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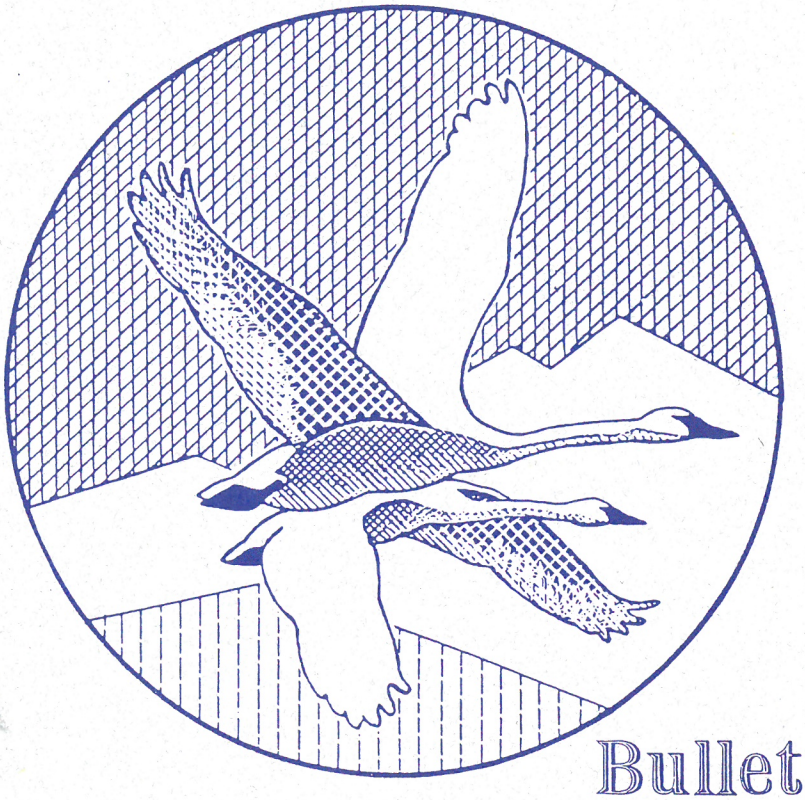

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Volume 32, No. 1 - June 2004

