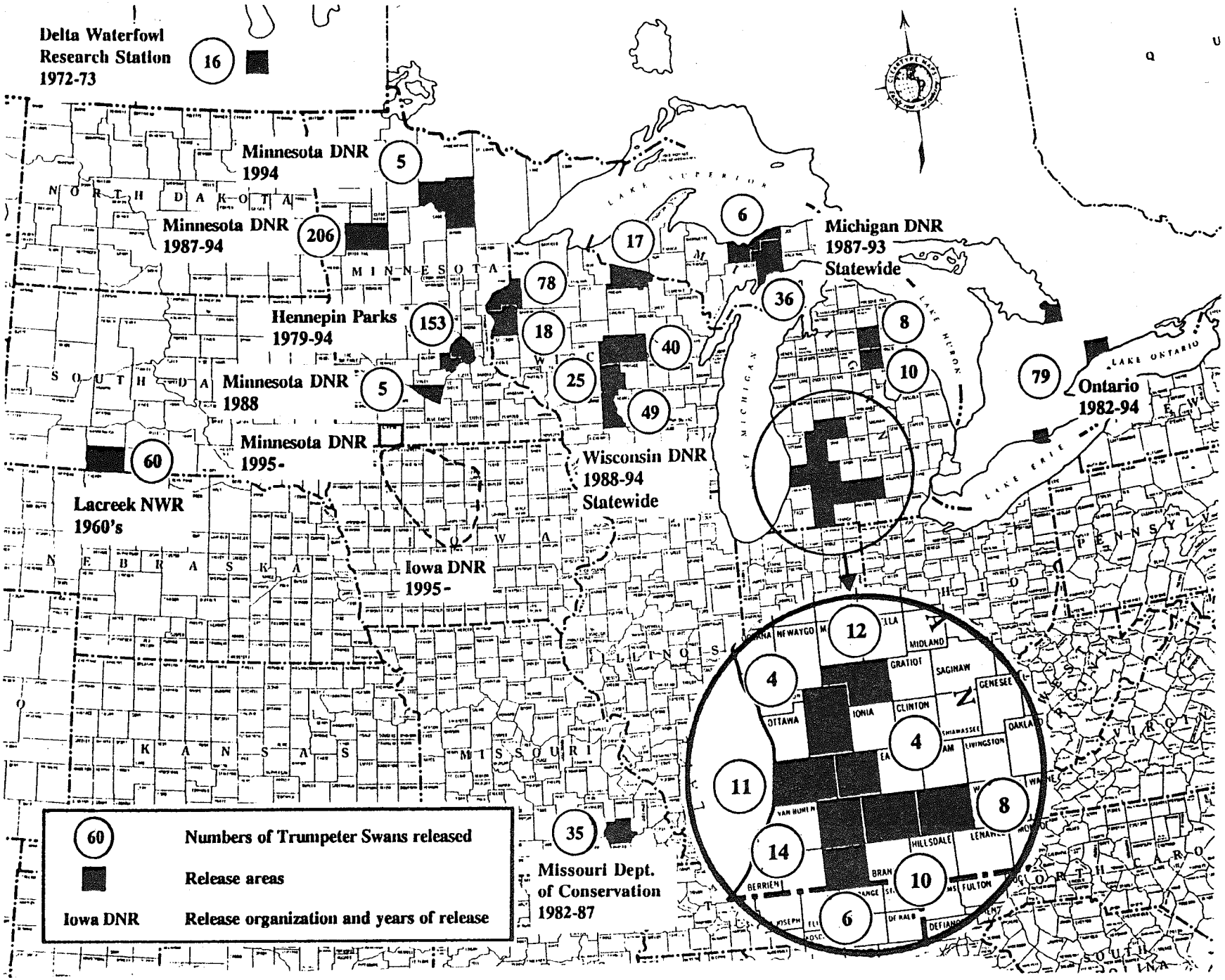


Figure 3. Numbers of Trumpeter Swans released by each restoration project per county through 1994.

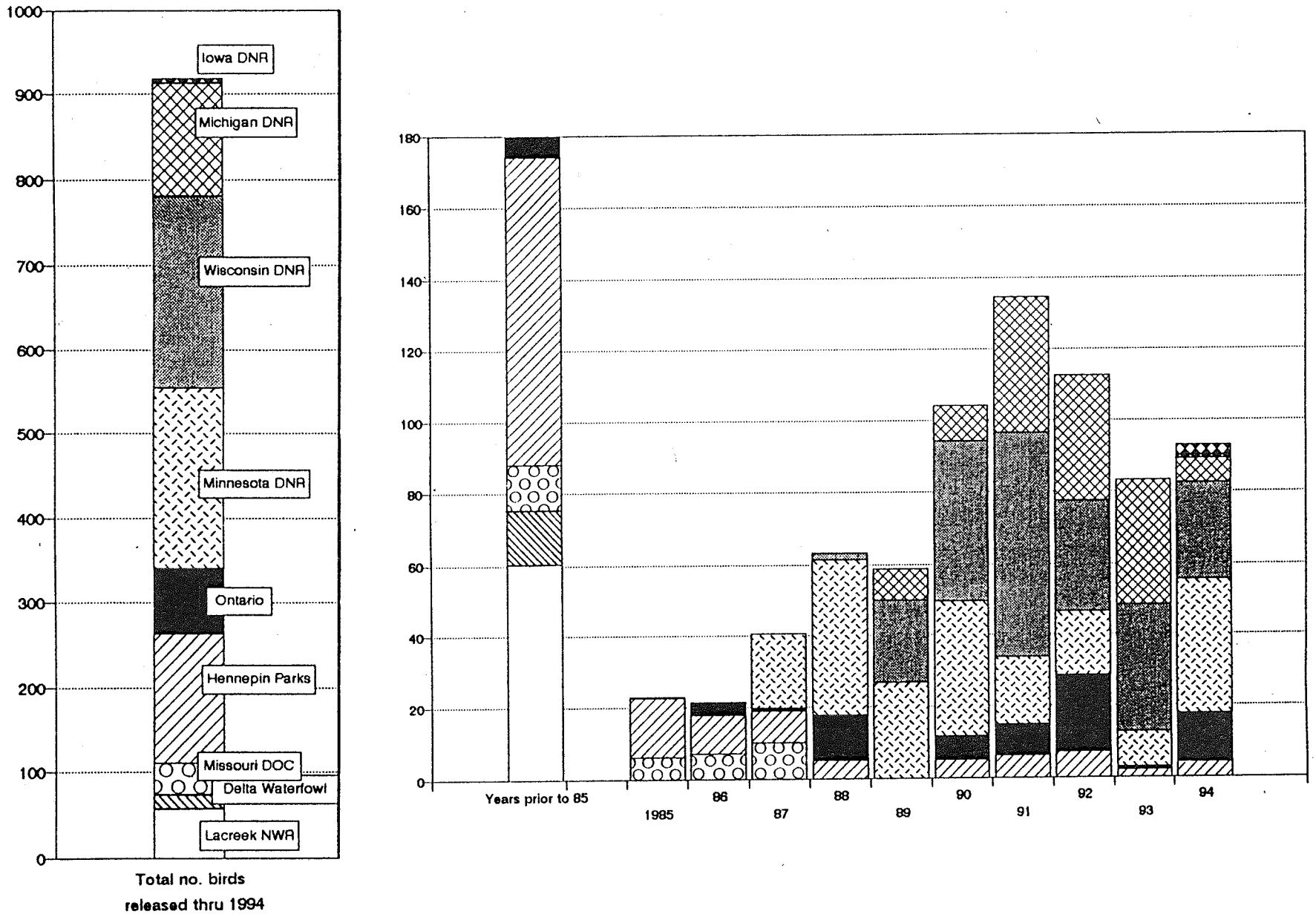
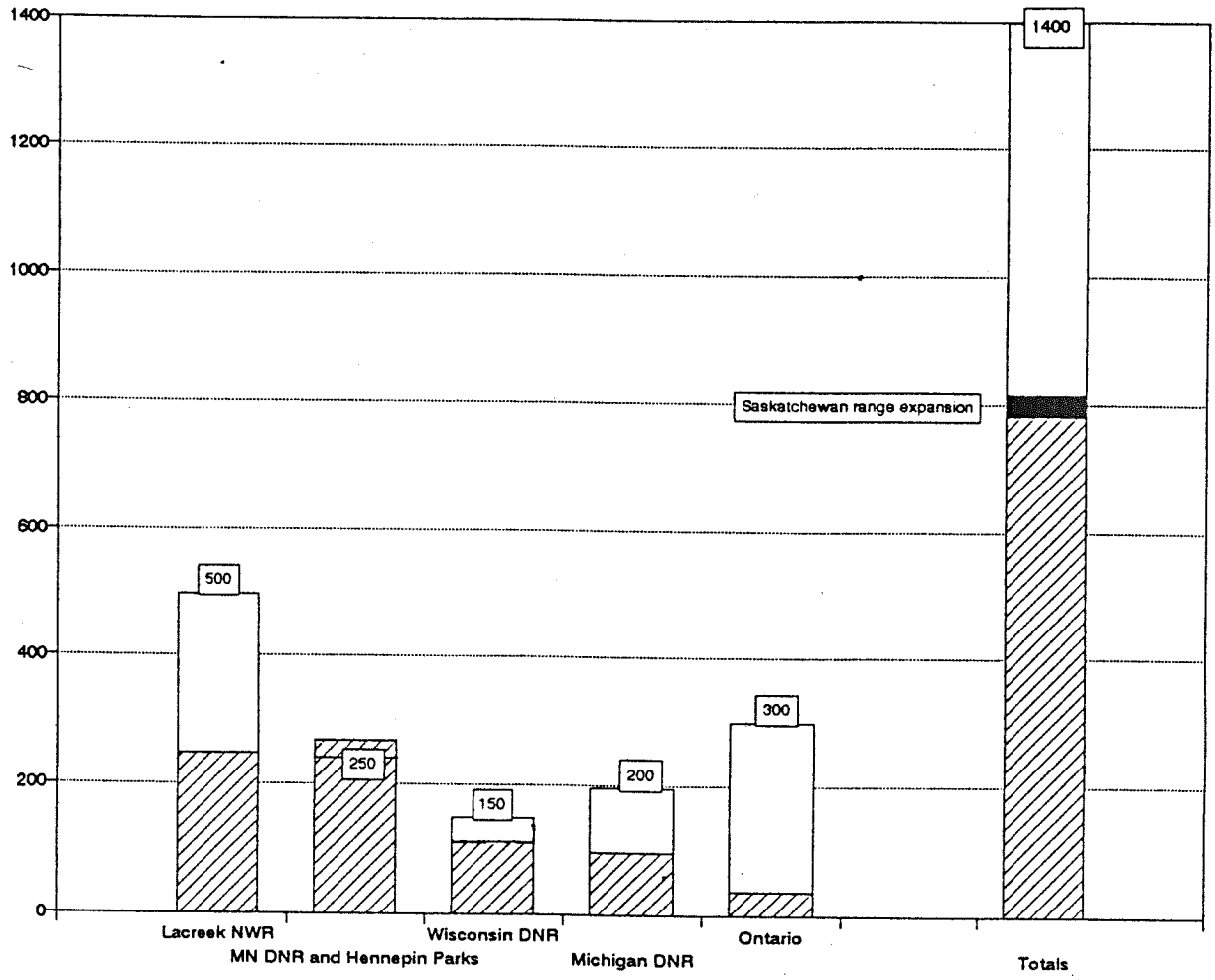


Figure 4. Numbers of Trumpeter Swans released from captivity per restoration project per year through 1994.



Portion of project goal yet to be achieved

Wild range expansion

Portion of project goal that has been achieved

Figure 5. Assessment of progress toward stated project goals as of December 1994.

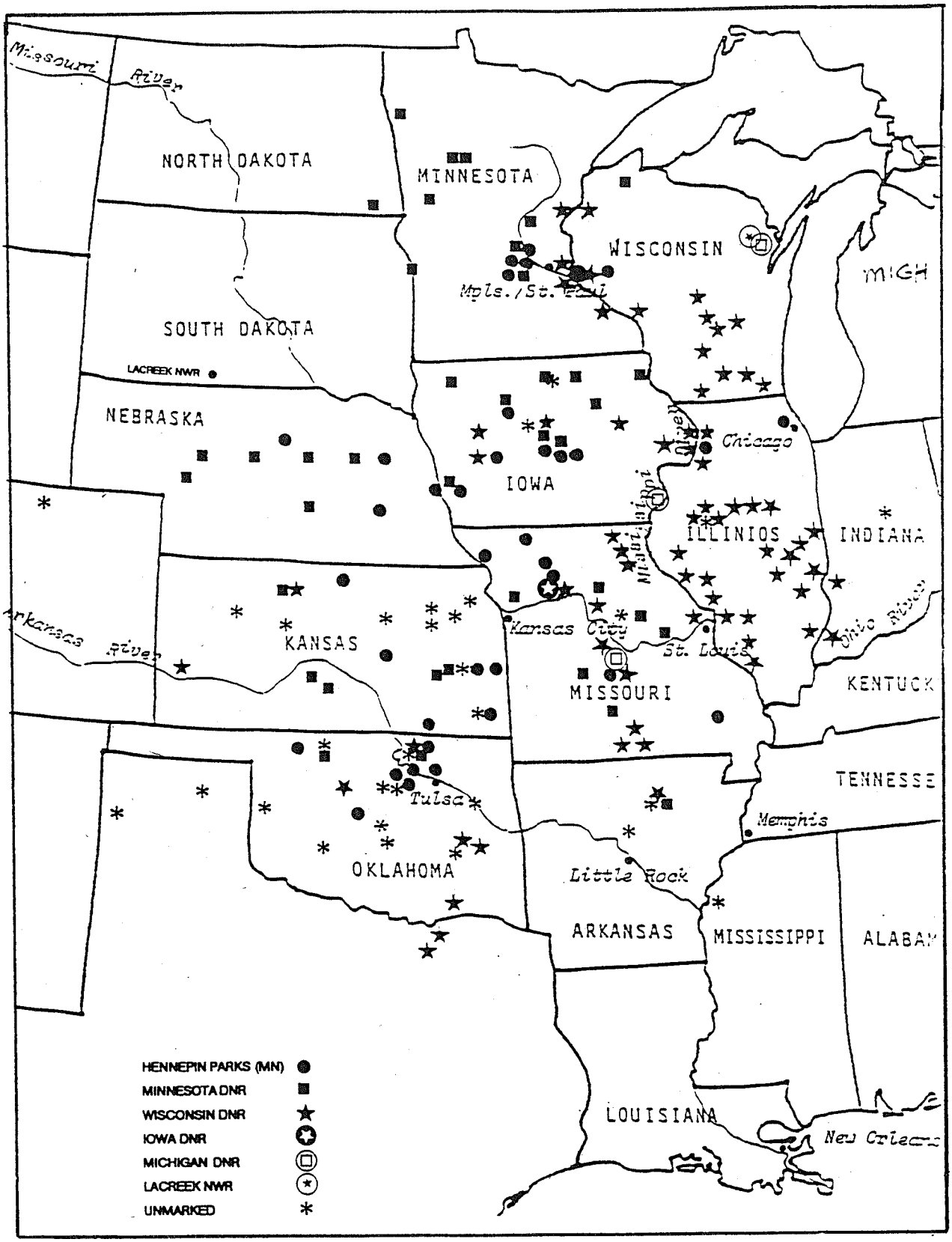


Figure 6. Winter sightings of Interior Population Trumpeter Swans, 1984-1995 (The Trumpeter Swan Society 1995).

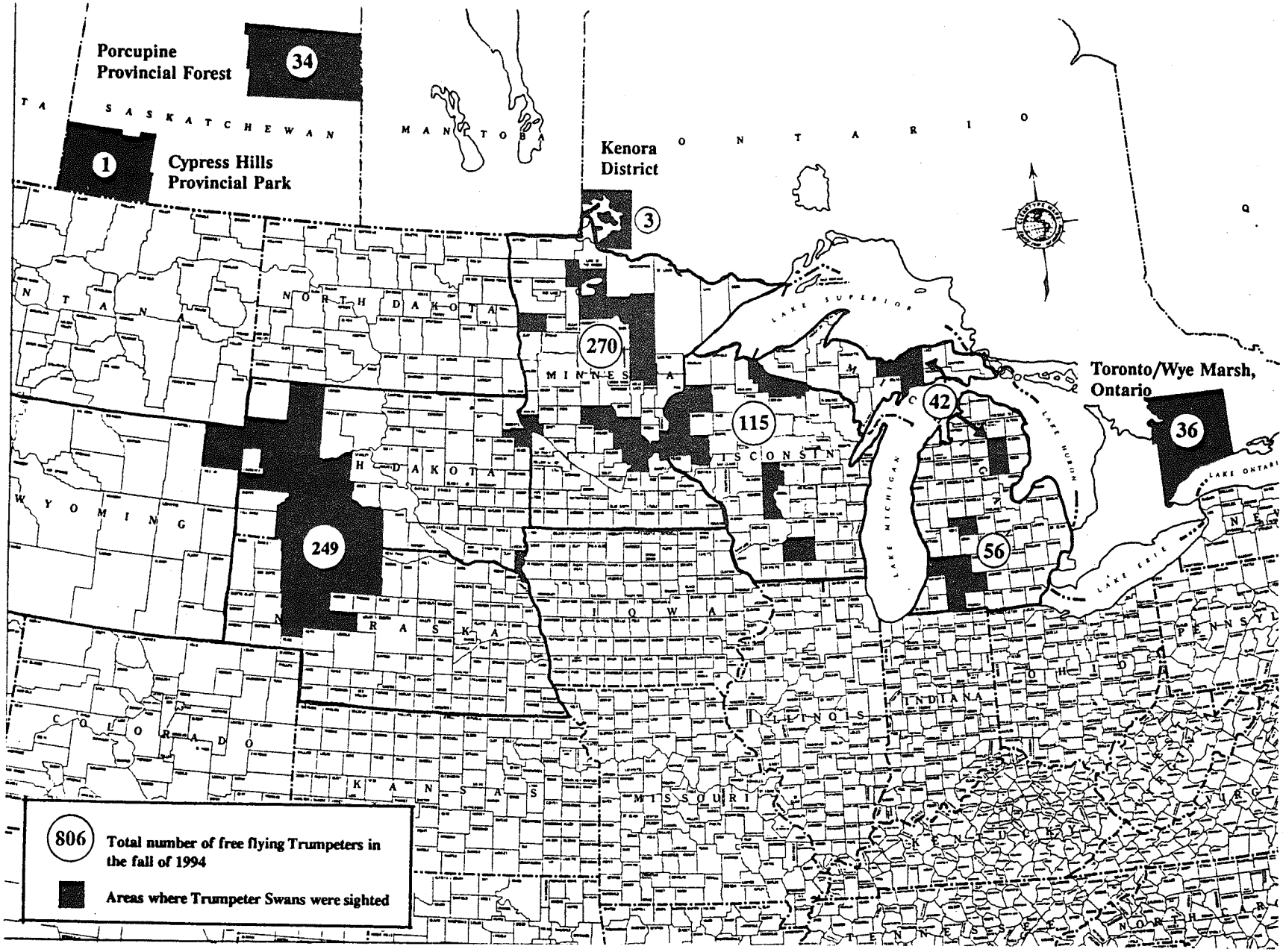


Figure 7. 1994 summer through fall total counts of Trumpeter Swans per region.

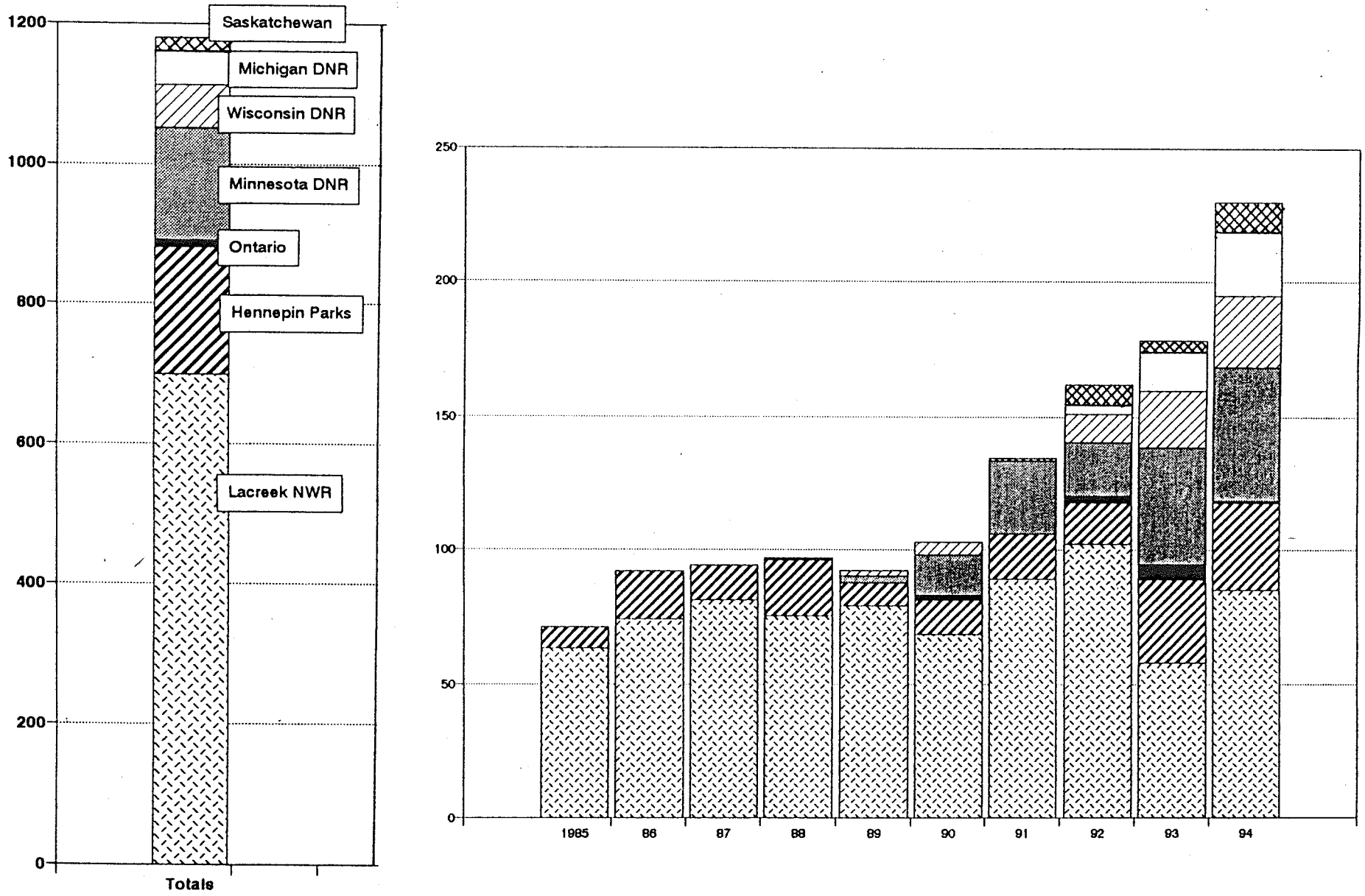


Figure 9. Numbers of cygnets fledged in the wild by Trumpeters per project per year, total annual production of the Interior Population through 1994.

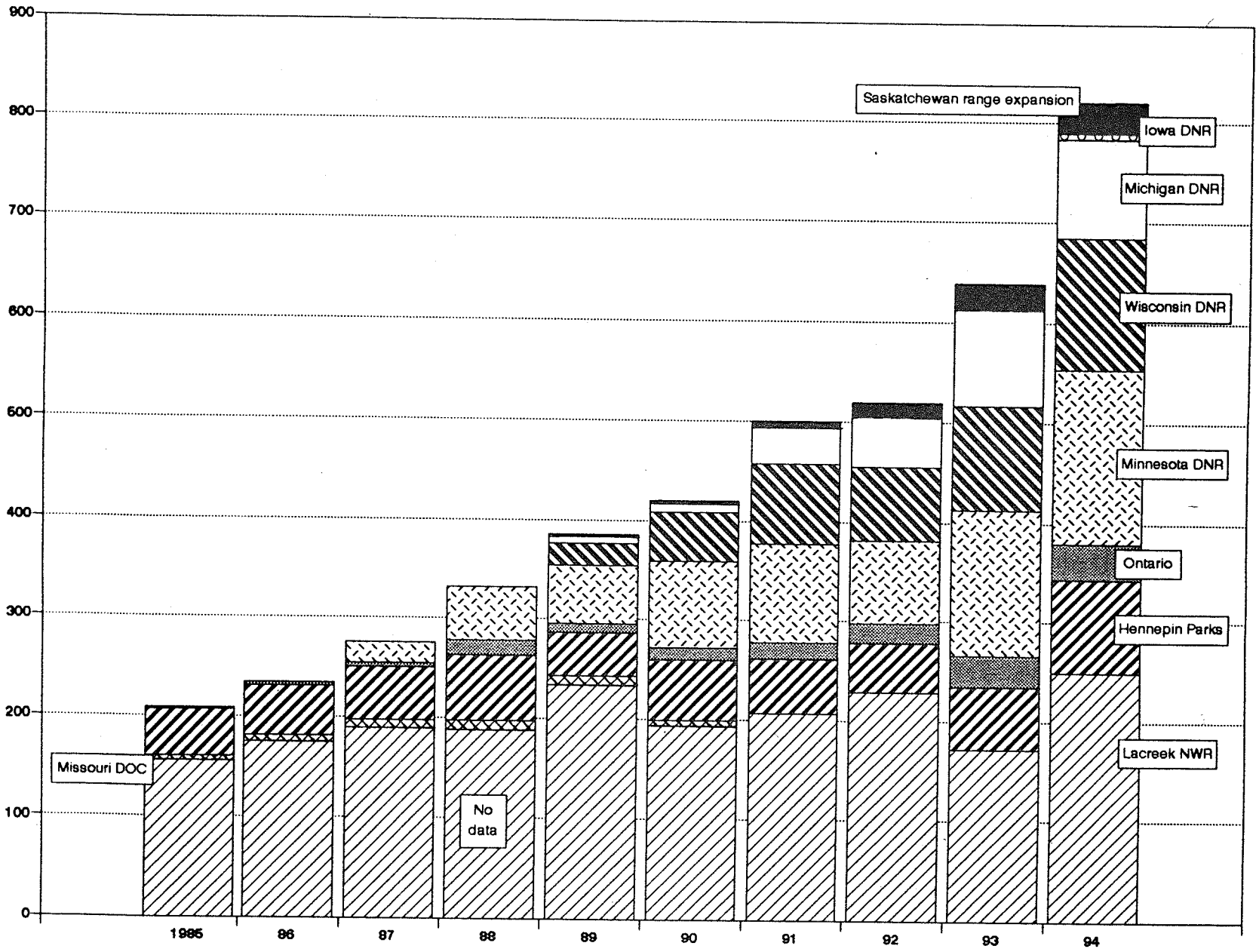


Figure 8. Number of free flying Trumpeter Swans per restoration project per year, total annual count for the Interior Population through 1994.

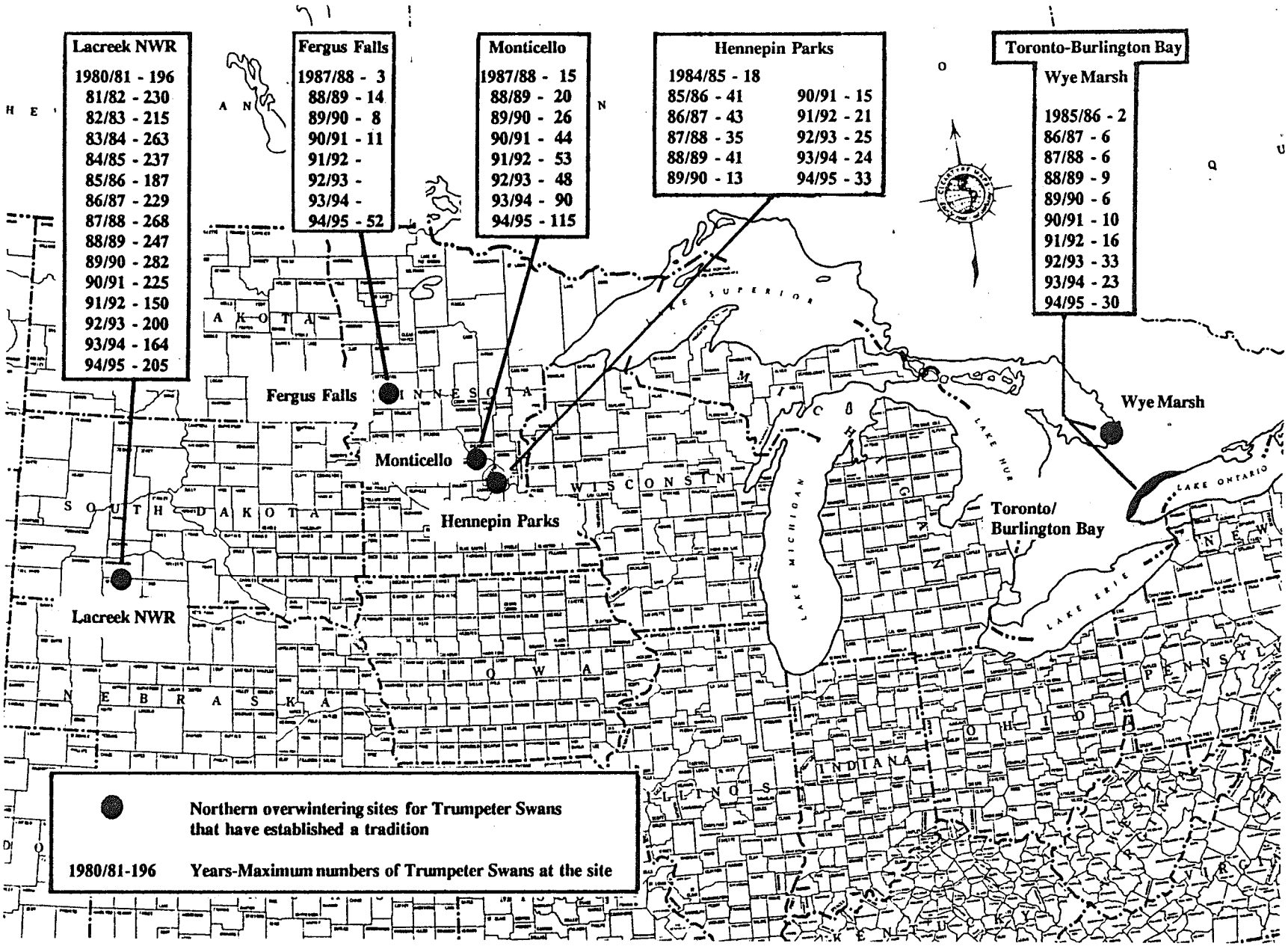


Figure 10. Northern overwintering sites where Interior Population Trumpeter Swans have established a tradition.

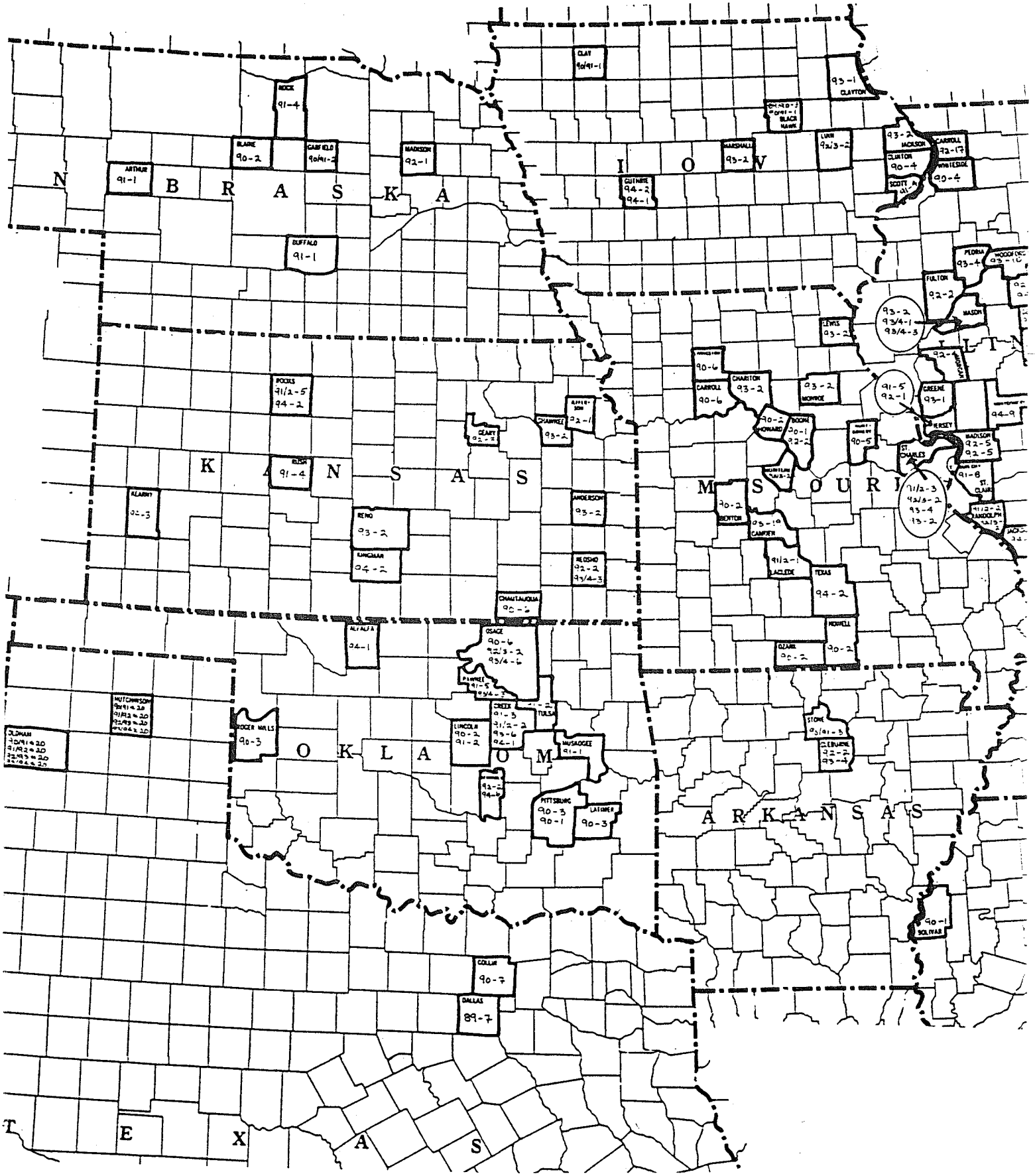
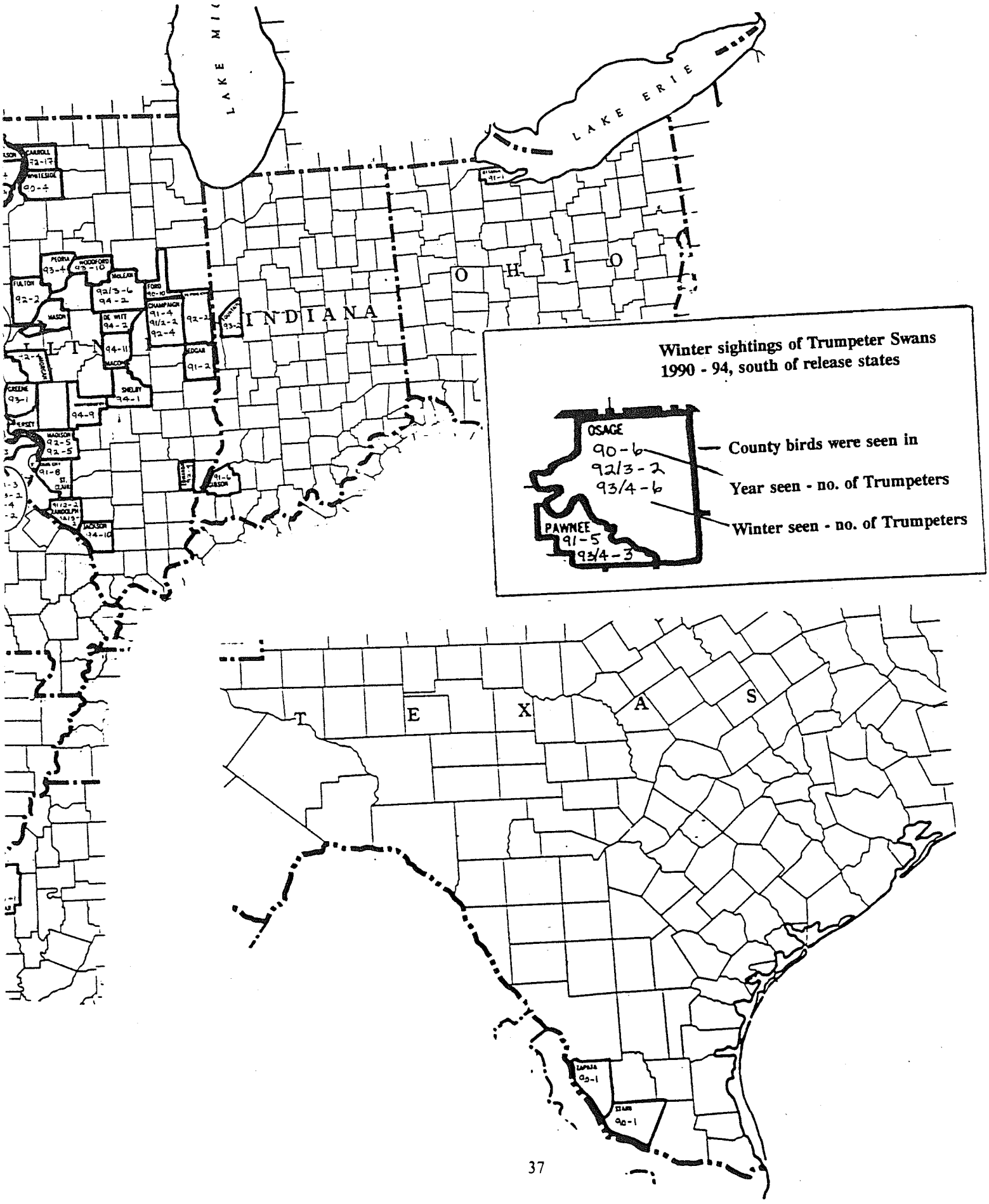
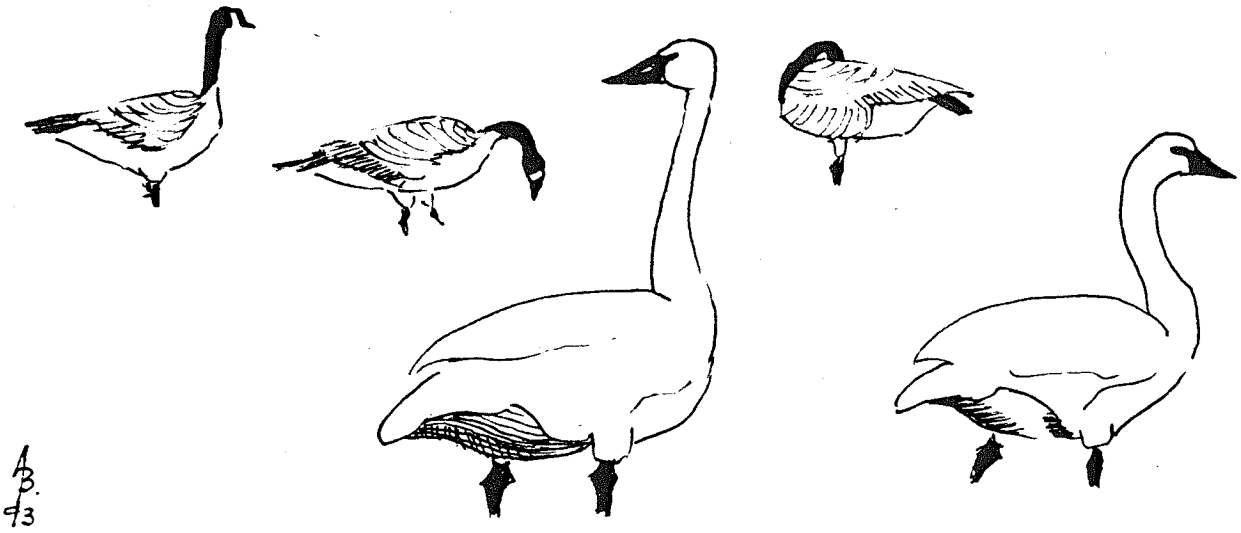


Figure 11. Recent winter sightings (1990-94) of Trumpeter Swans south of the release states. Numbers of Trumpeters are given per county per year reported.


LAKE MI
LAKE ERIE
INDIANA
OHIO
ILLINOIS
TEXAS
Winter sightings of Trumpeter Swans
1990 - 94, south of release states
OSAGE
90-6
92/3-2
93/4-6
PAWNEE
91-5
93/4-3
County birds were seen in
Year seen - no. of Trumpeters
Winter seen - no. of Trumpeters



TRYING TO UNDERSTAND WHAT SWANS THINK ABOUT, ESPECIALLY WINTER HABITAT

J. King, 1700 Branta Road, Juneau, AK 99801

ABSTRACT

A brief review of behavior of wild American swans. A projection of three things wildlife managers must do if we are to have a half million swans for enjoyment of the half billion Americans of the 21st Century: First, a way must be found to compensate farmers for feeding wintering swans. Second, swans must be encouraged to learn where they are welcome and where they are not. Third, we must find ways to allow crowds of people to enjoy flocks of wintering swans.

In April we sometimes see strings of swans high overhead migrating toward their nesting grounds. What are they thinking about? They are no more personal to us than a stream of people rolling down the freeway in their cars. But we must assume in each case that these groups are composed of individuals each with their own story to tell; of hopes and fears, of trials and errors, of needs and desires, of sorrows and happiness.

Students of mental ability have repeatedly told us that other creatures lack our intelligence, an arrogant notion that overlooks the fact that other species can cope with countless situations of which we have no comprehension. Swans' eyes are on the side, not front of their faces, so what do they see? What do they hear or smell? What are swans' concerns about being in high places or swimming in deep water? How do they balance needs for eating, sleeping, exercising, resting, at various times of day or year? We cannot know what swans are sensing or thinking but if we look closely at their annual cycle, we can make some assumptions about what is important to them and what they must be considering and how perhaps we should relate to them.

The long string of seemingly identical white dots overhead is composed of various age groups. There are experienced nesting pairs at the peak of their physical and mental ability who, like any good pilot, may be thinking of some familiar rest stops they may need in case of a weather change. Younger pairs may be preoccupied with the euphoria that comes with the prospect of first reproduction. Adolescents will be full of the restless energy of youth and interested in the adventures associated with selecting a mate and exploring together for a future nesting site. Last year's young will be mostly following their elders, learning the landmarks, the resting places, the danger signals, the good food sources, how to cope with weather problems and so forth. And there may be some older birds who have lost a mate, who may have an injury that insures celibacy, who have some sort of mental incapacity or for some other reason remain single.

Once the nesting grounds are reached the older pairs become occupied with the logistics of spring thaw and nest building. They defend their territory against any large avian competitors (other swans, geese) and recognize and react to predators (otters, wolves, bears). They pay no attention to the large herbivores (moose, caribou) but react at the first sign of man, the most dangerous and unpredictable of the creatures they must deal with. The younger pairs and subadults are free to roam and play through the long summer days, seeking good food and investigating possible nesting opportunities for future use. Like occupants in a hotel, they quickly learn they are welcome to use only certain places and that unauthorized investigation of the territory of others brings a quick and sometimes fierce reaction. Each individual will have unique, character building, experiences that it will carry the rest of its life.

As fall approaches, the thoughts of all ages must begin to swing toward fall migration needs. They forsake the preciously guarded nesting territories and begin to gather at good feeding sites, sometimes in flocks of one to several thousand. They abandon the hotel rules for something more like athletic club rules where the focus of training is eating. Some late starting families may have to walk overland to open water for additional feeding. Even for the newly fledged young, it is more important to eat than to practice flying, and they may only spend a few minutes each day in the air. As the water begins to freeze, those without family obligations may leave the

nesting region for some staging area down the flyway. No doubt the elders give a lot of thought to where the late freezing places are. All must be aware that when the habitat fully freezes, early or late, those that cannot fly will be quickly consumed by predators.

Fall migration may not be the same sort of cheery grand parade that happens in the spring. The days are short, food plants have gone dormant for the winter, and storms can cause unscheduled delays and stops. The skill, knowledge and intelligence of the old leaders may be most severely tested at this time. There is often a hesitancy to move, even as familiar stopping or wintering places become overcrowded and food supplies wane. This is the most difficult and dangerous time of year for swans to explore or search out new resources. The cost of a bad quest may be extreme.

Swans do have the ability to adjust to changing conditions. Ten thousand years ago half the continent was covered with ice and sea level was down, exposing a major portion of the continental shelf. Swans were much as they are today but their habitat was in entirely different places. Tundra Swans may have migrated over the ice to nest in Arctic refugia whereas Trumpeters could have been more predominant south of the ice. As the ice melted, no question that both swans had to make major adjustments in their life patterns.

The human population explosion of the past several centuries has made perhaps even more dramatic habitat changes than did the Ice Age. Tundra Swans declined greatly and Trumpeters almost died out. Gunning is usually blamed for these declines, and control of hunting in the past 70 some years has provided essential help for swans. During the same period, the northern and Arctic nesting areas have remained largely undamaged whereas human activity has largely destroyed the estuarine and riverine winter habitats formerly used by both forms.

The swans are adapting again. The most successful (more than 90%) now winter on farm land where they eat waste grains, waste root crops and new grasses. The Tundra Swans utilize the near coast croplands of the mid Atlantic states and the rice fields of California's Central Valley. Some 80 percent of the Trumpeters, those that nest in the forested coasts and valleys of Alaska and are increasing the most rapidly, now winter on farm lands in southwest British Columbia and western Washington. A few Trumpeters manage to eek out a winter living at open water sites in southern Alaska, central British Columbia and high in the Rocky Mountains near Yellowstone National Park. These likely are the remnant that prevented extinction of their kind. Trumpeters introduced into the Midwest in recent years have not developed any sound wintering strategy, but some manage to survive, often with the help of refuge feeding programs.

So we can be almost certain, as the strings of swans fly south in late October, they are not thinking of quiet estuaries and sleepy lagoons inundated with delicious aquatic vegetation. No, for no such provender still exists in the places suitable for wintering. What they must be envisioning are the shattered corn and grains, the flooded rice, the succulent potatoes and carrots, and the new green of winter wheat and pasture grasses in the larger fields of the nation's richest agricultural regions. Perhaps, too, they think of power lines, lighted towers, power boats, aircraft, motor vehicles, skyscrapers and other phenomena that render life risky. And perhaps they think of the interesting social interplay that develops in a large, well fed, crowd.