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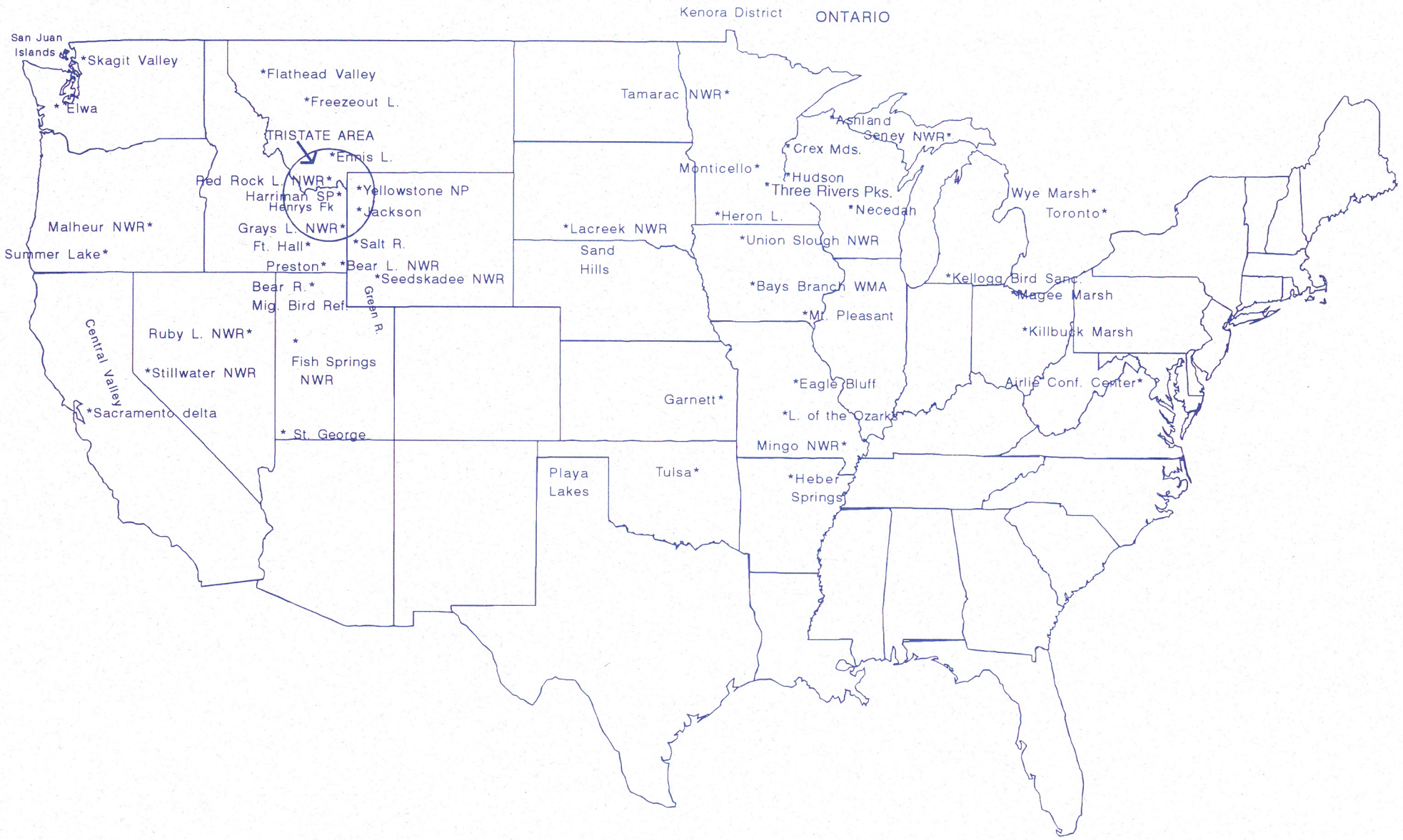
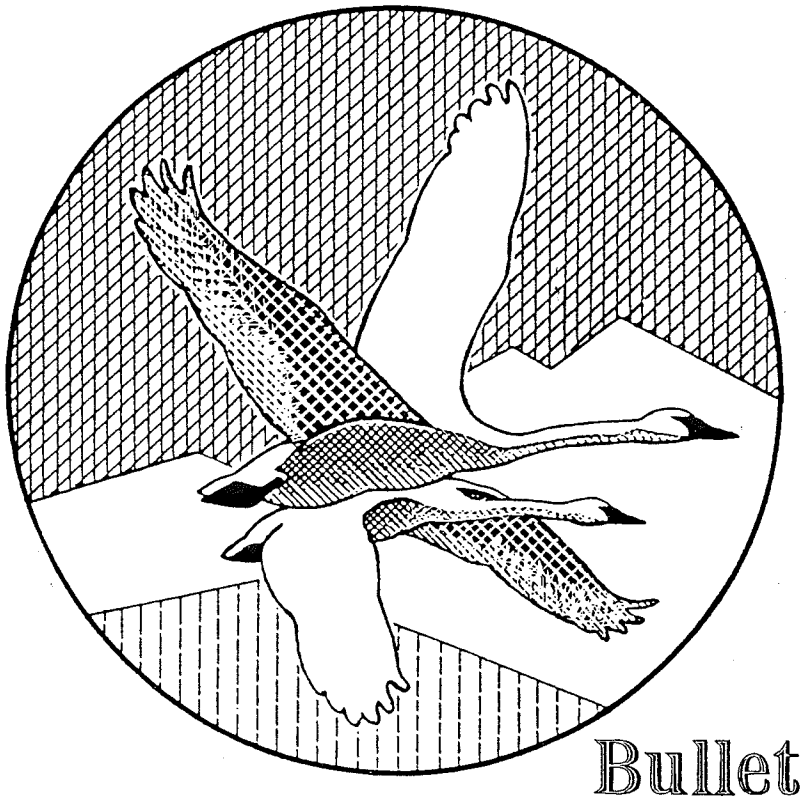


AREAS OF SIGNIFICANCE FOR TRUMPETER SWANS

North American Swans



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Editors' Note: *North American Swans* replaces *The Trumpeter Swan Society Newsletter*. We will preserve the same system of numbering volumes and issues so that historical information available from the *Newsletters* will not be lost. Our intent is to cover topics in depth, have regional information in each edition and publish reports of research and management that would otherwise be unavailable. We will include articles and research on other species of swans as the information is pertinent to Trumpeter Swans. Publication schedule will be determined by the Editorial Board.