And what of the future? The swans appear to be intent on filling their former nesting habitat north of the agricultural zone. How far can they go with a population explosion? We see no indication they can compromise on the large size and quality of their nesting territories, thus they can probably never reach the numbers achieved by geese. Even with a free hand on our farm land in winter, it seems unlikely that swans could make over half a million, 250 thousand of each kind. Half a million! Sometimes there are more large geese than that on a single National Wildlife Refuge. Half a million swans on a continent where the human population will zoom past half a billion in the next century. That is just one swan for each thousand people. Surely we can afford them if we want to.

What conservationists and wildlife managers must be thinking, is that our dreams of natural habitat for wintering swans are no longer realistic. We have modified the continent too far. The waters are full of lead shot and other deadly poisons and no longer grow a suitable abundance of swan food. Our challenge for the future is threefold. First, we must develop ways that make it profitable for farmers to produce some extra for swans. Swans and farm profits are not necessarily incompatible. In most cases 90 percent or more of the crop can be sold for human use. Second, we must learn to train the swans

so they know where it is acceptable to feed and where they are not wanted. Ducks Unlimited is making progress with this matter in British Columbia now. Third, we must find ways to allow crowds of people to enjoy swans. We need swan refuges with visitor centers near big cities for public viewing and education. With a little research and a little public support, swan management may prove to be one of the simplest problems facing wildlife managers of the future.

It seems unlikely that humanity can overcome its reputation as the most dangerous and unpredictable species the swans must learn to deal with. However, we can be absolutely certain the swans will be grateful for any help we can give them and will respond with the grand show their presence can provide.

COMOX VALLEY WATERFOWL MANAGEMENT PROJECT 1991-94 REPORT: A REPORT ON TRUMPETER SWAN MANAGEMENT IN THE COMOX VALLEY, BRITISH COLUMBIA

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PREFACE

The Comox Valley Waterfowl Management Project (CVWMP) was established in 1991 to assess the impacts of overwintering Trumpeter Swans on agricultural operations and to determine management options which would ensure adequate habitat remained without limiting agricultural operations.

Historically, Trumpeter Swans did not impact agricultural operations along the British Columbia coast, as this species was in a decline in the early part of the century. Through conservation efforts, the Trumpeter Swan population on the west coast of North America has rebounded significantly, with the total coastal population now standing at approximately 14,000 birds. In the past few decades, these birds have adapted their feeding behavior to take advantage of food sources available to them on agricultural lands. Large numbers of swans can cause extensive damage to grass fields which farmers require as feed for dairy cattle.

The Trumpeter Swan population is expected to continue growing. This creates a need to establish a swan management strategy that ensures their long term survival and which addresses the needs of agricultural producers. This will require cooperation of many agencies and private organizations.

The CVWMP has now been in effect for 3 years. Funding is provided by the Canadian Wildlife Service and administered by Ducks Unlimited Canada. This report summarizes results and discussions to date, including information written up after the initial year of the program (Wareham & Fowler 1993) and offers recommendations for managing overwintering Trumpeter Swans in the Comox Valley.

EXECUTIVE SUMMARY

The CVWMP has been successful at meeting its objectives to date. The incidence of severe impacts by swans on agricultural fields in the Comox Valley has decreased significantly compared to that experienced by farmers prior to the CVWMP. Since the program started in 1991, some new techniques have been implemented and additional information on swan activity documented.

For the past 3 years, Trumpeter Swans counted in the Comox Valley have peaked at 1,007, 1,225 and 1,191 for 1991, 1992 and 1993 respectively. It is speculated that the Comox area overwintering population has leveled off at approximately 1,200 swans.

Swans displayed consistent movement patterns between valley habitats for the past 3 years. Most swans were observed feeding or resting in farm fields during daylight hours, then returning to the estuary, inland lakes or marshes to roost for the night. Feeding activity was not observed on the inland marshes or lakes, which suggests these habitats are important to the swans only as safe roosting sites. Swans which routinely fed on potatoes and grass fields at Comox Valley Produce remained on this site for 24 hours a day when fields were in a flooded condition. This suggests that swans will stay on feeding grounds given the correct field conditions and safety from predators. Trumpeter Swans usually stayed on selected feeding grounds throughout the day if left undisturbed.

Trumpeter Swans followed this general pattern each year, with the exception of that seen during an extended heavy snowfall in the winter of 1992-93. Ten inches of snow prevented swans from foraging on agricultural land for nearly a month. The birds focused their effort entirely on the marshes and mudflats of the Courtenay River Estuary.

Swan use of different types of agricultural fields was similar for the period of the study. In vegetable farm fields, swans were observed eating a variety of root vegetables which were available in fields after the growing season. Root crops such as potatoes, carrots, and parsnips were eaten regularly, and swans were

observed feeding from cull piles of potatoes, carrots and lettuce throughout the winter season.

Corn fields were used for lengthy periods by these birds. From October to December, swans primarily fed on corn cobs remaining in fields after harvest. From January through March, swans continued to actively use corn stubble fields, but the corn cobs had all been eaten. Swans were observed grazing weeds and native grasses beginning to grow in the corn fields with the onset of spring weather. The swans would occasionally shake corn stalks and roots but primarily fed on green forage between the harvested rows of corn.

The project purchased a small crop of standing corn in 1992 with the anticipation that it would attract swans. Unfortunately, winter rains began before the swans arrived and the other waterfowl took the opportunity to consume the entire crop.

The majority of grass field feeding occurred during January through March, with the exception of newly-seeded areas which were used earlier. Swans were observed targeting grass fields which had surface water accumulations. Grazing of dry sections of grass fields throughout the winter months appeared to have no permanent effect on the crops observed.

Cover crops were used extensively by Trumpeter Swans during all 3 years of the program. The areas' most heavily-used crops were located on vegetable farms. The advanced growth of summer sown crops appeared to attract swans already in the area foraging for vegetables. Swans also used late-seeded cover crops on vegetable farms but these crops did not withstand the grazing pressure, and once depleted did not display any regrowth in the spring.

Swan surveys indicated that swans favor the youngest seeding of Annual Rye Grass, other Annual Rye Grass seedings, Winter Wheat and Fall Rye respectively. Trumpeter Swans using the Farquharson Farm showed preferences for Oats and Barley over Fall Rye.

An aerial seeding trial was conducted 1 September 1993, with Annual Rye Grass seeded into fields of standing corn from a fixed-wing aircraft. This trial was initiated in an attempt to provide a more advanced, robust crop of Annual Rye Grass for the swans to feed on during the winter season. A total of 206 acres was seeded in this way. Poor post seeding growing conditions limited establishment of this crop, and there was limited use of these sparse crops by the swans. However, this will be repeated at an earlier date to give greater chance of seedling establishment before judging the effectiveness of this technique.

During harsh winter conditions in January of 1993, swans were observed foraging along the estuary shoreline at high tide. During low tides they walked the mud flats grubbing for rhizomes of aquatic plants. Swans were also seen grazing vegetation in the high marsh areas.

Other waterfowl species were documented using the same habitats as swans. Flocks of six to 300 Canada Geese were observed feeding and resting with Trumpeter Swans. Flocks of up to 200 Mallards and Wigeon were also observed feeding in the same fields as Trumpeter Swans for the duration of the project.

Several techniques were tested as to their effectiveness in protecting specific fields from swan damage. The use of the project coordinator's dog proved to be an effective short term method of scaring swans from farm fields. The Phoenix Whailer, an electronic audio device, proved to be effective at protecting approximately 5-7 acres of grass field from Trumpeter Swan use. Swans in the general vicinity of the Whailer were not alarmed when the device sounded, but swans within, or directly adjacent to the protection zone hastily moved out the area when the unit sounded. With some modifications, this method could effectively protect larger areas.

Two kinds of noise-making shells were tried as deterrents. Banger shells fired from approximately 100 metres had little to no effect on swans, but were effective at scaring other types of waterfowl such as Canada Geese. When Cracker shells were fired within 100 metres of swans, they would take flight and leave the area but were sometimes observed back in the field within the hour. This method also involved considerable time on the part of the operator to locate the birds, approach them to an effective distance and discharge the shells.

Flash tape sections were used on a number of farms throughout the Comox Valley, all with varying degrees of success. It is concluded that grass fields which are very attractive to the birds will require an increased density of flash tape sections which need regular maintenance for optimum effectiveness.

Strings of pennant flags were placed on fields that experienced repeated swan use. This method was effective in reducing swan use on grass fields.

Black flags were placed on a number of farms throughout the study area with varying levels of effectiveness.

Barrels proved to be the most effective method of preventing swans from feeding on specific fields. The drawback to this method is the time required to position the number of barrels needed to protect a large field.

Communications activities were given high priority during the past 2 years of this project. The Trumpeter Swan Society's 14th Conference, Courtenay's Trumpeter Swan Festival, an eight page colour brochure, a project newsletter and press releases all contributed to increasing the public's awareness of the Trumpeter Swan/agriculture issue.

Due to the positive response to the program by local farmers, the CVWMP has been extended for 3 more years pending the availability of funding. The project will continue to manage the swans and to track any long term changes in feeding preferences and response to various scare tactics.

ACKNOWLEDEGMENTS

The implementation of this project was successful thanks to the assistance and involvement of many concerned individuals and organizations. Special thanks go to the following for their support and assistance.

Gary Rolston and Wendy Laliberte from the Ministry of Agriculture and Fisheries and Food who provided resource information, meeting rooms and support to local farmers.

The Comox Strathcona Natural History Society who conducted weekly swan counts, organized the Trumpeter Swan Society conference, contributed to Courtenay's Swan Festival and distributed project newsletters to their membership.

The project cooperators: Beaver Meadow Farms, Berry's Farm, Birkdale Farms, Buisman Orchard, Casawood Farm, Clark Farm, Comox Valley Produce, Daldas Farm, Devonshire Turf Farm, Evansdale Farm, Farquharson Farm, Glacierview Farm, Glen Alwin Farm, Haven Farm, Hazelmere Farms, Holbek Farm, Jackson Farm, Juandrea Holsteins, Knight Farm, Lazo-Tyee Farms, Lloydshaven Holsteins, Ludwig Dairies, Mikerri Farms, Northey Lake Farms, Riverbend Holsteins, River Meadow Farms, Roycreek Farm, Russell Farm, Ser Fen Te Farm, Smith Farm, Sunnybrooke Farm, UBC Farm, Wendill Farms, and the Williams Farm, all of whose cooperation was essential to the success of this project.

Rick McKelvey of the Canadian Wildlife Service and Ed Hennan of Ducks Unlimited Canada who provided resource information and direction for project activities.

Finally, we thank Environment Canada and the Canadian Wildlife Service for the financial support which made the project possible.

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Editor's Note: This paper is a summary of the complete report which may be obtained by contacting the authors at Ducks Unlimited Canada, BC Coastal Region Office, WRPS, Box 39530, White Rock, BC V4A 9P3.

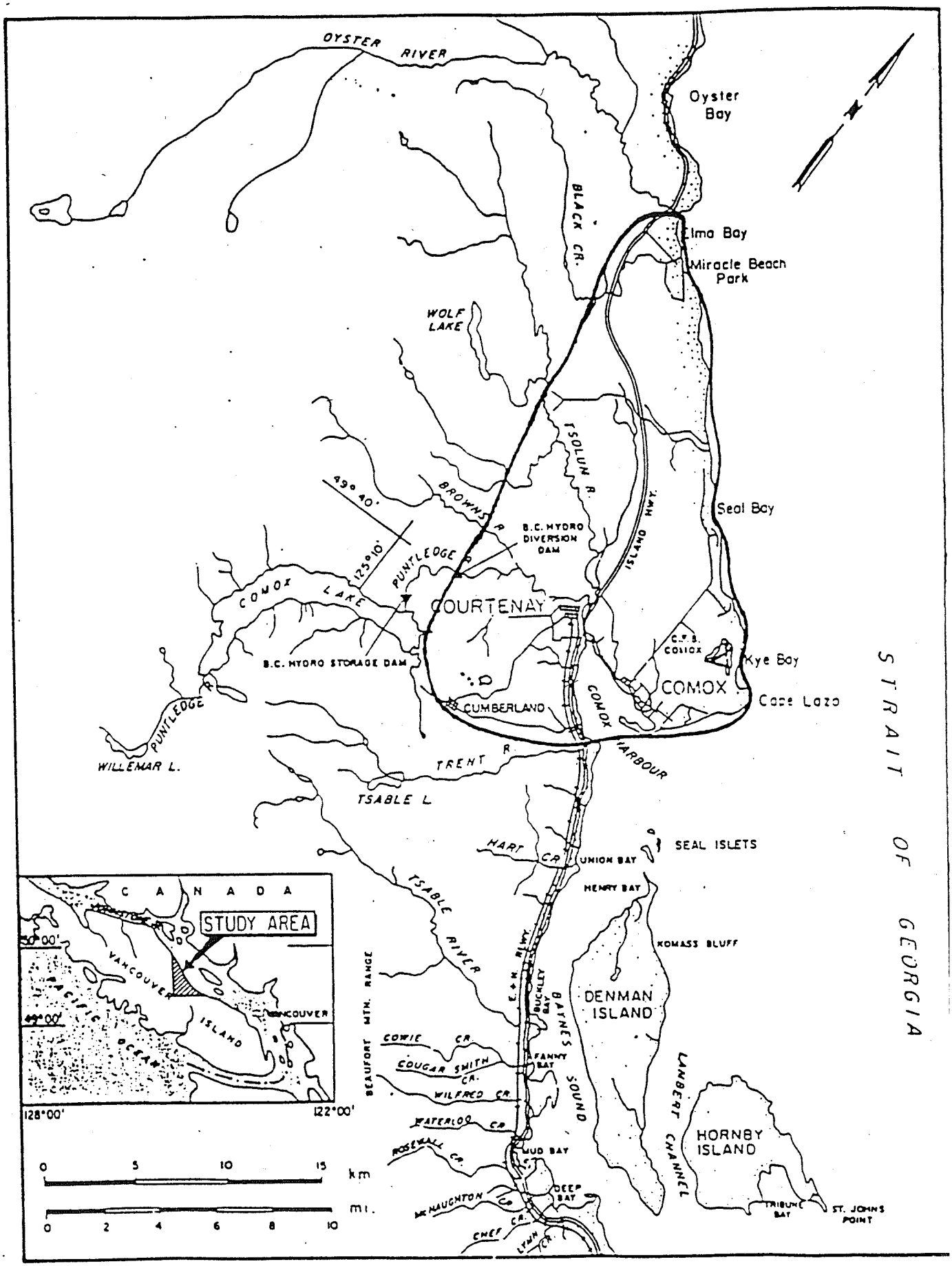

Figure 1. The Comox Valley Study Area.

TUNDRA SWAN USE IN CALIFORNIA'S CENTRAL VALLEY

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ABSTRACT

The Central Valley of California is the most important Tundra Swan area in the west, annually supporting 70-85 percent of the entire Pacific Flyway population. Approximately 90 percent of this use occurs in an eight-county area in the Sacramento Valley and the Sacramento-San Joaquin River Delta. Swans extensively utilize private agricultural lands for feeding with rice, corn, and wheat being the most important crops. In recent years swans have shifted from using corn and wheat in the Delta to rice in the Sacramento Valley.

The Central Valley of California is approximately 400 miles long, 45 miles wide and covers an area about the size of England. It extends from Red Bluff on the north to Bakersfield on the south and is part of a larger watershed that is 500 miles long and 120 miles wide on average. The valley floor is a gently sloping, practically unbroken, alluvial plain which comprises nearly one third of the total watershed. It is bound on the east by the rugged Sierra Nevada Mountains several of which reach 14,000 feet elevation and on the west by the less rugged coastal range, which average less than 4,000 feet.

The Central Valley is comprised of three main sub-areas. To the north is the Sacramento Valley which is drained by the Sacramento River, the largest watershed in the state. To the south is the San Joaquin Valley with its primary drainage being the San Joaquin River. These two rivers flow toward each other and join at the Sacramento-San Joaquin River Delta, the third main sub-area of the Central Valley.

The valley floor climate is characterized by warm dry summers with an almost complete absence of rainfall during the summer months and mild winters with relatively light rainfall but often heavy fog particularly around water bodies. Precipitation ranges from 23 inches at Red Bluff to 6 inches at Bakersfield. Summer temperatures frequently exceed 100°F, but the winter climate is exceptionally mild. Valley-wide, the average frost-free period is 7 1/2 months. At no place in the valley floor is there an average of more than 15 days per year when the minimum temperature drops to 32° degrees or below (U.S. Bureau of Reclamation, 1949).

Most of the precipitation in the watershed falls on the west slope of the Sierras as heavy winter rains at the lower elevations and deep snows at the higher elevations. Historically, large winter and spring floods were common, accounting for more than 4 million acres of wetlands on the valley floor. These wetlands were bordered by extensive riparian forests.

Ninety one percent of the Valley's wetlands are now gone, converted primarily to agriculture at the turn of the century (Frayer et. al. 1989). The Central Valley has the largest concentration of irrigated farm land in the United States encompassing two thirds of California's 8 million irrigated acres. The richness of this land for agriculture is unparalleled. For example, California accounts for only 3 percent of farmland in America yet it produces 55 percent of all the nation's fruits, nuts, and vegetables and 25 percent of all the table food consumed nationally (American Farmland Trust 1995).

Where millions of waterfowl once fed on native plants in pristine wetlands and grasslands, many of today's waterfowl have now shifted to agricultural fields with rice, corn, wheat and pastures being the most important food crops. Deep rich alluvial soils, an abundance of waste grain, and a moderate winter climate combine to make the Central Valley the single most important wintering area in the west, supporting 60 percent of the waterfowl wintering in the Pacific Flyway. For species like the Tundra Swan, the importance of the valley is even greater.

Typically, 70-85 percent of the Pacific Flyway Tundra Swans winter in California (Aldrich et. al. 1994). They usually arrive in mid-October and depart in mid-February, a period of 4 months. Although there are small numbers of Tundra Swans that consistently

winter in outlying areas like the Humboldt Bay - Eel River Delta in Northwestern California and Klamath-Modoc Basins in Northeastern California (J. Bartonek, pers. comm.), 89 percent of the Tundra Swans in California winter in eight counties (Figure 1): Butte, Glenn, Colusa, Sutter, Yuba, Yolo, Sacramento, and San Joaquin (G. Mensik and D. Yparraguirre, pers. obs.) Within this area are two sub-areas: the Sacramento Valley and the Delta, and they are uniquely different.

Much of the Sacramento Valley is characterized by heavy impervious clay soils that evolved under hydric conditions. These areas coincide with extensive wetland systems created by frequent winter floods. In this area, 94 percent of the state's rice is grown (Tippett 1991). It is also an area which, by California standards, has a good distribution of high quality managed wetlands located in several national wildlife refuges, state wildlife areas, and private duck clubs.

The Delta is characterized by deep peat soil which also evolved under hydric conditions. Because of oxidation and erosion, these peat soils have subsided to the point where many of the leveed islands in the Delta are now 10 to 20 feet below sea level. From a waterfowl standpoint the important food crops are corn and wheat, with San Joaquin County being the leading corn producer in the state. Most of the Delta is in private agriculture. Managed native wetlands in the Delta are negligible.

Aldrich et al. (1994) summarized over 40 years of mid-winter Tundra Swan data for the Pacific Flyway (Figure 2). These winter indices displayed as 3 year rolling averages indicate the following trends. First, the Pacific Flyway Tundra Swan population increased for a period of 30 years from the early 1950's to the early 1980's. The 40 year average index is 54, 306 birds and in 1991-94 index was 63,341 (J. Bartonek, pers. comm.). For the past 10 years, the population has declined slightly, fluctuating annually, but still well above the flyway objective level of 38,000 birds.

Further analysis of this data set reveals that during the 1980's and 1990's the overall percent of swans wintering in California has increased slightly while the percent wintering in Utah and Nevada has decreased. This shift is likely due to the catastrophic floods that occurred throughout the Great Basin in the early 1980's followed by drought that decimated habitat particularly in the Great Salt Lake areas of Utah and the Stillwater area of Nevada.

In the Sacramento Valley, Tundra Swans utilize two primary habitats: privately owned flooded rice for day time feeding and managed wetlands, which are mostly publicly owned, for roosting and nocturnal sanctuary. For the period 1991-94, the average winter index for the Sacramento Valley was 28,700 swans and the trend is upward (J. Bartonek, pers. comm.). This corresponds with a similar upward trend in the area for rice.

In the Delta, swans predominately use private agricultural lands with corn and winter wheat being the most important crops. For the 1991-94 period, the average winter index for the Delta was 16,700 birds and the trend is downward (J. Bartonek, pers. comm.).

There are three factors that may explain the shift in Tundra Swan use from the Delta to the Sacramento Valley. First, there have been substantial increases in the acres of managed wetlands in the Sacramento Valley in recent years. Areas such as the Upper Butte Sink Wildlife Area managed by California Department of Fish and Game and Rancho Llano Seco managed by the U.S. Fish and Wildlife Service have protected and restored thousands of acres of new habitat for Tundra Swans and other waterfowl. Second, corn and wheat production has been declining in the Delta while rice production in the Sacramento Valley has been increasing. Finally, rice fields have recently become more attractive because of a recently passed state law requiring rice farmers to phase out of field burning to improve air quality. Instead of burning, many rice farmers are now shallow flooding their fields as a means of decomposing rice straw. This practice enhances feeding opportunities for Tundra Swans and other waterfowl.

Tundra Swans appear to be one of the more adaptable of North America's waterfowl species. It was only in the 1960's that Tundra Swans for the first time were documented moving out of the marshes and feeding in agricultural fields (Nagel 1965, Tate and Tate 1966, Gunn 1973, Munro 1981). Now that the field feeding tradition has been well established, Tundra Swans have shown the ability to shift their feeding behavior locally in response to changing agricultural practices (e.g. from Delta corn to Sacramento Valley rice), but also regionally due to broader climatic factors such as floods (Utah) and droughts (Nevada). Although field feeding Tundra Swans are largely traditionalists, heavily using crops such as corn, rice and wheat, they are also opportunistic and can shift to non-traditional food resources as exhibited in the winter of 1994-95 when several hundred swans

extensively used flooded tomato fields on Staten Island in San Joaquin County for several months (pers. obs.).

In the short term, the future for Tundra Swans in the Central Valley looks good. Substantial increases in restored wetlands have been made in recent years and there appears to be no shortage in agricultural fields for feeding. In the long term, urban encroachment in agricultural areas and the conversion of cereal grains to less desirable food crops will have broad, negative impacts on the Valley's ability to support Tundra Swans and other waterfowl.

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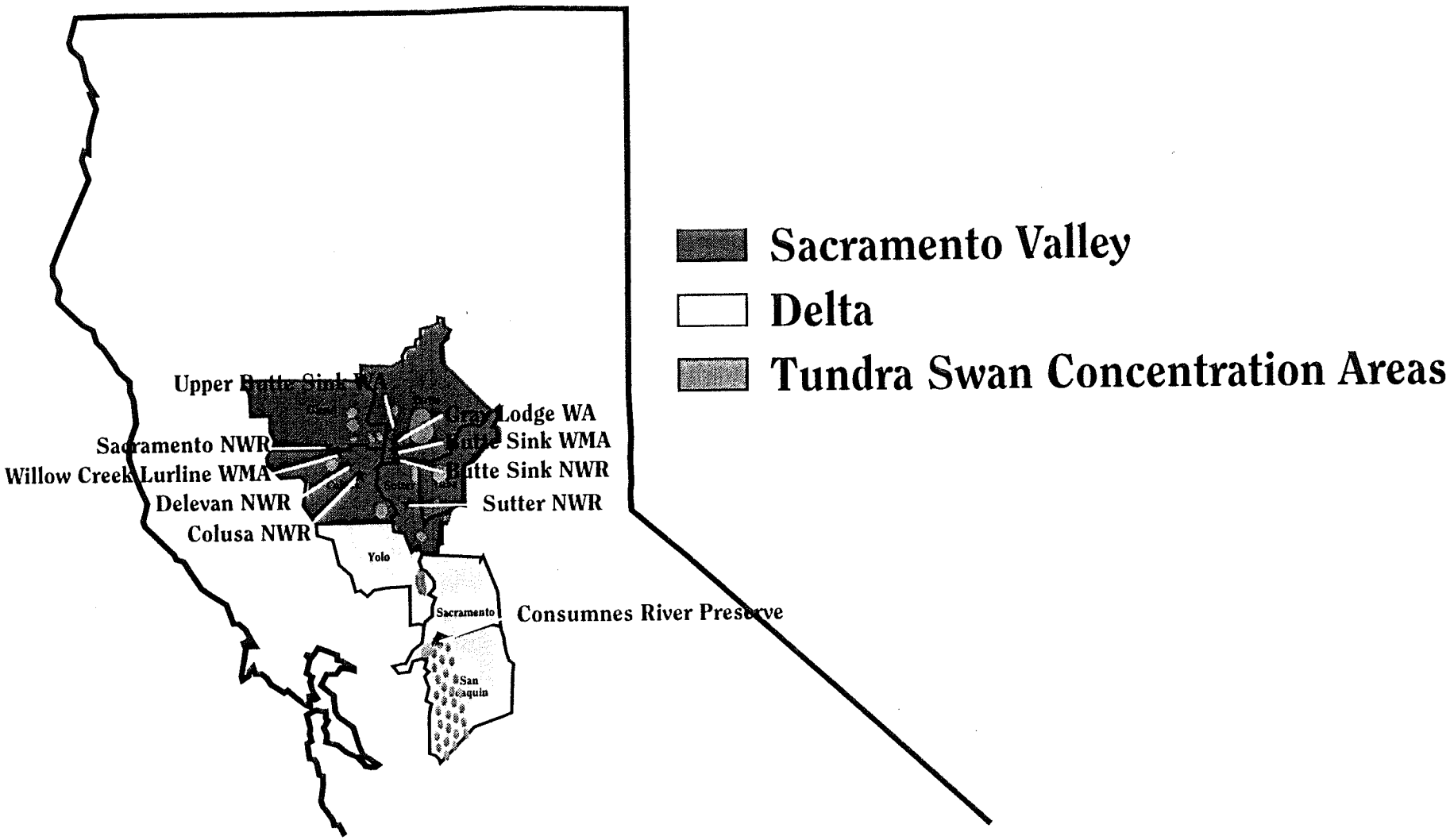

Figure 1. The Primary tundra swan wintering areas in California.

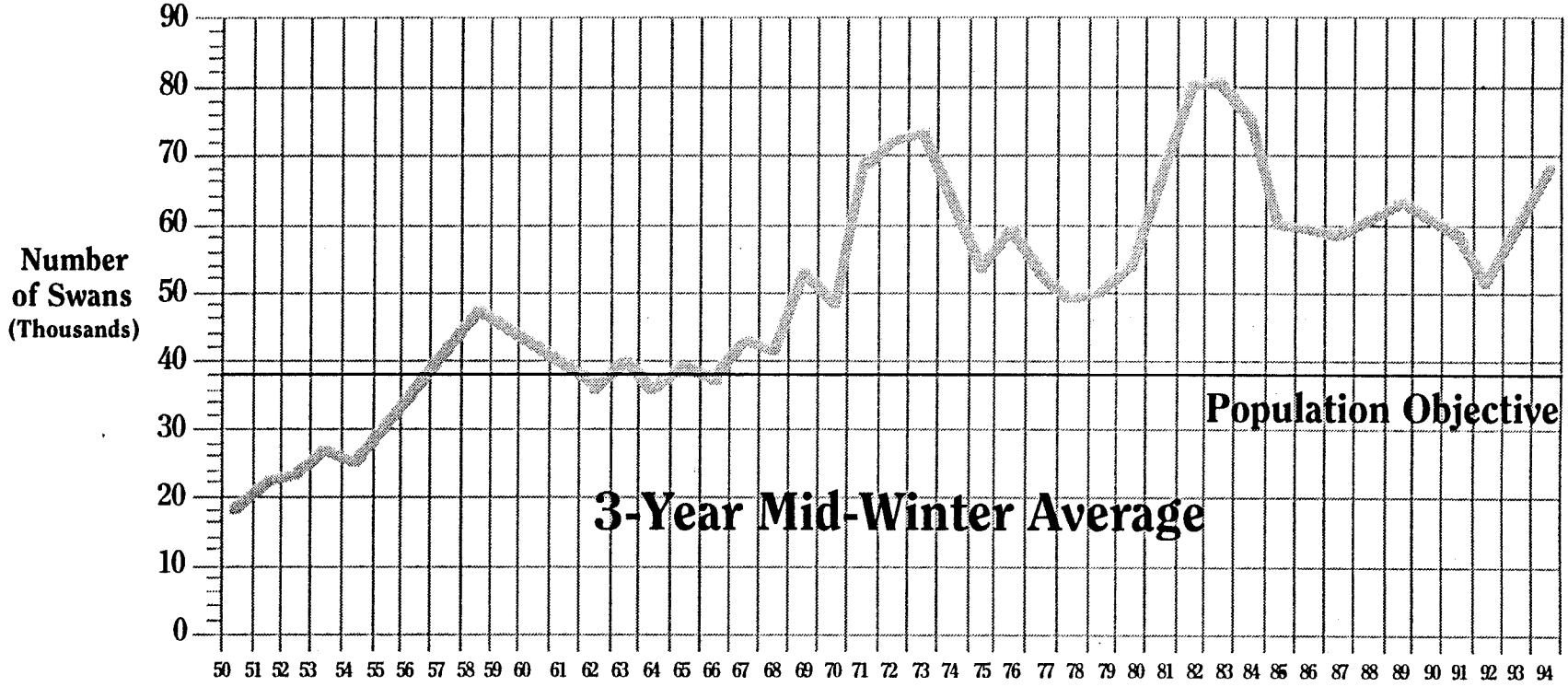

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Figure 2. Pacific flyway mid-winter tundra swan estimates.*

TRUMPETER AND TUNDRA SWANS: THEIR HISTORY AND FUTURE AT THE BEAR RIVER MIGRATORY BIRD REFUGE

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The Bear River Delta on the northern end of the Great Salt Lake in Utah has played a significant role in the life cycle of the western population of Tundra Swans. Weather, water conditions, and food resources greatly influenced the abundance, distribution and timing of Tundra Swan use. The establishment and construction of the Bear River Migratory Bird Refuge (BRMBR) in the early 1930's altered both the water and food resources available to Tundra Swans. Five large (approximately 5,000 acre) impoundments were constructed and managed to provide habitat for a wide variety of waterbirds. Presumably the large fresh water impoundments provided a more consistent and abundant source of sago pondweed (Potamogeton pectinatus), the Tundra Swan's main food source. Records from BRMBR annual narrative reports indicate that Tundra Swan use increased dramatically on the Refuge, often to the exclusion of other wetlands in the delta.

As early as 1930, Tundra Swans were disproportionately using the northern portion of the Refuge known as unit 1. This area encompasses approximately 9 square miles of seasonally flooded, shallow (approximately 6-12 in.) wetland. The highly alkaline, inorganic, clay soils can produce abundant growth of aquatic vegetation, primarily sago pondweed. Sago pondweed does not over winter vegetatively on the Refuge, and germination of tubers probably accounts for much of the rapid regrowth each summer. Unfortunately, in most years insufficient water is available to keep unit 1 completely flooded during the entire growing season. Carp (Cyprinus carpio) are also abundant and may severely limit sago pondweed growth. Thus, food supplies for Tundra Swans in unit 1 are at best unpredictable. Other characteristics, such as the large, open vista, and lack of disturbance, may be the critical factors determining use.

Historically, Tundra Swans used the Refuge during the spring and fall migration, and during some winters. Spring migration numbers were erratic, but noteworthy in some years (median=3260, 95% C.L. 2375-7000) (Figure 1). Sporadic spring use may be indicative of the near absence of pondweed early in the season and thus limited food supplies for swans. Spring numbers generally peaked the last week of March and the majority of birds left the refuge by late April.

Fall numbers were more consistent (median=17575, 95%C.L. 14500-20,000), peaking between November 15 and 28 (Figure 2). Fall migrants gradually increased through 1950-60 followed by a sharp decline in the early 1970's. No explanation is given for this decline, although by this time, inadequate water management and carp had taken a heavy toll on productivity throughout the Refuge. Intensive carp control was implemented in unit 1 in the early 1980's, followed by an increase in sago pondweed production, and subsequent use by Tundra Swans. In most years, swans left the Refuge by the end of December.

Thousands of Tundra Swans wintered at BRMBR most years during the 1930-40's (Table 1). However, records indicate that large amounts of grain were made available to wintering waterfowl during this time. Feeding was discontinued sometime in the early 1950's, after which few swans wintered on the Refuge. Tundra Swans have wintered on the Refuge in only 8 of the past 44 years. The lack of aquatic vegetation even in mild winters is likely limiting. Swans wintering on the BRMBR must rely entirely on tubers as a food source.

A hunt on Tundra Swans in Utah was implemented in 1962. Concern was noted for the potential harvest of Trumpeter Swans, although no confirmed sightings had previously been documented in the Refuge files. Measurements were taken of all swans harvested on the Refuge during 1962-65. No Trumpeter Swans were harvested during this time. Confirmed sightings of Trumpeters have been documented in the Refuge files 3 times in its 64 year history (1966, 1973, 1993). However, difficulty in surveying remote portions of the Refuge and in distinguishing Trumpeters from Tundras, could severely limit the number of sightings.

Harvest rates of Tundra Swans at BRMBR have been consistently low (mean harvest rate = 0.002 + 0.001 SD). The highest number of Tundra Swans harvested

from the Refuge was 69 in 1969 (Figure 3). Harvest rates are not correlated with swan density (r =0.04, P=0.3) (Figure 3). Tundra Swans are not harvested in proportion to their numbers at BRMBR. Inaccessibility to swan use areas severely limits hunter success. The northern portion of unit 1 has always been closed to all hunting and other public access (Figures 4 and 5). Tundra Swans loafing in unit 1 are surrounded by at least a mile of open, shallowly flooded mudflats. The birds are difficult to see and completely inaccessible by anything other than an airboat. Typically freeze-up occurs around Thanksgiving each year. At this time, a large proportion of the Tundra Swans continue migrating, while those remaining move to open water areas south of the Refuge. Swans become much more accessible to hunters during this time.

The Refuge was inundated by flood water from the Great Salt Lake from 1983-1989. Habitat for Tundra Swans was not available during this time. Post flood numbers have only recently begun to show an increase, but are expected to continue an upward trend as adequate habitat becomes more abundant.

Currently, the U.S. Fish and Wildlife Service is in the process of rebuilding the BRMBR. Repair of dikes and water control structures is nearing completion. Construction of new interior cross dikes and installation of state of the art water management capabilities are underway. Of critical importance to the health of wildlife populations in the Bear River Delta is the protection of wetlands and uplands surrounding the existing Refuge. Acquisition of 17,000 acres of upland nesting habitat and the protection of 21,000 acres of privately owned wetlands through easements is actively progressing (Figure 6). However, funding for these programs is tightly controlled by Congress. State and community support for these efforts is essential for the appropriation of funding.

The Bear River Delta hosts some of the highest concentrations of waterbirds found anywhere in North America. Hundreds of thousands of ducks, and millions of shorebirds use the delta as a migration stopover twice each year. Any actions that may jeopardize the protection of an additional 38,000 acres of this prime habitat must be seriously weighed against the benefits gained. Careful consideration must be given to the importance of the Bear River Delta to Trumpeter Swans and the overall importance of protecting a large portion of the habitat for all species. Insufficient data exists to confirm the historic use of the delta as a migration route by Trumpeter Swans. The suitability of the habitat to support Trumpeter Swans as a migrational stopover or potential wintering site has not been established. The impacts of hunting at BRMBR, if any, are not adequately demonstrated by the available data.

These questions must be sufficiently addressed before major changes to habitat or hunting management are proposed. Goal oriented, long term, objectives for habitat and population management of Trumpeter Swans specific to the Bear River Delta must be carefully devised and implemented in a manner that is clear, logical, and acceptable to both public opinion and agency directives. Finally, the public must be given the opportunity to become informed, and to comment on any proposed actions. If properly timed and presented, local support and cooperation could be generated. However, the public must be made a part of the process as soon as possible.

[Editor's Note: Paper presented by Al Trout.]

Table 1: Tundra Swans wintering at Bear River Migratory Bird Refuge, Utah 1932-1993*

Year	Tundra Swans
1932	1500
1933	2000
1934	6000
1935	6000
1936	Some
1938	6000
1940	5000
1943	1000
1945	1500
____	____
1953	200
1956	182
1962	75
1965	2-3000
1969	628
1981	1000
1982	50
1993	2000

* All data taken from annual narrative reports. For years not indicated no mention was made in the report of swans wintering on the Refuge.

____ before line-Swans fed during these years

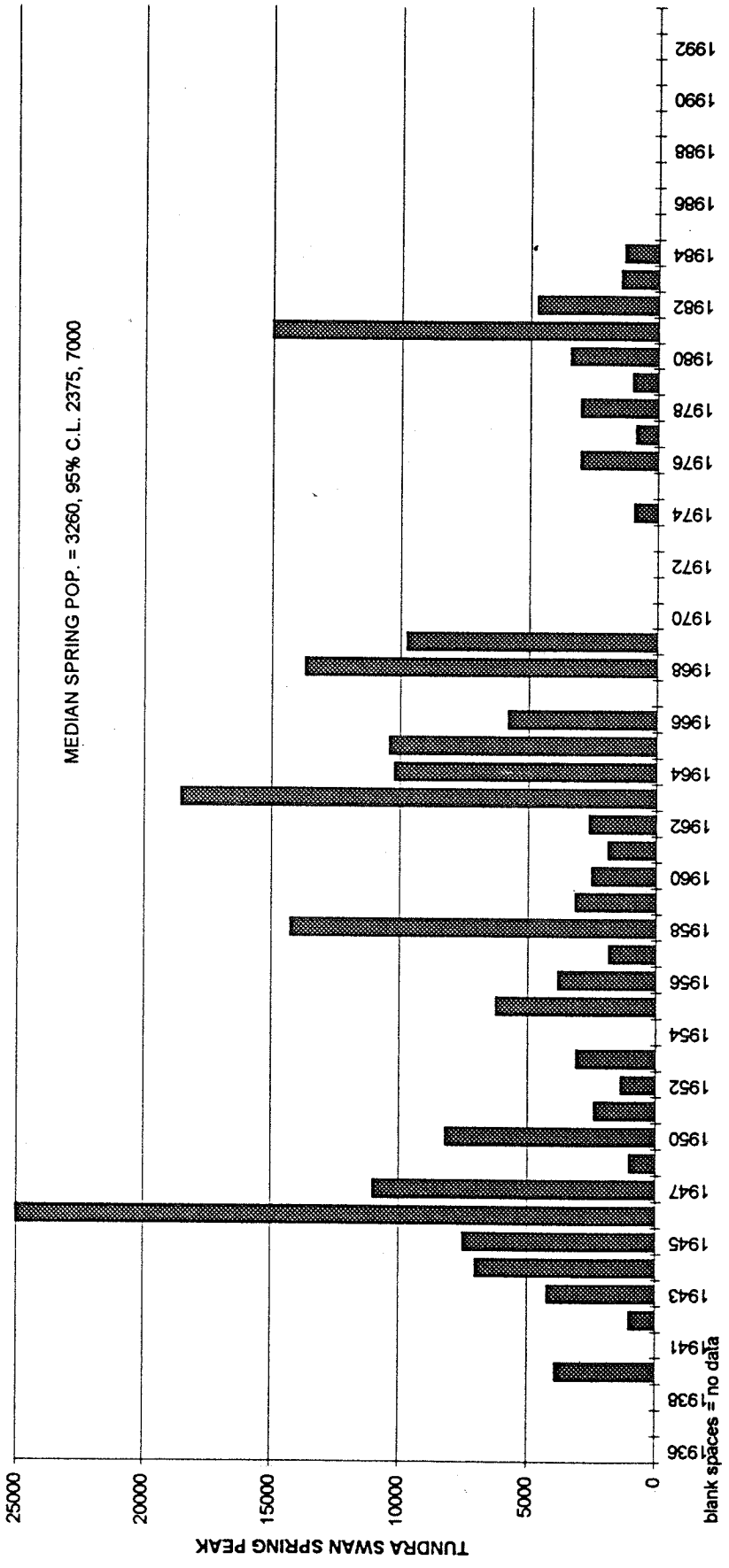


FIG. 1 PEAK SPRING POPULATION OF TUNDRA SWAN AT BEAR RIVER MBR

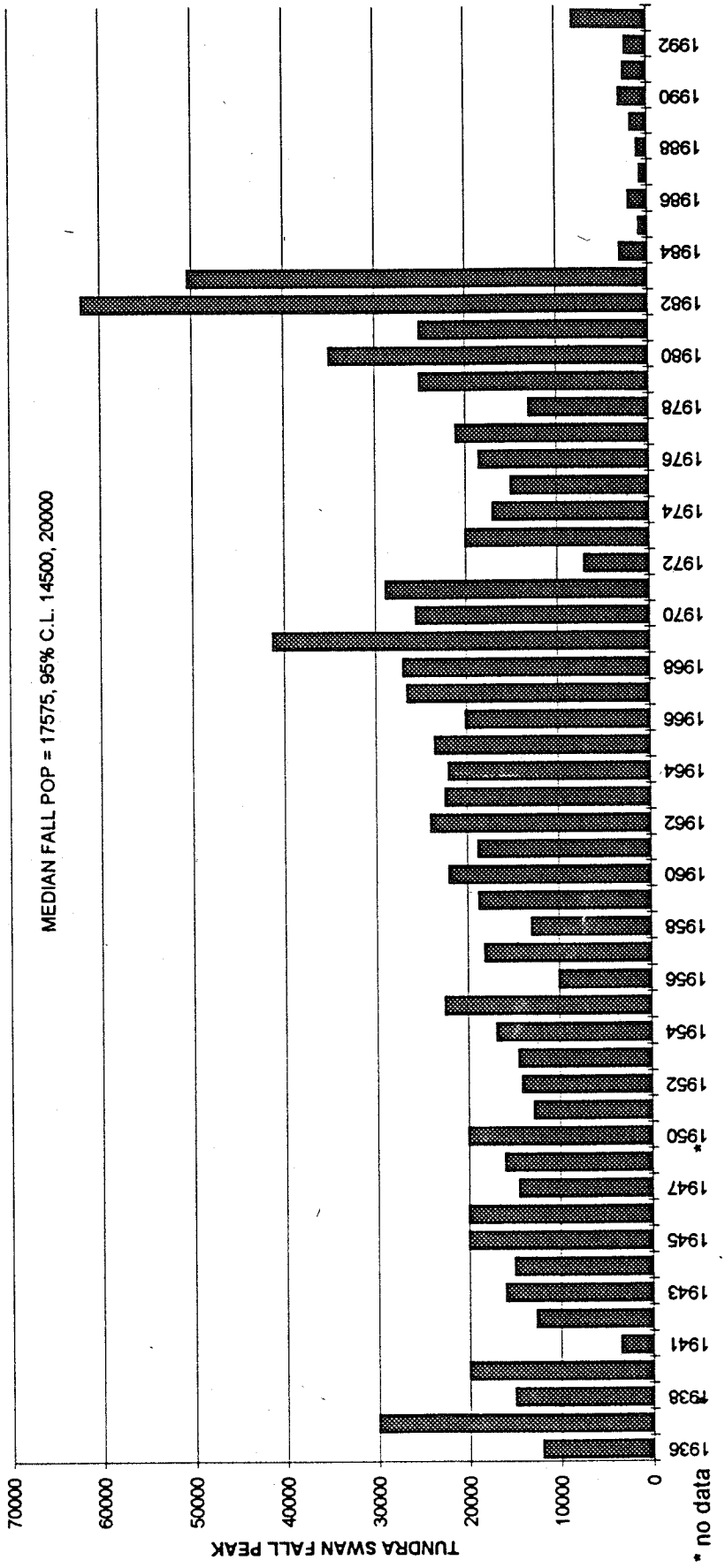
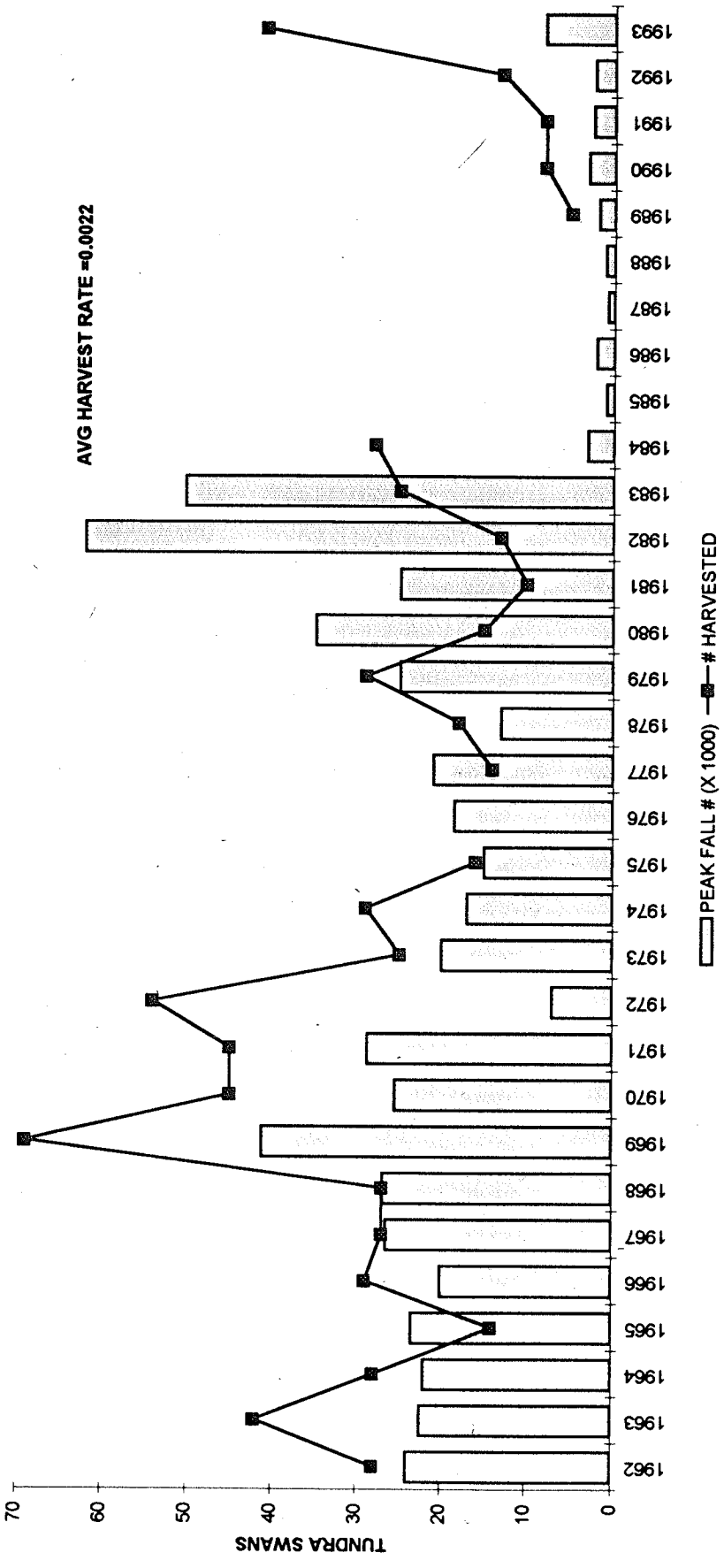


FIG. 2: PEAK FALL POPULATION OF TUNDRA SWAN AT BEAR RIVER MBR

FIG 3: PEAK FALL POPULATIONS OF TUNDRA SWANS VS NUMBER HARVESTED AT BEAR RIVER MBR



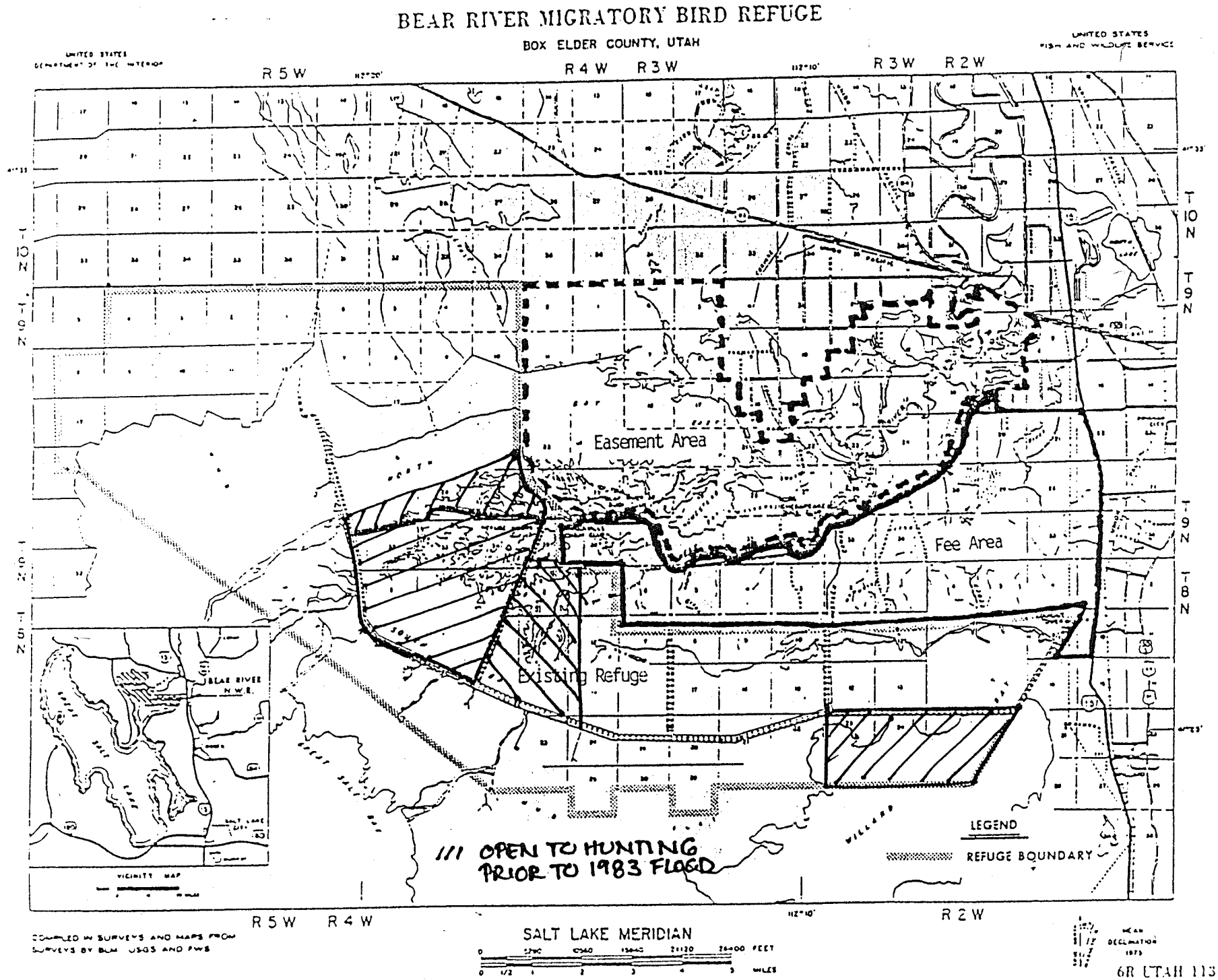


FIG.4: HISTORIC HUNTING AREAS AT BEAR RIVER MBR, UT.