Please feel free to submit reports or articles for publication at any time. Submit articles to: The Trumpeter Swan Society, 3800 County Road 24, Maple Plain, Minnesota 55359. Diskettes can be accepted. Please format in Microsoft Word if possible. Clearly label diskette and send a hard copy as well.

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SELECTED PAPERS OF THE NINETEENTH TRUMPETER SWAN SOCIETY CONFERENCE

Working Together to Conserve Our Native Swans

5-8 February 2003
Richmond, British Columbia

David K. Weaver
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Ruth E. Shea
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PREFACE

During the 20th century, our native swans began a welcome recovery after the severe declines in numbers and distribution that accompanied European settlement of North America. As the continent's human density and habitat alteration increase, finding creative ways to protect that recovery and to ensure the security of Canadian and U. S. swan populations will pose many challenges. It has been sobering to realize that even the largest of the Trumpeter Swan populations, those swans that nest in Alaska, remains vulnerable to unexpected threats, such as the current lead poisoning crisis. The problems of providing adequate habitat, rebuilding secure distributions of all Trumpeter Swan populations, reducing mortality from environmental contaminants, working with agriculture to provide new habitats and to minimize crop damage, and reducing nonnative swan populations will require much effort and greater coordination across administrative boundaries. Participants in the 19th Conference addressed these and other issues, and shared their ideas for strengthening partnerships to conserve our native swans. Over 80 swan enthusiasts toured the Fraser River Delta and visited the Reifel Migratory Bird Sanctuary. Attendees enjoyed a lunch served at the historic Minnekhada Lodge.

Objectives of the 19th Conference were to:

1) Provide a forum for the exchange of knowledge and diverse perspectives that can help improve swan habitat and population management in North America;
2) Clarify the current status and problems of each of the native swan populations in North America;
3) Identify specific ways to strengthen partnerships among policy makers, "on-the-ground" managers, and private sector entities to conserve our native swans and their habitats; and
4) Strengthen the network of people that is working to benefit our native swans and encourage the participation of young biologists and new partners.

Members of The Trumpeter Swan Society share a common mission – to assure the vitality and welfare of wild Trumpeter Swan populations. We focus our efforts on the areas of population security, range expansion, habitat conservation and management, research, advocacy, agency coordination, and public education as we work to restore Trumpeters to as much suitable habitat as possible.

Since our founding in 1968, our conferences have brought together agency managers and researchers, private sector partners, and interested citizens to discuss the issues, problems, and opportunities of Trumpeter Swan restoration and management. By maintaining this network between conferences, the Society has helped promote more effective management and restoration of Trumpeter Swans across North America.

Although the human population of Canada and the U.S. is well over 250 million and growing, the restoration of Trumpeter Swans will be accomplished through the actions of a few hundred knowledgeable and dedicated people, including many of those who attended our 19th Conference. In the next decade, their combined efforts will help shape the future of all swans in North America – our native Trumpeters and Tundras – as well as the nonnative Mute Swans. During the 4 days of the Conference, participants had many opportunities to get to know each other better, share knowledge and ideas, and find new ways to merge resources and forge partnerships to conserve our native swans and their important habitats.

We are indebted to Ducks Unlimited Canada (DU Canada) for their tremendous help in arranging the many conference logistics and helping substantially to defray conference costs. The all-day field trip was hosted by DU Canada and the Canadian Wildlife Service. The success of the conference was due in large part to the wonderful help provided by Les Bogdan, Judy Griffith, Dan Buffet of DU Canada, Lillian Sugahara for program layout, Shele O'Hollaren for logo and shirt design work, and Paul Fischbach for pre-conference assistance. Thank you to all TTSS members who helped with many tasks that needed to be done throughout the conference. We also deeply thank our other conference co-sponsors: the Canadian Wildlife Service, Confederated Salish and Kootenai Tribes of the Flathead Nation, Ducks Unlimited, Inc., U.S. Fish and Wildlife Service, Washington State Dairy Federation, and the Wildlife Management Institute.

Ruth Shea, Program Chair
Martha Jordan, Logistics Chair

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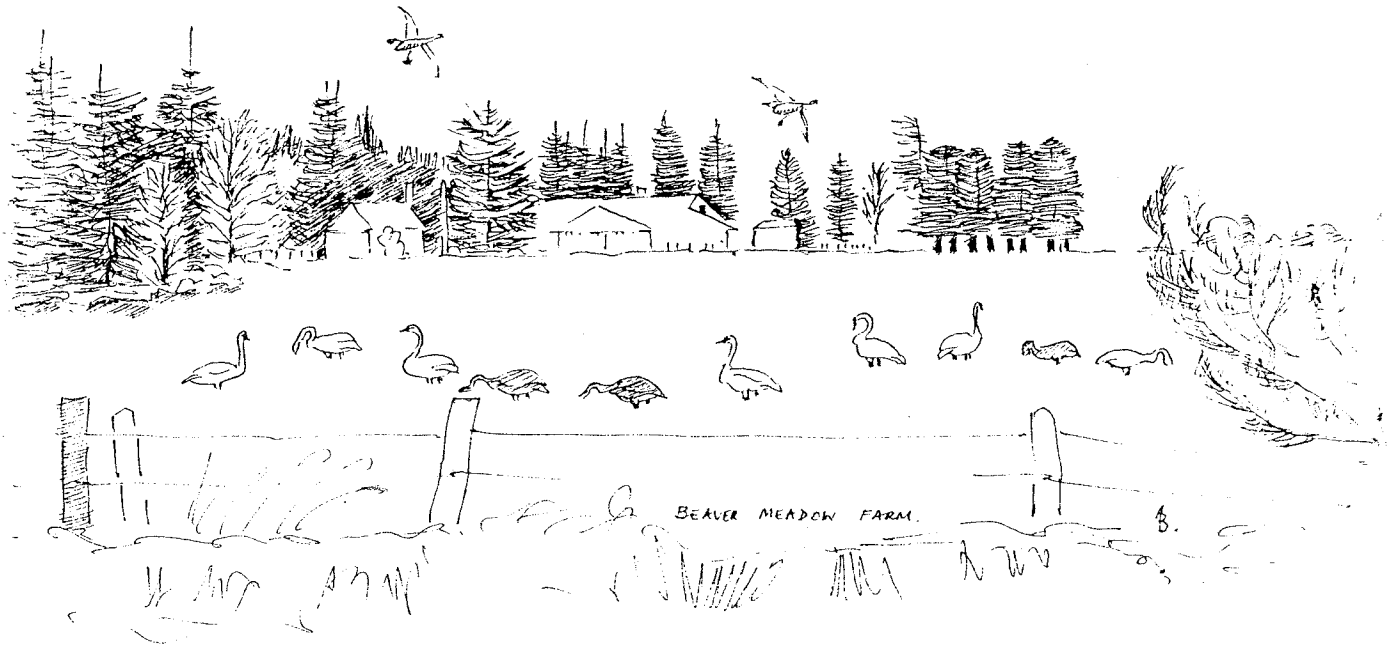