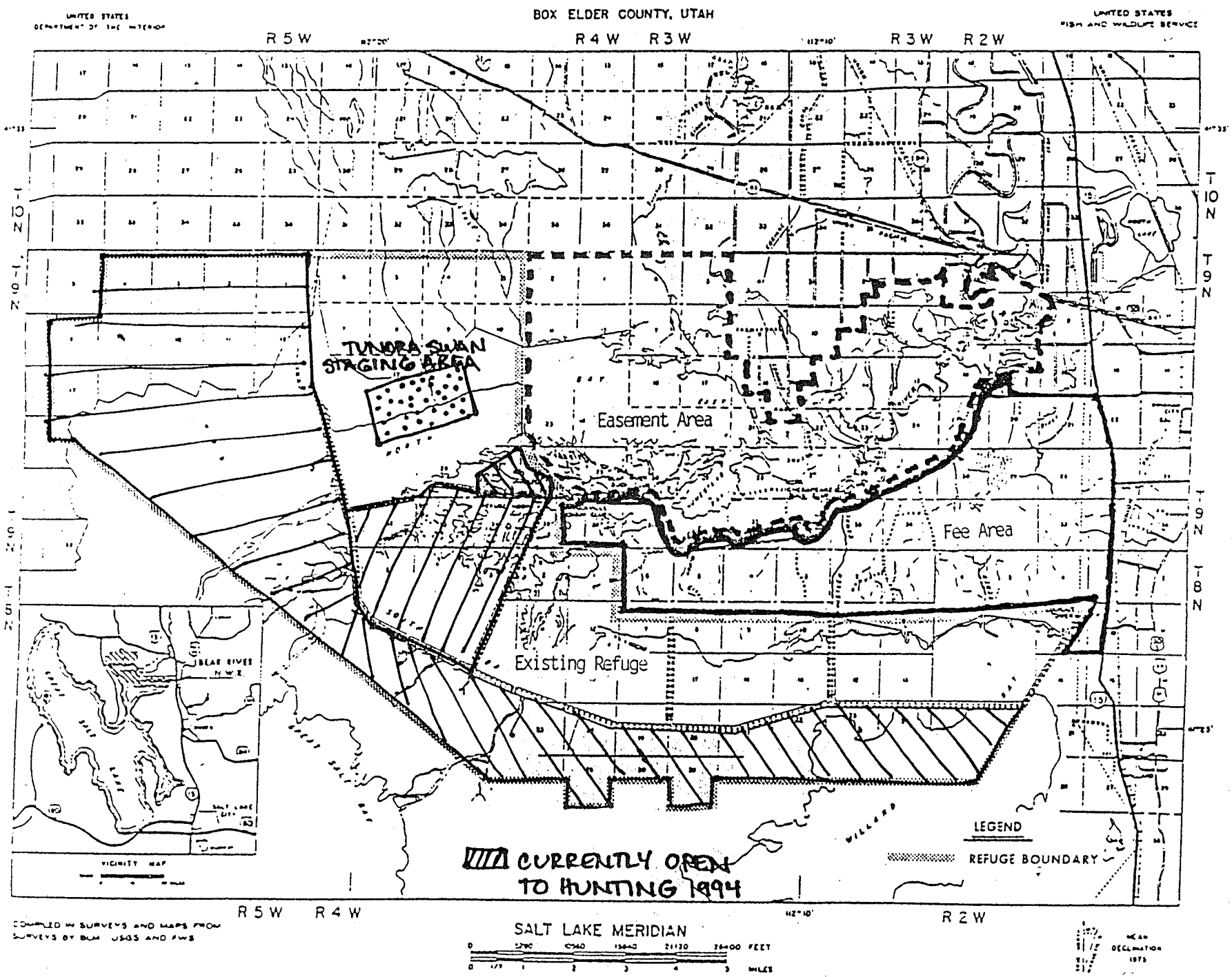


FIG.5: OPEN HUNTING AREAS AT BEAR RIVER MBR.
JUNE 1994.

BEAR RIVER MIGRATORY BIRD REFUGE

BOX ELDER COUNTY, UTAH

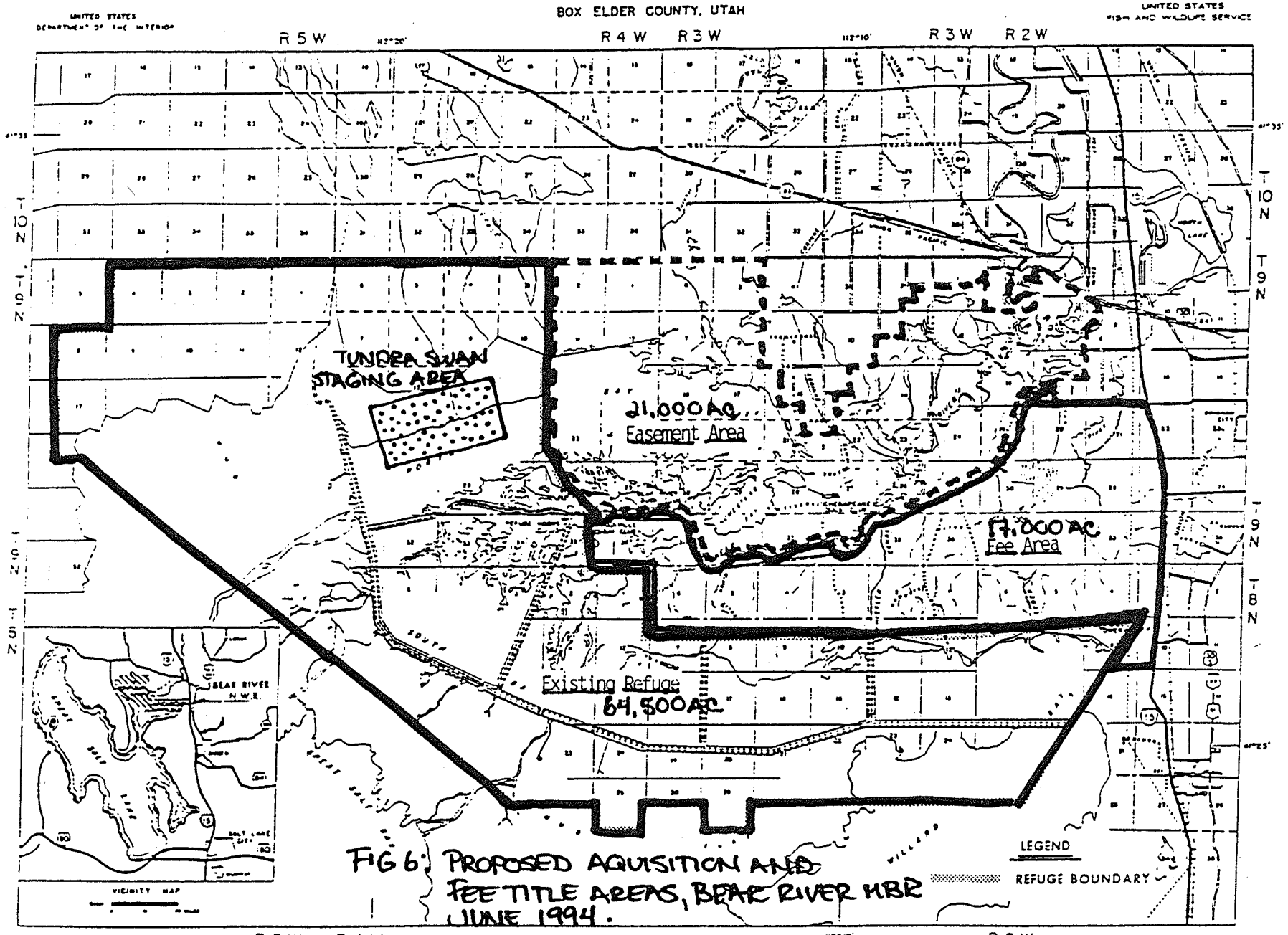


FIG 6. PROPOSED AQUISITION AND FEE TITLE AREAS, BEAR RIVER MBR JUNE 1994.

TERMINATION OF ARTIFICIAL FEEDING AT RED ROCK LAKES NATIONAL WILDLIFE REFUGE, MONTANA

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ABSTRACT

A summary of the feeding program, the need for termination, and results to date are presented. From its beginnings in 1935, the artificial feeding program sustained and recovered a remnant flock of Trumpeter Swans at the Refuge. As continental populations expanded through natural and management-assisted means, the feeding program was phased out and terminated to promote migration of Trumpeter Swans from the Refuge and adjacent Centennial Valley. Some swans have migrated to new areas, while others have made only local movements. Although migration patterns are emerging, many pioneering swans have succumbed to similar factors affecting all migrating bird species. Management strategies have helped to maintain the area's nesting population throughout the termination of feeding. The text includes results from the termination of feeding with partial updates to 1995. Banding records and collar observations were used to describe results.

INTRODUCTION

Artificial feeding of Trumpeter Swans has not occurred at the Red Rock Lakes National Wildlife Refuge (NWR) since the Winter 1992-93. Former Refuge biologist K. Niethammer presented a Progress Report on events leading to the termination of feeding during the 14th Annual Trumpeter Swan Society Conference at Courtenay, British Columbia (Niethammer 1993).

The artificial feeding of Trumpeter Swans at this Refuge began in 1935. The feeding helped recover a remnant flock of about 46 Trumpeter Swans using the Refuge in 1935 (Banko 1960). Through the decades, the feeding program sustained about 200 - 300 Trumpeter Swans. Trumpeter Swans from surrounding areas also relied on some of this feeding during the winter. Although Refuge swans were historically used to reestablish other flocks, more aggressive efforts to restore them to former range began in the late 1980's and continued into the early 1990's. At that time, the Rocky Mountain Population (RMP) was increasing as a whole. Winter habitat in the Red Rock Lakes and Henry's Fork of the Snake River areas began to show its limitations for supporting this expanding RMP during the winter. The need to terminate artificial feeding and further distribute RMP swans was apparent. This would assist in reestablishing lost migratory traditions and reduce overcrowding at the Refuge ponds and the likelihood of disease outbreaks. Termination of the feeding program was also intended to reduce the attraction of Refuge wintering ponds to migrant Trumpeter Swans from the Interior Canada Subpopulation (ICSP). This would allow more southward migration of these swans as envisioned by swan managers (Niethammer 1993).

Because other flocks of RMP swans were established and the overall RMP population was increasing, the timing appeared appropriate. Refuge staff attempted to minimize loss of nesting pairs from Red Rock Lakes. Nesting pairs were not relocated in the years preceding the termination of feeding. However, nonbreeding adults, subadults, and cygnets were continually relocated during restoration efforts prior to the termination of feeding.

The liberal use of collars laid the foundation for continued monitoring of the effects of termination of feeding, although the monitoring program suffers from inadequate staffing and funding at the Refuge.

METHODS

Collars and leg bands were placed on Centennial Valley Trumpeter Swans as described in Niethammer (1992). During the fall and winter of 1994, Refuge staff compiled collar sightings and banding records to determine fate of swans since the termination of feeding. The sightings were then grouped into

categories as shown in this paper. This is not an exhaustive investigation as other records exist in various field offices of the cooperating agencies. A more extensive compilation may reveal the fate of birds not known at this time.

Not all Trumpeter Swans in the Centennial Valley were collared or banded. As described in Niethammer (1993), Refuge staff attempted to band what birds could be captured or trapped and succeeded in marking about 60 percent of the Valley flock.

Aerial Trumpeter Swan surveys are annually conducted in the fall and winter. These surveys only count birds seen and correction factors are not used. Because the fall survey (formerly called the Tristate survey) counts swans before seasonal movements begin, it is considered an accurate count in the Tristate Region of Montana, Wyoming and Idaho, including Yellowstone Park (Figure 1).

The mid-winter survey counts swans which have generally settled into their wintering sites. This survey also counts the Canadian migrants, which have joined Tristate birds for the winter (Figure 2). The fall survey total is subtracted from the mid-winter total to indirectly estimate the size of the Canadian flock.

To account for dispersing swans, both surveys now include locations immediately adjacent to the traditional Tristate survey area. Trumpeter Swans in Oregon and Nevada are also included.

During the summer months, Red Rock Lakes Refuge staff attempt to identify any swan collars seen in the Centennial Valley and the immediate area. Aerial surveys in spring and summer locate nesting pairs and nonbreeding swans. Staff and volunteers then use spotting scopes to ground check collars. This allows the Refuge to track swans which have returned from wintering areas.

Refuge staff gradually delayed the onset of winter feeding in recent years. Movement patterns for some swans were revealed by collar sightings. These patterns indicated many swans were familiar with the Henry's Fork and other areas and could be expected to move in response to food and weather conditions.

These factors were enhanced by the reduction of local numbers through several years of relocation efforts. Thus, the winter feeding program was phased out.

RESULTS

Capture records indicate that prior to the final phase out of winter feeding during Winter 1992-93, at least 471 Trumpeter Swans were banded or collared at Red Rock Lakes. Of the 471 swans, 265 were captured during summer and fall and considered Centennial Valley birds. Of those 265 swans, 132 were released back on the Refuge, and 133 relocated to other sites out of the Centennial Valley (Table 1) (Scheuering 1994).

Another 206 Trumpeter Swans were also captured during previous winters. However, many of these were likely Canadian migrants although an unknown few were believed Red Rock Lakes swans (Table 2). Birds of unknown origin are not considered in this paper since it discusses known Red Rock Lakes or Centennial Valley birds.

Unfortunately, Winter 1992-93 was a harsh one. The severity prompted some swans to move further south. Without winter feeding though, some of those that remained within the Tristate Region succumbed to this severity.

At least 32 birds, or 12 percent, of the total 265 Centennial Valley swans are known dead (Table 3) (Scheuering 1994). Several others are unaccounted for, and several have been observed and known alive. These numbers will change as more information is compiled.

The survival rate for Centennial Valley swans can be roughly inferred from the number known dead. Although many marked swans have been observed after the termination of feeding, many have not, and some have lost their collars.

At least 22 marked Trumpeter Swans have been observed in the Centennial Valley as recently as 1994. A total of 58 marked/unmarked Trumpeter Swans were counted on the Refuge and 65 elsewhere in the Centennial Valley during a July 1994 survey . Six of these were observed in the summer of 1995 when a total of 57 Trumpeter Swans was counted on the Refuge and 23 elsewhere in the Valley during a July 1995 survey. Movement history of those six marked swans are described in Table 4. A more in-depth analysis of both summer and winter observations has been hampered by reductions in staffing and funding.

DISCUSSION

Although much of the data has only been partially analyzed, some trends are evident. The majority of Trumpeter Swans captured during the summer, fall and winter months at Red Rock Lakes have not been observed again on the Refuge. Several have returned in the years following the termination of winter feeding. However, many of these returning swans do not appear to venture out of the Tristate Region during the winter.

Birds wintering in the Tristate Region remain at risk to climatic factors. However, birds leaving the security of Red Rock Lakes are exposed to the hazards other migratory birds encounter such as wetland deterioration, disease, shootings, and collisions with structures.

The population of Trumpeter Swans in the Centennial Valley will continue to fluctuate due to the loss of the artificial feeding program. The population may experience several years of depressed numbers compared to the consistent 250 swans found in the Valley when feeding was conducted.

The artificial feeding was a stabilizing factor as it allowed swans to remain in the relatively secure area of the Refuge where they were protected from human disturbance. Feeding maintained their general health through the winter and allowed swans to enter the nesting period in good condition. Because it maintained a reservoir of swans, the feeding program allowed the relocation and restoration of swans to other parts of the nation.

However, in recent years, these benefits were outweighed by the need to re-instill a migratory tradition, minimize overcrowding at the feed ponds, aid in distribution of swans from the Henry's Fork in Idaho, and establish nesting flocks in areas with more temperate climates. The increase in swans in Canada (over 2,000 swans) and Alaska (over 13,000) allowed for the risks taken in terminating the feeding program.

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Table 1. Trumpeter Swans captured at Red Rock Lakes NWR, MT during summers 1990 - 1992. Numbers represent Centennial Valley/Red Rock Lakes Trumpeter Swans (RRL - Red Rock Lakes)("x" denotes various alphabetic characters).

Years 1990 - 1992

Captured RRL - Released RRL, July-Sep 1990-92: 01AE - 99AE = 98 xxAE collars
Captured RRL - Released Ft. Hall, ID, July 1991: P29 - P41 = 13 Pxx collars
Captured RRL - Released Roaring Fork, Swift River, Hawley, WY, July-Sep 1991: P42 - P79 = 38 Pxx collars
Captured RRL - Released Summer Lake, OR, July-Sep 1992: 0J0 - 0J9, 1J0 - 1J9, 2J0 - 2J9, 3J0 - 3J9, 4J0-4J9, 5J0-5J2 = 53 xJx collars
Captured RRL - Released RRL, July 1992: 00J-33J, = 34 xxJ collars
Captured RRL - Released Grays Lake NWR, ID, July 1992: P00 - P28 = 29 Pxx collars

Summary: A total of 265 Trumpeter Swans were captured in summer or fall during the years 1990 - 1992 at Red Rock Lakes NWR. Of these, 132 were released on the Refuge, 13 at Ft. Hall, ID, 29 at Grays Lake NWR, ID, 53 at Summer Lake, OR, 38 in Wyoming. For purposes of analysis, these birds can be considered "Centennial Valley/Red Rock Lakes" Trumpeter Swans since they were summer/fall captures before any migration had begun. Of these 265 birds, 32, or 12%, are known dead as of 1994 (Table 3) (Compiled from banding and collar records).

Table 2. Trumpeter Swans captured at Red Rock Lakes NWR, MT during winter 1990 - 1991. Includes mostly Canadian migrants with an unknown number of Centennial Valley, Yellowstone NP, other tri-state area Trumpeter Swans. (RRL - Red Rock Lakes)("x" denotes various alphabetic characters)

Years 1990 - 1991

Captured RRL - released Brunneau Dunes, ID 12/90: A31-A55= 25, A77-A86=10, H12-H33=22, H43-99=57 p= 114 collars
Captured RRL - released Fish Springs, UT, Dec. 1990: collars A87-A99=13, H00-H11=12 =25
Captured RRL - released Star Valley, WY, Dec. 1990: H34-H42=9 collars
Captured RRL - released Ft. Hall, ID, Dec. 1991: J00-J57=58 collars

Summary: A total of 206 Trumpeter Swans were captured at Red Rock Lakes NWR and released at various sites out of the Centennial Valley. While most of these birds are considered Canadian migrants, it is possible a few were unbanded or uncollared Centennial Valley swans. However, it is not possible to determine what percentage of this total this represents. No winter captures occurred during the winter of 1992 or henceforth. Most migrating swans leave the Refuge winter feeding ponds by late December. A few return to roost on these ponds. The fate of most of the winter translocated birds is not compiled in this paper. These data may be available from R. Shea. The winter numbers are included to describe the intensity of relocation and dispersion efforts during the phase out prior to termination of artificial feeding at Red Rock Lakes (Compiled from banding and collar records.

Table 3. Mortality of Centennial Valley/Red Rock Lakes collared Trumpeter Swans up to 1994. All birds captured at Red Rock Lakes during the summer and fall of 1990-1992.

Collar and Date		Date and Place of Death or Report	Remarks	
14AE	07/11/90	02/25/93, near Boise, ID		
18AE	"	05/21/93, Upper Odell Creek, RRL		
23AE	"	04/17/93, Madison R., near Lyons Bridge, MT		
24AE	"	03/27/93, Quake Lake, MT		
27AE	"	05/22/93, near Hidden Lake, MT		
32AE	"	03/08/93, near Jeffers, MT		
48AE	08/07/91	04/13/93, Madison River/Cliff Lake, MT		
52AE	ca. 1976	04/30/93, Lake Creek, MT		DLT *
56AE	08/09/91	Spring 1993, Henry's Fork, ID		
64AE	07/16/84	Spring 1994, West of Ashton, ID		DLT
65AE	07/08/81	Spring 1993, near West Yellowstone, MT		
66AE	07/02/93	04/13/93, Madison River/Cliff Lake, MT	DLT	
83AE	07/14/83	08/19/93, Goose/Otter Lakes		
84AE	07/16/84	04/04/95, MacDonald Pond, RRL, MT		skeletal remains
91AE	07/16/75	05/02/93, Madison River, MT		DLT
96AE	09/20/78	04/13/93, Madison River, MT		
98AE	07/07/80	winter 92-93, Upper Red Rock Creek		
15J	07/17/84	04/30/93, Lake Creek		DLT
19J	07/11/83	before winter 1992, Elk Springs Creek,RRL		
30J	09/23/92	11/13/92, Ogden Bay, UT		shot
32J	09/23/92	11/21/92, Utah		shot
V25	??HSP??	03/15/94, near Grover, WY		
P43	07/09/92	03/18/94, near N Daily L, MT		
1J6	07/09/92	04/21/94, near Hermiston, OR		
P41	09/16/91	05/26/94, Pocatello, ID 5 mi W		
A36	11/20/90	07/26/94, Last Chance, ID		
J12	12/17/91	08/24/94, near Pocatello, ID		

Note: Collar date prior to 1990 is the date the bird was leg banded. It was then recaptured and collared during 1990-1992. The band date is a clue as to the age of the bird at time of death.

* DLT means "dead a long time", indicating only remains and the collar were found with no clue as to cause of death (Source: Scheuering 1994).

Table 4. Movement history of six collared Trumpeter Swans observed at Red Rock Lakes in 1995. (Source: Scheuering 1994).

Collar: 38AE Date Observed: 25 May 95
History: ASY-F (after second year - female. Captured at RRL, 07/11/90. Red Rock Lakes NWR, 11/06 & 11/07/92. Elk Lake, ID (near Harriman), 11/25/92. Mack's Inn, 11/27 & 12/15/92 and 02/08 & 02/18/93. Harriman SP, 12/11/93. Red Rock Lakes NWR, 11/24, 11/26/93 and 02/22, 03/07, 03/10, 03/14, 03/17, 03/22, 03/25, 04/12, 04/20/94. Culver Pond, 10/29, 11/15, 11/18/94. (With **P55**). RRL May 1995.

Collar: 87AE Date Observed: 30 May 95
History: ASY-M (after second year - male). Captured at Pintail Ditch, 07/22/92. Harriman SP, 11/12/92. MacDonald Pond, 04/08/93. (Paired with an uncollared bird.) MacDonald Pond, 04/21/93. (With **55AE**.) Red Rock Lakes NWR, 04/26/93 - 05/05/93. Wigeon Pond area, Summer 1993. MacDonald Pond, 10/30/93. Red Rock Lakes NWR, 11/02, 11/04, 11/08, 11/14/93 and 03/07, 03/10, 03/14, 03/17, 03/22, 03/25, 03/28, 04/12/94. Culver Pond, 10/14, 11/08/94. In pair (**55AE**) with 6 cygnets. Teton Basin, 11/15/94. South Park, WY (suburb of Jackson), 12/19/94. RRL May 1995.

Collar: 55AE Date Observed: 30 May 95
History: ASY-F. Captured at RRL, 08/09/91. Red Rock Lakes NWR, 11/12, 11/18, 11/20, 11/23/92. MacDonald Pond, 04/21/93. (With **87AE**.) Red Rock Lakes NWR, 04/26/93 - 05/05/93. Wigeon Pond area, Summer 1993. MacDonald Pond, 10/30/93. Red Rock Lakes NWR, 11/02, 11/04, 11/08, 11/14/93 and 03/07, 03/08, 03/10, 03/14, 03/17, 03/22, 03/25, 03/28, 04/12/94. Culver Pond, 10/14, 11/08/94. In pair (**87AE**) with 6 cygnets. Teton Basin, 11/15/94. South Park, WY (suburb of Jackson), 12/19/94. RRL, May 1995

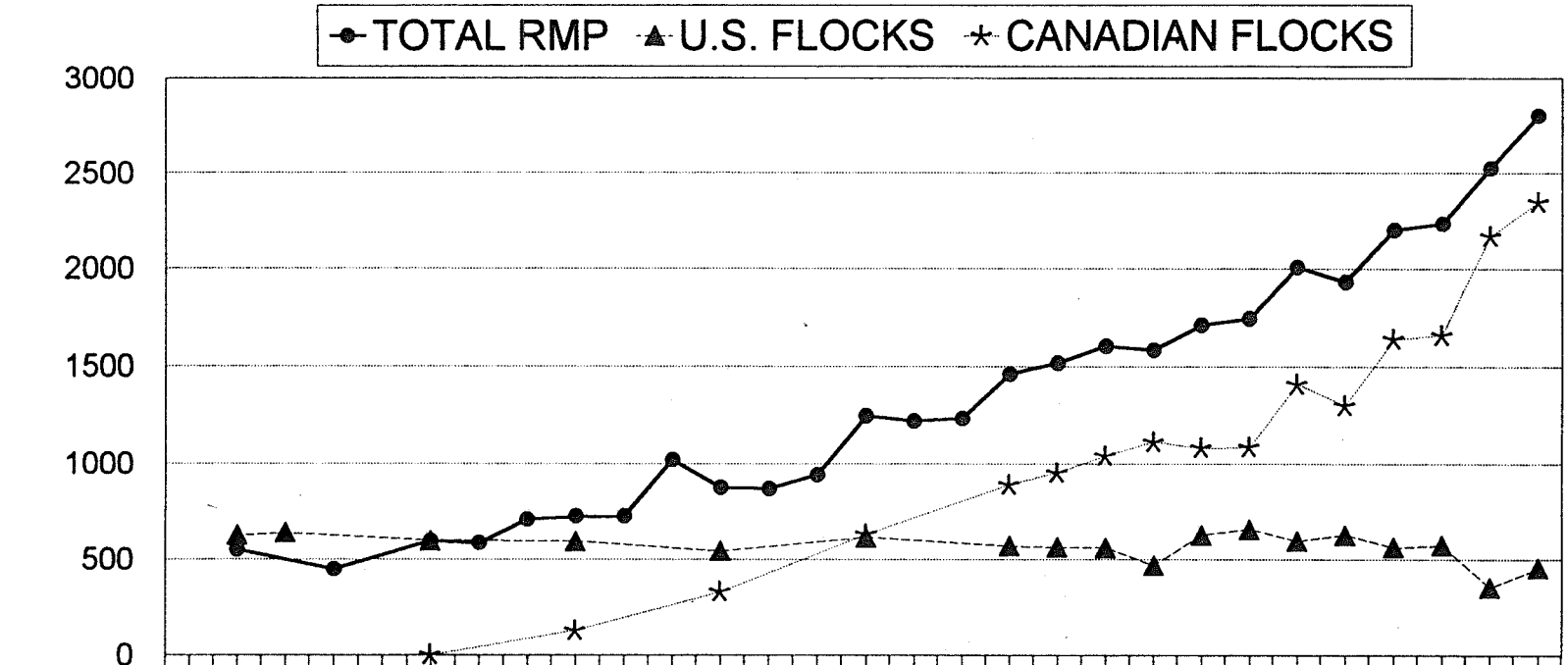
Collar: P35 Date Observed: 31 May 95
History: L-M. Captured at RRL, moved to Fort Hall, 09/16/91. Red Rock Lakes NWR, 11/24/93. Fort Hall, 12/22/93. Fort Hall, 01/10, 01/24/95. RRL , May 1995

Collar: 22AE Date Observed: 31 May 95
History: ASY-M. Captured at RRL, 07/11/90. Harriman SP, 12/28/92. Harriman SP, 01/07/93. Harriman SP, 02/04/93. Red Rock Lakes NWR, 11/24, 11/26, 11/29, 12/06, 12/09, 12/13, 12/17, 12/20/93. Known alive as of January 1994 and May 1995.

Collar: 17AE Date Observed: 01 June 95
History: SY-M. Captured at RRL, 07/11/90. Cliff Lake, 01/19/93.
Lower Red Rock Lake, 05/17/93. (Paired with **09AE**.) Lower Red Rock Lake, 07/19/93. Known alive as of May 1994 and 1995.

Note: This table presents a history of six collared Trumpeter Swans seen back at the Refuge in 1995. It does not include other collars which may have been sighted after that time. A more complete history may be obtained by contacting Red Rock Lakes NWR at 406-276-3536.

Figure 1. Rocky Mountain Population Trends, 1967-94.

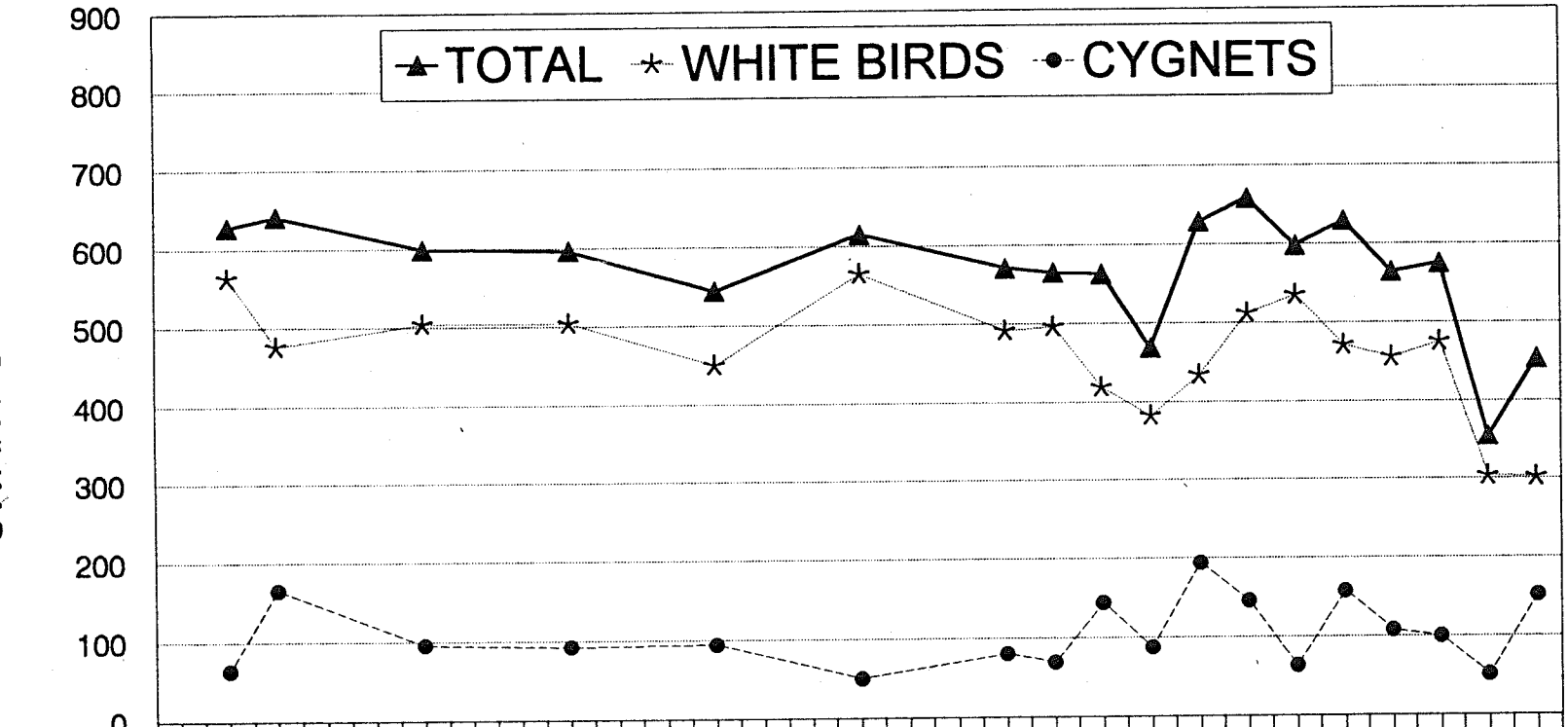


	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94
TOTAL RMP		550		448		596	585	709	723	725	1017	874	866	939	1247	1218	1232	1460	1516	1603	1582	1710	1743	2007	1931	2203	2235	2526	2803
U.S. FLOCKS		627	641			599			596			544			615			571	565	563	469	628	658	598	629	564	575	354	454
CANADIAN FLOCKS						0			127			330			632			889	951	1040	1113	1082	1085	1409	1302	1639	1660	2172	2349

YEAR

The Fall Survey (U.S. Flocks) total is subtracted from the Mid-Winter Survey total to estimate the size of the Canadian Flock.
(Source: Mid-winter and Fall Surveys, Niethammer 1992-94, Gomez 1994-95).

Figure 2. U.S. Flocks
Rocky Mountain Population

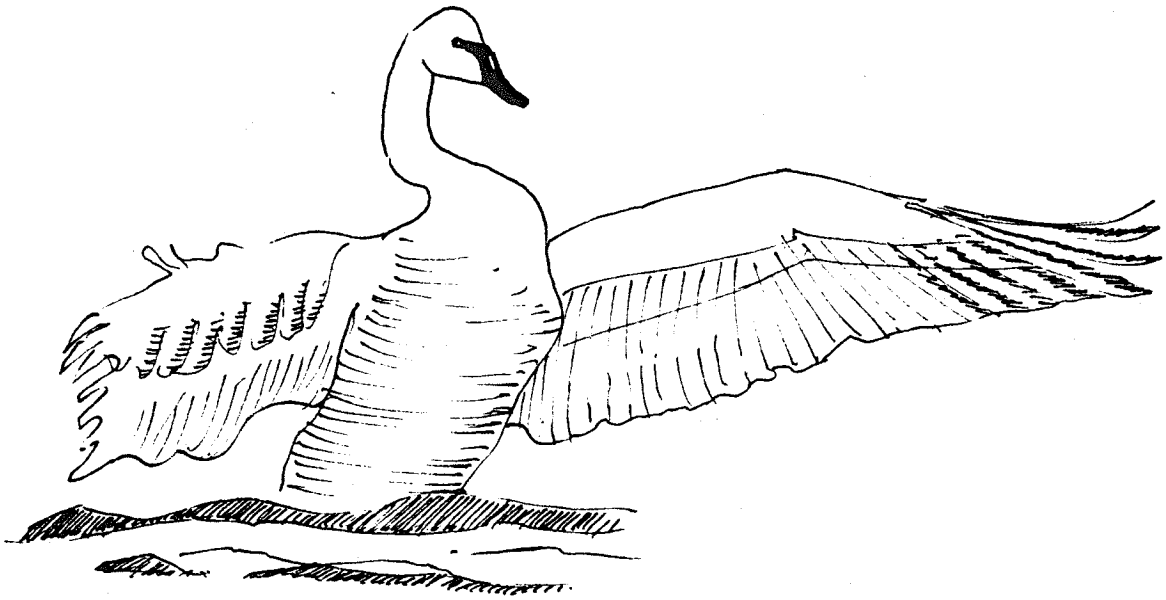


	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94
TOTAL		627	641			599			596			544			615			571	565	563	469	628	658	598	629	564	575	354	454
WHITE BIRDS		564	476			504			504			450			565			491	496	419	382	434	512	535	471	456	475	303	302
CYGNETS		63	165			95			92			94			50			80	69	144	87	194	146	63	158	108	100	51	152

YEAR

(Source: Fall Surveys, Niethammer 1992-93, Gomez 1994-95)

RESTORATION EFFORTS: PROGRESS, PROBLEMS AND POTENTIAL



WISCONSIN'S TRUMPETER SWAN RESTORATION EFFORTS, 1987-1994

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ABSTRACT

We review strategies and techniques to restore a Wisconsin breeding and migratory population of at least 20 pairs of Trumpeter Swans by the year 2000. Data are presented on the following topics: hatching success of eggs collected from Alaska and avicultural sources; impairments in program-reared cygnets; number of swans released by year and technique, 1989-94; rearing technique and age at first breeding; mortality and other losses of released and wild-produced swans; migrational distances and wintering-site traditions; statewide population size, number of nesting pairs, and nesting success.

INTRODUCTION

The goal of Wisconsin's Trumpeter Swan restoration program is to establish a breeding and migratory flock of at least 20 pairs by the year 2000 (Matteson et al. 1986, 1988). These 20 pairs will be part of a larger Wisconsin/Minnesota population that will hopefully comprise at least 50 pairs.

We have used four release techniques in our program: 1) cross-fostering Trumpeter Swan eggs under feral Mute Swans, 2) decoy-rearing, 3) captive-rearing, and 4) captive parent-rearing. Cross-fostering, used during 1987-88, was ineffective and discontinued (Matteson 1989, Matteson et al. 1991). This paper describes the remaining techniques, presents some results, and discusses issues of management concern.

METHODS

We used Alaskan and avicultural eggs as sources of stock for both decoy-rearing and captive-rearing. All eggs used in decoy-rearing and captive-rearing were incubated and hatched at the Milwaukee County Zoo (MCZ). We used only avicultural eggs during 1987-88 (for captive-reared birds to be released in 1989 and 1990), both Alaskan and avicultural eggs during 1989-93, and Alaskan eggs only during 1994.

The protocol for Alaskan egg collection and incubation was presented in detail by Matteson et al. (1991). In short, for the years 1989-94 the U.S. Fish and Wildlife Service (USFWS) identified Trumpeter Swan nests and marked them on topographical maps during spring survey flights. In June, the USFWS flew a Wisconsin egg collection team to the Minto Flats (1989, 1992, 1994) in east-central Alaska, or into the Nelchina Basin in south-central Alaska (1990, 1991, 1993) to collect up to 50 eggs for Wisconsin's program. One to six eggs were collected from each nest, and at least two viable eggs were left in each nest where collection occurred. Each egg was marked with an alpha-numeric code and "candled" with a non-electric, tube-type field candler.

Eggs collected during 1989-94 generally ranged from 14-27 days old, with occasional eggs less than 2 weeks old. Compton (1989) recommended egg collection between the 15th and 25th day of incubation.

In 1989 and 1990, the Wisconsin Department of Natural Resources (WI DNR) egg collection team used Minnesota Department of Natural Resources (MN DNR) suitcase-like boxes to transport eggs. Beginning in 1991, we used specially designed crates digitally controlled and programmed to maintain a temperature range of 92-94°F. "Misting" of eggs with a hand-held bottle spray occurred 1-2 times during the 10-12-hour return flights to Wisconsin.

Eggs were incubated at the MCZ at 99.5°F, with a wet bulb reading of 84-86°F. The MCZ used two types of incubators: Humidaire "Gooser" and Petersime, Model 1. The Humidaire eggs turned automatically 180° every 2 hours. The Petersime eggs were hand-turned 3 times a day at 0800 hrs, 1200 hrs, and 1600 hrs.

Newly hatched cygnets were weighed 3-6 hours after hatching, or on the morning following an overnight hatch (Ellen Saksefski, pers. comm.).

All birds released in our program were marked with USFWS aluminum leg bands and with plastic collars -- yellow collars with black alpha-numeric codes (1988-93) and green collars with white alpha-numeric codes (1994). For the purpose of analysis, decoy-reared cygnets were considered "released" when they no longer spent nights in their cages, about 2 nights weeks prior to first flights. We considered released and wild-produced cygnets "fledged" or "produced" only if they were known to have actually flown.

Decoy-rearing

Decoy-rearing was developed by the University of Wisconsin (UW) and the WI DNR Bureau of Research, and was described by Abel (1989, 1993). Cygnets were first imprinted on calls when they moved into the air cell of the egg. Tape-recorded Trumpeter Swan vocalizations were played for 1 hour, 3-4 times a day. Cygnets were removed from hatching trays 3-6 hours after hatching (cygnets that hatched during the night were 9-11 hours old) and placed in an isolated chamber where they imprinted on a surrogate Trumpeter Swan decoy manipulated on a pulley system.

Several types of decoys were designed and used; the last was a modified 37-inch magnum Canada Goose shell decoy painted with white latex and filled with urethane foam to improve flotation.

The swan decoy was moved in front of the cygnets as "follow me" signals were broadcast from a speaker fitted in a hole in the decoy's back. Cygnets learned to associate following the decoy with a time to eat. Imprinting and exercise sessions lasted up to about 15 minutes and occurred 4-8 times each day, with 1.5-4 hour intervals between sessions. Exposure to humans, always disguised, was kept to a minimum.

Generally, after 3-5 days, cygnets were flown from the MCZ to a wetland in northern Wisconsin where they followed floating decoys maneuvered by University of Wisconsin (UW) interns in camouflaged float-tube blinds. One decoy was placed with each brood. To maneuver the decoy, an eye bolt was attached to the front of the decoy, fitted with a 3-foot rope tied to a 3-foot rod.

Float tubes were camouflaged and kept fully inflated. Blinds were constructed from plywood, chicken wire, PVC tubing, and camouflage netting, and were built to fit well over float tubes. "Follow me" calls were played to keep a brood together, and alarm calls were broadcast when potential predators were in the area.

Typically, three broods of cygnets followed decoys to separate aquatic feeding and roosting sites. Supplemental foods and predator-proof cages (ca. 8 ft x 8 ft x 6 ft tall) were constructed on islands or isolated spoil banks. Propane heaters were provided at the cage sites for the first 10 days. Cygnets were led into these pens each evening and a decoy was placed with them.

After about the first week, the food in the cage was switched from a duck starter feed (17.5% protein) to a gamebird maintenance feed (14% protein). Prior to 1993, cygnets were switched at 3-3.5 weeks old to a duck grower maintenance feed (12% protein). Aquatic foods (e.g. Elodea, Sagittaria, Potamogeton, Najas) were also provided.

Cygnets spent nights outside the pens as they approached fledging and were gradually weaned from the decoys. They were allowed to fly free and to migrate, but prior to release they were health-checked, with physical condition noted and 5-7 ml of blood collected from each cygnet. Blood samples were analyzed for lead levels and parasites that would harm young birds. All birds were weighed and vent-sexed, fecal samples were collected, and cloacal swabs taken, to test for viruses and pathogenic intestinal bacteria.

Captive-rearing

Protocol for captive-rearing was described by Matteson (1994). Cygnets were moved from the hatching tray within 24 hours of hatching to six brooders (5 cygnets to a brooder). Each brooder measured 88 in x 68 in wide x 18 in high, consisting of a flat, 40-inch wide loafing area and a ramp descending into a 48-inch wide swimming pool. A heat lamp, food, and water dishes were provided.

In 1989, 1990, and 1992, cygnets were fed commercial duck starter feed (17.5% protein) and were shifted to a gamebird maintenance feed (12.5% protein) during 2-3 weeks of age. In 1994, cygnets were fed mealworms and hard-boiled eggs with shell for the first 3 days as well as duck starter. Thereafter, feed consisted of the following proportions of duck starter to gamebird maintenance feed: Days 4-5, 1:0; Days 6-7, 2:1; Days 8-9, 1:1; Days 10-11, 1:2; Days 12-21, 0:1 (Ellen Saksefski, pers. comm.)

Beginning in 1993, Enka mat was placed under indoor/outdoor carpeting across the loafing area. Enka mat stretched from the loafing area down a ramp into the brooder pool and was weighted at the bottom. This provided traction for cygnets climbing out of the pool and was initiated in response to observed leg problems (bowed legs, slipped tendons) in previous years.

Cygnets with leg developmental problems were exercised in an outdoor, fenced, aviary pond in 1989, 1990 and 1992.

Cygnets were allowed access to the brooder pool at age 3 days (1989, 1990, 1992-93) or age 2 days (1994).

Beginning at age 3 days in 1993 and at age 4 days in 1994, all cygnets received exercise twice daily for up to 1 hour per session in a large "kiddie pool" filled to 12-14 in. The pool was cleaned daily. Two to three broods sometimes swam together.

Zoo attendants wore camouflaged costumes at all times (in 1994, a sage-green poncho with a modified welder's mask) when near the brooders. Cygnets were weighed every day for the first 3 weeks in 1994; prior to 1994, they were weighed every 3 days unless health or developmental problems were evident.

Vita-Lites provide about 17 hours of continuous daylight during the first 3 weeks when the cygnets were at the zoo prior to transfer to a captive-rearing site.

At age 5 weeks (1989-92) or 3 weeks (1993-94), cygnets were transferred from the MCZ to one of two outdoor pens, 16 ft x 32 ft x 6 ft tall, each located on the edge of a larger, fenced-in pond at the general Electric Medical Systems (GEMS) facility near Pewaukee, Wisconsin. Each pen was completely covered with 1 x 2-in welded wire, reinforced with 1/4-in mesh hardware cloth. Each pen was approximately half in water, half on land, with a gradual slope into the water.

From day 22 to day 84, no more than 10-15 cygnets were held together in the same pen. A heat lamp covered by a plywood roof maintained warm conditions for cygnets at age 3-6 weeks. The entrance to each pen was through a plywood door. A heavy-duty tarpaulin was erected in front of the pens to restrict visibility and minimize human disturbance.
Gamebird maintenance feed was provided to the cygnets in a wooden feeder, loaded from outside the pen. The feeder and ground were checked daily for moldy or spilled feed to guard against potential health threats such as aspergillosis. The feeders were cleaned once weekly with Environ One-Stroke in a dilution of 1:256. The cygnets' diet was supplemented by Potamogeton spp., Sagittaria latifolia, Elodea canadensis, Vallisneria americana, Lemna minor, Chara vulgaris, Ceratophyllum demersum, and Ranunculus flabellaris.

Commercial grit was placed on the ground near the wooden feeder while the cygnets were still housed inside the pen.

At approximately day 84, cygnets were released from their pens onto the larger fenced pond.

From day 85 to 23 months of age, birds were maintained at the GEMS ponds and required little maintenance. A wooden feeder was maintained year-round. Spilled feed was removed. Commercial feed was supplemented with aquatic vegetation and in winter with store-bought greens and vegetables.

At day 120, a "scratch" mix of cracked corn, wheat, oats, and black sunflower seeds was gradually introduced until the feed mixture was about 50 percent scratch mix and 50 percent maintenance diet by about day 140. When natural grit seemed unavailable to the swans, it was obtained commercially and sprinkled liberally in shallow portions of the pond and near the feeder.

Starting in early April of the following spring, the scratch mix component was reduced so that by mid May the swans were back to only the maintenance diet, supplemented by aquatic plants. During their second spring, the swans were provided oyster shells as a calcium source (Maureen Gross, pers. comm.).
Birds were wing-clipped each year in captivity and released into the wild at 23 months of age after passing a final health check like that described for

decoy-reared cygnets. In addition to birds reared by this technique, 6 cygnets were hatched and reared at the Minnesota Zoo in 1992, wing-clipped, and released at age 10 months. These are described hereafter as "captive-reared yearlings."

Captive parent-rearing

Captive parent-rearing involved five cooperators with captive pairs of Trumpeter Swans. Each cooperator had a formal cooperative agreement to maintain one state-owned pair under the direction of the WI DNR. In addition, the WI DNR in 1992 and 1993 purchased a total of ten yearling birds produced by swans owned by a game farm cooperator.

The young produced from these captive pairs were wing-clipped, health-checked, and released at age 10 months by the WI DNR at selected wetland sites in the "Grantsburg" and "Vilas" study areas of northern Wisconsin.

Health Protocol

The following protocol was implemented at sites where cygnets were confined: 1) Foot baths with disinfectant (One-Stroke Environ; dilution: 1 part to 256 parts water) and scrub brushes were set up at all access points and used whenever people entered or left the swan holding areas. 2) Food and watering troughs were cleaned and disinfected weekly. 3) Floors were cleaned at least once a week. 4) Blood samples, cloacal swabs, and weights were taken before or shortly after cygnets were removed from the MCZ, and from the captive-rearing or decoy-rearing site prior to release into the wild.

WI DNR biologists and health specialists developed a detailed protocol (Matteson 1994) for handling sick or injured swans in Wisconsin's program, including procedures for: transporting a swan to an emergency clinic, transporting a swan to the Raptor Center in St. Paul, Minnesota (where many program swans are cared for), what to do with failing cygnets at the MCZ, and handling known and suspected disease problems.

Release Sites

Release sites were selected on the basis of the following criteria: minimal waterfowl hunting during the years of lead-shot use; abundant and diverse submerged and emergent aquatic plant food (e.g. Elodea, Sagittaria, Najas, Nitella, Potamogeton, Sparganium); minimal uncontrolled human use; presence of emergent or shrubby escape cover; absence of power lines; abundant and diverse wetlands within 10 miles. In addition, decoy-rearing required sites with controlled access, proximity to WI DNR or USFWS maintenance facilities, appropriate water depth (1-3 ft) for working in float tubes, and presence of islands or dikes appropriate for overnight cages.

Table 1 summarizes the number of swans released by each technique during 1989-94. Trumpeter Swans were released in the following areas:

Grantsburg Study Area. We released 92 swans during the years 1989-92 on 13 wetland sites, using the following release methods: decoy-rearing (46), captive-rearing (36), captive parent-rearing (10). Sites included six in managed, mostly artificial impoundments within a landscape of extensive sedge meadows, oak-pine barrens, and oak-pine-birch-aspen forest at Crex Meadows and Fish Lake wildlife areas in northwestern Wisconsin (Burnett County); and seven in lakes, marshes, and ponds in southern Burnett and northern Polk counties.

Central Study Area. We released 115 decoy-reared cygnets during 1991-94 in 14 impounded wetlands at Mead, Sandhill, and Meadow Valley wildlife areas and at the Necedah National Wildlife Refuge. Mead Wildlife Area (Marathon and Portage counties) is in a landscape of upland and lowland hardwood forests and woodlots, impounded lakes, and agriculture. The others are in Wood and Juneau counties in a landscape dominated by conifer and hardwood swamps, cranberry operations, and oak-pine forest.

Vilas Study Area. Eighteen swans were released in north-central Vilas County in 1991, 1993 and 1994, at four wetlands in a landscape of extensive northern hardwood forest, bogs and lakes. Four of the swans were captive-reared, eight were captive parent-reared, and six were captive-reared yearlings.

Monitoring released and free-ranging Trumpeter Swans

All reports of marked and unmarked swans were recorded and nearly all were field-checked. Aerial surveys were conducted regularly in areas frequented by swans or known to have been used by swans in the past. We made extensive field observations of all located released or wild-produced individuals.

We visited nests 1-2 times to determine clutch size, viability, and stage of embryonic development. We conducted time/activity budgets of swan families and nonbreeding swans, and evaluated habitat in wetlands used by Trumpeter Swans for feeding, molting, or nesting.

Molting and pre-fledged swans were captured for health checks (blood samples, cloacal swabs, weights, sexing, morphometrics) and banded and collared. Additional swans were captured when opportunities arose. Methods varied from single-handed captures of birds taking hand-outs, to full-scale "round-ups" that utilized a crew of up to 25 people in canoes, on land, and motorboat, with communication from a pilot overhead.

Sick or injured free-ranging swans were transported to the Raptor Center or to the UW Veterinary Medicine - Teaching Hospital in Madison, and re-released if rehabilitation was successful.

To encourage reports of swan sightings and prevent accidental shootings of swans, swan-use areas were marked with hunter-education posters, a statewide swan "hotline" was established, videos and slide shows were developed on the recovery program, fact sheets on Trumpeter Swan life history and identification were developed, and articles and press releases were circulated widely.

In the fall, before or at the onset of migration each year since 1989, a memo was sent to state natural resource agencies in the Mississippi Flyway region and/or to the Trumpeter Swan Society listing all marked Wisconsin swans and alerting wildlife professionals to possible occurrences in their state. Reports of migrating and wintering swans were recorded and followed-up by requests for details on location, behaviors, and condition of the observed swans. In this manner, detailed records of swan movements and migration distances were documented from 1989 through 1994.

Migration distances for Wisconsin Trumpeter Swans.

We categorized individual swans according to maximum known distance between summer and wintering sites, as *short-distance migrants* (<50 miles), *medium-distance migrants* (50-200 miles), or *long-distance migrants* (>200 miles). A wintering site was defined as the most distant site known during the period 5 January to 28 February. Individuals were also considered long-distance migrants if reported from a long-distance site during migration, outside the period 5 January to 28 February. Each individual was categorized according to the longest migration known for its life.

We defined *traditional wintering site* as one visited by Trumpeters more than 1 year, but not necessarily by the same individuals. We considered a site to be as large as approximately 10 miles in radius, rather than a specific wetland. These criteria seem reasonable given the observed and reported winter behavior of Wisconsin Trumpeters, the lack of a complete and continuous record of any bird's winter movements, the fact that birds sometimes lose their collars, and the chance nature of many winter reports. Wisconsin-released Trumpeters move around somewhat within their wintering areas within a given winter period, between different wetlands and upland feeding sites, and probably find different feeding and roosting sites from year to year within the same area. We are not confident that they would be reported from the same site year to year, even if they occurred there.

Data analysis

We used logit models (Agresti 1990) to investigate the effects of year, site of origin, and rearing technique on rates of leg impairment in captive-reared and decoy-reared cygnets. We used chi-square to test for differences in the probability of nesting, for birds released by different techniques.

RESULTS

Egg collection and hatching success

We collected 277 eggs from Alaska during 1989-94, including 20 eggs for the state of Michigan in 1989 and 12 eggs for the state of Minnesota in 1992. Of 245 eggs collected for Wisconsin's program, the MCZ hatched 227 (93%) (Table 2), with a mean cygnet hatching weight of 234.9 g. In total, including eggs we collected for the other two states, 258 (93%) eggs hatched. The comparatively lower hatching success (82%) in 1991 was due to seven embryos dying late in incubation -- five of them within 24 hours of hatching. Of 66 eggs collected from captive sources during 1989-93 and incubated at the MCZ, 57 (86%) hatched.

Cygnets impaired during the first 10 weeks

During the first 10 weeks of life in the captive-rearing and decoy-rearing programs, some cygnets exhibited physical impairments that impeded movements or development and occasionally resulted in mortalities. These included leg problems such as bowed or deformed legs, slipped tendon, and displaced or lax hock. Other problems included chronic low weight, weight loss, scoliotic neck, sinus and eye infections, severely drooped wings, and "angel-wing."

Of the 227 cygnets hatched from Alaskan eggs at the MCZ during 1989-94, seven were reared in Minnesota. Of the 220 cygnets reared in Wisconsin, 50 (22.7%) suffered an impairment. Twenty-one (9.5%) cygnets died as a result of impairment, and the remaining birds recovered. Leg problems contributed to the impairments of 30 cygnets, 10 of which died or could not be released.

Both year and rearing technique had a highly significant ($p<.001$) effect on the rate of leg impairments. This reflects an especially high rate of impairment for both rearing techniques in 1993 (=37%), and a significantly higher rate over all years for captive-reared cygnets (27.0%) as compared with decoy-reared cygnets (4.6%)(Table 3). The site of egg origin (Nelchina Basin vs Minto Flats) had no significant effect on the rate of leg impairments. Of the additional 57 cygnets hatched from captive-produced eggs at the MCZ during 1989-93, 3 (5.3%) suffered impairments.

Effect of health concerns in 1990 on captive-rearing

During the summer of 1990, a previously undescribed coccidial parasite (Barry Campbell, National Fish and Wildlife Health Research Center, pers. comm.) was isolated from two cygnets and suspected in three others at a captive-rearing site on the grounds of the Oakhill Correctional Institution in southern Wisconsin. One of the two infected cygnets died on 8 September 1990. WI DNR health specialists pointed out that coccidia as a group are very infectious, with young birds most severely affected. Those that survive become subclinically infected carriers. The carriers tend to shed only occasionally, particularly during metabolic changes such as egg-laying. WI DNR health specialists assumed that the 14 surviving cygnets were exposed to the coccidial parasite.

Consequently, four cygnets that had either shed coccidia at some time in their lives or had been brood mates were transferred to the National Fish and Wildlife Health Research Center in Madison for use in studies of histomoniasis in Trumpeter Swans. The remaining cygnets were transferred to a GEMS site and experimentally treated with a coccidiocidal drug, then monitored for 6 weeks post-treatment for fecal shedding. Subsequent tests were negative but the sites where these birds were present were taken out of production for 12 months. As a result, captive-rearing did not resume until 1993 due to non-availability of rearing sites.

To date the treated "coccidial" swans have not been released and eight of these birds (4 unrelated pairs) have been placed with private cooperators to produce eggs that will be artificially incubated for the program. Coccidia cannot be transferred from a female to her eggs.

Wisconsin Trumpeter Swan program losses

We documented the cause of death for 58 released and wild-fledged swans during 1989-94 (Table 4). Eleven additional deaths were from undetermined causes. Also, three live birds were removed from the program due to behavioral problems associated with imprinting on humans. The leading cause of mortality among program swans was accidental or intentional shooting, followed by lead poisoning from ingesting spent lead shot, and then by collisions with utility lines. The first two factors accounted for 60 percent of known mortalities; all three factors accounted for 76 percent of known mortalities.

Of the known deaths from shooting, about half (10) occurred in wintering or migration areas in Missouri and Illinois. The others occurred in Wisconsin and Minnesota during waterfowl hunting season when these birds were still near their release or summering sites.

Swans shot did not necessarily die at the site. Rehabilitation efforts for some swans necessitated removal to captivity and sometimes wing amputations or eventual euthanization. In several cases not presented here, Wisconsin program swans captured for marking or rehabilitation (not directly related to a shooting incident) had shot pellets lodged within their bodies, indicating that some Trumpeter Swans were shot but not seriously injured.

Lead-poisoning caused deaths throughout the year, both in Wisconsin and in southern wintering areas. We also captured several lead-poisoned, Wisconsin-released swans, which were subsequently treated for lead poisoning at the Raptor Center and released again in Wisconsin.

Collisions with powerlines and other structures were documented at all seasons except summer, when swans are typically rather sedentary.

Vehicular collisions claimed the lives of two territorial swans that had apparently charged vehicles moving through their respective territories.

Losses of swans attributed to morbidity included one that died from hepatitis, and one with an injured foot that succumbed to a systemic infection. Three swans that burned to death were from a family group: a 2-year-old adult female and two cygnets, which entered a 90-acre sedge meadow during a controlled wildlife management burn after the fire had been lit, in October 1992. At least one of the cygnets was not yet able to fly.

Entanglement in fish line led to or caused the death of two swans. One swan had fish line wrapped about its leg, which became badly infected; this bird was euthanized. In the other case, the swan was found dead with line wrapped around its neck and legs.

The only death known to be due to predation occurred when a nearly fledged decoy-reared cygnet, roosting apart from its brood, was found with its head missing. We assumed this to be Great Horned Owl predation.

We made hundreds of captures and health-checks of free-ranging and wing-clipped, post-release Trumpeters in Wisconsin during 1989-94. The only injuries that we know resulted from our captures were an apparently dislocated hip that healed itself prior to recapture, and the death of a wild-produced cygnet due to capture myopathy. The latter bird had been handled by an inexperienced worker, who carried it by drawing the humeri together over the back and grasping them in one hand--a method unsuitable for a young bird as heavy as a swan. The wing appeared displaced upon release, and the bird was found dead 5 days later from an infection originating in the shoulder.

We know of two swans beaten to death by people: a nonaggressive female was killed by an intoxicated man on the wintering grounds in Iowa (considered vandalism); and an unpaired territorial male was killed with an oar by people in self-defense from a boat.

Characteristics of the Wisconsin breeding population

In 1989, Trumpeter Swans nested in Wisconsin for the first time since they were extirpated from the state in the late nineteenth century. During 1989-94, the breeding population grew to 10 pairs, fledging 62 young from 30 nesting attempts (Table 5). The total statewide Trumpeter Swan population in early October 1994 was approximately 115. All birds nesting during 1989-91 originated from releases in Minnesota by MN DNR and Hennepin Parks, or were unmarked and of unknown (non-Wisconsin) origin. WI DNR swans, first successfully released in 1989, began nesting in 1992.

Thirty-seven individuals were involved in the 30 nestings during 1989-94: 17 decoy-reared, six captive-reared, six captive-reared from the MN DNR and Hennepin Parks programs, five from an unknown origin, two wild-produced, and one captive parent-reared. Of the 17 decoy-reared breeders, 11 (65%) first nested at age 2 years (24 months), five first nested at age 3 years, and one first nested at age 4 years. Of the six captive-reared breeders, five first nested at age 3 years, and one first nested at 4 years. Thus far, swans released by either decoy-rearing or captive-rearing have demonstrated a 15 percent probability of nesting, while the small sample of captive parent-reared birds had a probability of 6 percent. The difference in nesting probabilities of birds released by the three techniques is not significant (X^2=0.96, 2 d.f.) (Table 6).

Swan matings have involved all possible combinations of decoy-reared and captive-reared males and females, as well as decoy-reared male with captive parent-reared female.

Migration

Wisconsin's Trumpeter Swans began to migrate as early as late October, with most birds leaving in late November or mid-December. They returned to summering areas as early as late February, most by mid-March.

Between Autumn 1989 and Spring 1994, we documented winter locations of 136 released swans, many represented in multiple years. These included nine

short-distance migrants, 16 medium-distance migrants, and 111 long-distance migrants. Most Wisconsin Trumpeter Swans migrated to southern and central Illinois and eastern Missouri. The most distant wintering sites were near Dallas, Texas, northeastern New Mexico, and Indiana County, Pennsylvania. The least distant (nearest) wintering site occurred within 1 mile of a summer territory along the Trade River in Polk County, Wisconsin.

We know of nine traditional wintering sites for Wisconsin swans: four in Illinois (St. Clair, Wabash, Champaign, and Mason counties), and three in Wisconsin (Sauk, Burnett, and St. Croix counties). These sites were each active for two-four of the five winters. None was active in 1990, and five were active in 1994. They were each used by a minimum of three - 19 individuals over the entire 5-year period between January 1990 and February 1994. The number of individuals known to return to the same traditional site for more than one winter ranged from 1 to 4. Due to collar losses and inconsistent monitoring of these sites, these numbers must be considered minimum. Some of these traditional sites were also used by migrating Wisconsin Trumpeters (not counted here) that settled elsewhere for the winter.

Four of the nine traditional wintering sites occurred in the main channels, backwater sloughs, and impoundments of the Illinois, Mississippi, St. Croix, and Wisconsin rivers. The other five sites included natural and artificial lakes, borrow-pit ponds, and farm ponds. At no traditional sites was water kept open by aeration. According to reports, wintering Wisconsin-released swans tended to roost and feed on the water, but also fed in flooded or dry wheat, corn, popcorn, and soybean fields within a 10-mile radius of the usual roost sites. Swans were fed cracked corn and other handouts at several sites, although we did not encourage it.

DISCUSSION

The Wisconsin Trumpeter Swan restoration program, like those of other states and provinces, has experienced its own particular successes and tribulations. In this paper we have not reviewed these thoroughly, but have reported on our methodologies and some of the program's achievements, which may be of use to other swan restoration programs.

For instance, of the various factors that may limit the growth of our restoration flock, the collection and hatching of Alaskan eggs is not one of them. We attribute the high hatching success (93%) and excellent health of hatchlings to several factors, including: healthy source populations, effective field-candling, the efficient transportation provided by USFWS's Rod King during egg collections and the Windway Capital Corporation during the return flight, and the care provided by the MCZ staff under the direction of curators Ed Diebold and Ellen Saksefski.

Given this success, the number of birds actually released to the wild has not been as high as we would like: of 303 Alaskan and captive-produced eggs hatched (with the resultant birds of releasable age by 1994), 225 (74%) were released. Although this survivorship is higher than for young birds in the wild, the losses are significant because of the potential importance of each bird to our restoration efforts. One source of concern is with developmental problems, especially leg deformities, which can result from rearing in captivity. Although many captive-reared cygnets recovered from leg problems, 10 died.

We were unable to determine the cause(s) of the high rate of impairment during 1993. It seems clear, however, that the significantly lower rate of impairments in decoy-reared (vs captive-reared) cygnets is due to the fact that these cygnets generally spent 6-9 hours per day in the water, actively swimming and feeding, beginning usually at age 3-5 days. Captive-reared cygnets experienced shorter periods of swimming during their first 3-5 weeks and these were unrelated to feeding activities.

Another advantage of decoy-rearing has been that swans reared by this technique commonly bred at 2 years of age. These early nestings were probably encouraged by the fact that in a small, young restoration flock such as Wisconsin's, there may have been relatively little competition for breeding habitat and mates. Two-year-old birds, however, often mated successfully with older swans and maintained territories in the Granstburg Study Area, where older unmated swans (from various release techniques) also occurred throughout spring and summer.

Each release technique has its own logistical advantages and disadvantages. For example, decoy-rearing is time-intensive and requires large wetlands with particular characteristics, but allows large numbers of birds to be released successfully early in life; captive-rearing requires 2 years of care in captivity, but allows birds to be released in smaller, scattered, less

accessible wetlands; captive parent-rearing allows birds to be reared in semi-natural situations (e.g., with parents and ready access to water), does not require egg collection or artificial incubation, and makes use of captive breeding pairs, which are often unreleasable birds removed from the wild. Individuals originating from all three techniques have inter-mated successfully, with similar probabilities of breeding. We plan to continue using all three techniques in our restoration program.

Birds from all release techniques have migrated, most travelling over 200 miles to wintering areas. Except for a few human-imprinted birds early in our program, the ability and proclivity of birds to migrate has been clearly demonstrated, and those that have remained in Wisconsin generally have used natural, open-water sites that seemed as suitable as those farther south. Because Wisconsin's restoration program is young (as of this writing only five winters have passed since the first successful releases), the nine "traditional" wintering areas we have identified must be considered tentative. Even though each area has been used only 2-4 years, five sites were active in 1994, and some of these attracted individuals that had not been present in previous years. Hopefully, this reflects a natural process that involves discovery, trial-and-error, and recruitment by which secure, long-term migrational traditions will develop.

Strict health protocol has been integral to the Wisconsin restoration program, both for the benefit of the restoration flock and to guard against transmission of pathogens into wild waterfowl populations. We have described part of that protocol here, and an example of its effects on the program--the permanent removal of several birds to captivity because of known or suspected infection with a previously undescribed coccidial parasite, which had contributed to the death of at least one captive cygnet. This and other cases (e.g., the quarantine of decoy-reared cygnets infected with or exposed to avian pox) required significant additional effort and interruption of rearing procedures. Releasing infected birds, however, may have created serious health problems and proved potentially disastrous.

Unfortunately, not enough is known about the occurrence and impacts of some pathogens (especially ones with subclinical effects) in wild populations of swans that we can always make definitive decisions about releasing birds with known or potential infections. To help address this dearth of data we have collected blood, cloacal swabs, and sometimes feces from routine health-checks of many free-ranging Trumpeter Swans annually. Until more information is gathered from these and other studies of wild and captive swans, we will err on the side of caution.

The capture and health-checking of free-ranging and post-release, wing-clipped swans has proven quite safe, at least in terms of injuries or mortalities sustained by captured birds. Safe and effective captures, however, often require a coordinated and experienced crew.

Mortality of free-ranging swans in the Wisconsin restoration flock has been dominated by illegal shooting and lead-poisoning. Lead poisoning is an insidious factor that will remain a problem for decades. Aside from maintaining our efforts to release birds only on sites with a history of minimal waterfowl hunting, and the rehabilitation of lead-poisoned birds, this is a factor over which we have little control, unless we can encourage birds to winter in relatively lead-free sites through the use of artificial feeding. Thus far we have not interfered with the movements of healthy swans at any season.

Hunter education in states throughout the Mississippi Flyway, and the prosecution of criminal shooters, is essential to reducing this major impact on Wisconsin's Trumpeter Swan recovery effort.

The Wisconsin restoration program released a total of 225 swans during 1989-94. We are halfway to our population goal of 20 breeding pairs by the year 2000. This population is wild and migratory, but the extent to which it is self-sustaining is uncertain, and not within the scope of this paper's discussion. The analysis of population data and, ultimately, time, will tell.

SUMMARY

The WI DNR initiated a Trumpeter Swan recovery program in 1987. Since 1989, when Alaskan egg collections began, the program has featured three techniques: decoy-rearing, captive-rearing, and captive parent-rearing. A total of 245 Alaskan eggs was collected for Wisconsin's program, of which 227 (93%) hatched. A total of 225 swans was released during 1989-94, comprising 161 decoy-reared cygnets, 40 captive-reared subadults, six captive-reared yearlings, and 18 captive parent-reared yearlings. The Wisconsin population was augmented, especially in the early years of the Wisconsin restoration program, by a few birds that immigrated or were released here from restoration programs in Minnesota. In October

1994 the statewide Wisconsin Trumpeter Swan population was approximately 115.

An aggressive health protocol has retained some swans from release temporarily or permanently, but is considered necessary to protect the restoration flock and wild waterfowl populations, as well as to define the health parameters of both wild and captive Trumpeters. The leading cause of mortality for 58 released and wild-produced swans was accidental and intentional shooting (33%), followed by lead poisoning (28%).

A total of 37 individuals was involved in 30 nestings in Wisconsin during 1989-94, with 17 decoy-reared birds, six captive-reared birds, one captive parent-reared bird, six captive-reared birds from the MN DNR and Hennepin Parks programs, two wild-produced birds, and five birds from an unknown origin. Nestings included all possible combinations of decoy-reared and captive-reared males and females, as well as decoy-reared male with captive parent-reared female. The likelihood of nesting was 16 percent for both decoy-reared and captive-reared birds and 6 percent for captive parent-reared birds. Twenty-three (77%) nesting attempts were successful and produced 62 fledglings (2.06 per active nest). In 1994, 10 pairs produced 24 young.

Each release technique has particular advantages and disadvantages. Decoy-rearing -- a technique developed experimentally by WI DNR and the University of Wisconsin -- has the advantages of producing birds with comparatively few developmental leg impairments, and which nest commonly at the age of 2 years.

Most Wisconsin Trumpeter Swans winter in Missouri and Illinois, although some have travelled as far as New Mexico, Texas, and Pennsylvania. Of 136 swans for which winter locations are known, 111 travelled at least 200 miles between summering and wintering areas. Some birds established migratory traditions. Wisconsin-released swans used at least nine wintering areas for 2 or more consecutive years; five of these areas were active in 1994. One Wisconsin site was used for 4 years, one in Missouri was used for 3 years, and the others were each used for 2 years.

We consider the Wisconsin Trumpeter Swan population to be wild, migratory, and halfway to the recovery goal of 20 breeding pairs by year 2000. We are uncertain whether this population is self-sustaining.

ACKNOWLEDGMENTS

Transportation to and from Alaska was donated by the Windway Capital Corporation. Rodney King of the USFWS flew the egg collection team to sites to collect eggs in the Minto Flats and Nelchina Basin all years except 1990. Randle Jurewicz of the WI DNR's Bureau of Endangered Resources assisted with egg collection each year during 1989-94. We used crates specially designed by the Volrath Company to transport eggs from Alaska to Wisconsin.
Ed Diebold and Ellen Saksefski of the MCZ led a team that carefully monitored the incubation and hatching of all program swans during 1989-94.

WI DNR wildlife biologists Becky Abel, Marty Johnson, Rebecca Christofel, and Jennifer Skoloda each directed UW intern teams in the successful decoy-rearing program. Special acknowledgment is due Becky Abel and Dr. Stanley Temple for their essential roles in developing this technique.

WI DNR biologist Maureen Gross and wildlife managers Mark Andersen and Tom Becker efficiently managed the long-term GEMS captive-rearing sites, with cooperation from Dennis Hussey and the staff at GEMS.

Many WI DNR and USFWS wildlife managers and technicians have helped the restoration program in various ways, e.g. participating in round-ups, collecting observations of released birds, responding to various emergencies, developing captive-rearing sites, providing expertise and logistical support for many aspects of the different release programs, and managing the impounded wetlands on which many birds were released and nested. Special recognition goes to the Crex Meadows Wildlife Area management crew who have been involved annually since 1989. WI DNR pilots have been essential to swan monitoring and round-ups. Mitch Bergeson worked on the research field crew for 3 years and collected many of the data reported here. Paul Rasmussen ran the statistical analysis of cygnet impairment data.

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Table 1. Number of Trumpeter Swans released in Wisconsin, by year and technique.

Year	Decoy-rearing	Captive-rearing	Captive parent-rearing	Captive-reared yearlings	Total
1989	18	5	-	-	23
1990	28	17	-	-	45
1991	41	18	4	-	63
1992	25	-	6	-	31
1993	24	-	6	6	36
1994	25	-	2	-	27
TOTAL	161	40	18	6	225

Table 2. Hatching success of Alaskan Trumpeter Swan eggs at Milwaukee County Zoo, 1989-1994.

Year	Location	# Collected	# Hatched	Mean Wt. (g)
1989	Minto Flats	37	35 (95%)	234.1
1990	Nelchina Basin	40	39 (98%)	233.4
1991	Nelchina Basin	40	33 (82%)	227.1
1992	Minto Flats	28	27 (96%)	230.7
1993	Nelchina Basin	50	46 (92%)	236.7
1994	Minto Flats	50	47 (94%)	242.8
	TOTAL	245	227 (93%)	234.9

Table 3. Numbers of Trumpeter Swan cygnets (from Alaskan eggs) suffering leg impairments during first 10 weeks of life, according to year, origin, and rearing technique, 1989-1994.

Year	Site of Origin	Rearing Technique	Number of Swans	Number with Leg Impaired	% Impaired
1989	Minto	Captive Decoy	25 10	5 0	20 0
1990	Nelchina	Captive Decoy	19 20	2 1	10 5
1991	Nelchina	Decoy	33	0	0
1992	Minto	Decoy	20	2	10
1993	Nelchina	Captive Decoy	24 22	14 3	58 14
1994	Minto	Captive Decoy	21 26	3 0	14 0
All	Both	Captive Decoy	89 131	24 6	27 5
All	Both	Both	220	30	14

Table 4. Numbers of Wisconsin-released Trumpeter Swans that died in the wild or were permanently removed from the wild due to injury.

Cause of Death/Removal	Total # Swans	%
Shooting	19	33
Lead poisoning	16	28
Collision	9	16
Morbidity	3	5
Burned	3	5
Vehicle	2	3
Fish line	2	3
Vandalism	1	2
Predation	1	2
Capture myopathy	1	2
Human defense	1	2
TOTAL	58	100 %

Table 5. Nesting success of Trumpeter Swans in Wisconsin.

Year	# Nesting Pairs	# Successful Nests	# Young Fledged
1989	1	1	2
1990	2	2	5
1991	2	0	0
1992	6	5	10
1993	9	7	21
1994	10	8	24
TOTAL	30	23	62

Table 6. Comparison, by release technique, of numbers of Wisconsin-released Trumpeter Swans nesting by 1994[1].

Technique	# Released	# Nesting
Decoy-rearing	112	17 (15%)
Captive-rearing	40	6 (15%)
Captive parent-rearing	16	1 (6%)
TOTAL	168	24 (14%)

[1] Includes only birds old enough to nest by 1994, i.e., captive-reared birds hatched before 1992, and decoy-reared and captive parent-reared birds hatched before 1993.

STATUS REPORT OF THE LACREEK TRUMPETER SWAN FLOCK FOR 1994

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ABSTRACT

A total of 205 Trumpeter Swans returned to Lacreek National Wildlife Refuge following the 1994 breeding season, including 61 cygnets. A total of 249 Trumpeter Swans was observed during the summer aerial production survey, including 54 nesting pairs, 32 broods with 85 cygnets, and 47 nonbreeders in nine flocks. Since 1991, the breeding season (winter) peaks have been less than the total number of birds observed during their respective summer aerial production surveys. This change in data is significant. The recent data indicate that the breeding season population returning to Lacreek has stabilized, while the production population is expanding. If the high plains population is expanding, but apparently not returning to Lacreek, then a fall migration must be occurring. Three pairs of swans nested on the refuge in 1994. Out of the three nesting pairs on the refuge, three broods totaling 13 cygnets were hatched with only two cygnets surviving to fledge. Seven Trumpeter Swans marked by Rhys Beaulieu, Saskatchewan Environment and Resource Management (SERM), and Gerry Beyersbergen, Canadian Wildlife Service (CWS), in 1994, near Greenwater Lake Provincial Park, Saskatchewan (Collared A00 - A07) and Trumpeter Swan 30AC, banded earlier, were observed on Lacreek National Wildlife Refuge on 7 December 1994 and remained to the end of the year. Swan A00 was paired with an unmarked swan and they arrived with five cygnets, A03 and A04 seemed to be paired, and 30AC also appeared to be paired with an unmarked bird. Two Trumpeters were shot and killed on the Platte River in Nebraska this fall.

POPULATION REPORT

A total of 205 Trumpeter Swans (Cygnus buccinator) returned to Lacreek National Wildlife Refuge following the 1994 breeding season, including 61 cygnets. This compares to 164 Trumpeters, including 42 cygnets in 1993, 200 Trumpeters, including 62 cygnets in 1992, and 150 Trumpeters, including 45 cygnets in 1991 (Table 1). A total of 249 Trumpeter Swans was observed during the late summer aerial production survey, including 54 nesting pairs, 32 broods with 85 cygnets, and 47 non-breeders in nine flocks (Table 2).

Fall Trumpeter Swan populations began building on 22 November 1994, with the arrival of 70 Trumpeter Swans when 80 percent of refuge waters and most off-refuge wetlands froze over with the onset of cold weather. Another surge of cold weather increased the swan population to 185 on 16 December. Even with a December warming trend, outlying wetlands remained frozen and the breeding season peak of 205, including 61 cygnets, was reached on 27 December 1994. Some winter migration probably occurred despite the warm December weather as the winter peak population of 205 was still significantly below the summer peak of 249. In past years we have seen the winter peak occur in mid to late December followed by a significant decline when the severe cold temperatures occur. In December 1994, the increase to the peak of 205 was gradual, but a rapid decline to below zero temperatures reduced the population to 171 on 7 January 1995.

Seven Trumpeter Swans marked by Rhys Beaulieu (SERM) and Gerry Beyersbergen (CWS) in 1994, near Greenwater Lake Provincial Park, Saskatchewan (Collared A00 - A07) and Trumpeter Swan 30AC, banded earlier, were observed on Lacreek National Wildlife Refuge on 7 December 1994 and remained to the end of the year. Swan A00 was paired with an unmarked swan and they arrived with five cygnets, A03 and A04 seemed to be paired, and 30AC also appeared to be paired with an unmarked bird. Two Trumpeters were shot and killed on the Platte River in Nebraska this fall. The perpetrators were caught and fined.

None of the Wyoming banded birds (01RC - 05RC) have been seen since January 1993. The power line west of the refuge, where several Trumpeter Swan line-strike fatalities occurred in 1992, was marked with orange Tana Ball power line markers, and no additional mortalities have been observed.

PRODUCTION REPORT

The 1994 aerial production survey was conducted 30, 31 August and 1 September 1994. The survey included Bennett, Shannon, Pennington, Meade, Butte, Perkins, Ziebach, Haakon, Jackson, Mellette, and Todd Counties in South Dakota; Cherry, Sheridan, Garden, Grant, McPherson, and Arthur Counties in Nebraska; and Crook County in Wyoming. A total of 249 Trumpeter Swans was observed including 54 nesting pairs, 32 broods with 85 cygnets, and 47 nonbreeders in nine flocks. Even though the number of cygnets for 1994 is down from the all-time high of 102 in 1992, there was an increase over the 58 cygnets produced in 1993. The 164 adults observed this summer is an all-time high and the number of nonbreeders counted this summer is also the highest since 57 were counted in 1980. Since Trumpeter Swans do not breed until they are 3 or more years old, the high number of nonbreeders is also an indication of a growing population (Table 2).

REFUGE PRODUCTION

Three pairs of swans nested on the refuge in 1994 on Pools 7 and 8. Out of the three nesting pairs on the refuge, three broods totaling 13 cygnets were hatched with only two cygnets surviving to fledge (Table 3). This is the lowest on-refuge production in over 18 years. The pair on Pool 8 included 54FA, a pen banded as an adult on 23 July 1991. The pair nested on a muskrat house in the southwest central part of the unit with a clutch of seven eggs, including one goose egg on 9 May 1994. The pair hatched seven cygnets on 6 June 1994. The brood was down to three cygnets on August 20 and fledged only two cygnets in September. Two pairs nested on Pool 7. The pair in the west central part of the unit hatched five cygnets and the pair on the north end hatched only one cygnet. None of the Pool 7 cygnets survived to flight. Refuge production suffered major setbacks in 1994 due to several management problems. Pools 6, 9, and 11 were drawn down for planned carp control work in 1994 disrupting the swan nesting there, and Pool 2 was drawn down in response to water rights negotiations with adjacent landowners. The pairs that normally nest on Pools 6, 9, and 11 were displaced, and the pair that established a territory on Pool 2 moved to Pool 7.

Four pairs of swans nested on the refuge in 1993 on Pools 6, 7, 8, and 9. The established pairs on Pools 7 and 8 produced 3 and 4 cygnets, respectively, and brought two cygnets, each, to flight. The other two pairs did not produce broods. The pair in Pool 8 nested and produced cygnets to flight despite the drawdown on Pool 8 for carp control in 1993, demonstrating the tenacity of experienced nesting pairs. The pairs on Pools 6 and 9 did not hatch any cygnets, but may have been disturbed by a graduate student who had wildlife monitoring transects in the marsh. Also, Pool 6 was drawn down in 1993 to protect the carp control work completed in Pool 5. An above average runoff during the summer compromised the integrity of the fish barriers in Dike 5.

MIGRATION ATTEMPTS

Since 1991, the breeding season (winter) peaks have been less than the total number of birds observed during their respective summer aerial production surveys. The winter breeding season peak population has usually been significantly higher than the summer production survey total because it was assumed that the entire summer population is not seen during the production survey. Normally, the breeding season peak for cygnets is just slightly less than the production survey count with additional mortality suspected as the reason. But during the last 4 years, the breeding season cygnet count has been significantly less than the production survey count. In summation, the breeding season population returning to Lacreek appears to have stabilized (Table 1), while the production survey indicates an expanding population (Table 2). If the high plains population is expanding, but apparently not returning to Lacreek, the author optimistically suggests that a fall migration must be occurring. Additional evidence of winter migration is the report of 13 unmarked Trumpeter Swans at Fort Cobb State Park in Caddo County, southwest of Oklahoma City, Oklahoma, on 3 December 1994. The report indicated four white adults and nine "grey" swans. Also, two Trumpeters were shot and killed on the Platte River in Nebraska this fall. The perpetrators were caught and fined.

Seven Trumpeter Swans marked by Rhys Beaulieu (SERM) and Gerry Beyersbergen (CWS) in 1994, near Greenwater Lake Provincial Park, Saskatchewan (Collared A00 - A07) and Trumpeter Swan 30AC, banded in the same area earlier, were observed on Lacreek National Wildlife Refuge on 7 December 1994 and were still on the refuge as of 4 January 1995. Swan A00 was paired with an unmarked swan and they arrived with five cygnets, A03 and A04 seemed to be paired, and 30AC also appeared to be paired with an unmarked bird. Since all of the birds marked in eastern Saskatchewan are showing up at

Lacreek National Wildlife Refuge in the winter, it is believed that the eastern Saskatchewan birds are part of the high plains flock and a new migration is developing to the north for breeding. The problem is that they do not appear to being going any further south in the winter.

Banding and collaring of subadults and adults will continue in the vicinity of the refuge to provide an increasing pool of marked birds in the environment to aid in positive observations. Twenty-one Trumpeters were banded in South Dakota, and one in Nebraska during 1994, but more needs to be done. Eighteen Trumpeters were caught and banded on 31 January 1994 using a drop net on a baited site. We used a turkey trap for the capture, but the mesh was too large (2 inch) and we had problems with wings being caught in the net. The problem was worse with the geese caught in the trap. The technique appears to be sound and a new trap is being constructed using smaller (1 inch) mesh netting. Four additional swans were caught and banded using an airboat on 28 July 1994. There is no doubt that considerable winter pioneering and migration is taking place, but despite the stability of the breeding population, the loss of birds, though undocumented, must be significant. We, as a profession, restored these magnificent birds to their former breeding ranges without adequate consideration for their winter survival. It is now incumbent upon us to find suitable wintering habitat and assist this species to find it.

Table 1. Breeding Season Peak Population and Production Data for Trumpeter Swans Wintering on Lacreek National Wildlife Refuge.

Breeding Season	Adults	Cygnets	Total
1994	144	61	205
1993	122	42	164
1992	138	62	200
1991	105	45	150
1990	164	61	225
1989	221	61	282
1988	169	78	247
1987	182	86	268
1986	166	63	229
1985	144	43	187
1984	190	47	237
1983	206	57	263
1982	167	48	215
1981	172	58	230

Table 2. Breeding Performance of Nebraska and South Dakota Trumpeter Swans.

Year	#Adults	#Pairs	#Broods	#Cygnets	Total
1994	164	54	32	85	249
1993	115	42	21	58	173
1992	126	48	30	102	228
1991	117	44	24	89	206
1990	127	41	22	68	195
1989	152	51	30	79	231
1988	-*	-*	-*	-*	-*
1987	110	34	23	81	191
1986	103	41	21	74	177
1985	95	40	22	63	158
1984	116	42	28	65	181
1983	-*	-*	-*	-*	-*
1982	-*	-*	-*	-*	-*
1981	104	30	16	54	158

* No Data

Table 3. Production Data for Trumpeter Swans on Lacreek NWR.

YEAR	NESTING PAIRS	BROODS	HATCHED	FLEDGED
1994	3	3	13	2
1993	4	2	7	4
1992	5	3	11	5
1991	6	6	21	6
1990	5	4	18	8
1989	6	6	16	7
1988	6	5	15	8
1987	6	5	13	11
1986	6	6	19	19
1985	6	5	18	13
1984	5	5	15	7
1983	5	4	17	9

OBSERVATIONS OF TRUMPETER SWAN BEHAVIOR AND MANAGEMENT TECHNIQUES

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ABSTRACT

The greatest threat to Trumpeter Swans in the lower conterminous United States is limited winter habitat in the north. The breeding population is expanding and some pioneering to find southern wintering grounds is occurring, but pioneering from a hostile northern environment to unknown wintering grounds is unnatural and extremely risky for the birds involved. Though pioneering is the way migration routes are initially established in nature, the natural evolution of migration routes always develops from south to north in the northern hemisphere, not the other way around. Trumpeter Swans were first introduced to Lacreek National Wildlife Refuge (NWR) from Red Rock Lakes NWR in 1960. The first successful nesting occurred in 1963. Captive swans require considerable care and protection. The species is very docile and will do very little while in captivity to defend itself. Trumpeter Swans prefer isolated wetlands for nesting territories that are agressively defended against other swans. Trumpeter Swans appear to mate for life, but they apparently do have family squabbles. Experienced Trumpter Swans go to great lengths to protect their young. Cygnet mortality is very high among first and second year nesters, but cygnet mortality declines rapidly over the years as the parents gain cygnet rearing experience. Some Trumpeter Swans possess full yellow to blotched yellow feet and small yellow lores on the bill as subadults. The flightless molting period is the best time to capture swans for management purposes. The most common means for capturing Trumpeter Swans at Lacreek NWR involves the use of dip nets and an airboat. Walk-in traps without a roof are futile, but walk-in traps with roof netting can be successful. Cannon and rocket nets used for ducks should not be used for Trumpeter Swans. The earliest indication of winter migration of the Lacreek Refuge flock was a rapid decline of ten birds in December 1976. Evidence of continued pioneering has been observed. Specific plans to re-establish a natural migration to safe wintering grounds are needed for the long-term survival of the species.

INTRODUCTION

The greatest threat to Trumpeter Swans (Cygnus buccinator) in the lower conterminous United States is limited winter habitat. The high plains (western South Dakota and Nebraska, and northeast Wyoming), Minnesota, and Wisconsin flocks are expanding their breeding ranges, and the populations are increasing, but the survival of these populations depends largely on artificial feeding. As these populations continue to increase, greater and greater demands are placed on winter feeding programs, while stress and the potential for disease also increases. These population increases have encouraged pioneering as evidenced by winter movements that have been documented in Iowa, Missouri, Kansas, Oklahoma, Arkansas, and Texas. The problem is that pioneering from a hostile northern environment to unknown wintering grounds is unnatural and extremely risky for the birds involved. The high mortality associated with reverse pioneering severely limits success, and progress will continue to be very slow.