THE PACIFIC COAST POPULATION—HISTORICAL PERSPECTIVE AND FUTURE CONCERNS

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ABSTRACT

Since its rediscovery in 1955, the Pacific Coast Population (PCP) of Trumpeter Swans (*Cygnus buccinator*) (TRSW) has increased dramatically. The first comprehensive census occurred in 1968 and found 2,847 swans. The 2000 census found 17,551 swans, an increase of over 600% from 1968. Since 1975, comprehensive surveys have been conducted every 5 years. Between 1968 and 2000, the average annual change in the PCP was a 7.1% growth, with the slowest rate of growth (1.5%) during the 1995-2000 interval. It is unclear if the recent decline in the PCP growth rate is attributable to breeding ground or wintering ground conditions. The wintering populations of TRSW in southern British Columbia, Washington, and Oregon increased significantly during the last decade, with continued expansion in the wintering range. Management issues for the PCP continue to be adequacy of high quality wintering habitat on agricultural lands, lead poisoning, and proposed management changes in Alaska. In western Washington, dairy farms, which support 85% of wintering TRSW, are declining. Between 1999 and 2001, over 700 wintering PCP TRSW have died of lead poisoning in northwestern Washington and the British Columbia lower mainland. A spring TRSW subsistence harvest has been proposed for portions of Alaska. Recently, managers within the U.S. Fish and Wildlife Service proposed changing from a complete census to a sampling survey of the TRSW breeding population in Alaska. A sampling survey may be less sensitive to changes in population or distribution.

INTRODUCTION

Since the rediscovery of Trumpeter Swans (*Cygnus buccinator*) in Alaska in 1955 (Hansen *et al.* 1971), the Pacific Coast Population (PCP) has increased dramatically. In 2000, the PCP accounted for 74% of the Trumpeter Swans in North America (Caithamer 2001). The increase in the PCP has not been trouble free and future prospects for the population are uncertain. The PCP will likely represent a significant proportion of North America's Trumpeters, but whether the population will continue to expand is unclear. Some breeding and wintering areas appear to be reaching carrying capacity (Conant *et al.* 2002; Sean Boyd, pers. comm.), maintaining prime agricultural wintering habitat is an ongoing concern, lead poisoning continues to be a serious problem for wintering birds, and there has been a proposal to authorize a subsistence harvest in Alaska. This paper will present a brief summary of the breeding and wintering distribution of the PCP and current management issues. Several of these topics will be discussed in detail by subsequent authors.

The first comprehensive Alaskan breeding survey for Trumpeter Swans in 1968 counted 2,847 swans in six survey areas. Since 1975, these surveys have been conducted every 5 years, with the 2000 survey locating 17,155 swans in 11 survey areas (Conant *et al.* 2002). An additional 396 Trumpeters, a 19% decline from 489 in 1995, were counted in British Columbia and the Yukon Territory, bringing the PCP total to 17,551 birds in the autumn of 2000 (Caithamer 2001). The North American Waterfowl Management Plan autumn index objective for the PCP is 43,200 Trumpeter Swans (North American Waterfowl Management Plan Committee 1998). The average annual change in the PCP for the period (1968-2000) has been a 7.1% growth, with the highest growth rate (16.9%) in the 1975-1980 interval and the lowest growth rate (1.5%) in the 1995-2000 interval (Figure 1). It is unclear if the lower growth rate for the 1995-2000 interval is an anomaly or reflects conditions on the breeding or wintering grounds. During the 2000 Alaska breeding survey, the population did not increase in 3 of the 11 survey areas, apparently due to the occupation of all suitable nesting habitat (Conant *et al.* 2002).

PCP Trumpeter Swans winter along the Pacific Coast from the Copper River Delta, Alaska, to the Willamette Valley, Oregon (Deborah Groves, pers. comm.), with the majority of birds wintering in British Columbia (BC) (Figure 2). Those occasional Trumpeter Swans reported in the Sacramento Valley area, California, Audubon Society Christmas Bird Counts (CBC) are from the Rocky Mountain Population (Martha Jordan, pers. comm.; National

Audubon Society 2003). Wintering Trumpeter Swans were first noted in the Comox Valley, British Columbia, in 1965 and in the Skagit Valley, Washington, in 1957 (McKelvey 1984; Canniff 1984; National Audubon Society 2003). In the 2001 winter survey, a significant proportion (30.7 %) of the PCP was still unaccounted-for. It is believed most of these unaccounted-for birds winter along the rugged northern BC coast. The Comox Valley on eastern Vancouver Island and Washington's Skagit Valley are important wintering areas, supporting up to 6,000 Trumpeter Swans in 2001 (Environment Canada 2002; Martha Jordan, pers. comm.). The Comox Valley may be reaching carrying capacity. The Fraser River Delta and BC lower mainland have become increasingly important as wintering areas since 1988 (Environment Canada 2002). In Washington State, Whatcom, Skagit, Snohomish, and Grays Harbor Counties are important wintering areas, supporting up to 3,850 Trumpeters, or 89% of the state's wintering population in 2001 (Jordan 2001).