Though pioneering is the way migration routes are initially established in nature, the natural evolution of migration routes always develops from south to north in the northern hemisphere, not the other way around. All birds, in their evolution, began in areas where year around survival was assured. Only as breeding populations increased beyond the carrying capacity of local habitats, did certain species begin to pioneer to other areas to nest and reproduce. Many species pioneered north in the spring and found suitable breeding grounds, but when harsh winter weather threatened their survival, these birds knew where they came from and returned to suitable habitat for the winter. Obviously, many migratory species evolved from other species that were already migrational.

Human beings, in their "infinite wisdom", have manipulated wildlife species in many ways, being particularly successful at introducing waterfowl onto suitable breeding grounds. Nature always provided a "virtually unnoticed" helping hand though, in the form of naturally migrating birds of the same species that could guide the introduced birds to traditional

wintering grounds. This concept worked exceptionally well with Canada Geese, as most areas where breeding birds were introduced, still had remnant populations of migrating birds.

This is not the case with the artificially restored populations of Trumpeter Swans. When the Trumpeter Swans were restored to historical breeding grounds at Lacreek NWR in South Dakota and Hennepin Parks in Minnesota, no remnant populations of wild Trumpeters remained. As a result, there were no wild migrating swans to act as guide birds and both populations became residential and required artificial feeding for winter survival. Both breeding populations became successful and have increased in size. As the numbers of free-flying subadults increased, some of these birds have pioneered to seek natural wintering areas. Birds from both populations have been documented in areas far enough south to assure winter survival, but no true migration of any flock to any specific wintering areas has been established. True migrating flocks, following natural migration routes will probably develop over time, but the cost in pioneering birds will be heavy.

The wildlife profession created these circumstances by introducing this species into breeding areas without adequate consideration for winter survival. That situation must be corrected for Trumpeter Swans on the high plains, Wisconsin and Minnesota to become true wild and free-ranging flocks, independent of artificial feeding. The only realistic way to establish natural migration routes is to establish breeding populations in suitable habitat far enough south to assure year around survival, and allow those populations to expand and pioneer north on their own. With their winter survival assured, these birds will eventually establish migration routes north and connect with the existing breeding populations. When that happens, these naturally migrating birds will act as guide birds for the existing sedentary flocks and a natural migration of the entire population should follow. Some old resident birds will, no doubt, remain attracted to the artificial feeders, but most of the younger birds will probably migrate. Only when Trumpeter Swans can breed north and migrate south without the help of humans, can we consider the Central Flyway flocks fully restored.

BACKGROUND

Relocating Trumpeter Swans to a new area is always a perilous adventure at best. Trumpeter Swans were first introduced to Lacreek NWR in 1960. The birds were transplanted from Red Rock Lakes NWR over 3 consecutive years (20 cygnets in 1960, 17 cygnets in 1961, and 20 cygnets in 1962). The first successful nesting occurred in 1963 with three cygnets fledged. During 1964, the first cygnets were hatched and fledged off the refuge by pioneering swans. Captive swans require considerable care and protection. One must first recognize that even though these birds are beautiful and graceful, they are not very bright. If there is a way to get into trouble, these birds will find it. One of the early cygnets fell into a two-and-a-half gallon water pail and drowned because it did not struggle enough to overturn the bucket. The species is very docile and will do very little while in captivity to defend itself. Several grown cygnets were killed by Great Horned Owls in 1961 (Hughlett 1962).

OBSERVATIONS

Trumpeter Swans prefer isolated wetlands for nesting territories. Territories are agressively defended against other swans, and sometimes geese. Any wetland, up to several hundred acres, is defended by one pair. I have observed only a few instances where more than one Trumpeter pair nested on the same wetland. These were large wetlands of 200 -300 acres and the nesting sites were quite far apart and well screened from each other by tall cattails.

The site must have an unobstructed open water area of at least 2 - 3 acres for the cygnets to exercise their wings and practice take-offs and landings. Parents apparently "coach" their cygnets during first flight attempts and "encourage" them with much vocalization following flight attempts (Jay Peterson, pers. comm.). The wetland must be surrounded by tall vegetative cover for screening, as nesting has not been observed on wetlands that are either grazed or mowed to the water's edge. Small islands or muskrat houses are normally used for nesting platforms, but Trumpeters have been observed constructing their own nesting platforms from surrounding vegetative materials.

Trumpeter Swans appear to mate for life, but they apparently do have family squabbles. One pair of swans that nested on South Twin Lake in Cherry County, Nebraska, was rearing three cygnets in 1982 and we had decided to transplant the entire family to Missouri as part of a program to develop winter migration sites. When the pre-capture flight was made the day before the capture, to count the cygnets to assure they were all caught, only the cob and one

cygnet were found on the lake. An inquiry with the landowner revealed that the pen was seen on foot with two cygnets headed east about 2 miles from the natal wetland 2 days before. An aerial survey found the pen still heading east 6 miles from her mate. The cygnets were never found and were presumed lost (Kraft 1984).

Trumpeter Swans begin to establish territiories in late March and through April in South Dakota. Egg laying and nesting begins in early May in South Dakota just as it does in Montana, even though ice out in southwestern South Dakota usually occurs in early March. Incubation takes 32 to 37 days (Mitchell 1994) with most cygnets hatching by mid to late June. Experienced Trumpter Swans go to great lengths to protect their young. While capturing family groups with an airboat and dip nets, the adults send the cygnets into dense cover to hide and then expose themselves to lure us away from the young. The young do not come out of hiding for some time following the disturbance (Kraft 1984). The cygnets fledge at 99 - 101 days following the hatch (Kraft 1989) and 91 - 122 days after hatch (Banko 1960). After the cygnets learn to fly the parents take them on short flights to surrounding wetlands. Once, while I was flying overhead, the adults apparently considered my airplane an airborne predator and flew directly above their young and guided them to the nearest wetland with tall emergent cover. The cygnets landed and immediately dashed for cover and disappeared while the adults landed and exposed themselves on the open water. After a few minutes the adults took off and led me away from the wetland where the cygnets remained hidden. Inexperienced nesting pairs, on the other hand, are not so adept at luring away predators and often just abandon their cygnets, leaving them to fend for themselves. Cygnet mortality is very high among first and second year nesters, but cygnet mortality declines rapidly over the years as the parents gain cygnet rearing experience. I have observed several Trumpeter pairs with 6 or more years of brooding experience bring all, or most, of their cygnets to flight year after year.

Some tolerence of other swans on the brooding area has been observed after the cygnets have hatched. In both instances that I observed, the territorial brooding area of a Trumpeter pair with cygnets was invaded by nonbreeding Trumpeters in small flocks. The brooding pairs and their cygnets remained together on the far end of the brood wetland near their nesting site while the flock of nonbreeders remained at the other end of the wetland. In both cases, the wetlands were quite large, over 100 acres. The following are accounts of these observations: Flocks of nonbreeding Trumpeter Swans invaded the normally defended nesting territories of two separate pairs of Trumpeter Swans with young this year (1988), a phenomenon never previously observed. In one instance the adults were first time breeders (21RA and 22RA) on Clubhouse Lake, Cherry County, Nebraska, with two cygnets. Eighteen nonbreeders began using the same lake in July. The two cygnets died, but whether the loss was due to the disturbance from the flock or the inexperience of the breeding pair, is unknown. Later, in late August, a flock of 14 nonbreeders invaded the nesting territory of an old experienced pair with seven cygnets on their traditional nesting marsh one mile north of Goose Lake, Cherry County, Nebraska. The flock appeared to be tolerated, but the pair and the cygnets remained together, isolated from the rest of the birds. No losses from this brood were observed (Kraft 1988).

Trumpeter Swans without cygnets have a very low tolerence for disturbance, particularly by human beings. The following account of an observation in 1986 demonstrates the lengths swans will go to get away: I was going to capture some nonbreeding swans for transplant to Missouri and wanted to make the capture while the birds were flightless. The year before we were too late in late July when brooding pens are normally caught, so a run was made in late June after some molted remiges were seen from the air near a nonbreeding flock on Scotchmans Lake in southern Bennett County, South Dakota. We caught and banded three swans, but the other three flew away losing feathers as they flew. We were a little early, and since we wanted all six birds for the transplant and did not want to hold the captured birds in a holding facility for several days for stress reasons, we decided we would release the marked birds and come back and capture the entire flock of marked and unmarked swans all at once. WRONG! When I flew the area the next day, the flightless collared birds were gone. They were located "on foot" 1.5 miles southeast headed towards Winslow Lake, Cherry County, Nebraska. I figured that the stress of the capture forced them to leave Scotchman Lake, but we could still capture them on Winslow Lake. WRONG AGAIN! Five days later the birds were gone again and could not be found. I conducted an aerial survey covering a 15 by 30 mile area around their last location and found nothing. They walked away. Two of the marked birds were observed on the refuge the following December, so they did go somewhere and survived (Kraft 1986).

Some Trumpeter Swans possess full yellow to blotched yellow feet as subadults. It was earlier believed that the full yellow feet carried over into adulthood, and though I have observed yellow-mottled feet in subadults, I have not observed full yellow feet on breeding adults. The condition has recently been termed "leucistic" and is considered a recessive genetic trait, though not albinism as the birds appear to grow out of it. Some swans with leucistic characteristics also have small yellow lores on the bill. The leucistic cygnets possess pure white plumage as opposed to white tinged with dingy grey, that is typical of Trumpeter Swan cygnets. The condition was documented at Yellowstone National Park in Montana in 1937 by David de Lancey Condon as a "white phase" (Banko 1960). Also, an article on waterfowl hunting in the early 1900's, on what is now Lacreek NWR, shows a photograph of a bagged Trumpeter that appears to be leucistic (Farrar 1994). The full white plumage of late summer cygnets makes them difficult to distinguish from adults, but with experience, the observer can usually make the distinction based on behavior. Typically, the cygnets group together, grey and white, while an extra adult obviously associated with the family, is usually distinctly separate from the cygnets and the brooding pair. This behavior is more readily observable from the air, but it is not absolute and some leucistic cygnets may be mistaken for adults in late summer and during the fall. The study of this phenomenon continues.

TECHNIQUES

Immature and adult swans regularly undergo an annual molt during the summer and become flightless because of a more or less simultaneous loss of the primary flight feathers (Banko 1960). This flightless molting period is the best time to capture swans for management purposes. Trumpeter Swans molt from June through September. The pens usually molt first, while most late-molting swans have been cobs (Banko 1960). In my observations, all of the primary flight feathers (remiges) are lost over 2 - 3 days and it takes about 3 - 6 weeks for them to grow new remiges and regain flight. In South Dakota, most subadult swans molt their remiges in late-June to mid-July, most nesting pens molt from mid-July to mid-August, and most breeding adult cobs molt from mid-August to mid-September. An interesting phenomenon is that flying cobs can often be caught with their flightless mates in July-August. I have caught midsummer cobs that possessed fully feathered wings, but chose to remain with their mates. Cobs that did fly in midsummer have been caught flightless in September just prior to the first flights of the cygnets.

The most common means for capturing Trumpeter Swans at Lacreek involves the use of dip nets and an airboat. The airboat operator manuevers the boat to place the swimming swan to one side of the bow and the netter brings the net down from above, over the swan. The boat operator immediately turns the boat, full rudder, towards the captured swan and slows the boat to an idle, allowing the netter and helper to haul the bird on board. The engine is usually left running to avoid a stalled engine away from shore. The swan is then placed in a burlap holding bag to restrain the wings and feet. The bags are prepared in advance by cutting a small, 4 inch hole in the bottom. The helper reaches through the hole and rolls the bag up his/her arm, grabs the swan's head and pulls it through the hole, and then rolls the bag down over the swan's body while the netter holds the swan's wings against its body. The swans are placed in a secure area under the seats to prevent their being stepped on during subsequent captures. Some swan captures are made by just grabbing the proximal end of the swan's wings by hand while the bird is along side of the boat. Neck grabbing, or grabbing the ends of the wings, should be avoided to prevent injury to the bird. Unrestrained swans are handled by grasping both wings by the humeri from the rear, to control the wings and prevent the handler from being injured by the flailing feet. The toe nails are very sharp and the legs are very strong. The birds are carried by holding the humeri against the swan's body while the handler holds the swan away from her/his body with the feet facing forward. Swans can be quieted by tucking the head under a wing and gently rocking the bird.

Walk-in traps without a roof are futile. Even though swans take a long distance to get off the water in the wild, they can jump into flight like a Mallard when confined. Walk-in traps with roof netting can be successful. We used a turkey trap in January 1994 to capture swans adjacent to a feeder. The trap has the outward appearance of a circus tent and the birds are lured inside with grain. An electrically detonated charge drops the netting on the birds and the netting holds them for removal. The handlers must move quickly to remove and work the birds to reduce stress. The main problem with the turkey drop net was the size of the mesh (2 inches). Some swans and many of the Canada Geese caught in the trap managed to shove their wings and necks through the mesh and became seriously entangled. Some injury resulted. A

new drop net is being constructed with 1-inch mesh nylon netting and will be tested next winter.

Cannon and rocket nets used for ducks should not be used for Trumpeter Swans because their necks are too long causing their heads to stand too tall.
If swans are being captured for transplant and it will be desirable to pull the remiges to render the birds flightless for a time, it is far better to pull the primary flight feathers immediately upon capture. I have found that the remiges will pull easily immediately after the capture, but after a few hours the feathers become very difficult to pull and many times the feather follicles become torn and bleed profusely. It is believed that the stress of captivity may cause rigor of the intricate musculature surrounding the follicle and that increases the tension on the calamus. It appears that remex regrowth takes considerably longer during the fall and winter. Primary feather replacement requires a high demand for energy that may be limited during cold weather. Replacement in the fall and winter may take 8 or more weeks.

When capturing whole families of swans, it is best to make the capture in late summer just prior to the first flights of the cygnets. The cygnets are big enough to band then and their survival is also much better. It is important to capture all of the cygnets, as without the protection of their parents, the cygnets left behind will probably not survive. To assure that all cygnets are caught, it is important to make a pre-capture survey, no earlier than the day before the capture, to count the cygnets. An aerial survey is best. The disturbance of the capture boat will cause the cygnets to flee for cover while the adults expose themselves to lure the "predator", us, away. The adults are easily captured in late summer as the cob is usually flightless and the pen has strong ties to the family unit. The cygnets will be very difficult to find and will remain hidden as long as the boat disturbance continues. The use an aircraft circling overhead can be of considerable assistance. After the adults and the obvious cygnets are caught, and the count shows that some cygnets remain, the boat can be shut down while the aircraft throttles back and flies slow, quiet circles 1000 feet, or more, above the wetland. When hiding, the cygnets usually cannot be seen from the air, but after about 15 - 20 minutes, the remaining cygnets will emerge from the cover. When they swim into the open water, the aircraft pilot can direct the boat in by radio to make the final captures. Capturing subadults is not so critical, as subadults left behind can fend for themselves.

NATURAL MIGRATION ATTEMPTS

The earliest indication of winter migration of the Lacreek flock was a rapid decline of ten birds in December 1976. The breeding season peak of 159 Trumpeters occurred 12 November 1976, but the population dropped to 149 by mid-December with no obvious mortality. The first conclusive evidence of a winter migration was the discovery of a banded adult pen with two cygnets found dead and discarded at the Thomas Hill Reservoir near Macon, Missouri, in December 1978.

Severe cold in 1983 forced over 100 Trumpeters to leave Lacreek NWR in December. No evidence of major mortality was found, indicating that most of these birds migrated somewhere. Further evidence of winter pioneering, probably resulting from the severe cold, is demonstrated by the following observations: On 20 December and 28 December 1983, six unmarked adults and five cygnets, and eight unmarked adults and five cygnets were observed near Dumas, Arkansas, and Ada, Oklahoma, respectively. Other unmarked Trumpeters were reported near Perry, Oklahoma, on 6 January 1984; Cedar Bluff, Kansas, on 26 November 1985; Emporia, Kansas on 12 December 1985; and one cygnet with five adults near Mangum, Oklahoma, on 8 February 1986. The reduced 1985 winter peak of 187 may have been the result of the small southern migration that began in 1983. Even though the 1986 winter peak of 229 brought the Lacreek winter population back to normal, the minor migration may indeed have continued.

Following the midwinter peak of 268 for the 1987 breeding season that occurred on 4 January 1988, the Lacreek population declined sharply to 192 on 20 January 1988. This rapid loss of an estimated 76 birds indicates that some migration must have occurred. That number of birds could not have died without some evidence. An aerial survey of the surrounding swan wintering habitat failed to reveal any of the missing birds. Four collared swans were among the missing (15FA, 25FA, 26FA, 27FA). 15FA (originally banded 53TY in 1973) and 27FA have not been seen since December 1987. 25FA was seen again January 1988 and 26FA was observed December 1988 and February 1990 on Lacreek NWR; however, on the last sighting of 26FA, the collar had been lost and only the yellow leg band remains. The Arkansas Audobon Society reported additional unmarked Trumpeters in January 1991. These may be Lacreek birds, because most Minnesota swans

were marked. Three cygnets were observed near Heber Springs, Arkansas, (Cleburne County) on 8 January 1991, and one adult and three cygnets were observed near Conway, Arkansas (Faulkner County).

Additional confirmed evidence of southern winter migration attempts from Lacreek were obtained when Trumpeter Swan 43RA, banded on Clubhouse Lake, Cherry County, Nebraska, 12 miles south of the refuge during the 1987 summer, was observed 18-24 January 1988 on Lake Dardanelle, near Russellville, Arkansas. Also, another Trumpeter, 20RA transferred via aircraft to Mingo NWR in 1986, returned to the vicinity of Lacreek in July 1986, and has been seen several times on Lacreek NWR with the last observation at Lacreek on 7 November 1991. To our knowledge it never returned to Missouri. Another Trumpeter, 36FA (AHY M) that was banded on Lacreek NWR in 1988, spent the summer of 1990 on the Upper Peninsula of Michigan at Tee Lake near Blaney Park and was observed again during the first part of January 1991 at the confluence of the Chippewa and Mississippi rivers near Wabasha, Minnesota. 36FA was observed back on Tee Lake 20 April 1991 and remained there until 8 June 1991. He was observed again on Tee Lake on 7 August 1991 and remained through the summer. Recent reports are not available.

Banding and collaring of subadults and adults will continue in the vicinity of the Refuge to provide an increasing pool of marked birds in the environment to aid in positive observations.

Two Trumpeter Swans with Canadian collars were observed on Lacreek NWR on 29 October 1991. The swans were wearing yellow collars with black alpha-numerics and were identified as 30AC and 31AC. The swans were banded by Len Shandruk of the Canadian Wildlife Service (CWS), Edmonton, Alberta, on 23 July 1991 at Greenwater Lake Provincial Park in eastern Saskatchewan. Rhys Beaulieu, Regional Wildlife Ecologist, CWS, Hudson Bay, Saskatchewan, said that the Trumpeters had been nesting in the area for several years. It is believed that the Canadian nesting pair are part of the high plains flock that normally winters on Lacreek NWR and nests throughout western South Dakota, western Nebraska, and northeastern Wyoming. These birds are the first record for high plains Trumpeters nesting in Canada.

More recently, the CWS and Saskatchewan Environment and Resource Management marked an additional seven Trumpeter Swans at Greenwater Provincial Park in east-central Saskatchewan. The Trumpeters were banded A00-A07 (red with white alpha-numerics) on 25 - 26 July 1994. All of these birds were observed at Lacreek Refuge in South Dakota on 7 December 1994, along with 30AC (see above) and an unmarked mate. All of these Canadian nesting birds were still on the refuge in January 1995. It is believed that these are high plains Trumpeters that have developed a migration to Canada to nest.

From the above information, one must conclude that a fragmented natural migration is taking place, but at a considerable toll on the birds. Reverse pioneering, as described above, has been occurring over many years without much success, while the normal migration of Trumpeters from the high plains area to Canada for nesting has developed with considerable success. Apparently, Trumpeter Swans can migrate from a secure winter area to a northern nesting area on their own, but conversely, they apparently need help to develop a southern migration to secure wintering grounds. We, as a profession, restored these magnificent birds to their former breeding ranges without adequate consideration for their winter survival. It is now incumbent upon us to find suitable wintering habitat and assist the species to find it.

RESULTS OF TRANSPLANT EFFORTS

In an effort to reestablish a natural migration of Trumpeter Swans to their historical wintering grounds, negotiations to transfer swans to Missouri began in 1981. The first family of Trumpeter Swans was transferred to Mingo NWR, Puxico, Missouri, 31 August 1982. The family consisted of two established adults (98TY and 82TY) and three cygnets. In 1983, two families of Trumpeters were captured and released at Mingo NWR on 9 September. The families from South Twin Lake and East Lake, Cherry County, Nebraska, had one and two cygnets, respectively, at the time of transfer. Unfortunately, three of the adults and one cygnet were confirmed as killed by predators by the end of October and the other adult was missing. The two adults transferred in 1982 were still alive, but their cygnets were lost.

The 1982 swans were held in a holding facility for a time prior to release while the 1983 birds were released immediately. The 1983 birds had their flight feathers pulled to hold them at the release site until they were acclimated. After the failure of the 1983 transplant, and considering the difficulty of capturing

complete families, it was decided to transfer only nonbreeding subadults in the future. The late July timing for the 1984 capture was based on the experience we had with families, but to our dismay, we discovered that nonbreeding birds molt earlier and they were already flying in late July when we attempted the capture. As a result, no birds were transferred in 1984.

In 1985, six subadults were captured on 27 June and transferred the next day. Three of these died later in 1985, two were found dead and one was killed by a bobcat. Two additional birds from this transfer were found dead in January 1986, but one (23FA) survived and returned to Lacreek in December of 1986. Seven subadults were captured on 30 June for the 1986 transfer. Three died of stress during the summer and one died in a flying accident. Swan 20RA was missing for a while, but was observed again at Mingo 30 December 1986 (see above).

Ten subadult Trumpeters were captured 8 July - September 1987 and transferred to Mingo 10 July. These were placed in a holding pen for 7 days prior to release, but three died in the pen. All of those that died were showing stress prior to the transfer and it was decided that all birds with signs of stress prior to transfer in the future would not be transferred and released immediately. Four of the remaining swans were released on Mingo NWR and two were released on the Grand Pass Wildlife Management Area near Marshall in northern Missouri. One of the 1987 birds on Mingo died in October.

The Missouri transplant program ended with the 1987 transfers. Overall, 35 swans were transferred, two returned to Lacreek, and six adults and one cygnet survived as of 1988. Dense vegetation on Mingo interferes with observations during the summer; however, four adults were observed on Mingo Refuge in 1990. Another adult Trumpeter was observed on Lake Wappapello near Poplar Bluff, Missouri. It was believed to be a release from the Kansas City Zoo. Two adult Trumpeters were killed on the Duck Creek Wildlife Area in November 1990 (John Smith, pers. comm.).

The original two adults of the first transfer in 1982 were the only pair to reproduce. They were last seen in 1990. This pair (98TY and 82TY) were over 11 years old when they were last seen. 82TY was banded as an adult on 20 July 1976 and even though 98TY was not banded until 13 July 1982, this pair had been an established nesting pair on Pool 6 on Lacreek NWR for many years prior to his capture. They were a very successful nesting pair at Lacreek for many years prior to their transfer to Mingo, bringing five or more cygnets to flight every year. They successfully raised one cygnet to flight stage in 1988 and 1989, respectively, but no cygnets were observed in 1990 (John Smith, pers. comm.).

The experience gained over the past decade demonstrates that small transfers of Trumpeter Swans to unsecure wintering areas will not solve the winter migration problem. It may happen over time, but only with major losses in birds. We need to develop a large-scale proposal to establish a breeding population in a secure wintering area. That breeding population must be capable of providing sufficient reproduction to expand the southern population, so that a natural northern migration can occur.

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BUILDING A MIGRATORY TRADITION FOR THE INTERIOR POPULATION OF TRUMPETER SWANS

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Historically, the Interior Population (IP) of Trumpeter Swans probably contained more Trumpeter Swans than the Rocky Mountain and Pacific Coast populations combined. Estimates exceed 100,000 swans, but they were all gone by 1890 as a result of market and sport hunting. Thus, restoration efforts have had to start from scratch to try to build migratory traditions in a landscape that has been altered tremendously by man.

Donna Compton reported on the population status and winter distribution of the restored IP of Trumpeter Swans in her paper yesterday. Approximately 20 percent of the birds that were alive at the end of 1993 had migrated far enough south to reach locations where naturally occurring food and open water could be expected throughout the winter under normal conditions. This description will be used as a definition for migration for this paper. Swans in the Midwest usually have to go at least to Kansas, Missouri, southern Illinois or southern Indiana to find these conditions during most winters.

There are numerous reasons why more swans are not migrating in the Midwest, but in my estimation, the lack of any organized, widespread effort to manage for Trumpeters in southern areas is the biggest reason why more progress has not been made. Swans that do go south on their own find very little reason to return, if they survive.

A formal management plan with specific details for managing wintering sites has never been approved for the IP. Part of the reason is that a few waterfowl managers and hunters in southern states are concerned that the presence of Trumpeters may jeopardize existing waterfowl seasons or at least make management more difficult. This attitude will only make matters worse in the future, since restoration efforts are continuing to the north (Table 1) and the number of migrating swans will only increase possibly by as much as 10 times if all northern wintering sites are finally closed. Failure to start managing for them now only ensures additional conflicts.

A more significant reason for the lack of progress in developing the management plan is that the states that have released Trumpeters have never reached a consensus on what is needed or how the swans should be managed in the south. The reasons for the lack of consensus will be discussed later in this paper.

Restoration in the Midwest to date has generally focused around federal, state or local agencies independently initiating restoration programs through the release of swans on northern breeding grounds. These groups are finally starting to work together to develop a coordinated program for the IP of Trumpeters. Representatives from Wisconsin, Minnesota, Iowa, USFWS, Hennepin Parks and The Trumpeter Swan Society met in a preliminary planning meeting in September 1993. As a result, a regional meeting was hosted by these organizations in September 1994 in Iowa with the following objectives:

1. to develop a consensus for the management of the Interior Population of Trumpeter Swans

2. to prepare a management plan based on this consensus

3. to begin implementation of a coordinated program to establish a migratory population of Trumpeters.

The group that met in Iowa reached consensus on some topics, but left other items unresolved. Following their recommendation, a committee is being formed now to prepare a management plan for approval by the flyway councils in March of 1996. Current unresolved issues will need to be resolved by this date. Several short term management experiments are underway to evaluate techniques to get more swans to migrate and to increase the number of swans going south even if the locations are only temporary destinations. The results of these experiments may provide guidance in developing the management plan.

The situation in the Midwest is different from the situation confronting the Rocky Mountain Population (RMP) of Trumpeter Swans for at least four major reasons. First, the RMP birds are funneled down to a very limited wintering area in the Tristate Region

while Midwest birds can stay spread out over a 1,000 mile front (Figure 1). Second, there is an abundance of water in the Midwest compared to the Rocky Mountain area and the distance between potential stopping points is much shorter. Third, the most probable route south for the RMP swans is through the Salt Lake Basin of Utah which is open to Tundra Swan hunting and then involves a long jump to California. Most Trumpeters in the Midwest never cross areas that are open to Tundra Swan hunting, so the potential for conflicts is reduced.

These three differences make it appear it should be relatively easy to reestablish a migratory population in the Midwest. Just release the swans in the north and they will find their way south. Unfortunately, the potential for lead poisoning appears to be much greater in the Midwest than in the Rocky Mountain area. Trumpeters cannot differentiate between hazardous marshes with lead and safe marshes. Trumpeters are more likely to ingest lead than most other species of waterfowl. Lead poisoning is the number one cause of mortality in the Midwest. This final difference may more than offset the other three advantages the Midwest appears to have for an unmanaged population.

Everyone recognizes that lead poisoning is a problem. However, how significant it is and how to best manage swans to reduce the impact of lead has not been resolved. In my estimation, the more swans wander from marsh to marsh, the greater the probability of ingesting lead. Managing Trumpeters at "clean" wintering areas is a way to reduce the significance of lead poisoning until lead is totally removed from the environment which could take decades.

I contend that it is best to manage a number of specific sites for Trumpeter Swans and try to concentrate birds at these safe sites which would be scattered across the South. Some of the advantages of concentrating swans include:

- Reduced potential for lead poisoning
- Reduced potential for shooting
- Less interference with other waterfowl seasons
- Increased chances of finding new mates
- Opportunities for public viewing and education

Providing supplemental food, using flightless Trumpeters as decoys and keeping disturbance to a minimum are the primary ways to attract and hold Trumpeters. Of the three, feeding seems to be the most controversial. Disadvantages of concentrating swans include:

- Potential for increased spread of disease
- Possibility of the swans becoming tame which could increase the chances for adverse interactions with people. This is a major concern for captive-reared swans used in restorations.
- It may be difficult to avoid attracting other waterfowl.
- It isn't "natural".

I suggest that the problem of adverse interactions with people is caused almost entirely by the technique used to rear the swans as opposed to their contact with people later in life. Swans that are imprinted on people will always be a problem, while swans raised by other swans will not cause problems no matter how tame they may appear to be. Once again, this is an unresolved issue.

Our increased knowledge of Trumpeter Swan behavior and social interactions can be applied to restoring migratory traditions. Some examples of pertinent information include:

- Trumpeters migrate primarily as family units. It is almost impossible for other swans to join these units and to accompany the family on a migration. (Newly released cygnets will migrate together in fairly large flocks for the first year.)

- Cygnets learn the migration route from their parents. The cygnets go where the adults go, and the adults usually return to the same general area each winter. Newly released swans must establish a migration route by trial and error.

- Survival of adults is better than it is for subadults. One of the primary reasons in the Midwest, besides lack of experience, is that nesting swans usually confine their activities to familiar nesting, staging and wintering sites. They are exposed to fewer dangers. Subadults wander, which increases the chances of lead poisoning, shooting, accidents, etc.

- Subadult swans may not return to the same winter site that they visited as cygnets with their parents. Young swans often join small subadult flocks once they leave their parents. One swan may determine the destination for the group.

- As they mature, the subadult swans often pair with older swans that have established territories and migration patterns which may be different from any route followed previously by the subadult.

These behavioral patterns could make it very difficult to establish a new migration route when the bulk of the swans in a population spend the winter elsewhere. The larger pool of swans may continue to pull the offspring back into the old wintering patterns. We hope that each cygnet retains the knowledge of its first migration (or translocation) and can retrace the original trip if needed. Obviously, this same situation could affect translocation efforts for the RMP.

There are two major wintering concentrations of Trumpeter Swans in the upper Midwest. One is located at Lacreek National Wildlife Refuge which was described by Rolf Kraft. The other is at Monticello, Minnesota, and was described by Donna Compton. The population has grown to 115 swans in only 9 years at Monticello. As Donna said, at first the numbers increased primarily through recruitment of released swans, while it is increasing now due to natural recruitment of cygnets from the swans that winter there.

It cannot be denied that the presence of these two sites has kept swans from migrating south. But how many of these swans would have survived if they had migrated? Survival of swans at Lacreek and Monticello is greater than it is for birds that have tried to migrate under hazardous conditions as they exist today. There are more swans in each respective subpopulation and the programs have progressed faster because of these wintering sites. These sites have contributed immensely to the success of these restoration programs and, in my opinion, should not be abandoned until suitable replacement sites to the south are being used by swans. Ultimately, they should be abandoned in favor of migration to more southern sites.

Restoring "migratory" populations of Trumpeter Swans remains the primary objective for restorations in the Midwest, including Monticello. The following are some of the techniques that have been suggested or are being tried:

1. Currently most swans are migrating at random. Contacts with people are kept to a minimum (no feeding) in Wisconsin and Illinois, while there are no strict guidelines for states further west. Eventually, the swans should find suitable habitat. This technique should be adequate in a pristine environment but will it work in the contaminated environments that exist today? We are monitoring the present migratory movements of IP swans (described by Compton) to see if any patterns emerge.

2. The swans could be forced to leave northern sites by stopping feeding. As mentioned, I consider this to be premature in the Midwest until managers determine how and where they want to manage for Trumpeters in the South.

3. Private citizens are trying to entice swans to return to several southern wintering sites by providing protection from disturbance, using decoys and/or providing supplemental food. All three are being evaluated. It is assumed that swans will return to a site only if they like it. The more that is done to improve a site, the better. Once a tradition has been established, it is hoped the swans will continue to use a site, even if feeding or use of decoys is discontinued.

4. Release of subadult swans at wintering sites has been suggested to supplement populations at places which are already being used by other subadults. It is hoped the released subadults will join with the others and be lead back north. This technique may have potential for RMP swans, especially if a few migrants can be located in California. In the Midwest, the subadults will be newly released swans with no previous exposure with northern breeding grounds, instead of wild-caught swans encountered in the Rockies.

5. Rolf Kraft has suggested propagating swans at wintering sites and letting the offspring fly free. If it is true that migrating patterns evolved by birds expanding their ranges northward, the newly released birds may move this way as well.

While the last two options may have merit and may offer the greatest probability of success, it is doubtful that any of the southern states will be able to make the financial commitment necessary to accomplish them, without outside assistance.

It is the author's opinion that restoration programs would have proceeded more rapidly if greater attention had been given to managing wintering sites. Lead poisoning has diminished temporarily as a threat

over the past 4 years due to extremely high water throughout the Midwest. The return of drier conditions may increase the need for management of wintering sites to protect the swans. Planning taking place today should help ensure that resource managers will be ready to meet this challenge. Greater effort managing for Trumpeters in the south should pay off in more swans nesting in the north.

Table 1. Interior Population of Trumpeter Swans Population Projections.

Location	1994 Estimate	Restoration Objective	Gillette's[1] Projection
Lacreek (Dakotas)	249	500	500
Minnesota (Includes HP)	270	250	500
Wisconsin	130	150 (20 NP)	400
Michigan	98	250 (30 NP)	500
Ontario	35	150 (?)	400
Iowa	0	110 (15 NP)	200
Eastern Sask.	34	NONE	300
Other (IL,IN,OH)	0	NONE	200
Totals	816	1410	3,000

[1] Based on estimates of what the population should be to be self-supporting and what the available summer habitat can support using only the best habitat.

ELK ISLAND NATIONAL PARK TRUMPETER SWAN REINTRODUCTION - 1994

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ABSTRACT

Trumpeter Swan cygnets were relocated from Grande Prairie to Elk Island National Park (EINP) and either released directly to the park or held overwinter for release the following spring. Fledging rate in the park was 100 percent among direct release cygnets and 60 percent among overwintered yearlings. In 1994, 46.6 percent of the 1993 direct release cygnets returned to EINP. During 1991-94, a return rate of 71.4 percent (Camrose yearlings) and 13.0-43.5 percent (direct release cygnets) was observed among the birds relocated to the park. Furthermore, EINP swans have established a new migration route through Oregon to a wintering area in northern California.

INTRODUCTION

The Elk Island National Park Trumpeter Swan Reintroduction Program was established in 1987 to restore the Trumpeter Swan (Cygnus buccinator) as a free flying migratory breeding bird in EINP. The objectives of the program include increasing summering and breeding range of Trumpeter Swans in Alberta by establishing a free-flying, breeding flock of 10 pairs in EINP and diversifying the migration patterns and wintering areas (Kaye and Shandruk 1992). The goals set for 1991-94 include: transplanting cygnets each fall to suitable wetlands in EINP; refining capture, transplant and marking techniques; and refining techniques for increasing cygnet survival rate by overwintering and release the following spring.

METHODS

Grande Prairie breeding and production surveys

Fixed-wing aerial surveys using a Cessna 210 were conducted, in June and September, on approximately 200 lakes in the Grande Prairie area (Figure 1). Survey techniques followed those described in Shandruk and Winkler (1988). The June surveys provided information on nesting pairs and an estimate of the nonbreeding adult population. September surveys which provided production success (number of broods, brood size and total cygnets) also identified the location of prospective swan transplants.

Trumpeter Swan transplant

Capture, relocation and direct release

Trumpeter Swan cygnets were captured during the first half of September, when they were approximately 80-90 days of age. Techniques were similar to those described in Shandruk and Winkler (1988) except that the smaller and more responsive Jet Ranger 206B helicopter, with low skid gear, was used and only one individual conducted the capture. The most efficient ground team consisted of five individuals, each assigned a specific task.

The cygnets were sexed, banded, weighed and the 9th primary measured. Cygnets not chosen for transplant were returned to the adults on the lakes. Those cygnets slated for transplant were also colour-marked, tube-fed an electrolyte solution and given two injections. In 1993 the birds were marked with a red dye (rhodamine-b) (Kozlik *et al.* 1959) on the chest and, in 1994, on the chest and underside of the tail. Each cygnet is tube-fed a 180 mls sugar/electrolyte mixture (Table 1) as prescribed by Dr. F. Marshall of Camrose Veterinary Group. The individual dosage recommended was a result of rehabilitation work with swans in Washington State (Martha Jordan, pers. comm.). Each cygnet received an injection, subcutaneously in the breast muscle, of 1/2 cc of Biocid (Vitamin B complex used to combat stress) and 0.30 mls of Dystosel (used to combat internal worms and parasites). Two birds were placed per dog transport kennel lined with wood shavings.

The birds were released, later that same day, on the appropriate lakes in the park. In 1991, a family group

was relocated to the park with an adult guide bird. In 1992-94, only cygnets were moved in an attempt to foster them to the nonbreeding adults in the park.

Camrose captive overwintering program

A number of cygnets were held each year at a swan facility, operated by City of Camrose Leisure Services Department, Parks Section, over their first winter and released the following spring (referred to as "Camrose yearlings"). Overwintering of a few cygnets was initiated in 1990, repeated in 1991 and expanded in regards to the number of cygnets in 1992. During this period, the cygnets were moved from Grande Prairie directly to the facility. Extremely high mortality in 1992 resulted in a reduction in the number of cygnets held overwinter in 1993-94. In addition, these birds, with the primaries clipped on one wing, were moved from the capture site and released onto a park lake for another month to allow further growth. The flightless young were then recaptured and moved to Camrose by mid-October.

At the swan facility they were provided an assortment of food types during the first 2 weeks which included a dry pellet swan food (developed by a local feed company nutritionist for the Camrose swans) and pellets soaked in water. Beginning in October 1992, lettuce floating in water and an assortment of aquatic plants and tubers from EINP were also provided. During the first few days of captivity, the birds were force fed in order to condition them to the existence of the new food source. The swan diet pellets was their main food source during the winter months. The birds were checked twice daily during the first week of captivity and a video-recorder was used to monitor behaviour and feeding activity. A radio provided background noise in the facility. Once the birds were conditioned to captivity, to the food source and appeared in stable condition, they were provided with a large tub for swimming.

The birds are monitored daily throughout the winter and examined, at least once, by a veterinarian. In late April, when the lakes are ice free in EINP, the captive birds are fitted with a yellow collar with black numeric/numeric/alpha/alpha coding and transferred to the park for release ("AC" in EINP).

Elk Island National Park monitoring

Aerial surveys, using a Cessna 172, were conducted in late May/early June to check for swan return, distribution and possible nesting. Fall surveys were flown in early September, prior to the transplant from Grande Prairie, and early October prior to Tundra Swan arrival. Parks staff conduct ground surveillance of the lakes periodically through spring, summer and fall.

During the moult in July, unmarked flightless swans are captured, using one or two canoes on shallow lakes and a power boat on Astotin Lake. The birds are weighed, sexed, measured (9th primary), banded (if not a recapture) and fitted with a yellow collar.

An active public relations program was implemented by Parks staff and the Friends of Elk Island Park Society to reduce human disturbance on the swans. In 1994, Astotin Lake was closed to boating activity from early September through freezeup to allow the transplanted cygnets and the nonbreeding adults to establish a close bond. Media releases, newspaper articles and interviews were conducted to reach a wider audience.

United States winter observation program

A monitoring program of marked Trumpeter Swans was implemented in conjunction with the winter transplant program in the Tristate Region (Subcommittee on Rocky Mountain Trumpeter Swans 1992). A network of wildlife agency personnel and volunteer observers, in Canada and the United States, reported marked swans to Ruth Shea, transplant project coordinator, who entered the information in a database and forwarded reports to the appropriate agencies. The information on wintering EINP Trumpeter Swans was collected through this mechanism.

RESULTS AND DISCUSSION

Grande Prairie breeding and production surveys

Survey results for the spring and fall (Table 2) show a gradual, yearly increase in the adult population. Poor environmental conditions at the time of hatch, 1991 and 1994, resulted in a high loss of nests and cygnets as is evident by the number of broods observed during the fall surveys. Environmental conditions were favourable for breeding success in 1992 and a record number of cygnets, 211, survived to the fall.

Trumpeter Swan transplant

Direct release to the park

The administration of the sugar/electrolyte solution prior to transport resulted in all birds surviving transport from Grande Prairie. The release of these cygnets the same day as capture ensured a minimal abstinence period from water and food in natural conditions which improved the chances of long term survival. Detailed observations of transplanted swans will be covered under the section Elk Island National Park Monitoring. In 1991, a family group of four cygnets and the male parent (Table 3) were released on Walter Lake (Figure 2). This was the last adult in the transplant program that was moved from Grande Prairie to EINP. Nonbreeding swans normally stage or congregate on specific lakes in the Grande Prairie area during their first couple years of life. The choice of Astotin Lake by the nonbreeding swans in 1992, resulted in the decision to conduct all future releases on Astotin Lake. In 1992, 1993 and 1994, a total of four, 15 and 22 cygnets was released onto Astotin Lake, respectively. In 1994, poor flying conditions delayed the capture at Grande Prairie and resulted in the birds not being released until after dark. The cygnets could not be released near the adults and were observed the following day in two groups.

During the transplant period, 1991-94, there were 45 cygnets, consisting of 17 males and 28 females, released directly into the park. In 1993, more females than males were released because studies (Alison 1977, Cooke *et al.* 1975, Coleman and Minton 1979) have shown females home to natal areas more readily than males. These females, as adults, should attract males on the wintering areas and return with them to EINP.

Camrose overwintering program

This part of the transplant program involved overwintering cygnets for release to EINP the following spring. Mortality on the wintering area, apparently is highest among young of the year, in this case, cygnets. Keeping a few cygnets in captivity and releasing them in the spring should increase the chances of them becoming a viable component of the population. In 1993-94 the yearlings were wing clipped which confined them to Astotin Lake, forced them to become more familiar with their new surroundings and hopefully, created a stronger bond with the area.

During the period 1991-94, there were four yearlings (from the 1990 cygnet capture) and 37 cygnets involved in the Camrose overwintering program (Table 3). In April 1991, four Camrose yearlings were released on Astotin Lake and in July, two adult guide birds were relocated from Grande Prairie to the lake. In September 1991, six cygnets were moved to the facility directly from Grande Prairie. Four survived the winter to be released along with two Camrose reared yearlings in April 1992. In September 1992, 19 cygnets were moved directly from Grande Prairie to captivity and within a week 17 had died. The post-mortem report indicated extreme emaciation as the major cause of death. An additional five cygnets were captured in October and moved into the facility with the two surviving cygnets. Five of these birds died overwinter. The birds were generally in a poor, emaciated condition and had to be force fed through tube-feeding. Other causes of mortality included heart failure, lung congestion (aspergillosis) and a ruptured oesophagus, result of the tubing operation. This extreme level of mortality necessitated a change in our approach to this component of the program. Five cygnets were captured for overwintering in each of the next 2 years.

Two yearlings were released on Astotin Lake in April 1993. In September five cygnets from Grande Prairie were wing clipped, and placed in a large pen on Bailey Lake. The pen enclosed an area of cattails, open water with aquatic vegetation and an old beaver house to be used as a roost site. One bird was found dead in the pen after 10 days of captivity and post-mortem showed the bird to be extremely emaciated. The death of a second bird, two days later, in similar condition prompted the release of the remaining cygnets to Astotin Lake with the other swans. The three cygnets were recaptured on October 10 and moved to Camrose. These three birds survived the winter and were released on Astotin Lake in April 1994.

In September 1994, five cygnets which would be overwintered were released on Astotin Lake with the direct release cygnets. Two birds had sufficient primary growth to be clipped while the remaining three were just starting growth of the primaries. The plans for recapture of the five cygnets was delayed to 12 October to ensure the majority of the direct release cygnets were able to fly. Three of the five cygnets planned for overwintering were able to fly and only one of the wing clipped birds, a female, was located. No evidence of the other clipped swan was located or reported, so it was probably consumed by a predator.

Only one cygnet was overwintered and it will be released in April 1995.

Fifteen yearlings (eight males and seven females), including those from the 1990 capture, were released in EINP during the period 1991-94. Two of the yearlings released in 1992 were from the captive flock in Camrose. Thus, nine of 35 cygnets (25.7 %) survived overwinter to be released as yearlings (two cygnets identified for overwintering and release in 1995 excluded from analysis). The survival rate among the captive birds, 1993-94, improved slightly by changing the procedures but overall the mortality rate among these cygnets remained high.

Elk Island National Park monitoring

The monitoring of the park and surrounding area, by aerial and ground surveys (Table 4) identified which birds returned from the wintering area and which lakes were frequented. The interaction between the returning swans and newly introduced birds was also monitored. In 1991 Yellow (Yw) collared swan 20AC returned, without its mate, to Running Dog Lake. This pair had produced the first cygnets observed in the area in over 100 years (Kaye and Shandruk 1992). Two other swans also returned, one to the park and one to Beaverhill Lake, 15 km east of EINP. Movements of the birds in the area resulted in Yw 20AC and 11AC pairing. The pair has returned each year through 1994 but no breeding activity has been observed.

In 1991, the four Camrose yearlings released on Astotin Lake (Table 3) were observed on the lake through the summer and fall. On 17 September, the four yearlings were observed flying together while guide bird, Yw 40AC was off by itself and, Yw 54AC was not found. It is not known if the guide birds departed Astotin Lake with the four yearlings at freeze-up. The family group on Walter Lake was observed on 16 September and departed the lake later in the fall, exact date unknown.

The release of two Camrose yearlings, in 1992, on each of three separate lakes resulted in limited success. The two males on Goose Lake were lost to predators and the two males on Adamson Lake disappeared. The pair, a male and female, on Astotin Lake survived and were joined for the summer by two collared swans which had been released on Astotin Lake in 1991.

The four cygnets relocated in September 1992 spent the fall separate from the adults. However, as they started to fly and the lake area constricted due to freeze-up, they were forced into a smaller area and in closer contact with the adults. The adults and cygnets departed together when the lake froze completely.

The number of birds which returned to the park increased dramatically in 1993. Seven swans returned to the park area and one to Joseph Lake, about 25 km south of EINP. Trumpeter Swan female, 33AC, returned with an unmarked adult male which was captured, during the moult, on Birch Island Lake (a locally named wetland in EINP, north of Astotin Lake) and fitted with yellow collar, 53AC. A yearling female, one of four cygnets released September 1992, returned to Astotin Lake (25% return rate of direct release cygnets) where it spent the summer with Yw 51AC, a 1993 Camrose yearling. The second yearling, 50AC, was not seen after its release. An adult female swan was captured and fitted with yellow collar, 52AC on a wetland west of Adamson Lake. It was identified as a 1990 cygnet released on Walter Lake. The female was seen periodically on Astotin Lake until mid October 1993. Yw 73AC was observed briefly in April then disappeared until late September when it reappeared on Astotin Lake. Yw 52AC and 73AC have not been observed in the park since October 1993.