In Oregon, the Willamette Valley offers the best wintering habitat. Trumpeter Swans have been observed in the Airlie area north of Corvallis since the late 1980s. They use the agricultural areas including dairy farms in the general area. The Columbia estuary, where Lewis and Clark noted an abundance of swans (Banko 1960), is the major wintering area for Tundra Swans (*C. columbianus columbianus*) but is not currently used by many Trumpeter Swans. Ridgefield National Wildlife Refuge, north of Vancouver, Washington, has reported an increase in Trumpeter Swans over the past decade (Martha Jordan, pers. comm.). Also, the Chehalis Valley, west of Olympia, Washington, has become a significant site for wintering Trumpeters over the past decade. Skagit and Whatcom Counties are the other principal wintering areas for Tundra Swans in Washington State. All of the major Trumpeter wintering areas are agricultural centers, particularly dairy farms. In western Washington, most corn is grown as feed for dairy cattle and dairy pastures are an important Trumpeter Swan winter food source because of its high protein content. Eighty-five percent of wintering Trumpeters are associated with dairies (Martha Jordan, pers. comm.). Corn and pasture grass, along with potatoes and winter wheat, are the principal winter foods for Trumpeters in northwestern Washington and lower British Columbia (Anderson 1994; Environment Canada 2002).

MANAGEMENT ISSUES

Rangewide issues

From the Comox Valley south, the most important issue facing PCP Trumpeters is the maintenance of high quality agricultural habitat for wintering swans. The rapid increase in the PCP since the 1960s has been attributed, in part, to Trumpeter Swans learning to feed in agricultural fields in BC and Washington, a previously unused resource (King 1994). During this same period, the human population has increased dramatically with a concomitant decrease in farmed acreage. Land-use regulation has slowed the conversion of farmland to urban/industrial uses, but has not stopped the loss of available habitat to wintering waterfowl. Conversion from pasture or grain crops to hothouses, flower bulbs, or cottonwood plantations has reduced the wintering habitat carrying capacity. Maintaining "swan friendly" agriculture is an ongoing challenge and will affect the ultimate size of the PCP.

Utility (power transmission lines, radio towers) construction within nesting or wintering areas is an issue for the PCP. A power line crossing the Tanana Flats, an important Trumpeter Swan nesting area, has been proposed and received federal permits (Kenai Peninsula Online 2000). In Snohomish County, Washington, a radio tower farm has been proposed on property within 1.2 miles of Shadow Lake, a significant Trumpeter Swan night roost and major migratory route for thousands of waterfowl (Poterff 2003). Power lines continue to be problematic throughout western Washington, especially in areas of frequent fog or high winds.

Alaska

The major management issues facing Trumpeter Swans in Alaska are the proposed sample of the breeding population, rather than a complete census, and the implementation of a subsistence harvest. Prior to the 2000 nesting survey, some managers advocated a sample of the breeding population as a cost savings measure over a complete census (Bruce Conant, pers. comm.). A complete census was conducted, identifying the continued expansion of the breeding range for 8 of the 11 survey units (Conant *el al.* 2002). Since the PCP is still growing, a sampling survey is less likely to detect range and population expansions. It is not clear what type of survey will be conducted in 2005.

Alaskan Native groups, Alaska Fish and Game, and the U. S. Fish and Wildlife Service (FWS) have been

working since 1997 to develop subsistence harvest regulations. Trumpeter Swans have been included in 106 eligible bird species proposed by Alaska Natives for spring subsistence harvest. Resource managers believe that unreported harvest is already occurring and that the proposed regulations, if implemented, would assist managers in monitoring Trumpeter Swan harvest. The preliminary proposed rules are scheduled to be published by 1 February 2003 and will be open to public comment (Robert Trost, pers. comm.).