The fifteen cygnets released on Astotin Lake in the fall of 1993 were observed in close association with the nonbreeding swans staging on the lake. When the cygnets were capable of flight, a group of ten were observed with 33AC and 53AC on Birch Island Lake. Two cygnets disappeared around the same time as 52AC. A variable number of cygnets were observed with 27AC and 51AC throughout the fall. In early November, all the remaining adults and cygnets departed together.

Six adults and at least seven yearlings returned to EINP in the spring of 1994. The lakes on which adults were observed included Blackfoot Lake, Birch Island Lake and Paul Lake. Two of the 1994 Camrose yearlings, 47AC and 91AC, were observed through the summer and fall on Astotin Lake. The fate of the yearling 93AC is unknown. Seven yearlings were observed on Astotin Lake for a short period of time in May. Following this a group of five were seen briefly on Trappers Lake. This group of five birds was not observed again in 1994. In July, two yearlings were captured and collared on Flyingshot Lake. The two birds, both females, were

fitted with yellow collars, 28AC and 29AC. These two were part of the group of 15 cygnets released the previous fall. If the other five to seven yearlings seen on Astotin Lake and Trappers Lake are also part of this larger group, then there was a return rate to the park, of the 1993 released cygnets, of 50-60 percent. The two birds from Flyingshot Lake staged on Astotin Lake in early September.

The 1994 cygnets, released on Astotin Lake, formed two distinct groups with varied adults throughout the fall. The yearlings 28AC and 29AC were last observed on 10 October on Astotin Lake. Yw 33AC and 53AC were last observed with 10 cygnets on Birch Island Lake on 15 October. Yw 27AC and 51AC moved from Paul Lake to Astotin Lake and were last seen with eight cygnets on 30 October on Astotin Lake. On 2 November Yw 47AC and 91AC accompanied by five cygnets were seen on Astotin Lake. The lake froze completely a few days later and no swans were observed in the area. However, Yellow 47AC was picked up near Wetaskiwin, about 70 km south of the park on 14 December in an emaciated condition and died a day later. The fate of 91AC and the five cygnets is unknown and may only be clarified next spring if they return to the park.

The failure of the two Camrose birds to bond with resident guide birds was further complicated when they adopted a number of cygnets and the group failed to migrate with these guide birds in November 1994. These birds will probably be lost to the population. In previous releases, the four yearlings in 1991 were on Astotin with guide birds from July onwards, in 1992 two Camrose birds were joined for the summer by migrant Trumpeter Swans and in 1993, a single Camrose bird bonded with a migrant swan for the entire season. It was unfortunate that the two Camrose yearlings on Astotin Lake had no contact with other swans until September. This probably resulted in a stronger bond between them than with the other adults later in the fall.

All 45 cygnets (17 male and 28 female) released directly to the park fledged (100%) and migrated south with the nonbreeding adults. In this same period, of the 15 Camrose yearlings released only 9 (6 females and 3 males) fledged (60.0 %) from EINP. The 1994 Camrose yearlings cannot be included in the return rate until 1995. Therefore, five of seven fledged yearlings returned to the park (return rate of 71.4 %) which included three females and two males. The males, 35AC and 73AC, have not shown any fidelity to the park and have not been seen since April and October 1993, respectively. The male 35AC did not return directly to the park and has not been seen since April 1993. Two of the females are still observed in the park. The number of fledged cygnets used for comparative return rates, excluding the 1994 releases, would be 23 including five males and 18 females. Three female yearlings were recaptured in 1993-94 and an additional five to seven unidentified yearlings, possibly 1993 cygnets, also returned in 1994. This represents a return rate of 13.0-43.5 percent among cygnets. In comparison, during 1987-90, four of 32 fledged cygnets (12.5%) returned (Kaye and Shandruk 1992). The rate of return, in 1994, was higher then any previous year. Therefore, as many as nine yearlings could return to the park in 1995 based on the 1994 maximum cygnet return rate of 43.5 percent.

The results also indicate that females show a greater site fidelity then males. A concern at present is that only female 33AC has returned from the wintering area with a male mate. The young age of the females may be a factor. An equal number of male and female cygnets were relocated in 1994. The return of the birds in the spring of 1995 should provide some answers.

United States winter observations

The Trumpeter Swan family groups relocated to EINP, in 1987-91, traditionally migrated with the guide birds to the Tristate Region which is identified as an overcrowded wintering area. The Camrose released birds were the first to pioneer new wintering areas (Table 5) and in January 1993, three collared swans with two unmarked cygnets were observed on Harney Lake in the Malheur National Wildlife Refuge (NWR), Oregon (Figure 1). EINP Trumpeter Swans (73AC & 75AC) may have wandered into Oregon the winter of 1991-92 because we are not certain how the yearlings migrated from the park in 1991. They may have followed the guide bird(s) to the Tristate Region and then wandered through the wintering area, or they may have joined with a flock of Tundra Swans (Cygnus columbianus). Large concentrations of Tundra Swans move through EINP in October and continue on their migration through Oregon to their final destination in the Sacramento Valley in northern California (Bellrose 1976).

One of the unmarked cygnets seen at Malheur NWR in 1993 may be Yw 27AC because this bird, along with 51AC and four cygnets, was observed along the Snake River near King Hill, Idaho, in late November

1993. They were then observed at Nelson, California, in December 1993 and January 1994 in the company of a green collared swan released at Summer Lake Wildlife Area, Oregon. This routing would have taken them over Malheur NWR. They were among a flock of 4,000 Tundra Swans. Yw 27AC and 51AC were observed 2 January 1995, for a second consecutive winter, in northern California (Greg Menz, pers. comm.) which confirms a new wintering area for EINP Trumpeter Swans.

Female 52AC was observed with two yellow tarsal banded cygnets at Harriman State Park, Idaho, through November 1993 which accounts for the two cygnets which disappeared from EINP in October. EINP swans have also been observed at Red Rock Lakes NWR, Montana, Rexburg, Idaho, Teton Basin, Wyoming, and Jackson, Wyoming.

CONCLUSIONS AND RECOMMENDATIONS

Kaye and Shandruk (1992) postulated that the removal of 20-30 cygnets per year from the Grande Prairie flock would have less of an effect on its growth than environmental conditions on the breeding and wintering areas. This was reaffirmed by an increase (84.6%) in the adult population from 1991-94 despite the relocation of 82 cygnets. This increase should have been greater if environmental conditions at hatch had been more favourable in 1991 and 1994.

Most of the Trumpeter Swans, prior to 1993, were released in the south half of EINP in an effort to reduce human disturbance. Apparently suitable lakes were chosen but high predator numbers in the park and high mortality on the wintering area resulted in a low return rate of cygnets during this time. Astotin Lake had the highest survival rate to fledging (81.8%) among the Camrose yearling and cygnets (100%) released in the park. This success prompted two decisions to be made. This lake, the hub of human activity in the park, became the core staging lake in EINP and from here the birds emigrated to lakes of their choosing and with the mate of their choice. The dispersal of swans in the park in 1994 reaffirmed this decision. Furthermore, the success of cygnets bonding to the nonbreeding resident adults on Astotin Lake eliminated the need to relocate Grande Prairie guide birds.

Although the high mortality among Camrose birds was reduced in successive years, the overall rate was still high. The overwinter program had an additional negative point when the 1994 Camrose yearlings failed to migrate with the park swans. The establishment of a new migration route and wintering area coupled with the high fledging and return rate of direct release cygnets has eliminated the need for overwintering swans and therefore this program component will be discontinued.

Human activity around Astotin Lake appeared to have no direct negative effect on the birds. We hope that as the birds become accustomed to human activity they will be less likely to abandon their territory when they begin breeding. A public information program and area closures will be implemented to minimize human disturbance during critical times for Trumpeter Swans in EINP. Closure of areas under the park administration is feasible but closure of other public lands may be more difficult so a progressive information campaign may be the only way of protecting these swans outside the park area.

Over the years several swans return in the spring but disappear until later in the season or simply never return to the park. Further coordinated efforts with other partner agencies throughout Alberta will be required to address this issue.

The techniques to successfully relocate large numbers of cygnets to the park have been refined. The return rate of cygnets has increased dramatically in recent years (46.6% in 1994) but the survival of these cygnets is still strongly related to winter severity and the habitat conditions on the wintering areas. The success of the EINP Trumpeter Swan relocation program will depend on the expansion of the wintering areas through the relocation program implemented by the United States wildlife agencies and through the pioneering of new areas, as is occurring in California and Oregon. The return of numerous, healthy swans (13 in 1994) will eventually show positive results in establishing a breeding population of 10 pairs of Trumpeter Swans in the EINP area.

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Table 1. Tube-feeding mixture for Trumpeter Swan cygnets transported from Grande Prairie to Elk Island National Park.

Component	**Volume**
Dextrose	30 ml
Ionalyte (Electrolyte)	15 ml
Ivomec	1/2 cc
Albendazole	1 cc
Vitamin C	50 mg
Water	Fill to 250ml

Table 2. Survey totals for spring and fall flights of the Grande Prairie Trumpeter Swan flock

Year	Paired Adults		Other Adults		Total Adults		Nests	Cygnets (Broods)	Total Swans	
	Spring	Fall	Spring	Fall	Spring	Fall		Fall	Spring	Fall
1991	138	112	44	57	182	169	49	98 (34)	182	267
1992	146	156	48	92	194	248	55	211 (53)	194	459
1993	134	124	97	141	231	265	43	128 (37)	231	393
1994	154	116	76	196	230	312	46	107 (32)	230	419
Mean	143	127	66.2	121.5	209.2	248.5	48.2	136 (39)	209.2	384.5

Table 3. Summary of cygnets and adults released directly in Elk Island National Park and held overwinter at Camrose and released the following spring.

Year	Date	Age Class	Total Birds	Yellow Collar : Black Code (# # AC)	Release Site	Comments
1991	April	Yearlings	4	07 / 34 / 73 / 75	Astotin Lake	Camrose : overwintering program
	July	Adults	2	54AC / 40AC	Astotin Lake	Grande Prairie - guide birds.
	Sept.	Adult/cyg.	1 / 4	38AC	Walter Lake	Family group from Grande Prairie
	Sept.	Cygnets	6		Camrose	Camrose : overwintering program (four survive for release in 1992)
1992	April	Yearlings	6	33AC / 35AC 36AC / 37AC 34AC*/ 39AC	Astotin Lake Adamson Lake Goose Lake	Camrose : overwintering program **(Two yearlings :** 1991 - Eggs from Grande Prairie incubated by Camrose Mute Swans and cygnets raised by same, release in 1992)
	Sept.	Cygnets	4		Astotin Lake	Released directly on Astotin Lake
	Sept. 9 Oct. 7	Cygnets Cygnets	19 5		Camrose	Camrose : overwintering program (mortality - 17 in first week, 5 overwinter) Major revision of program component.
1993	April	Yearlings	2	50AC / 51AC	Astotin Lake	Camrose : overwintering program
	Sept.	Cygnets	15	71**/ 72/ 74/ 75/ 77/ 78/ 79/ 80/ 81/ 82/ 84	Astotin Lake	Released directly on Astotin Lake ** Yellow tarsal bands . Marked cygnets with all available tarsal bands.
	Sept.	Cygnets	5		Camrose	Wing clipped, held in pen on Bailey Lake (mortality - 2); moved to Astotin Lake; then moved to Camrose
1994	April	Yearlings	3	47 / 91 / 93 AC	Astotin Lake	Camrose : overwintering program 93AC - predation - Astotin Lake? 47AC - dead, south of EINP- Dec/94
	Sept.	Cygnets	22		Astotin Lake	Released directly on Astotin Lake.
		Cygnets	2		Camrose	Wing clipped and released on Astotin Lake (mortality - 1); moved to Camrose

(* Used a duplicate numbered collar, however, the bird died from predation in the park in 1992)

Table 4. Trumpeter Swans observed returning to Elk Island National Park and the surrounding area.

Year	Collar	Age	Sex	Lake Name	Comments
1991	20 AC	4	M	Running Dog	Mate died
	11 AC	2	F	Walter Lake	Paired with 20AC during the summer
	Gr V39	1	F	Beaverhill Lake	Tristate Region winter transplant swan
1992	73 AC 75 AC	2 2	M F	Astotin Lake "	Spent most of summer and fall on Astotin Lake.
	20 AC 11 AC	5 3	M F	Running Dog "	Paired birds, showed no indication of breeding.
1993	33 AC 53 AC	2	F M	Astotin Lake "	33AC returned with adult male to Astotin Lake, captured Male - July/93 on Birch Island Lake - Band # 1939-00312. Staged-fall on Astotin Lake
	73 AC	3	M	Astotin Lake	Observed in April, disappeared for summer and returned to Astotin Lake in late September.
	20 AC 11 AC	6	M F	Running Dog "	Paired birds, no nesting observed this year.
	27 AC	1	F	Astotin Lake	Released on Astotin Lake in Sept. 1992. Band 1939-00278: collared in July/93. Spent summer on Astotin Lake with Yw 51AC.
	52 AC	3	F	Trappers Lake	Band 1939-00236 - 1990 cygnet release-Walter. Staged on Astotin Lake in September
	35AC	2	M	Joseph Lake	Observed once in April. Yellow collar swan observed in area several times, no confirmation.
1994	53 AC 33 AC	Ad. 3	M F	Birch Island Lake "	Observed on lake for second consecutive year. Staged on Astotin Lake in the September.
	51 AC 27 AC	2 2	F F	Paul Lake "	Observed in northern California during winters 1993/94 and 1994/95. Staged on Astotin - Oct.
	20 AC 11 AC	7 5	M F	Blackfoot Lake "	Not observed during the fall, not known when they migrated.
	28 AC 29 AC	1 1	F F	Flying Shot "	Released as cygnets on Astotin in Sept. 1993. Banded July/94:29=1939-00322(81AC) &28-=1939-00317(78AC). Staged on Astotin in September/94.
	Yrlg 1 Yrlg 2 Yrlg 3 Yrlg 4 Yrlg 5	1 1 1 1 1		Astotin Lake " " " "	Seven yearlings seen on Astotin Lake; two moved to Flyingshot Lake and were marked as noted above. Five yearlings seen on **Trapper's Lake,** probably part of this group. These five left the park area and not observed again this year.

Table 5. Observations of Elk Island National Park Trumpeter Swans on the wintering areas in the United States.

Yellow Collar	Date of Observation	Location
11 AC / 20 AC	12/ 16/ 92 11/ 16 - 24 / 93 03/ 11 - 15/ 94	Rexburg,, Idaho Sheridan Res., Idaho Ennis Lake, Montana
20 AC & leg banded adult	12 / 03/ 94	Rexburg, Idaho
33 AC / 35 AC / 73 AC & 2 unmarked cygnets	01/ 14/ 93	Malheur NWR, Oregon
33 AC / 53 AC	11/ 09/ 93 01/ 03/ 94 01/ 18/ 94 03/ 03/ 94	Red Rock Lakes, Montana Harriman S.P., Idaho Teton Basin, Wyoming Ennis Lake, Montana
52 AC / 80 AC(t)* / 81 AC(t)	11/ 3 - 21/ 93	Harriman S.P., Idaho
27 AC / 51 AC / 4cyg	11/ 17 - 26/ 93	King Hill, Idaho
27 AC / 51 AC	12/ 10&13/ 93; 01/ 6&9/ 94 01 / 02 / 95	Nelson, California Ashton, California
74 AC (t)	11/30/93	Bliss, Idaho
82 AC (t)	12/07/93	National Elk Refuge Jackson, Wyoming.
73 AC 73 AC	1/05/92 12/27/93; 01/31/94	Flathead River, Montana Malheur NWR, Oregon

* (t) is a yellow tarsal band with black coding.

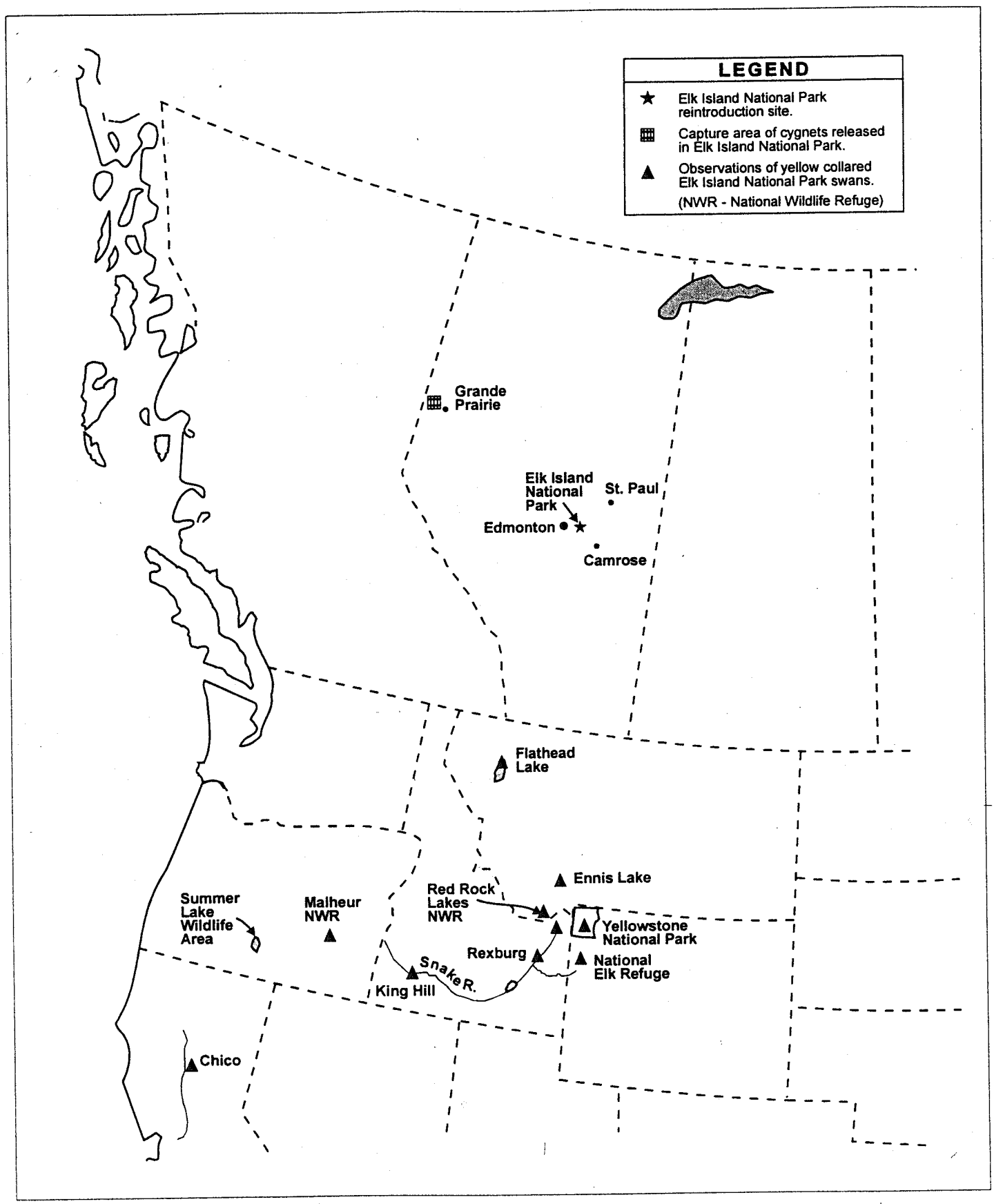

Figure 1. Capture and relocation sites, and winter observations of Elk Island National Park Trumpter Swans.

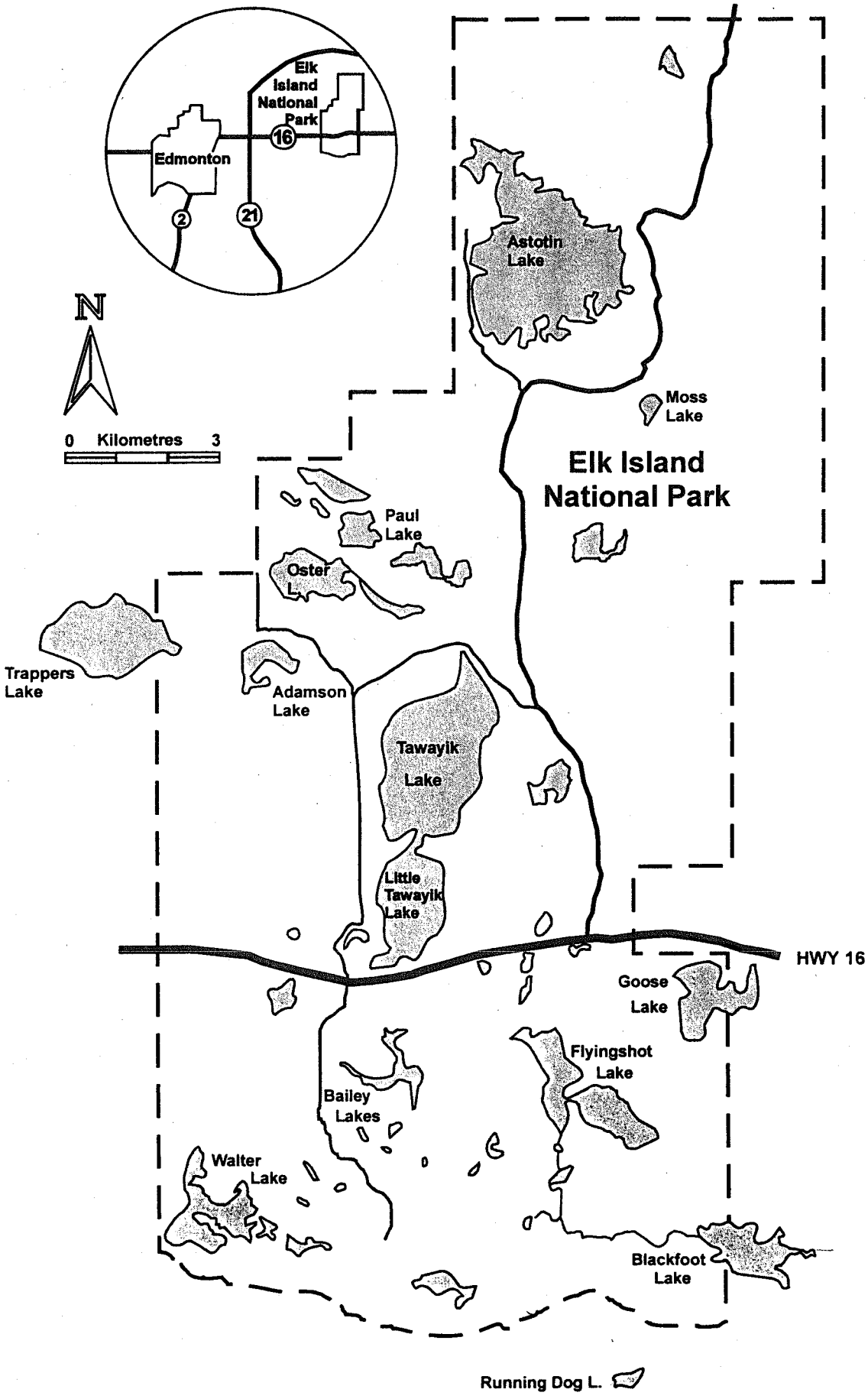

Figure 2. Elk Island National Park

REHABILITATION AND RESEARCH ON TRUMPETER AND TUNDRA SWANS WITH LEAD POISONING IN WASHINGTON'S SKAGIT VALLEY AREA

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INTRODUCTION

Lead poisoning in Trumpeter and Tundra Swans continues to be a problem, despite the fact there has been a ban on lead shot in northwestern Washington since 1986. Based on the swans that we have received at our rehabilitation center in the past 6 years, there has been a consistently greater number of lead poisoned swans than any other mortality. In the 1994-95 season, we have seen five juvenile swans (3 Trumpeter, 2 Tundra) out of 11 with lead poisoning. One Tundra had approximately 110 large lead pellets in the gizzard.

The purpose of this paper is to summarize the following: The signs of lead ingestion in swans; diagnostic tools used to detect lead shot treatment options in swans with lead poisoning; prognosis of swans with lead poisoning; and possible secondary problems associated with blood lead levels in swans.

SIGNS OF LEAD INGESTION

The clinical signs of lead ingestion in a swan may include the following: weakness (i.e. a "down" swan), regurgitation of stomach contents, (which may be green to brown in color), green feces (or green staining of the vent area), and pale mucous membranes (i.e. pale oral tissue). However, swans may fail to show any of the above clinical signs and still have detectable blood lead levels that are considered toxic. Seven out of 49 swans collected in the last 3 years have had detectable blood lead levels without showing overt clinical signs.

DIAGNOSTIC TOOLS

Diagnostic tools used to detect ingested lead pellets included the following: radiographs (x-rays); blood lead levels (>.4 parts per million (ppm) lead levels are considered to be toxic), and complete blood counts (CBC's) to detect secondary problems, such as infection.

TREATMENT OPTIONS

Treating a swan that has detectable blood lead levels can be tedious, expensive, stressful for the swan, and physically demanding for the rehabilitator. Realistically, one swan may need 2-3 months worth of treatments (6 to 8 treatments) to reduce blood lead levels back to normal.

Chelation with Calcium (Ca)EDTA (trade name Versonate) can be used to bind lead in the blood and excrete it through the kidneys. This treatment option is both expensive and time consuming. CaEDTA is administered twice daily, (intermuscular and undiluted, Dr. Kraft, Sno-Wood Veterinary Hospital,pers. comm.) for 5 days if blood lead levels are > 1. ppm, then wait 1 week and repeat twice daily for 3 days. This is one of a few different treatment options using CaEDTA. This option is less traumatic to the swan compared to surgical removal of pellets or gastric lavage. Chelation should be used as a follow up to failed attempts of gastric lavage or surgical removal to pull any residual lead from the blood. The residual lead in the blood does not leave the blood on its own.

Tube feedings are an important mechanism for supporting the swans when chelating or administering antibiotics. Peanut butter may possibly adhere to the lead pellets allowing them to pass, and therefore is an important part of the tube feeding regimen (Appendix A).

Surgical removal of ingested pellets can also be expensive, time consuming, and frustrating. Gastric peristalsis constantly propels the pellets and stomach contents (ranging from copious green vegetation to 1-2 tablespoons of various kinds of grit). This makes detection and location of pellets nearly impossible. X-rays have been useful to locate pellets during surgery. The three surgeries that have been performed during the last 2 years failed to completely remove all of the pellets. Chelation still has to be used until the pellets have been digested and the blood lead level comes back "below the detection limit".

Gastric lavage has been used as a method to remove pellets from the gizzard with very little success. Once again, chelation will still have to be used until the pellets have been digested and the blood lead level returns to "below the detection limit". In one case last year, a swan's crop had become paralyzed from lead poisoning. Because the swan continued to eat and drink, the crop became impacted with vegetation, which backed up the neck 10 inches. Therefore, we were unable to pass any pellets out of the crop or gizzard by gastric lavage.

NOTES ON TWO DOCUMENTED CASES OF LEAD POISONING

1. "Princess" a 2-3-year-old female Trumpeter Swan (Weight: 20 lbs).

12-30-93: The swan had been on a reservoir 4-5 days, and was too weak to fly out with the flock. The swan was retrieved using aggressive rescue attempts with a motorboat. X-rays revealed approximately 18 lead pellets in the gizzard; the crop was free of pellets. One steel pellet was found in lower body. Dr. Kraft was contacted, and surgery to remove the pellets was scheduled for 1-3-94.

1-3-94: The swan was regurgitating, weak with labored breathing. Auscultation before surgery revealed a heart murmur. (Possible enlarged heart from lead or immunocompromised from lead, allowing Microfilariae to invade the heart region.) Dr. Kraft performed surgery to suction out the pellets, and removed all but six small pellets. Versonate (CaEDTA), was administered for 5 days and Baytril (antibiotic) for 10 days. Blood lead levels were 3.8 ppm after surgery. Tube feedings 240ml, four times a day, with two tablespoons of peanut butter per quart of mixture.

1-10-94: Excellent response to surgery. Swan strong and alert. WBC 28,000; HCT 34; T.P. 4.2. Blood lead level 2.4ppm. X-rayed: Six pellets still present.

1-16-94: Dr. DeMaris borrowed Dr. Woods endoscope to look for pellets in gizzard, unable to locate or identify. He located the surgery site; it appeared to be healing normally with mucous present.

1-17-94: Blood lead level 1.7 ppm.

1-25-94: #2 dose of Versonate was administered: 1.8mls twice a day for 5 days. Baytril was used 1.8mls twice a day for 7 days.

1-31-94: To Dr. Kraft for x-ray and check up. Six pellets still present.

2-1-94: Blood lead level 1.1 ppm.

2-4-94: A swelling the size of a softball was detected in the epiglottal area. Dr. Kraft suggested that Amikacin should be used instead of Baytril. (.04 per 18 lbs, twice a day for 7 days). I am not familiar with its use in wildlife. Note: The swelling was later linked to lead encephalopathy and cerebral edema, which occurs in human children in whom it may be incipient and thus overlooked.

2-7-94: The swan showing signs of toxicity. (Central nervous system signs, uncoordinated, difficulty in standing). Dr. Kraft suggested #3 treatment dose of Versonate.

2-8-94: The swan DIED. Necropsy findings: Gizzard atrophied (small). Suspected high lead level in the gizzard from pellets at the time of surgery, causing inability to heal after surgery. It is possible swan was not able to digest food and became toxic. The kidneys appeared normal.

2. "Lucky" 2-3-year-old female Trumpeter Swan (Weight: 18 lbs).

1-8-94: Swan had been at Similk Bay Golf Course area for 4 days. Aggressive rescue with motorboat in Similk Bay. X-rays revealed the swan had been shot in the body and had approximately 17 lead pellets in the gizzard. CBC: WBC 20,800; HCT 23; T.P. 4.4. Blood lead level 1.7 ppm. Started chelation and antibiotics, fluids and tube feedings.

1-10-94: The swan was very weak, possibly from blood loss and lead poisoning. Dr. Kraft performed surgery to remove lead pellets. We assisted with a large tube in the esophagus flushing sterile water down to the gizzard to prevent the pellets from traveling upward. Dr. Kraft removed all but six pellets. He frequently used x-rays during surgery to locate the pellets in the stomach. The swan was weak after surgery. Mucus was found in the trachea, possibly due to irritation. (Later revealed a steel pellet under the tongue.) Versonate was used 1.5 ml twice a day for 5 days. Baytril was administered 1.8 ml twice a day for 10 days. Ancobon 500 mg twice a day for 10 days (as a preventative to aspergillosis).

1-16-94: X-rayed for post-op lead check; six pellets still present in gizzard.

1-17-94: Blood lead levels 0.80 ppm.

1-18-94: Rechecked HCT 28; should be higher.

1-20-94: To Dr. Kraft for recheck, HCT 35; WBC 27,700; T.P. 3.4.

1-26-94: To Dr. Kraft's for x-ray of head; revealed 1 pellet lodged under the tongue, with slight paralysis of the epiglottal area. Swelling around the head area (softball size). Note: The swelling was later linked to lead encephalopathy and cerebral edema, which occurs in human children in whom it may be incipient and thus overlooked.

1-28-94: Started Amikacin .4ml twice a day for 7 days. The swelling was gone in 24 hours.

2-7-94: Post-op recheck x-ray for lead; six pellets still present in gizzard.

2-14-94: WBC 8,000; HCT 39; T.P. 4.9

2-21-94: Dr. Rey x-rayed swan, which appeared to have a small egg or abscess at vent area.

2-24-94: To Dr. Kraft's for x-rays and recheck; egg or abscess gone. The lungs and air sacs are okay.

2-25-94: #2 Versonate treatment was administered at 1.5 ml twice a day for 3 days with Baytril at 1.5 ml twice a day for 3 days. The swan weighed 14 lbs, was not eating and had difficulty digesting food. Tube feeding started during this treatment.

2-28-94: The swan was placed with another swan in a large flight cage which had pool and wet food.

3-7-94: #3 Versonate treatment was administered at 1.5 ml twice a day for 3 days with Baytril used at 1.5 ml twice a day for 7 days. Tube feeding was started during this treatment. Wt. 13 lbs. WBC 20,200; HCT 35; T.P. 3.0.

3-14-94: Put out to flight cage with other swan.

3-21-94: To Dr. Kraft's for x-ray; NO LEAD PRESENT. A complete blood panel was run at Phoenix Lab, which came back NORMAL.
Wt. 14.5 lbs.

3-22-94: Blood lead level 0.70 ppm.

3-29-94: Dr. Kraft recommended #4 Versonate treatment at 1.5 ml, twice a day for 3 days with Baytril at the same dose as a final treatment.

After this treatment, there was a noticeable improvement in eating habits and a gradual improvement in digestion. Note: S. Murphy's personal opinion: this swan is not a normal bird. Body behavior indicates that this swan's metabolism is slower and not as alert as the other swan that is in same cage. All physical health indicators (blood, fecal and x-rays) indicate a normal, healthy swan. My suggestion would be not to let this swan go back into the wild, as the doctors and S. Murphy do not know the long term affects of lead poisoning.

8-24-94: WBC 16,800; HCT 44; T.P. 4.1 with in the range of normal.

9-8-94: "Lucky" shipped to Swan Research Studies, Airlie, Virginia. January 1995: Lucky doing well.

SWAN MORTALITIES 1993 - 94

The following are combined reports from the Washington Department of Fish & Wildlife, Washington State University (WSU) Parasitology Lab and Pilchuck Valley Wildlife Rehabilitation Center. (Mike & Sue Murphy assisted with and documented by video the necropsies done at WSU.)

1. Trumpeter - adult female (Wt. 7.7 Kg/17 lbs)
LEAD POISONING

1-18-94: Swan picked up from Beaver Lake, Clear Lake, Washington. X-rayed by Dr. Rey: Apparent lead poisoning. Impacted gizzard with multiple lead pellets. Swan regurgitating, green mouth, tongue and vent. Crop clear, neck ridged. Euthanized by Dr. Rey.
NECROPSY FINDINGS: Lead shot in gizzard.
LIVER LEAD ANALYSIS: 20.00 ppm.

2. Trumpeter - adult male (Wt. 9.5 Kg/21 lbs)
LEAD/SHOT

1-23-94: Swan picked up from Judy Reservoir, Clear Lake, Washington. X-rayed by Dr. Rey: Apparent lead poisoning with 17 lead pellets. 2 steel shot into body. Appears to have an enlarged heart. Impacted and distended intestines. Euthanized by Dr. Rey.
NECROPSY FINDINGS: Normal
LIVER LEAD ANALYSIS; 18.00 ppm

3. Trumpeter - adult male (Wt. 8.8 Kg/19.4 lbs)
LEAD

1-30-94: Swan picked up from Barney Slough, Mt. Vernon, Washington. X-rayed by Dr. Rey: Apparent lead poisoning with 24 lead pellets in gizzard. Euthanized by Dr. Rey.
NECROPSY FINDINGS: Normal. Found 8 round steel fishing beads in gizzard in addition to lead shot.
LIVER LEAD ANALYSIS: 12.00 ppm.

4. Trumpeter - adult male (Wt.8.0Kg/17.7lbs)
LEAD/SHOT

1-30-94: Swan picked up from Barney Slough, Mt. Vernon, Washington. X-rayed by Dr. Rey. Apparent lead poisoning with 40 lead pellets in gizzard. Green fecal, edema lower mandible.
1-31-94: Dr. Kraft tried gastric lavage which was unsuccessful; x-ray revealed still 40 pellets in gizzard. Euthanized by Dr. Kraft.
NECROPSY FINDINGS: Impacted proventriculus. Impacted 10 inches up the neck from the crop with vegetation.
LIVER LEAD ANALYSIS: 11.00 ppm

5. Trumpeter - adult female (Wt. 7.6 Kg/16.8 lbs)
LEAD/SHOT

12-30-93: Swan picked up from Judy Reservoir, Mt. Vernon, Washington. X-rayed by Dr. Rey. Apparent lead poisoning with approximately 18 lead pellets in gizzard. Regurgitating, weak, labored breathing. Check before surgery revealed heart murmur, possible enlarged heart from the lead poisoning? #1 of 2 of the documented cases.
NECROPSY FINDINGS: Gizzard atrophied (small). One steel fishing bead in gizzard. Was shot with steel into the body.
LIVER LEAD ANALYSIS: Upon receiving, 3.8 ppm. At death, from chelation, 1.00 ppm.

6. Tundra - adult male (Wt. 6.6 Kg/14.6 lbs)
LEAD/BROKEN WING from possible powerline injury.

12-6-93: Swan picked up at Edison area Slough, Bow, Washington. X-rays revealed no lead, clear crop and gizzard. Compound fracture right humerus in three places. Blood count < 50 percent of normal. Dr. DeMaris euthanized.
NECROPSY FINDINGS: Some hemorrhage in chest cavity (consistent with powerline injuries).
LIVER LEAD ANALYSIS: 1.20 ppm

QUESTION: Did the swan hit the powerlines because of lead poisoning? Again, no visible signs of lead poisoning on the x-rays.

7. Trumpeter - adult male (Wt. 6.6 Kg/ 14.6 lbs)
LEAD

12-12-93: Swan picked up from Beaver Lake, Clear Lake, Washington. X-rayed by Dr. Rey. Apparent lead poisoning. Fishing gear, wire, spoon, lead sinkers in gizzard. Swan very weak, sick. Euthanized by Dr. Rey.
NECROPSY FINDINGS: Fishing spoon & wire, one brass bead & brass swivel end, two narrow pieces of lead sinker (1/4" & 1/2" long) in gizzard.
LIVER LEAD ANALYSIS: 30.00 ppm.

8. Trumpeter - adult female (Wt. 7.5 Kg/16.6 lbs)
LEAD

1-5-94: Swan picked up from Similk Beach, Anacortes, Washington. Dead on Arrival (DOA).
NECROPSY FINDINGS: Normal
LIVER LEAD ANALYSIS: 24.00 ppm.

9. Trumpeter - adult female (Wt. 8.3 Kg/18.3 lbs)
LEAD

1-25-94: Swan picked up from Barney Slough, Mt. Vernon, Washington. D.O.A.
NECROPSY FINDINGS: Severe Aspergillosis.
LIVER LEAD ANALYSIS: 4.00 ppm.

10. Trumpeter - juvenile male (Wt. 6.6 Kg/14.6 lbs)
LEAD/SHOT

1-30-94: Swan picked up from Barney Slough, Mt. Vernon, Washington. X-rayed by Dr. Rey. Apparent lead poisoning from multiple pellets in gizzard. Large amount of thick white mucus from mouth, pale mouth and tongue. Appears to have been shot into the gizzard too, causing peritonitis (confirmed at necropsy). Euthanized by Dr. Rey.
NECROPSY FINDINGS: Normal. Dr. Foreyt confirmed peritonitis, shot into proventriculus.
LIVER LEAD ANALYSIS: 18.00 ppm.

11. Trumpeter - juvenile male (Wt. 6.2 Kg/13.7 lbs)
LEAD

3-6-94: Swan picked up on the Skagit River. DOA.
NECROPSY FINDINGS: Normal
LIVER LEAD ANALYSIS: 12.00 ppm

12. Trumpeter - adult male (Wt. 8.9 Kg/ 19.7 lbs)
LEAD

2-11-94: Swan picked up from Beaver Lake, Clear Lake, Washington. DOA.
NECROPSY FINDINGS: Normal.
LIVER LEAD ANALYSIS: 16.00 ppm

13. Tundra - adult male (Wt. 5.2 Kg/11.5 lbs)
LEAD

3-10-94: Picked up Sunset & Chuckanut Dr., Bow, Washington. DOA.
NECROPSY FINDINGS: Severe Aspergillosis.
LIVER LEAD ANALYSIS: 0.48 ppm

14. Trumpeter - juvenile male (Wt. 8.4 Kg/18.6 lbs)
LEAD/SHOT

12-12-92 - 6-14-93: Swan picked up on Wylie Rd., Conway, Washington. X-rayed by Dr. DeMaris. Shot into left wing, fractured. Unable to be released; permission from Dept. of Fish & Wildlife to keep for other wild swans. Illegally shot on S. Murphy's place 6/93.
NECROPSY FINDINGS: Aspergillosis, walled off and subsequently died off in two air sacs.
New severe aspergillosis out break in another air sac that was penetrated as a result of being shot.
LIVER LEAD ANALYSIS: 0.30 ppm. Upon receiving, no visible signs of lead in crop or gizzard!

15. Tundra - juvenile male (Wt. 5.1 Kg/ 11.3 lbs)
LEAD

11-3-93: Swan picked up at Kayak Estates, Marysville, Washington. DOA.
NECROPSY FINDINGS: Normal
LIVER LEAD ANALYSIS: 0.53 ppm

16. Tundra - adult female (Wt. 5.6 Kg/12.4 lbs)
LEAD

12-20-93: Swan picked up at Judy Reservoir, Clear Lake, Washington. DOA.
NECROPSY FINDINGS: Normal .
LIVER LEAD ANALYSIS: 0.30 ppm

17. Trumpeter - juvenile male (Wt. 7.0 Kg/ 15.5 lbs)
ASPERGILLOSIS

2-12-94: Swan picked up at Judy Reservoir, Clear Lake, Washington. DOA.
NECROPSY FINDINGS: Normal.
LIVER LEAD ANALYSIS: Below detection limit.

1994-95: SWANS RECEIVED AT PILCHUCK VALLEY WILDLIFE REHABILITATION CENTER

1. Trumpeter - adult female (Wt. 18 lbs)
LEAD

11-10-94: Swan received from Rod King, USFWS, Fairbanks, Alaska. Nerve damage, elbow area of the right wing. Unable to fly. X-rayed by Dr. DeMaris. Clear crop and gizzard. Blood panel: Normal. Fecal: Clear
BLOOD LEAD LEVELS by WSU: 0.26 ppm.

2. Tundra - adult
SHOT

11-26-94: Swan picked up at Judy Reservoir, Mt. Vernon. DOA. X-rayed by Dr. DeMaris. Apparent shot into body.
BLOOD LEAD LEVELS: Unknown at this time.

3. Tundra - juvenile (Wt. 9 lbs)
LEAD/SHOT

11-13-94: Swan picked up from Game Range, Conway, Washington. X-rayed by Dr. Rey. Apparently illegally shot into body, resulting in fractured radius and ulna of the right wing. Also, shot into the gizzard. (Antibiotics within 12 hours of being shot, prevented peritonitis.) Clear crop and gizzard. Fecal: excessive Heterakis. Blood panel: Normal.
BLOOD LEAD LEVELS by WSU: 0.07 ppm.

4. Trumpeter - adult female (Wt. 22 lbs)
LEAD/POWERLINE

11-30-94: Swan picked up from Mike Davison, from Bayview - Edison, Bow, Washington. Laceration of the left wing web area, exposing tendon. Dislocation of the left elbow. X-rayed by Dr. DeMaris. Crop and gizzard clear. Fecal: Clear. Blood panel: Normal
BLOOD LEAD LEVELS by WSU: 0.09 ppm.

5. Trumpeter - adult male (Wt. 23 lbs)
LEAD/SHOT

12-6-94: Swan picked up from Bayview - Edison, Bow, Washington. X-rayed by Drs. DeMaris & Rey. Three steel shot pellets into right wing. Open spiral fracture of the right humerus, extremely necrotic and

approximately 5-7 days old. One lead pellet in gizzard. Massive body edema, infection.
12-9-94: Surgical removal of the wing at the shoulder joint.
Blood panel: PCV 42; WBC 15,700; HCT 5.3.
Fecal: Coccidia, Heterakis, Gapeworm.
BLOOD LEAD LEVELS by WSU: 0.80 ppm.

6. Trumpeter - adult (Wt. 13 lbs)
LEAD

12-6-94: Swan picked up at Judy Reservoir, Mt. Vernon. On Reservoir for about a week. Too weak to fly with the flock. Rescued by motorboat. Appears to have advanced stages of lead poisoning, regurgitating green, green mouth and tongue. Euthanized by Dr. Williams, Mt. Vernon.

7. Tundra - juvenile (Wt. 13 lbs)
LEAD

12-18-94: Found out in the bay off of Fir Island, Conway, Washington. 12-19-94: X-rayed by Dr. Rey. Approximately 110 partially digested lead pellets. Regurgitating. Euthanized by Dr. Rey.

8. Trumpeter - juvenile (Wt. 15.2 lbs) **LEAD**

1-8-94: Picked up from Wolf Hollow, Friday Harbor, San Juan Islands, Washington.
1-9-94: X-rayed by Dr. DeMaris. Fishing gear perforated gizzard and intestines. Swan unable to stand, severe dehydration, fetid odor from mouth and vent. Euthanized by Dr. DeMaris.
BLOOD LEAD LEVELS: Unknown.

9. Trumpeter - juvenile (Wt. 15.4 lbs)
LEAD

1-14-95: Swan picked up from Milltown Rd., Conway, Washington. X-rayed by Dr. DeMaris. 24 lead pellets in the gizzard. Swan unable to stand, atrophied thigh muscles. Dr. DeMaris performed surgery to suction lead pellets out of the gizzard. X-rays were used to locate the pellets. Gastric peristalsis constantly propels the pellets and stomach contents, (ranging from copious green vegetation to 1-2 tablespoons of various kinds of grit) up the esophagus and down into the intestines. This makes detection and location of remaining pellets nearly impossible. Twelve pellets removed. Euthanized after surgery by Dr. DeMaris.

10. Trumpeter adult (Wt. 15.8 lbs)
LEAD/FISHING GEAR

1-29-95: Swan picked up by Wolf Hollow from Cascade Lake, Orcus Island. Appears to be a 2- year-old: gray in white feathers with orange/black feet. Had been down on Cascade Lake about 2 weeks. Swan very weak, rescue easy.
X-rayed by Dr. DeMaris. Appears to have fishing gear throughout gizzard and intestines. Euthanized by Dr. DeMaris.

11. Trumpeter - juvenile (Wt. 14.1 lbs)
LEAD

1-30-95: Swan picked up on Skagit City Rd, Mt. Vernon, Washington. X-rayed by Dr. DeMaris. The swan appears to have 50 to 60 partially digested lead pellets in the gizzard. The proventriculus and gizzard are distended. The right wing is drooping on the ground, no evidence of a broken wing or of being shot. Still standing and walking, but very weak. Euthanized by Dr. DeMaris.

CONCLUSION

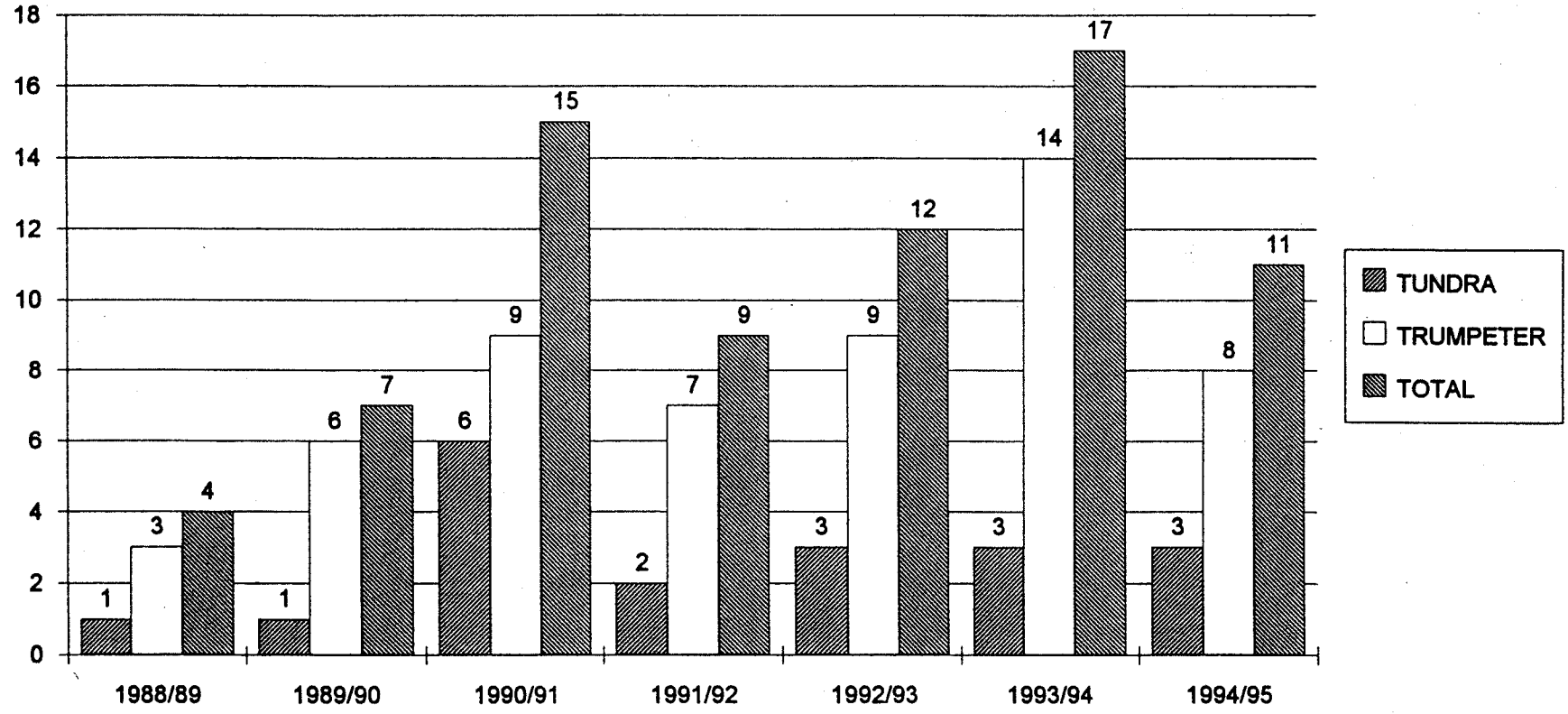
Lead poisoning in the Trumpeter and Tundra Swans is still a large concern in the Skagit Valley area. The result of our findings indicate the following: Low levels of lead may indeed predispose swans to aspergillosis, which is a condition that is extremely fatal in swans and other migratory waterfowl. It is also possible that it may take time for juvenile swans with heavy fledgling weights to succumb to the effects of lead poisoning. These swans may be ingesting lead in Canada, and then are migrating to the Skagit Valley before showing signs of lead toxicity.

Our findings have also shown that some swans with shot wounds and powerline injuries have low levels of lead poisoning. Could these low levels of lead have such a profound affect on the swans that they lose the ability to avoid powerlines and human contact?

In order to improve the situation for the swans, and other migratory waterfowl, we need better law enforcement with regard to steel shot being used instead of lead shot. We also need to locate where these birds are picking up lead shot, and devise plans to keep the swans and other migratory waterfowl away from these areas (e.g. possibly rerouting feeding grounds.). The problem may be more expansive than we think. Are swan mortalities from lead poisoning

as numerous in Canada and Alaska as they are here in the Skagit Valley area?

SWAN TOTALS

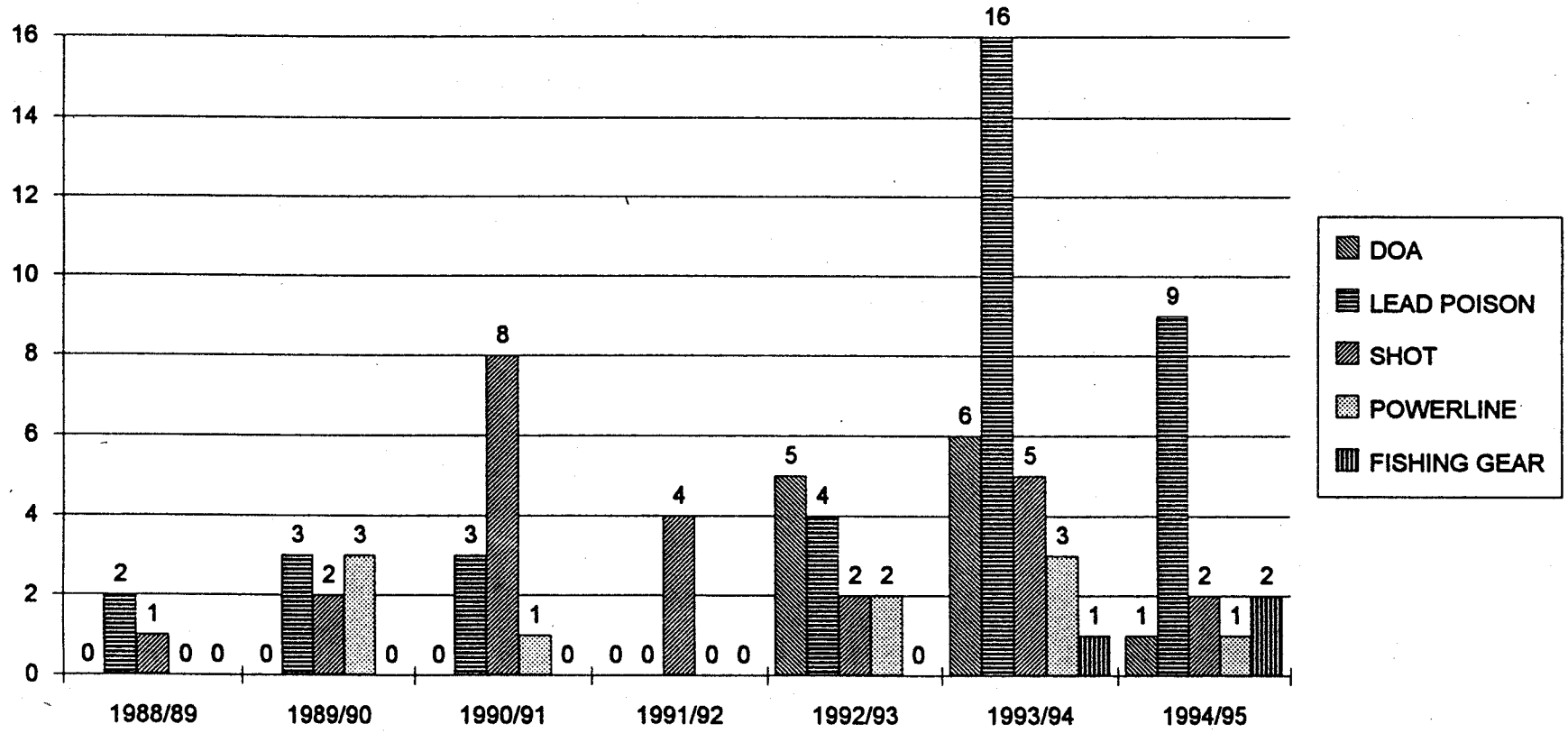


as of Jan 1995

Pilchuck Valley Wildlife Rehabilitation Center

Sue Murphy, Wildlife Technician

CAPTURE DATA

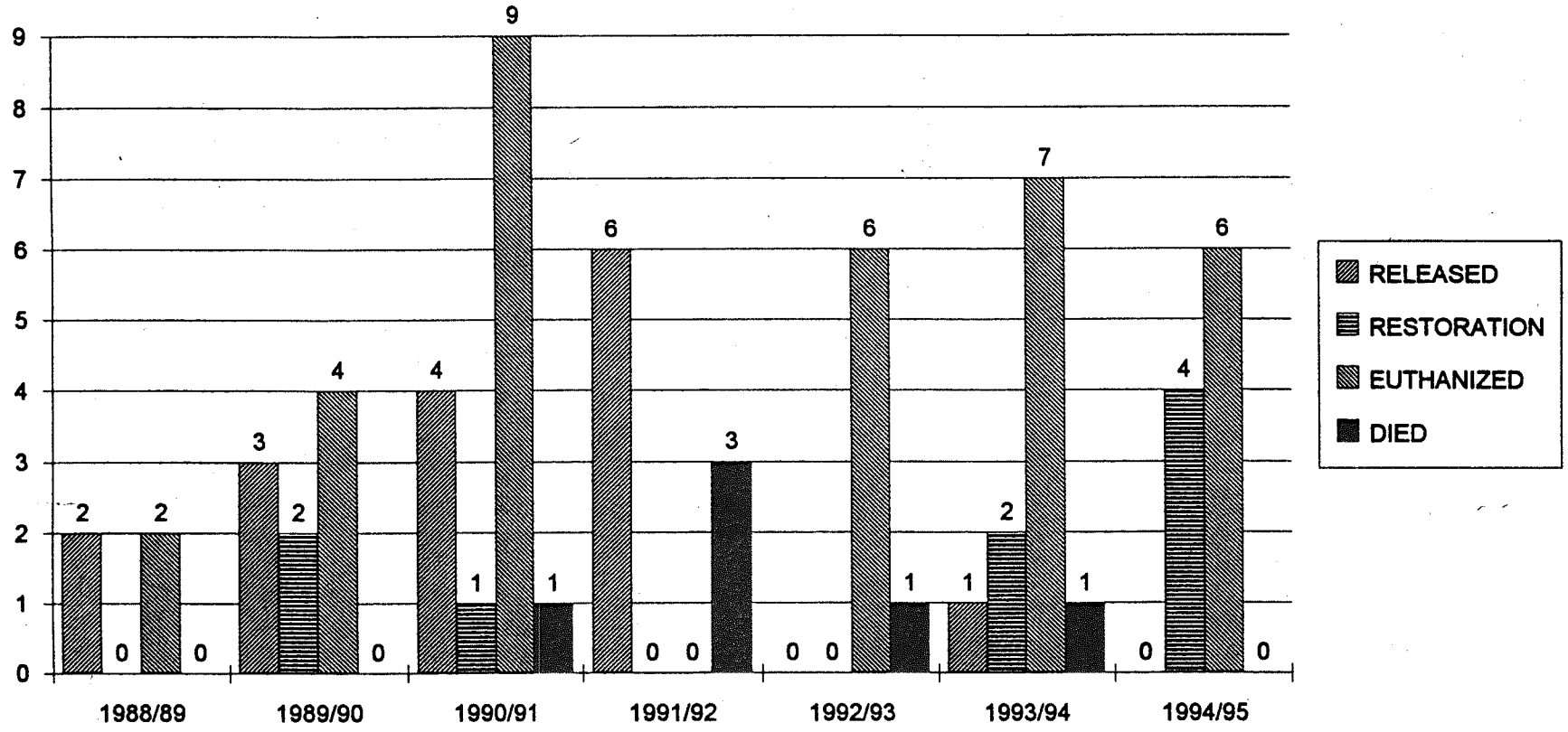


as of Jan 1995

Pilchuck Valley Wildlife Rehabilitation Center

Sue Murphy, Wildlife Technician

FINAL DISPOSITION



as of Jan 1995

Pilchuck Valley Wildlife Rehabilitation Center

Sue Murphy, Wildlife Technician

Appendix A. Trumpeter and Tundra Swan Rehabilitation Notes

UPON RECEIVING

Try to get background information, where swan was found, why? This may help with diagnosis and targeting problems. Have everything ready for treatment, including tube feeding mixture to minimize the stress of handling.

Suggested items: Immobilization bandages (vet rap), tape, fluids, antibiotics, Nolvasan diluted in spray bottle works well for wound cleaning; diluted nolvasan works well in syringe for wound flushing. Blood tubes for CBC and lead levels. Container for feces parasite check. Carbaryl (5.%) dusting powder for external parasites. Stethoscope for heart, lungs, air sacs and trachea. Vitamin and iron injections.

Once stabilized, proper veterinary care is essential for X-rays, lab work and surgeries. If surgery is necessary the swan should be anesthetized with isoflurane. The swans are unique in both veterinary and rehabilitation care.

PHYSICAL EXAM

Observe the behavior and attitude (this will come easier with experience). The posture can indicate ruptured air sacs, concussion, neurological abnormalities from lead poisoning and certain injuries.

Body weight averages:

TRUMPETER: Males 21-30 lbs; Females 20-25lbs.
TUNDRA: Males 12-18 lbs; Females 10-18 lbs.

Examine for external trauma: broken bones, bruises, lacerations, puncture wounds and swelling. Feet should be examined for signs of bumblefoot or injuries. Check for external parasites and dust once, then if necessary, a week later.

The keel (breast bone) is a subjective assessment of the weight of the swan. The thigh muscle will also give an idea of how long the swan has been down, because of decreased muscle mass. The mouth should be examined for evidence of bacterial or fungal growths or lesions on the roof of the mouth or by the tongue, and for other abnormalities, such as a foul odor (lead poisoning, infection), or brown or green discoloration (possible regurgitation). The tongue and mouth can be an indicator of degree of shock and or anemia.

The stethoscope will detect any gurgling or raspy sounds in the lungs or trachea. (Note: If a swan is dehydrated due to infection, blood loss or power line burns, there will be raspy sounds or a mucus wad in throat that will cause frequent swallowing.)

The check for hydration is the pinch test, using skin on top of the foot or on the hock joint. If skin remains pinched or tented for greater than 2 seconds, the swan is dehydrated. Skin on feet and leg will appear gray, dry and wrinkled. Recommend Lactated Ringers intravenous (IV), with 20 gauge needle at 100-200 ml, using the medial metatarsal vein below the hock joint. Swans are relatively docile when wrapped in a towel or sheet, around wings and body, with legs extended back enabling one or two persons to give IV's or take blood.

HEMATOLOGY

Using the medial metatarsal vein, obtain 3 to 4 ml's of blood for a complete blood count (CBC) and blood lead analysis. Most veterinary hospitals can run a CBC and a WBC. This includes a packed cell volume (PCV normals are 40-45), white blood count (WBC normals are 10,000-20,000 with less than 15,000 the best.), and blood parasites.

Recommend Ivormectin for blood parasites at .10ml per pound, once.

Blood lead analysis; heparin should be used as the anticoagulant and sample should be submitted to state diagnostic laboratories, human health department labs or vet toxicology lab. Values greater than 0.5 ppm are considered toxic.

Aspergillosis ELISA's (Enzyme Linked Immunosorbant Assy), may be run to help diagnose aspergillosis, a serious respiratory fungal disease. The Raptor Center, University of Minnesota, St. Paul, Minnesota, 55108, is the only facility currently running aspergillosis ELISA's (1 ml blood).

Reference: Degernes, L. A. and P. T. Redig. 1990. Diagnosis and Treatment of Aspergillosis in Trumpeter Swans. Pages 159-161 in D. Compton, ed. Proc. and Papers of the Eleventh Trumpeter Swan

Society Conf., The Trumpeter Swan Society, Maple Plain, MN.

RADIOGRAPHS

Once stabilized, x-rays of entire body will reveal fractures, shot pellets, lead in crop or gizzard area. It is hard to differentiate between lead and steel in the body. However, sometimes lead changes shape when it hits the body as well as when it is being digested in the gizzard. Steel is firm and round in body and gizzard. Advanced cases of aspergillosis may occasionally be seen on an x-ray as thickened areas in the region of the lungs, or in the thoracic or abdominal air sacs.

FECAL EXAM

A fresh feces sample should be examined for intestinal parasites, using both the direct smear technique and fecal flotation technique. It is useful to run a fecal every 2 weeks during treatment.

SUGGESTED PARASITE TREATMENT

Ascarid (roundworms)
Fenbendazole(Panacur) 50mg/Kg once, repeat in 10 days

Heterakis (cecal worms)
Fenbendazole(Panacur) 5mg/Kg once, repeat in 10 days

Capillaria
Fenbendazole(Panacur) 50mg/Kg q24x5 days

Coccidia
**Sulfadimethoxine(Albon) 55mg/Kg for initial dose, followed by 27.5mg/Kg q24x5 days
(**Recommend giving with 35 ml or more of water to maintain adequate water intake. Sulfadimethoxine puts stress on kidney function.)

Strongyloidea (Gapeworm)
Fenbendazole (Panacur) 50mg/Kg q24x7

Anoplocephalidae (Tapeworm)
Praziquantel (Droncit) 6mg/Kg, repeat in 10 days

Reference: Veterinary Parasitology - Reference Manual by Wm. J. Foreyt, Ph.D

INITIAL TREATMENT AND STABILIZATION OF ALL NEW SWANS

Injections:

Multicomplex B Vitamins (small animal concentration): 1 ml IM once daily while under treatment.

Iron Dextran 2mg-ml: 0.3 ml IM, repeat in 1 0 days for severe anemia or low PCV.

Vitamin A,D,E: 0.3 ml/Kg IM, repeat in 10 days.

Fluid Therapy: Is an important part of the initial treatment and stabilization of the swan.

Intravenous: Lactated Ringers and-or 5% dextrose in water: 10-20 ml/Kg q8-12h. Use of semi-permanent catheters should be avoided due to maintenance and sterility problems. A catheter can be used if on antibiotics.

Subcutaneous: The same fluids list above may be used subcutaneously if unable to use the veins or out in the field and need to stabilize.

1. The interscapular region, over the shoulders.
2. The groin region, between the legs and the abdomen. These are the best sites.
3. The axillary region, between the wings and thorax.
4. The patagium or wing web area.

15-20 ml of fluid can be administered in each site depending on the elasticity of the skin. Pinch the site until the skin closes to prevent fluid leakage.

ANTIBIOTIC THERAPY

Antibiotics depend on the WBC and when bacterial infection is present.

Professionals recommend Baytril (Haver); 5mg/Kg; tablets BID (twice daily), or injectable. Note: Injectable may bruise tissue. This may add stress to already depleted muscle mass. Baytril has been used with excellent results and injectable may be used orally. Treatment 7-10 days; when bone injuries are involved use for 14 days, then recheck PCV and WBC after a week off antibiotics. Cefadroxil (bristol); 50mg/Kg tablets BID. (twice daily) Same treatment.

ANTIFUNGAL THERAPY (Optional - Expensive)

Oral 5-Fluorocytosine (Ancobon: Roache Labs). Can be given to new swan patients as a preventive to aspergillosis, but not a treatment for the disease.

NUTRITION

Recommend force feeding while swans are on antibiotic treatment, to insure proper nutrition and hydration. Also, on swans that are debilitated or stressed. Upon completion of treatment, or before discontinuing tube feedings, swans should be at or above their normal weight, because the swans usually won't eat on their own for 3 or 6 days after tube feeding is halted.

Tube Feeding Mixture: Purina Gamebird Chow maintenance, 1 cup in blender, hydrated with water, then mix 8 ozs. of liquid high calorie balance nutrition to make a thick milkshake consistency. Recommend Osmolite HN or Isocal that has been donated by the local pharmacy when it becomes outdated. Products will keep their nutritional value a year after. Mix half teaspoon of powdered acidophilus with mixture. Recipe makes approximately 1 quart of tube feeding mixture.

Trumpeter Swan: Feed 240 mls per feeding. Tundra Swan: Feed 180 mls per feeding. Use 1/4" diameter, 16-18" long catheter/feeding tube. Feed 4 times a day for weight gain. Feed 3 times a day to maintain weight. Extreme care must be taken to place the tube past the trachea.

Suggestion: Use rubber gloves when opening mouth as not to abrase your fingers on the "teeth" of the mandibles. Hold the tongue down between your thumb and fore-finger while passing tube down the esophagus. Always check with your eyes to see that the tube is in the esophagus. Check weight every other day or once a week while under treatment.

Once this treatment is completed and the swan has recovered and is ready to eat on its own, congratulate yourself and staff on a difficult job well done.

"EATING ON ITS OWN"

Mix Gamebird Chow, cracked corn and wheat and, as an added treat, Pigeon Mix (swans love the seeds). It is important to add a bird grit with minerals and charcoal (1 Tbs. per week), to the food to replace what they may have lost with tube feeding. Provide lots and lots of fresh water with greens in the water (chickweed if available, or green leaf lettuce.)

OUTLINE OF TREATMENT FOR MOST COMMON SWAN REHABILITATION NEEDS

I. Lead (Ingestion)

A. Clinical Signs

1. Weakness ("down" swan)
2. Regurgitation (greenish brown)
3. Bright green feces, and area around vent.
4. Pale mucous membranes

B. Diagnostic Tools

1. Radiographs
2. Blood Lead Levels
3. CBC to detect problems/ infection

C. Treatment Options

1. Chelation (CaEDTA)/fluids/antibiotics
2. Nutritional tube feedings
3. Surgical removal
4. Euthanasia

D. Prognosis (When treating swans with lead pellets)

1. One out of 17 swans (1993-1994 Season) survived from lead pellet ingestion
2. Four out of 11 swans (1994-95 Season) survived from lead pellet ingestion

II. Lead/steel (shot wounds)

A. Severe internal damage (pellet changes shape when it hits the body)

1. Hemorrhaging
2. Muscle and nerve damage
3. Can cause lead poisoning if it penetrates body organs
4. Peritonitis (shot into gizzard and/or intestines)
5. Infection with secondary Aspergillosis

B. Dislocations of joints (permanently crippling the swans)

C. Fractures

D. Treatment

1. Debridement of devitalized tissue
2. Stabilization of bone fragments (wings only)
3. Supportive care (fluids, antibiotics, tube feedings)
4. Euthanasia

III. Aspergillosis (A secondary fungal infection from a primary stress-induced cause)

A. Symptoms

1. Lethargy
2. Difficulty in breathing

B. Treatment

1. Difficult to detect (except for advanced stages on an x-ray)
2. No known treatment for swans - euthanize
3. On acute situations, preventative measures are the best. Supportive care important.
4. Ancobon (5-Fluorocytosine) antifungal therapy (expensive)
   a. Preventive, not a treatment for the disease.

C. Possible Predisposing Factors

1. Immunocompromise
   a. Low to high levels of lead
   b. Acute injuries ("down" swans)
   c. Poor nutrition
   d. Flushing from an outside source

2. Loss of habitat (high flock concentrations)

Editor's Note: For further information, the following papers are recommended:

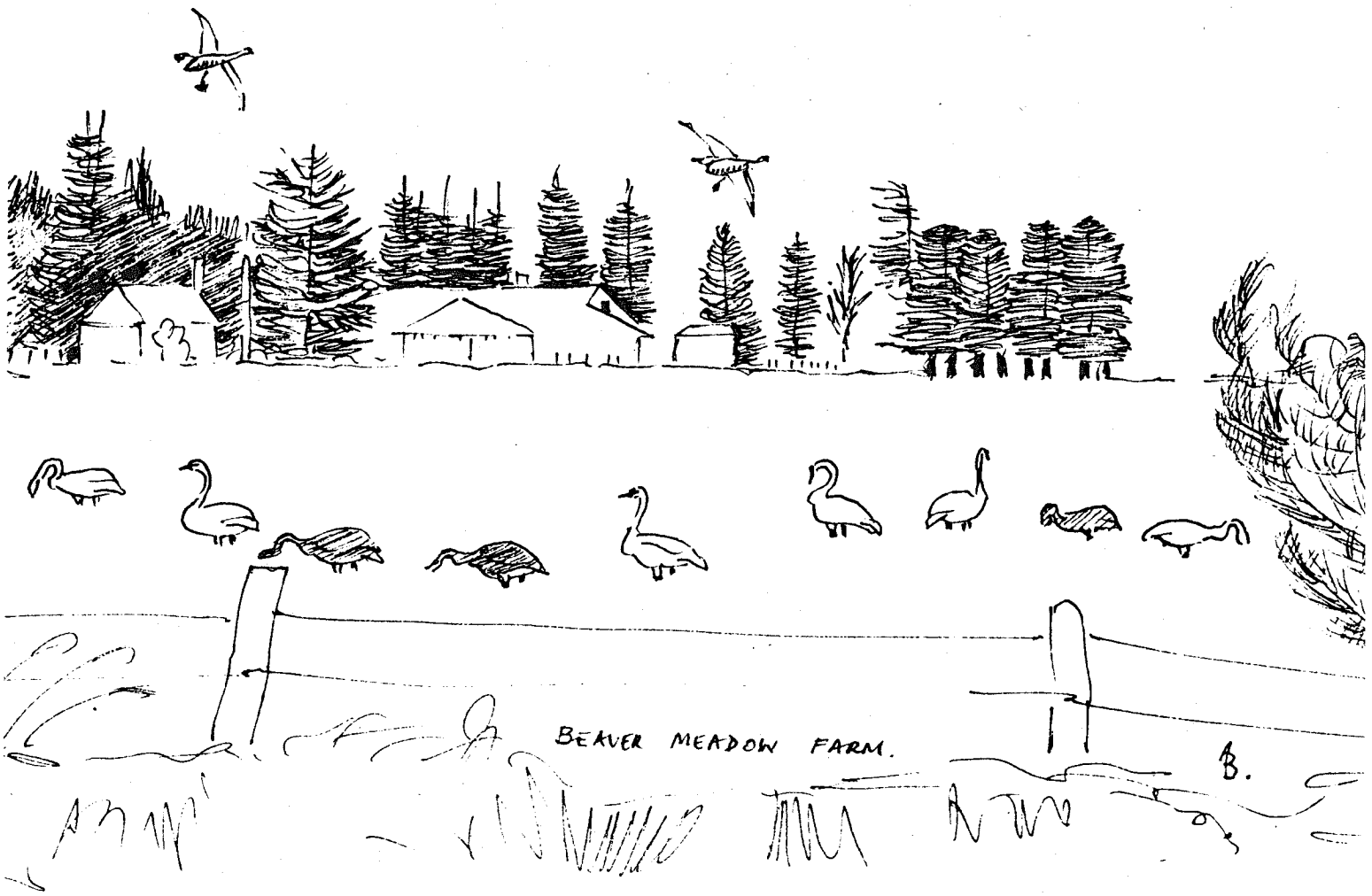
Degernes, L. A. 1991. The Minnesota Trumpeter Swan lead poisoning crisis of 1988-89. Pages 114-118 in J. Voigt Englund, ed. Proc. and Papers of the Twelfth Trumpeter Swan Society Conf., The Trumpeter Swan Society, Maple Plain, MN.

_____ and R. K. Frank. 1991. Minnesota Trumpeter Swan mortality, January 1988-June 1989. Pages 111-113 in J. Voigt Englund, ed. Proc. and Papers of the Twelfth Trumpeter Swan Society Conf. The Trumpeter Swan Society, Maple Plain, MN.

_____ and P. T. Redig. 1990a. Diagnosis and treatment of lead poisoning in Trumpeter Swans. Pages 153-158 in D. Compton, ed. Proc. and Papers of the Eleventh Trumpeter Swan Society Conf., The Trumpeter Swan Society, Maple Plain, MN.

_____ and _____. 1990b. Diagnosis and treatment of aspergillosis in Trumpeter Swans. Pages 159-161 in D. Compton, ed. Proc. and Papers of the Eleventh Trumpeter Swan Society Conf., The Trumpeter Swan Society, Maple Plain, MN.

CREATING AND IMPROVING FALL AND WINTER HABITAT



PACIFIC COAST JOINT VENTURE PROJECTS THAT SECURE OR ENHANCE SWAN HABITAT

Carey S. Smith, U.S. Fish and Wildlife Service, Region 1, 911 N.E. 11th Avenue, Portland, OR 97232-4181

ABSTRACT

Since the Pacific Coast Joint Venture's initiation in 1991, its partners have secured or enhanced wetland and associated upland habitat critical to Trumpeter and Tundra Swans along the Upper Middle Pacific Coast. Program accomplishments and projects affecting swan habitat are presented.

INTRODUCTION

The Pacific Coast Joint Venture (PCJV) is one of 10 habitat joint ventures under the North American Waterfowl Management Plan. The goal of this international program is to secure 250,000 acres of wetland and associated upland habitat and to restore or enhance an additional 40,000 acres through partnerships among more than 40 federal, state, and local governments, private conservation organizations, and corporations.

The PCJV area extends along the Pacific Coast from just north of San Francisco Bay to British Columbia's Skeena River and includes inland habitats associated with major river systems. It consists of islands of high quality waterfowl habitat in an otherwise inhospitable zone of steep, rugged terrain and rocky shores. The islands of habitat are the estuaries, fresh-water wetlands, and agricultural lands on the floodplains of creeks and rivers flowing out of the coastal mountain ranges. Despite its geographical limitations, the area provides critical wintering and migration habitat for several million waterfowl.

The designated "first step" areas for the PCJV are the Comox Valley and Boundary Bay in British Columbia and the Skagit River Delta in Washington State. These areas were given high priority based on their importance to wintering populations of Trumpeter and Tundra Swans, Snow Geese, and Pacific Brant.

RESULTS

During the PCJV's first 4 years, its partners have secured more than 80,000 acres of wetland and associated upland habitat at the cost of more than $100 million. While the early focus has been toward habitat securement, the partners have completed or obtained funding for approximately 10,000 acres of habitat restoration.

Following are some of the projects that will secure, enhance, or manage habitats critical to wintering swan populations.

British Columbia

In the Comox Valley near the city of Courtenay, the Comox Valley Waterfowl Management Project was initiated by Ducks Unlimited Canada, the Canadian Wildlife Service, the Ministry of Agriculture, Fisheries and Food, Environment Canada, and local farmers. Approximately 1,200 Trumpeter Swans winter in the valley, grazing on delicate and monetarily valuable grass fields. The project goal is to minimize swan depredations by planting lure crops in nearby fields to attract the birds, hazing birds from the pastures, and evaluating their actions in order to make indicated adjustments to their management techniques.

The Greenfields program was initiated by Ducks Unlimited Canada and the Canadian Wildlife Service to promote winter cover and prevent damage to grass fields in the Delta area south of Vancouver. Several thousand acres of winter cover crops are planted benefitting about 1,000 Trumpeter Swans.

Washington

The Washington Department of Fish and Wildlife was awarded a $1.2 million North American Wetland Conservation grant for acquisition of key waterfowl areas on the Skagit Delta. Several wetland and adjacent agricultural parcels are being purchased on the bay fronts, however the most important Swan habitat has been optioned at De Bays Slough. De Bays Slough, an oxbow lake surrounding an island of

habitat about 15 miles up the Skagit River, is a traditional Swan roosting and feeding area that provides security from disturbance because of its limited access. The area will be managed specifically for Swans.

Barley for Birds is a 3-year pilot program designed to promote sustainable agriculture, protect water quality, and enhance habitat for migratory waterfowl. The program is funded by Ducks Unlimited, Inc., the U.S. Fish and Wildlife Service, and the Washington Department of Fish and Wildlife. The program started in 1993, when 12 Skagit County farmers planted 500 acres of Poco barley, following the harvest of an early summer crop. Poco barley is a valuable food source for waterfowl that provides a rapid uptake of nutrients, good root structure to minimize erosion, and winter kills for easy spring tillage of organic residue reducing fertilizer costs. As a cover crop, it can also improve water quality by uptake and removal of nitrate-nitrogen from the soil and reducing runoff from fields. The 500 acres produced 450 tons of grain, which sustained thousands of waterfowl through the winter. In 1994, the program called for another 500 acres to be planted, however several farmers voluntarily planted an additional 230 acres. Although this program was designed to benefit dabbling ducks, other species have taken advantage of this extremely accessible forage. Flocks of 600 to 700 Trumpeter and Tundra Swans can be seen feeding in these fields.

Hood Canal estuaries are traditional wintering areas for small populations of Trumpeter Swans. PCJV partners have targeted these areas for protection and restoration. Acquisitions that will ensure habitat protection for these birds are being pursued at the Duckabush and Quilcene River estuaries by the Washington Department of Fish and Wildlife and the U.S. Fish and Wildlife Service. In the Skokomish River delta, a project to restore nearly a thousand acres is gaining momentum with the major participants; the Skokomish Tribe, the Environmental Protection Agency, and the U.S. Fish and Wildlife Service.

The Lower Columbia River winters about 3,500 Swans. Ridgefield National Wildlife Refuge and Washington Department of Fish and Wildlife's Vancouver and Shillapoo Lake Wildlife Areas provide 8,000 acres of habitat on the Washington side of the river. Through North American Wetlands Conservation Act funding, a restoration and enhancement project will be initiated in these areas in the summer of 1995. This $1.4 million project will furnish four new pumps and the necessary water control structures to provide moist soil management capabilities on several hundred acres. Project partners include Ducks Unlimited, Inc., U.S Fish and Wildlife Service, Washington Department of Fish and Wildlife, and Clark County, Washington. Major acquisitions are also being finalized for both of these wildlife areas.

Franz Lake National Wildlife Refuge lies below Bonneville Dam on the Columbia River. This small refuge winters up to 1,500 Swans (predominantly Tundra) that feed on wapato that covers its 50- acre lake. Degradation of an upstream dike threatens the existence of this lake. During winter dry spells, the lake level drops to the point where the Swans are forced to disperse. The U.S. Fish and Wildlife Service is working with Ducks Unlimited, Inc. and the Corps of Engineers to strengthen the dike and place a water control structure at the lake outlet to ensure desired water levels throughout the winter.

Oregon

The Oregon Department of Fish and Wildlife's Sauvie Island Wildlife Management Area shares the responsibilities for providing Swan habitat with the state and federal lands across the Columbia River. The Lower Columbia River habitat restoration and enhancement project will furnish pumps and water control structures that will affect 2,000 acres of wetland and fencing that will protect 5 miles of lake shore.

In the Willamette Valley, several agencies are acquiring and improving wetland habitat. The Bureau of Land Management, Corps of Engineers, City of Eugene, and Lane County have embarked on a 4,500-acre wetland project in the southern part of the valley. Several wetland habitat restoration projects have been recently completed in the mid valley on state wildlife areas and within the Western Oregon National Wildlife Refuge Complex.

California

A 1,400-acre wetland restoration at Humboldt Bay National Wildlife Refuge and a 274-acre expansion of the Eel River Delta Wildlife Management Area will benefit 800 Tundra Swans that winter in these areas.

DISCUSSION

Much of the PCJV's early success has been due to partnerships among federal, state, and local government programs. Many major projects have been achieved through shared goals and dollar matching opportunities created through this partnership. Private conservation organizations have provided guidance in their areas of expertise, financial and political support, and an ability to work in ways unavailable to public agencies. Private conservation organizations are becoming even more important as government environmental program funding continues to erode.

The Trumpeter Swan Society has participated on the PCJV's Washington State Steering Committee. Participants have provided valuable information on Swan distribution, feeding strategies, important roost areas, habitat loss, and disturbance problems. This material was integral in determining population and habitat objectives for the PCJV Strategic Plan. Future contributions from the Society would include: 1) continued guidance in objective setting; 2) evaluation of PCJV projects as they pertain to Swan populations; and 3) political support for the PCJV program and projects.

PRESERVING TRUMPETER SWAN HABITAT IN THE SAN JUAN ISLANDS: PERHAPS AN EXAMPLE FOR OTHER LAND TRUSTS

Bob Myhr, The San Juan Preservation Trust, Box 327, Lopez Island WA 98261

First of all, thank you for inviting me to participate and to tell you, briefly, about the San Juan Preservation Trust and wintering Trumpeter Swans in the San Juan Islands. Please understand that I am **not** a biologist or technical expert. However, I am a dedicated conservationist and delighted to be working to keep existing numbers of wintering swans in the islands and to, hopefully, encourage more to come.

The Trumpeter Swan is such a fantastic symbol of the wonder of nature!

The San Juan Preservation Trust is a private, nonprofit conservation land trust dedicated to helping people protect the wildlife, scenery, and traditional way of life in the San Juan Islands through conservation and preservation of land. Founded in 1979, the Trust is governed by a local board of trustees and is supported by contributions from its more than 1000 members.

A key focus of the Trust is trying to keep wildlife in the islands by preserving wildlife habitat, both for the wildlife itself and because the citizens of and visitors to the San Juans treasure sighting wildlife -- including bald eagles, peregrine falcons, tufted puffins...and, especially, **Trumpeter Swans.**

The San Juan Preservation Trust program to support the protection of Trumpeter Swans includes four basic elements: conservation easements, coordination with government agencies, volunteer monitoring work, and a public awareness program.

1. Encouraging private land owners to donate conservation easements to the Trust to preserve habitat.

   Through conservation easements, property owners donate the rights to conserve the land to the Land Trust, in perpetuity. They continue to own the property, but they and the future owners must abide by the conservation terms of the easement agreement. The Trust monitors these lands on a regular basis and has the right to stop any activity in violation of the conservation terms.

   - The Trust holds conservation easements on approximately 1500 acres of farmland in the islands --all parcels of which have both ponds and marsh areas--and provide open lands for swans.
   - The Trust also holds easements on about 30 acres of exclusively wetland areas of swan habitat.
   - One easement at "Swan Valley" is very close to the town of Friday Harbor. During wet winters it still attracts many swans. We took the conservation easement as sort of a gamble, but to try to save the habitat. We are watching it closely to see if it will continue to attract swans with the rapid growth that is occurring around the county's only town. So far the easement is accomplishing its goal. In fact, we may have set an example for a new and neighboring landowner to add more swan habitat protection to the original area.

2. Working with government agencies to protect habitat.
   - The Trust worked with the San Juan County Land Bank (funded by a 1 per cent purchaser paid real estate excise tax) to have the Land Bank purchase Fowler's Pond on Orcas Island--a swan feeding area.
   - Trust volunteers are very familiar with publicly-owned lands in the county, and alert government agencies when habitat areas are threatened by inappropriate activity.
   - The Trust worked out an arrangement with a local landowner and county government for appropriate timing for cattle usage of a traditionally agriculturally used marsh area so that the cattle would not disturb the swans.

3. Working with local volunteers to monitor the numbers and locations where the swans winter in the island (Table 1).
   - Over the past several years, the Trust has had 20-25 volunteers each year carrying out regular counts at key habitat sites in the islands. They record date, time, locale, numbers of adults and juveniles. Once a month they forward this date

to the Trust. It is a relatively simple process, but gives at least some baseline and trend data. This season, for example, swans appear to be in the islands in record numbers (it also has been wetter than it has been for the last 3-4 years). At the end of the season, the Trust forwards the information to Martha Jordan for final tabulation and analysis.

- Volunteers notice lethargic or injured swans and report them to Martha Jordan and have them taken to Wolf Hollow Wildlife Rehabilitation Center on San Juan Island. This year, one such swan was discovered. Unfortunately, it died from the ingestion of a fishhook.
- Many Trust volunteers are also members of the San Juan Islands Audubon Society and participate in the annual Christmas bird counts. The Audubon Society has a standing $500 reward for any person who provides information leading to the arrest and conviction of persons shooting swans in the islands. Six years ago the Society paid a $500 reward to a young person who turned in a person who had shot a swan.

4. Providing a public awareness and education program about swans in the islands.
   - Placing articles in the local newspapers.
   - Advertising the call for volunteers.
   - Articles about swans in the Trust newsletter.
   - Having speakers at our summer nature lecture series and at the Trust annual meeting.

A fifth element that is not directly a part of our program, but is certainly indirectly part of our program, and is crucial to swans in the islands and throughout the Pacific Northwest **is the wonderful professional support from the one and only Martha Jordan.** We are all deeply grateful to Martha for her inspiration and leadership.

If the time permits, a few 35 mm color slides can illustrate some of the points made above.

Thank you again for inviting me to participate.

Table 1. Trumpeter Swans in San Juan County: An Unofficial Tally

YEAR	MONITOR SURVEY	CHRISTMAS BIRD COUNT
1975-76	5	NA
1982-83	22	39
1983-84	39	29
1984-85	NA	38
1985-86	NA	37
1986-87	NA	62
1887-88	60	62
1988-89	35	39
1989-90	NA	20
1990-91	NA	49
1991-92	49	41
1992-93	44	43
1993-94	39	27
1994-95*	83	81

*On 14 December 1994, 83 swans were counted simultaneously between 10:00 am and noon throughout different locales in the San Juan Islands.

Includes both adults and juveniles (juveniles have usually been 20-25 percent).

The years 1990-94 were years of relatively low rainfall in the islands.

PRIVATE LAND STEWARDSHIP INITIATIVES IN CANADA: PROGRAMS, PUBLICATIONS AND PITFALLS

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INTRODUCTION

Stewardship is about the voluntary conservation of habitat by landowners. Private landowners, corporations, or other user-groups agree to undertake responsibility for conservation activities on land they control (Filyk 1991). Stewardship strives to obtain a positive attitude and responsible action toward habitat conservation in several ways; each approach reflects varying degrees of protection and commitment from the landowner. The tools of stewardship include awareness/education, handshake agreements, written agreements, more legally binding leases, easements and covenants. Recognition awards, financial incentives and management plans are other elements of stewardship programs.

The private land stewardship approach does not replace acquisition or land use planning as tools for reaching conservation goals, but complements them. Acquisitions and regulatory controls are limited by fiscal restraint, and difficulties because of local opposition, lack of understanding and lack of commitment (Hilts et al. 1991). Stewardship offers a cost effective approach in areas where a high percent of the land base in privately owned. It is a relatively new way of doing business that involves landowners in conservation decisions. Often the real wildlife managers are the landowners (WHC 1993).

This paper introduces some stewardship initiatives in Canada that may be used for habitat conservation on the Pacific Coast. The programs described are just a few examples of what is currently underway. Publications are important, for each target a specific audience, and each have obtained successes in promoting conservation goals. Common pitfalls of program management are also outlined to provide insight into the challenges that lay ahead.

PROGRAMS

One of the most extensive stewardship programs in Canada is the Wetland Habitat Agreement initiative in Ontario. Started in 1990, this 3-year program set out to protect southern Ontario's most important remaining wetlands. The main emphasis was on visiting private landowners, to educate and persuade them to be good stewards of their wetland property (O'Grady, Muldal and Kwicinski 1993).

Ten landowner representatives across the province contacted 3,781 landowners with information packages, of which 2,262 were interviewed. Of these, 1,003 voluntarily agreed to protect their land for conservation under the terms of the Natural Heritage Stewardship Award. This award is a verbal commitment to protect the owners' natural heritage, marked by a handshake and recognized by an honourary plaque. Many landowners also agreed to make a written agreement not to disturb their wetland. In addition several ongoing wetland property purchases arose from landowner contact.

The benefits of landowner contact extend beyond the measurable number of agreements negotiated. Landowner contact also has a role in conservation education, the resolution of negative attitudes toward regulations and land management project initiatives (O'Grady, Muldal and Kwicinski 1993). The Wetland Agreement program was a partnership between Wildlife Habitat Canada, the Ontario Ministry of Natural Resources and Ducks Unlimited Canada.

Another approach to stewardship occurs on Canada's east coast. Over a 15-year period, the Nova Scotia's Stewardship Project aims to secure 82,000 acres of fresh and salt water habitat through stewardship agreements. In this project landowners are contacted, informed of the value of their wetland and encouraged to participate through simple verbal agreements, management contracts, long term leases or permanent conservation easements. A management plan based on the type of ecosystem is provided for each type of wetland to suggest ways to maintain, improve or restore wetland quality.

Most of Nova Scotia's wetlands are isolated areas in forested habitat where protection depends upon influencing how the land is used around them. To date there has been success in recruiting large corporate landowners to participate in wetland

protection. The first corporate agreement was signed in 1991 between the Province of Nova Scotia and Bowater Mersey Paper Company Ltd. involving nearly 1,800 individual wetlands covering upwards of 100,000 acres. In 1992 another stewardship agreement was signed with Stora Forest Industries Limited, which not only included private land but also addressed the conservation and management of more than 5,000 wetlands covering close to 75,000 acres of Crown land that is leased by Stora.

There are several advantages of corporate stewardship agreements. They put value on natural areas that may have little or no economic value to forest companies and can protect large areas with few agreements. Agreements improve communication between conservation organizations and industry and offer opportunities for recreation, often not an option with individual landowners.

Funding partners in the Stewardship Project includes the Nova Scotia Department of Natural Resources, Wildlife Habitat Canada, Ducks Unlimited Canada and the Canadian Wildlife Service (CWS). Both this project and the Wetland Habitat Agreement are part of the Eastern Habitat Joint Venture (EHJV), which is one arm of an international wetland and waterfowl conservation program called the North American Waterfowl Management Plan.

In British Columbia, many local stewardship programs are being formed throughout the province. In response to the growing demand for information, the Stewardship Pledge Program was recently formed to encourage the voluntary protection of biological diversity on British Columbia's private lands. Encouraging stewardship involves raising the public profile and increasing awareness about the tools available to the landowners to voluntarily conserve nature on private holdings.

The Stewardship Pledge Program is directly involved in initiating a backyard habitat program, corporate stewardship and landowner contact programs. A Private Land Stewardship Working Group is currently being formed to advise on the best avenues to provide information and empower community groups to undertake stewardship activities. Although still in its infancy, the Stewardship Pledge Program has created an opportunity to develop an infrastructure which promotes and supports voluntary private land stewardship. The funding partners are Wildlife Habitat Canada, B.C. Ministry of Environment, Lands and Parks, the Habitat Conservation Fund and Canadian Wildlife Service.

Although not a program, the Landowner Resource Centre (LRC) in Manotick, Ontario, is another milestone in Canadian stewardship initiatives. "One stop shopping" or "one-window storefront" are phrases often used to describe this innovative approach to stewardship. The concept is to provide integrated services directly to landowners making information on conservation readily accessible. Landowner resource centres provide services that complement, not replace existing initiatives available through private or government agencies.

The Manotick LRC opened in 1993, as a 3-year pilot project to address the conservation or land management needs identified by local residents and organizations. Direction comes from a Steering Committee comprising of members of the community, landowners and conservation agencies. The overall goal of the program is to determine if integrated delivery systems can be effective, and to examine a number of alternative organizational and developmental structures.

Several communication tools are being used to exchange information between landowners and conservation agencies. Demonstration areas, landowner forums, and fact sheets are continually developed as required. Working closely with existing conservation agencies is an important component of landowner resource centres. The LRC has also sponsored a 1-day seminar for field staff on financial aspects of property management to complement their existing science and resource based knowledge.

The Ministry of Natural Resources and Wildlife Habitat Canada financially support this initiative. Office space and administrative services are supplied by the Rideau Valley Conservation Authority. Staffing is provided through the participating and sponsoring agencies.

PUBLICATIONS

One of the most influential publications for initiating private land stewardship programs in Canada is the *Natural Heritage Landowner Contact Training Manual.* This publication outlines a landowner contact methodology to encourage private stewardship of natural areas. The approach described in this manual grows out of experience in southern Ontario,

where development pressures and competition for land resources continue to increase. Although this manual was produced to support landowner contact projects of Ontario's Natural Heritage League, the concepts described could apply to any jurisdiction.

Landowner contact is the foundation of many stewardship programs. It provides a practical, honest approach to working with landowners on a basis of trust and respect. The landowner contact process follows a few simple steps (Hilts et al. 1991):

1. Develop your message.
2. Research information requirements.
3. Organize yourself.
4. Send Introductory letter to landowners.
5. Phone call to arrange interview.
6. Personal visit with landowner (listen to t h e i r views and offer information).
7. Stewardship negotiations.
8. Record keeping.
9. Short term follow-up.
10. Long term follow-up.

Several drafts of this manual have been published since 1989. The catalyst for the project was the positive reaction of many landowners to the conservation message. Funding was provided by the Ontario Heritage Foundation and through the Wetland Habitat Agreement program.

In British Columbia one of the problems identified by individuals working with landowners is the lack of information available on conservation management tools and techniques. Government agencies have responded by collaborating their resources to produce publications on how to practice stewardship. The first publication of the Stewardship Series is, *Stream Stewardship: A Guide for Planners and Developers.*

Stream Stewardship is unique in its approach in addressing conflicts with habitat conservation. The guide provides background information on fisheries, discusses accounting, polices, bylaws and outlines methods which best facilitate stream stewardship. The layout is user friendly and the photographs give vivid images of what works and what doesn't. However, the work doesn't stop there. Training sessions and workshops are currently underway to teach field practitioners, municipal staff and developers how to use the Stream Stewardship Guide and the associated technical report, Land Development Guidelines for the Protection of the Aquatic Habitat.

Of the many brochures that promote stewardship, few directly address the informational needs of the landowner. One exception is, *Private Stewardship Landowner's Options - A Guide to Voluntary Land Protection*, produced in Prince Edward Island by the Island Nature Trust. It offers landowners information on the protection tools available to them to conserve habitat. The brochure explains provincial legislation and describes the legal options available today.

In our zealous determination to instill a conservation ethic in landowners, often forgotten are children who are essential to developing natural heritage values. Publications that help youth understand ecological interactions with human settlement are well received by teachers and parents alike. This became apparent when the Greenfields Project released the colouring book, *Wildlife and Farms - Living Together in the Fraser Delta.* The books are very popular and are being distributed by both wildlife organizations and farmers. A second colouring book emphasizing coastal ecosystems recently produced is entitled, *Farms, Feathers and Fins.*

PITFALLS

With all the good things accomplished through private land stewardship initiatives, it is also necessary to examine the shortcomings. There are a few serious pitfalls to avoid when initiating a private land stewardship program.

The most important step in initiating programs is to develop a clear understanding of landowners, objectives and efforts. Landowners are an equal participant in stewardship and failure to respect or understand their perspective can lead to serious misunderstanding with long-term consequences. Disincentives for landowners participating in stewardship are the uncertainty about what they are giving up, belief of their rights to do what they want on their land and what other landowners are doing or thinking.

Landowner contact programs provide an excellent opportunity to find out about landowners attitudes and direction. However, not everyone makes a good landowner contact representative. The ideal person must get along with people, is friendly, personable, willing to listen and be enthusiastically persistent when appropriate (Hilts *et al.* 1991).

Many stewardship programs fail to plan for their long term needs, particularly in terms of monitoring, follow-up with the landowner and funding. Long term monitoring is more of an issue for government than community groups, who rely on volunteers and peer pressure to ensure compliance. Follow-up with landowner helps maintain the positive relationship established and requires continual effort though newsletters, educational activities, telephone calls or subsequent visits.

Continual funding is a problem for most groups, including those embarking on stewardship programs. If programs grow too big, too fast, it may be difficult to obtain funds for staff necessary to undertake the planned activities. Rather than waiting until all other funding sources have been totally depleted, local fund raising strategies should be pursued in the early stages of programs.

Finally, many stewardship agreements are not legally binding, therefore other tools are necessary to protect wildlife habitat. In British Columbia a recent change to the Land Title Act now allows approved nongovernment organizations to hold legally binding covenants. Yet, more incentives for landowners are needed. Effort is required to change tax laws that provide tax deductions for landowners conserving natural areas. There should also be better incentives for land donations, especially for people who cannot benefit from income tax deduction.

CONCLUSION

Private land stewardship initiatives are an important component of conservation efforts because they build partnerships with landowners and help instill a conservation ethic among rural landowners. The key to working with many landowners is to find ways to integrate wildlife habitat requirements with human needs. Stewardship can be accomplished in many ways: using education, recognition, and financial incentives. In any case, stewardship is voluntary, done in cooperation with landowners who take responsibility for maintaining their property.

Yet, it is important to remember that private stewardship programs are still experimental. Groups should continually learn from their experiences, try new approaches and remain flexible enough to adapt to unforseen changes. The only means to ensure a long-term commitment to conservation is to develop and encourage a sense of pride in stewardship of the land, and to present landowners with innovative, yet realistic alternatives to development pressures (Filyk 1991).

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ELWHA RIVER ECOSYSTEM RESTORATION: SUMMARY OF THE IMPACTS TO AND MITIGATION FOR TRUMPETER SWANS

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INTRODUCTION

This paper is intended as a summary of the Elwha River Ecosystem Restoration Project as it relates to Trumpeter and Tundra Swans. The final report on the two-year swan project will be completed and available by July 1996. The final outcome for dam removal has yet to be determined. For copies of the first year and final reports on swan research and Environmental Impact Statements 1 and 2, contact Brian Winter at 600 E. Park Ave., Port Angeles, WA 98362.

PROJECT HISTORY

The early part of this century promised tremendous growth potential for the north Olympic Peninsula with its abundance of natural resources. A visionary of this promise was Thomas Aldwell who developed the first hydroelectric power project for the area - the Elwha Project on the Elwha River a few miles west of Port Angeles (Figure 1). Lake Aldwell was created in 1913 when the Elwha Dam was completed, 4.9 miles upstream from the Strait of Juan de Fuca. Glines Canyon Dam, 7 miles further upstream, was completed in 1927 forming Lake Mills. The low velocity slack water, abundant aquatic plants, and relatively low levels of human disturbance at Lake Aldwell provide high quality winter swan habitat.

The blockage of fish passage by Elwha Dam caused immediate and long-term adverse impacts to fish and wildlife within the Elwha Valley. The Elwha River once produced ten stocks of Pacific Salmon and Searun Trout. These runs are now extinct or drastically reduced in numbers and under threat of extinction, or maintained by artificial propagation. The historic runs provided a wealth of nutrients through the decomposition of eggs and carcasses and as prey for at least 22 species of birds and mammals within what is now Olympic National Park.

The owner of the projects at the time, the Crown Zellerbach Corporation, filed a license application for the Elwha Project in 1968 and a relicense application for the Glines Canyon Project in 1973. The current owner of the projects is the James River Corporation while the projects are operated by Daishowa America. Although submitted much earlier, significant action by the licensing body, the Federal Energy Regulatory Commission (FERC), on the license applications did not occur until the early to mid-1980's.

The licensing process was extremely contentious, based primarily on different proposals for the mitigation of impacts to natural resources. The dam owner and operator proposed retention of the dams with the provision of upstream and downstream fish passage measures to mitigate fish impacts. Environmental groups, the Lower Elwha S'Klallam Tribe and Federal fish and wildlife agencies preferred dam removal.

As a means to settle the dispute, the U.S. Congress passed the Elwha River Ecosystem and Fisheries Restoration Act (Public Law 102-495) and President Bush signed it into law in October 1992. The Elwha Act authorizes the Secretary of the Interior to acquire and remove the dams if that is required for the "full restoration" of the Elwha River ecosystem and native anadromous fisheries.

The final environmental impact statement (FEIS) on the Elwha River Ecosystem Restoration was released in 1995 by the National Park Service (USDI 1995) and evaluates the proposed removal of two dams. While benefiting anadromous fish and the ecosystem, removal of Elwha and Glines Canyon dams will eliminate the reservoirs and the associated winter swan habitat at Lake Aldwell and Lake Mills.

As part of the restoration studies, the Lower Elwha S'Klallam Tribe has funded an investigation of Trumpeter Swan use of Lake Aldwell and Lake Mills, as well as other areas on the Olympic Peninsula. Aerial flights and ground surveys were used to identify swan numbers and habitat preferences in the study area. Existing records, and interviews with individuals, agencies and tribes for information on swan distribution and habitat use were conducted. The purpose of this study was to address the potential

impacts to swans under the proposed action of complete dam removal. The objectives of the study were to:

1. Quantify swan use of Lake Aldwell and Lake Mills and identify key characteristics of preferred sites on these lakes.

2. Determine the relative importance of habitat at Lake Aldwell to the winter swan use on the Olympic Peninsula.

3. Identify features of preferred swan use sites on the Olympic Peninsula and develop factors to consider to identify potential alternate swan wintering habitat (mitigation sites).

4. Identify sites that could be managed to mitigate for loss of swan habitat at Lake Aldwell and Lake Mills if the proposed action is implemented.

STUDY AREA

Olympic Peninsula

The study area included the lowlands, river valleys, lakes and coastal areas of the northern two-thirds of the Olympic Peninsula in northwest Washington excluding the Olympic Mountains. This area provides a variety of habitats for swans and other waterfowl including natural and man-made lakes and ponds, estuaries, rivers and their sloughs or old oxbows, and forested swamp. Primary swan habitat occurs at elevations from sea level to 700 feet above mean sea level (MSL) with most areas below 300 feet MSL. The Olympic Mountain range was excluded because it provides no winter habitat for swans.

Lake Aldwell and Lake Mills

The Elwha River is located near Port Angeles (Figure 1). Information on the human history and the hydrology, geology and biology of the area is provided in the EIS (USDI 1995). The shorelines of both impoundments (Lake Aldwell and Lake Mills) are formed by steep forested slopes.

Lake Aldwell is about 2.5 miles long with a surface area of 267 acres at an elevation of about 195 feet. It is divided into two major sections by a peninsula that creates a narrow U-shaped passage between the north and south halves of the lake. This peninsula appears to create a wind break that protects waterfowl from frequent north winds. Indian Creek enters at the southwest corner of the lake. The river and creek combine to form a broad delta at the south end of the lake with several narrow vegetated islands, shallows and deep water channels. Logs are scattered along this delta, either supported by the sediment or floating over deeper water with one end imbedded in the sediment. These logs provide resting and roosting areas for ducks, geese and swans. At least three stumps stick out of the water up to 6 feet in the south end wetlands and provide nesting habitat for Canada Geese. Water levels in the lake are relatively stable allowing development of diverse wetland plant communities.

Lake Mills is approximately 2 miles long with a surface area of 415 acres at an elevation of 590 feet MSL. The large delta at the south end where the river enters is nearly devoid of aquatic vegetation due to scouring from river flows, drawdowns and flood events. Water levels in the lake are not stable and generally fluctuate about 3 feet and up to 10 feet. As a result, most of the shallow water areas of the lake do not support submerged aquatic vegetation. Seven creeks enter Lake Mills along its shoreline; the largest is Boulder Creek on the west side. This creek forms a small inlet that provides some aquatic vegetation for swans. Lake Mills is subject to more wave action because it lacks topographical barriers to dampen wind affects. Lake Mills lies within the national park where human activity is more restricted and hunting is prohibited.

RESULTS AND DISCUSSION

Objective 1: Quantify swan use of Lake Aldwell and Lake Mills and identify key characteristics of preferred sites on these lakes.

Although both lakes are used by wintering swans, counts and observations suggest that Lake Aldwell provides the primary food resource, shelter and roosting areas, and Lake Mills is used secondarily for a secure area with limited food resources when the birds are disturbed at Lake Aldwell. Numbers of swans observed at both lakes are shown in Figure 2. Human disturbance at Lake Aldwell during the winter months includes recreational boating and waterfowl hunting.

At Lake Aldwell the principle swan foods are elodea and clasping leaf pondweed (Potomageton richardsonii). Swans feed on the leaves and stems of elodea, and the vegetative parts, seeds and roots of pondweeds. The other aquatic plant species found in

the lake are also eaten, especially when present with elodea or pondweed.

The most abundant aquatic plant was elodea (Elodea canadensis) which formed dense, nearly pure stands especially along the west side of the main river channel at Lake Aldwell. No plant survey was done at Lake Mills due to weather and budget restrictions.

Swans feed by reaching down with their long necks or "tipping up" with their rump in the air to reach plants, roots and seeds up to a depth of 4 feet. The Bureau of Reclamation estimates that approximately 52.4 acres are above the 4-foot depth contour at Lake Aldwell and 50.8 acres at Lake Mills. However, only part of this acreage supports aquatic plants due to river and creek scouring and substrate types. Approximately 20 acres are vegetated at Lake Aldwell and an estimated 3 acres at Lake Mills.

Objective 2: Determine the relative importance of habitat at Lake Aldwell and Lake Mills to winter swan use on the Olympic Peninsula. Relative importance considers the relationship of these lakes to other swan habitats on the Peninsula.

Washington State supported about 14 percent of the Pacific Coast Population (PCP) Trumpeters during the 1994-95 winter season (USFWS 1995). The Olympic Peninsula wintered about 8 percent of Washington's Trumpeters which therefore represents a little more than 1 percent of the PCP. Approximately 10 percent of the Western Population of Tundras winter in western Washington, with only a few Tundra individuals or family groups using the Peninsula either for migration or wintering.

Trumpeter Swans that use the Peninsula are not a distinct static wintering population. The family groups and small flocks of nonbreeding subadults move frequently to respond to changing habitat conditions such as floods, freezing weather or human disturbance. This mobility allows Trumpeters to take advantage of the many small wetlands on the Peninsula that may support a pair or family group for short periods as well as larger bodies of fresh or brackish water. The potential carrying capacity of the Olympic Peninsula is not possible to estimate due to the diversity of habitats and shifts in suitability from year to year as a result of weather or changes in land use practices.

Swans move around and inclement weather can limit areas surveyed; we likely missed areas used by swans during the aerial surveys. Over the years, swans have been reported in several areas where they were not observed during the surveys. These sites are primarily forested wetlands that typically support pairs or single family groups.

Peninsula swan use has increased approximately 50 percent since the 1991 count of 101 Trumpeters. The increase is primarily in north Hood Canal at Quilcene Bay, the Duckabush River estuary and several lakes and ponds in the vicinity. Smaller increases occurred along the outer coast at Cape Flattery and the Quinault River. Results of the aerial swan survey of the Olympic Peninsula during winter 1994-95 are shown in Figure 3.

Objective 3: Identify features of preferred swan use sites and develop factors to consider to identify potential alternate swan wintering habitat (mitigation sites).

Although Trumpeter Swans use a wide variety of habitat types on the Peninsula there appear to be a few preferred sites that are used regularly each winter and/or consistently from year to year. I examined these sites during my surveys and found that their characteristics are consistent with what is known about preferred swan habitat in non-agricultural areas. These sites share the following features: 1) an adequate food resource, usually aquatic plants; 2) loafing areas adjacent to feeding areas for preening and resting; 3) flight paths clear of obstacles sufficient for take-offs and landings; 4) low human disturbance; and 5) nearby alternate sites for use during periods of disturbance or freezing weather. I observed that on larger bodies of water swans prefer sites where feeding areas are adjacent to deeper, open water areas used for resting and roosting.

Several factors need to be considered for identifying quality habitat for wintering Trumpeters on the Peninsula. The following is a summary of the list found in the first year report (Jordan 1995).

- What are the food resources of the site?
- Does the site have suitable shallow water resting or loafing areas?
- Does the site have deeper open water adjacent to feeding areas?
- What is the level of human disturbance and how will it likely affect swans?
- What aerial hazards are present in the flight path for ingress and egress to the site? Powerlines and

other aerial hazards, including trees need to be considered.

- What effect does weather have on swan use of habitats?
- Is there a history of previous swan use?
- What is the history of lead shot accumulation from hunting or heavy metal pollution at the site?
- Property ownership, who owns the land may determine the type of mitigation possible and the funding available.

Objectice 4: Identify potential sites that could be managed to mitigate for loss of habitat at Lake Aldwell if the proposed action of dam removal is implemented.

Mitigation site selection is in the exploratory phase. The list is only intended to identify locations as possible sites for mitigation and have not been considered by the Department of the Interior. Information on these sites, based on consideration of the factors from Objective 3, is currently being collected and assessed for use during the site identification and selection process. Mitigation plans for these sites have not been developed.

The following locations all have a past or current history of swan use and are being provisionally considered for mitigation of the proposed action (This is a summary from Jordan 1995 and 1996.):

1. Quilcene Bay.
2. Duckabush River estuary.
3. Private farm ponds.
4. Price Lake and the Lilliwaup swamp area.
5. Dungeness Wildlife Recreation Area.
6. Elwha River - created wetlands within the restored river system.

CONCLUSIONS

Removal of the Elwha and Glines Canyon Dams is the only alternative that will fully restore the Elwha River ecosystem and native anadromous fisheries. The Elwha River Ecosystem and Fisheries Restoration Act provides a unique opportunity for true ecosystem restoration of a large river system while protecting the many diverse interests affected.

The environmental consequences of the proposed removal of both dams will eliminate lakes Aldwell and Mills as staging areas and winter habitat for swans. Loss of these lakes as staging areas will displace at least 80 swans. It is unclear what effect the loss of these staging areas will have on swan distribution on the Peninsula, especially the eastern side. It is possible the swans will go to their mid - to late winter destination areas on the Peninsula earlier in the season.

The loss of these lakes likely will result in swans shifting their migratory paths to the east or west resulting in fewer swans in the greater Sequim-Port Angeles-Elwha area. The decrease in the Sequim-Port Angeles-Elwha may be short term. There will likely not be a direct mortality to swans from dam removal.

Winter habitat loss will displace between 22 and 60 swans that use Lake Aldwell for a minimum of 2 months. If the PCP of Trumpeters continues to grow at the present rate, more swans will likely come to the Olympic Peninsula. Since the number of swans has been increasing the past 5 years, it is not possible to predict how many swans these lakes could support if the dams remained. It is unknown how many swans the lakes could support during an entire winter season because weather appears to affect carrying capacity. It is likely these lakes could support more than the current number for a few days during peak migration.

The proposed action will result in the loss of approximately 20 acres of forage area (aquatic plants) at Lake Aldwell and an estimated 3 acres at Lake Mills, a total of 23 acres. Open water resting and loafing areas that will be lost are estimated at 150 acres for Lake Aldwell and 100 acres at Lake Mills.

Restoration planning and mitigation measures have been proposed and can provide the beginning steps towards better understanding of Trumpeter Swans on the Olympic Peninsula and the opportunity to initiate the development of a management plan for these unique birds. We have already seen positive efforts of many agencies and Indian Nations to cooperate in the sharing of information and advice. The Trumpeter Swan Society and the Washington State Swan Working Group can continue to play a leadership role in this endeavor.

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FIGURE 1. Elwha Study Area - Lake Aldwell and Lake Mills

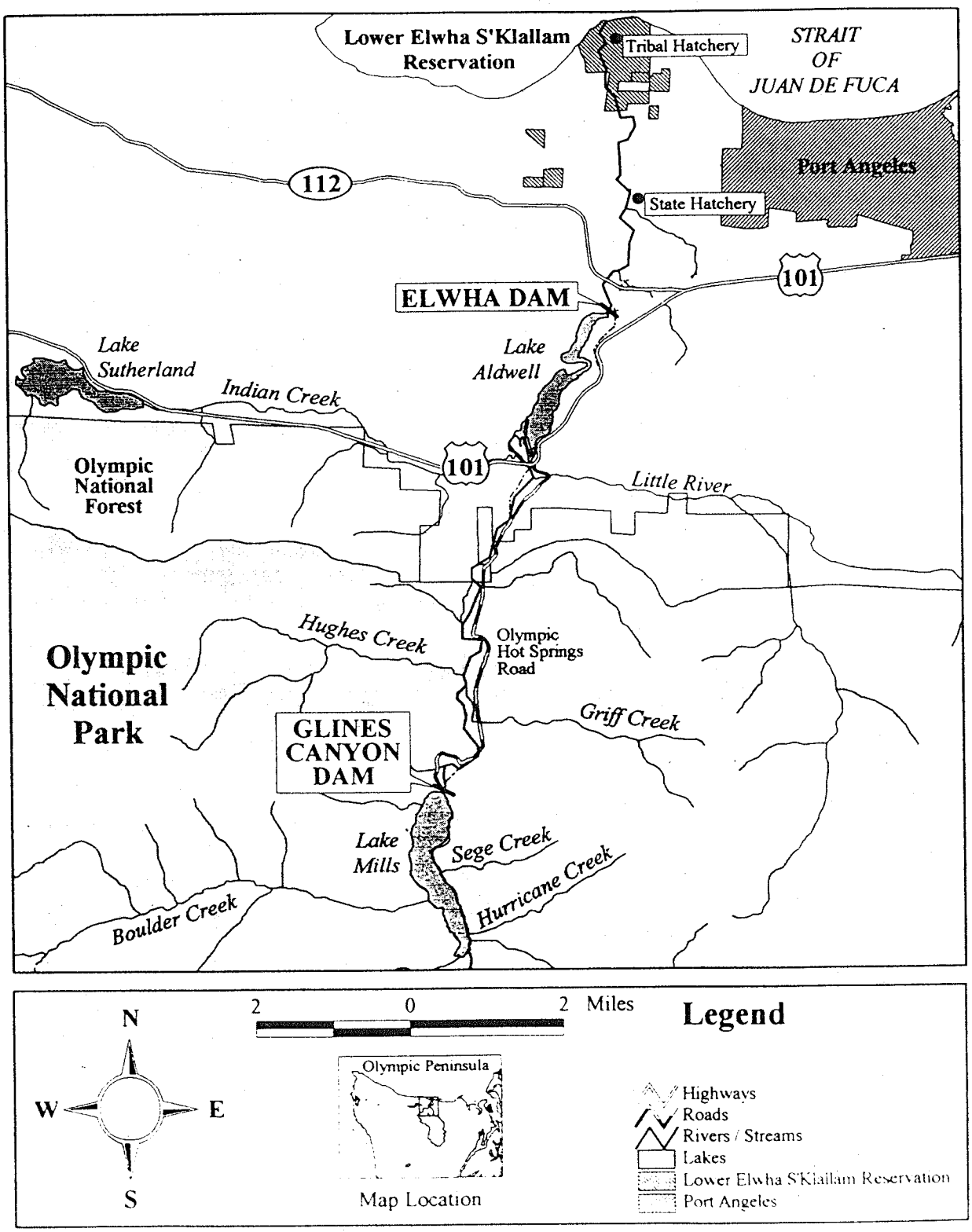


FIGURE 2 Swan Surveys of Lake Aldwell and Lake Mills During Winter 1994-1995

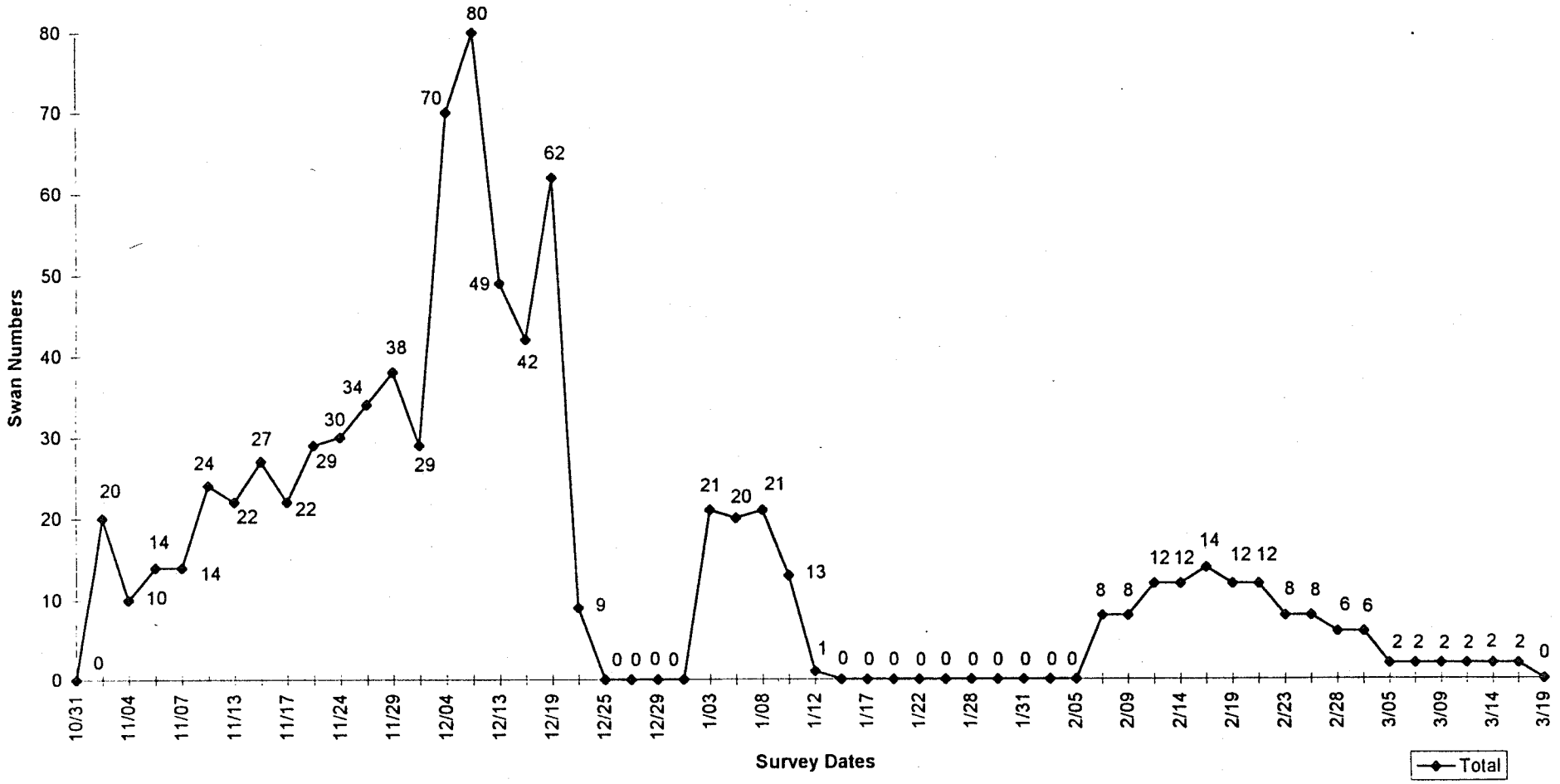
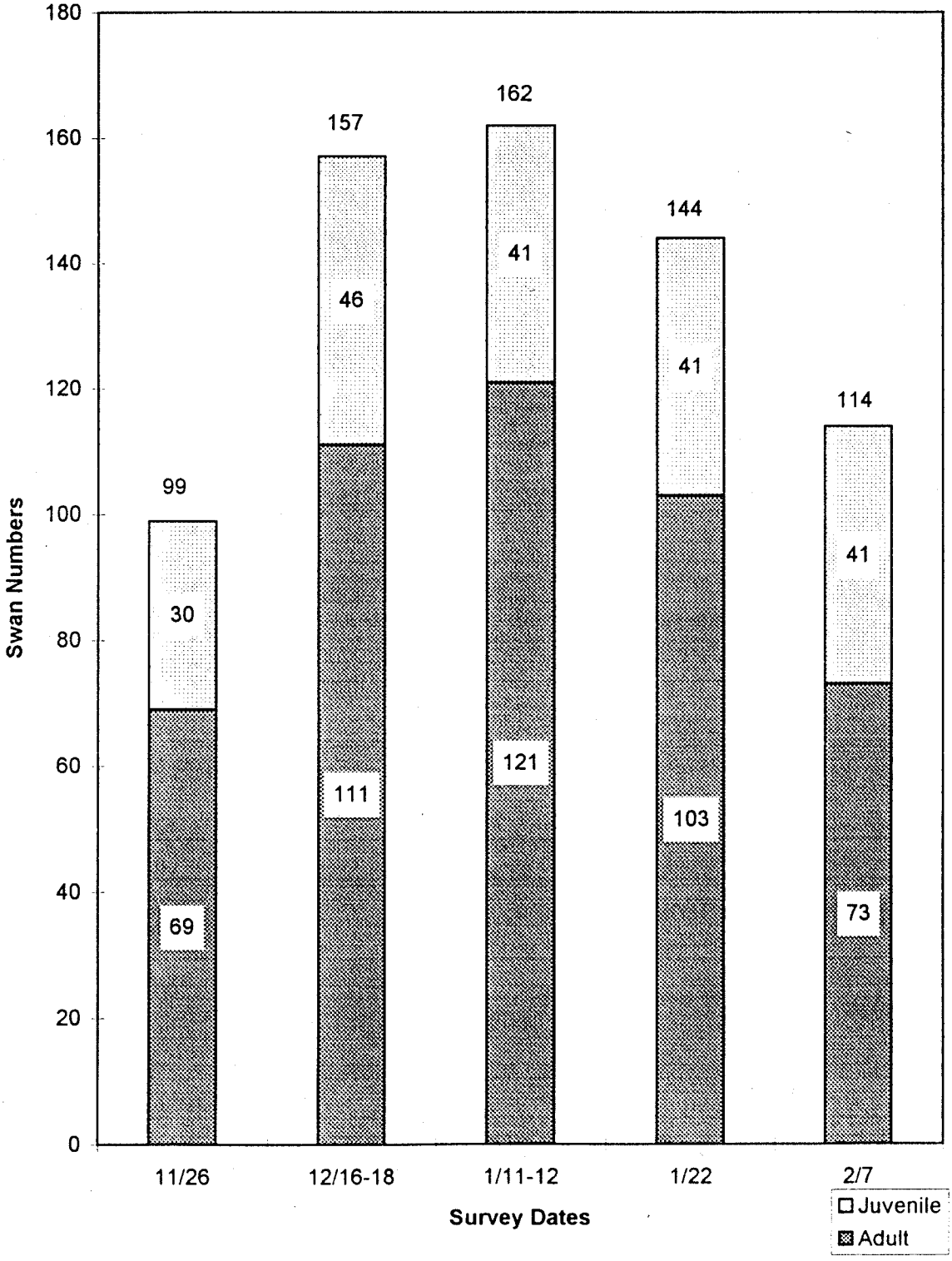


FIGURE 3 Aerial Swan Surveys of the Olympic Peninsula During Winter 1994-1995



TRUMPETER SWAN MANAGEMENT WITHIN AND BEYOND PARK BOUNDARIES

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ABSTRACT

Trumpeter Swans have always been of special management concern to Yellowstone National Park. From its initial discovery in Yellowstone in 1872 to the present, the Trumpeter Swan has been managed as if it were an endangered species. Ecologically speaking, Yellowstone is not a closed system. And consequently swan management encompasses actions within and beyond the scope of park boundaries. Swan management actions such as the elimination of Mute Swans, the implementation of a lead-free fishing program, experimentation using floating nest platforms, and mitigation of human impacts will be discussed in detail.

INTRODUCTION

The Trumpeter Swan (Cygnus buccinator) was first officially documented in Yellowstone National Park in 1872, when C. Hart Merriam collected a single specimen from Yellowstone Lake (Grinnell 1875). The first incidental population information started appearing around 1915, and in 1919 another milestone was reached when the first evidence of Trumpeter Swans nesting in the park was documented (Skinner 1920, Banko 1960).

In the 1930's, the first coordinated population information was collected on a parkwide basis (Childs 1934, Barrows 1937, Oberhansley and Barrows 1939, Condon 1941). Then, in the late 1940's, swan population information improved with the advent of the airplane for censusing swans within and beyond the confines of the park (Banko 1950). During the late 1970's, the most comprehensive swan population data was collected in Yellowstone (Shea 1979). Detailed population data continues to be collected in Yellowstone National Park.

Looking back into the history of Yellowstone National Park, swan management did not seriously begin until the late 1920's and early 1930's. From that point on, swan management has traditionally extended within and beyond park boundaries. Most instrumental in this undertaking was a park biologist by the name of George Wright, who, through his insight and ability to look beyond park boundaries, was instrumental in setting aside Red Rock Lakes as a migratory bird refuge for Trumpeter Swans (Wright and Thompson 1935).

Today, as in the past, swan management centers within the confines of Yellowstone National Park, but does at times extend beyond park boundaries since Yellowstone is not a closed system. This avenue represents more of an ecological approach to Trumpeter Swan management.

DISCUSSION

During the course of this discussion, four basic points will be elaborated on regarding each management action; they are as follows: 1) identifying the management dilemma, 2) developing a course of action, mainly through a written plan or procedure, 3) providing realistic solutions for solving the dilemma, and 4) evaluating or critiquing the program.

Eradication of Mute Swans

One management dilemma facing Trumpeter Swans beyond park boundaries was the introduction of Mute Swans on private property north of the park in the Paradise Valley of Montana. One pair of Mute Swans was introduced on a private ranch in the 1960's, and by the mid 1970's the Mute Swan population had reached as high as 120 individuals (McEneaney 1989). At the alarming rate this introduced population was heading, coupled with the reproductive potential of this species, Yellowstone National Park decided to get actively involved. Of paramount concern was that sometime in the near future, a conflict would occur where non-native Mute Swans would be competing with the native Trumpeter Swans for the same habitat.

The first course of action involved contacting the landowners and interested individuals. A meeting was set up in which a slide program was presented on the life history and status of the Trumpeter Swan in the Greater Yellowstone. During the presentation, the

Mute Swan problem was identified along with a solution on how to remedy the problem: mainly by replacing Mute Swans with captive Trumpeter Swans. All parties agreed, and the program Yellowstone Park presented was unanimously approved. A plan was quickly drafted with the following objectives: 1) reducing the potential conflicts between non-native Mute Swans and native Trumpeter Swans; 2) establishing a breeding population of Trumpeter Swans in the Paradise Valley; 3) allowing all Trumpeter Swan offspring produced from this project to be free-flying and therefore benefit Yellowstone and the Greater Yellowstone; and 4) creating additional wintering areas for resident Trumpeter Swans.

A very difficult obstacle to overcome was securing funding for the project. The landowners believed in the program, but could not provide financial support. The U.S. Government could not justify financing the program for a number of reasons, and working on private lands made it even more difficult. So in 1989, a Trumpeter Swan Recovery Fund was established via the non-profit Yellowstone Association, which allowed us to accept private contributions for programs of this very nature. The Trumpeter Swan Recovery Fund to date has raised over $12,000 from private donations.

The next order of business was eliminating the Mute Swans. This was accomplished primarily by capturing molting birds. The Mute Swans were then shipped to foster homes primarily in the southern United States. Our intent was to get Mute Swans as far away from Yellowstone as possible. Some individuals in Montana wanted to secure these Mute Swans for themselves, but we feared this method would only backfire and return to haunt us in the future. So all live captured Mute Swans were shipped out of state. Not all Mute Swans from this project were live captured and transplanted. Some had to be eliminated through ventilation. Although we were not proud of this technique, it was the only way to eliminate Mute Swans that could not be captured. If the Trumpeter Swans were to be helped, then the Mute Swans had to go. Waterfowl hunters also contributed to the demise of some Mute Swans once the word got out.

In the summer of 1989, the first captive raised Trumpeter Swans were purchased from an aviculturist and released in the Paradise Valley of Montana. All released swans were pinioned, since the agreement was that these swans would belong to the ranch. This also provided assurances to the landowner that the swans would stay around and would be grandfathered in from a legality standpoint, should for some reason the Trumpeter Swan be classified as a threatened or endangered species in the future. All swans secured from aviculturists for this project had genetic origins from Red Rock Lakes in Montana. It was felt that swans with genetic links to Red Rock Lakes had the greatest chance for survival in this area, not to mention unquantifiable subtleties such as behavior, habitat imprinting, predator evasion, and the ability to adapt to extremely harsh weather conditions.

The first captive-raised Trumpeter Swans were released on DePuy's Ranch in the Paradise Valley in 1989. Since the initial release, other ranches owned by J. Bailey, J. Brandis, and B. Dana have joined the program. These ranches are unique in that they offer excellent conditions for Trumpeter Swans, namely ponds that are open year round with quality natural springs coupled with abundant submerged vegetation. Some of these captive-raised Trumpeter Swans have already reached breeding age. In 1993, there were three nest attempts by captive raised swans fledging one cygnet, and in 1994 there were three nest attempts fledging a total of three cygnets. This introduced population and its accompanying wintering ponds should prove to be an excellent emergency backup should Yellowstone Trumpeter Swans show further problems. As of December 1994, a total of 21 Trumpeter Swans has been established in the Paradise Valley, whereas the Yellowstone resident population consisted of 27 adults/five cygnets for a total of 32 swans as of September 1994.

Implementation of a lead-free fishing program

There is overwhelming scientific evidence as to the severe threat lead poses on the environment. Of paramount concern are aquatic environments where lead concentrates, primarily traditional areas used by recreationalists such as waterfowl hunters and anglers. Lead pellets or fishing sinkers can in turn be swallowed by waterfowl, loons, etc. and often result in death. Lead shot has been banned recently for use in waterfowl hunting in the United States. Lead sinkers used for fishing have not received much attention in the United States, although lead-free fishing first came into existence in Great Britain in the 1980's when the Queen's Mute Swan population dramatically declined due to lead sinker poisoning. Lead-free fishing never really caught on in the United States.

Yellowstone National Park started planning for a lead-free fishing program in 1987. Of paramount concern was the low population levels of Trumpeter Swans in Yellowstone National Park. In recent years, approximately 150,000 anglers fished Yellowstone annually. In some areas of the park, Trumpeter Swans were identified occupying habitat where large numbers of anglers concentrated. Since one lead pellet or sinker could kill a Trumpeter Swan, we decided to take immediate action to eliminate the use of lead products, especially sinkers for fishing.

In 1988, Yellowstone National Park drafted a plan to convert over to a lead-free fishing program. Although we wanted to eliminate lead immediately, we soon realized that in order to reach our goal, certain obstacles had to be overcome. Our biggest obstacle was finding scientifically-proved lead-free fishing products. Another serious barrier was the availability of these products to the consumer. So a concerted effort was made to contact manufacturers, fly shops, sporting goods stores, and chain stores regarding our dilemma. Initially the response to convert over to lead-free fishing was warmly received and as products became available, the program started to take off.

The Yellowstone lead-free fishing program was broken down into three phases, mainly due to product development and availability. In 1988, Yellowstone seriously set the lead-free wheels in motion. The first phase of the program requested anglers to begin substituting lead-free jigs to replace lead-headed jigs (lead molded to a hook). Beginning in 1990, lead-headed jigs were banned from park waters. Law enforcement was the catalyst behind compliance. The first phase of the program was completed.

The second phase of the lead-free fishing program began by educating anglers of the importance of substituting lead-free sinkers for leaded sinkers. As of 1992, Yellowstone National Park banned the use of lead sinkers. The third phase of the program was the most difficult. In 1992 anglers were asked to begin substituting lead-free tungsten putty to replace wrap-around lead ribbon. Products of this nature are used primarily to sink artificial nymphs when fly fishing. A large scale educational program went into effect. A video entitled "Fishing with a Conscience" was produced that turned out to be a great educational tool to complement the lead-free fishing program. The video detailed the problems facing Yellowstone Trumpeter Swans, explaining the reasons why anglers shouldn't use lead fishing products, and showcased the state of the art substitutes currently on the market. After reviewing the video, anglers responded overwhelmingly positive toward the program and quickly converted to the new lead-free fishing products.

Have we reached our pinnacle of success regarding lead-free fishing in Yellowstone? Yes and no! We are proud of our efforts to educate the public about the dangers of lead, and to offer realistic fishing tackle alternatives. But we feel there is more we can do. Sometime in the near future we would like to eliminate lead from weighted flies and lures. Do we have a non-toxic fishing program? Not exactly! The most important change of events is that we have identified and eliminated a serious environmental contaminant from the environment. Converting over to a non-toxic program will require a substantial amount of time and investment in research and testing. If we start looking at the list of heavy metal alternatives, it leaves us in a quandary. Many of the remaining heavy metals (zinc, copper, brass, etc.) are toxic to different forms of life. We need careful research testing of these metals to come up with a viable or least harmful alternative. EPA and the USFWS Contaminants Division can play an important role in the future by determining the true toxicity of these substances. Research will have to prove which of these substances will cause the least amount of harm. Until this is done, the public will be reluctant to accept a non-toxic program.

So what have we learned from our lead-free fishing program? We do know that the public will accept change as long as they are properly informed and realistic alternatives are available for them. Forcing programs on the public backfires in the long run. It is important to go slowly, methodically educating the public, but it must be enforced seriously. Without enforcement of laws the program is non-functional and turns out to be a mere paper exercise. Banning all toxic fishing products will set us back unless we can provide concrete data and reasonable alternatives for fishing.

Experimentation using floating nest platforms

Manipulating swan nests began in Yellowstone National Park in the early 1930's and received mixed results. Similar efforts occurred at Red Rock Lakes in the Centennial Valley of Montana. The floating nest platform was designed by McEneaney in 1984. Initial experiments occurred at Red Rock Lakes incorporating floating nest platforms made of PVC pipe lined with foam. The floating nest platform was

designed to save as many Trumpeter Swan nests as possible by adjusting to fluctuating water levels while at the same time being somewhat maintenance free (McEneaney 1988).

Floating nest platforms were made of 6 inch PVC pipe measuring 4 feet by 4 feet. The platform had a square design connected in the four corners by elbow joints, and having a 4 foot cross arm running through the center of the platform connected by two "T" joints. Expandable foam was sprayed inside the platform to keep the structure from sinking and to prevent waterlogging. All joints were sealed with PVC glue. The platform was covered with rubber coated chicken wire and anchored by water ski rope using a cement bucket as an anchor. The platform, when placed on a marsh or lake, would then be covered with vegetation mimicking a muskrat house. Although initial efforts using floating nest platforms made of PVC pipe began at Red Rock Lakes NWR, numerous other management agencies began incorporating this design. Private propagators also found this design to be very helpful.

Yellowstone National Park began experimenting with floating nest platforms in 1985 (McEneaney 1988). Trumpeter Swan nests at Trumpeter Lake, Beach Springs Lagoon, Grebe Lake, and Seven Mile Bridge were manipulated using this technique. Due to the low numbers of swans in the park, especially the number of unoccupied sites, the practice of manipulating nests was curtailed at Grebe and Trumpeter Lakes. Nest manipulations using floating nest platforms continue to this day at Beach Springs Lagoon and Seven Mile Bridge. Park managers identified these two areas as being heavily impacted by visitors and consequently have designated these areas as management zones where public entry is unlawful. Also park visitors have a rare chance to see Trumpeter Swans from the road, especially in the summer.

Trumpeter Swan floating nest platforms do work. In one 3-year period alone, floating nest platforms were responsible for saving 15 Trumpeter Swan eggs and fledging nine cygnets. If one includes manipulating nests in the wild coupled with nests of swans in captivity, floating nest platforms have been instrumental in saving numerous egg clutches from flooding.

Are floating nest platforms maintenance free? No, they do require some form of maintenance. Vegetation has to be placed on the platforms annually and in some cases biannually, depending on the exposure of the nest to the elements. The biggest problem with the platforms is that they can become waterlogged. This requires taking out one platform and replacing it with another. Drying out the platform every 3 years is highly recommended.
Floating nest platforms are also instrumental in luring swans to the same nesting area year after year. This is critical in areas such as national parks, where unpredictable nesting sites near roads could result in swan abandonment due to human disturbance.

Mitigation of human impacts

Yellowstone National Park is visited by over three million people annually. In the past, visitors have been identified as being one of the factors responsible for the extremely low cygnet production. Although we admit Yellowstone has its share of wildlife/human conflicts, we do not believe the poor showing in swan nesting and production in recent years is the result of human disturbance. As you are aware, the swan population in recent years has been extremely low. The sheer lack of nesting pairs is due to this low overall population level. Over the years, we have documented weather and predation as having profound affects on swan nesting and cygnet production.

Providing public enjoyment of Yellowstone National Park, while at the same time protecting wildlife resources is like walking a tight rope. The key to wildlife protection is through people management, education, and enforcement. Signing is one way of managing people, but it has to be enforced and the message has to clearly identify the reason why the area is closed or closely managed. Feeding swans is a continuous problem, particularly in the summer in Yellowstone. People have this compelling urge to feed swans; maybe this is due to traditional swan feeding in public parks. Feeding wildlife is not ecologically sound. When wildlife lose their fear of people, they lose their fear of predators, thus putting their life at risk. Wildlife feeding by the public will only be curtailed through sound education and strict enforcement. Wildlife photographers, although posing as being supporters of wildlife, often push wildlife to the limit. Numerous magazine articles show pictures of wildlife eliciting behavioral clues that they are being disturbed. Editors of wildlife magazines are going to have to be better educated as to what constitutes a good or a bad picture. Establishing ethics for wildlife photographers is a step in the right direction.

CONCLUSIONS

One phenomenon is certain, the human population is increasing within and beyond the boundaries of Yellowstone. Our concern for the future should not necessarily revolve on whether we increase the Trumpeter Swan population, but rather preserving and protecting existing swan habitat while at the same time maintaining a representative swan population throughout the Greater Yellowstone. In order to meet the challenges of the next century, we as managers need to act responsively, responsibly, and realistically, yet think progressively, innovatively, and most important, ecologically. We must strive to keep human interference to a minimum. What we see happening to Yellowstone is a reality check in wildlife management. If we continue to think and manage within and beyond park boundaries, there is a good chance we will accomplish our goal of managing the icon bird of Yellowstone and its habitat for perpetuity.

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