British Columbia

Maintaining adequate Trumpeter Swan wintering habitat and lead poisoning are the most important issues for the PCP in BC. Agricultural land in coastal BC is limited to southern Vancouver Island and the BC lower mainland and in recent years, farmland on the Fraser River Delta continues to be converted to hothouses. The Comox Valley, one of the principal PCP wintering areas, may be at carrying capacity (Sean Boyd, pers. comm.). Trumpeter Swans feeding in Comox Valley dairy pastures and potato fields have caused crop damage (Wareham and Fowler 1994). The Comox Valley Waterfowl Management Project has been working with farmers to minimize crop damage by hazing swans from fields prone to damage and providing seed for cover crops (Environment Canada 2002).

Lead poisoning continues to be a problem for Trumpeter Swans wintering in the lower mainland. There are at least two known lead shot "hot spots" in British Columbia, but they do not appear to be a significant source of lead shot to swans. It has yet to be determined where lead-poisoned birds found in BC are ingesting the lead, but it is believed to be from a limited number of sites in Whatcom County, Washington (Lyke 2003). Swans wintering in the BC lower mainland and Whatcom County move between these areas throughout the winter (Martha Jordan pers. comm.).

Washington

As with BC, Maintaining adequate wintering habitat and lead poisoning are the most important issues for the PCP in Washington. As mentioned, dairies support 85% of the Trumpeters that winter in western Washington and the dairy industry is in decline. Milk prices are low and environmental regulations and farming conditions are less restrictive in eastern Washington, prompting dairies to close or move out of western Washington (Ashton 2003; Martha Jordan pers. comm.).

The Trumpeter Swan Society (TTSS) and its Washington Swan Working Group (WSWG) have been active in securing and restoring swan habitat and serving as swan advocates (e.g., KRKO radio tower farm) in Washington State. Current TTSS projects include the Johnson/Debay Swan Preserve in Skagit County, Elwha River Restoration in Clallam County, and Hines Marsh in Pacific County.

TTSS/WSWG has provided technical assistance in the acquisition, planning, and management of the 331-acre Johnson/DeBay Swan Preserve (TTSS 2001). Owned by the Washington Department of Fish and Wildlife (WDFW) and managed in partnership with TTSS, Washington Waterfowl Association, Skagit Audubon Society, and Pilchuck Wildlife Center, the Johnson/Debay Swan Preserve was acquired in 1997 and dedicated on 7 January 2001. This is the first swan reserve in Washington, possibly on the Pacific Coast. It is being developed as a public swan viewing and education center. Since the preserve's inception, there has been a crop management issue that has prevented the site from serving swans and people as originally intended. The problem is growing crops such as corn, and then knocking them down for the birds in November. The FWS considers this baiting if done within an area that may affect waterfowl distribution during hunting season. Hunting occurs on areas adjacent to the preserve proper. The Johnson/DeBay Swan Reserve Stewardship Group has been working with WDFW to develop farming and crop management strategies that will benefit swans in the early part of the season, providing a greater swan viewing opportunity for the public, and not be considered baiting (Martha Jordan, pers. comm.).

TTSS is working closely with the National Park Service at Olympic National Park to mitigate the loss of Trumpeter Swan wintering habitat on Lake Aldwell, which will occur when the Elwha River dams are removed. Removal of the dams has been recommended to help restore the native chinook salmon (*Oncorhynchus tshawytscha*) run. Presently, a combination of strategies is being considered including conservation easements on dairy farms, habitat restoration at Sequim Bay, and management regulations at Quilcene Bay and other areas (Martha Jordan, pers. comm.).

TTSS continues to be active in the restoration of Hines Marsh at the north end of Washington State's Long Beach Peninsula. This 700-acre marsh is one of the largest interdunal wetlands in the U.S., and prior to 1963, supported up to 80 wintering Trumpeter Swans. In 1963, the marsh was partially

drained for a housing development that failed. The altered hydrology transformed much of the marsh from an open water to a scrub-shrub wetland, eliminating Trumpeter Swan habitat. In 1984, TTSS was given two small parcels, which blocked the man-made ditch. In 1989, TTSS purchased 140 acres, which included the water control structure at the outflow for the marsh. TTSS was the victim of an environmental crime in 1997 when one of its dune restorations was destroyed by vandals. As a result of this crime, attention was brought to the marsh that has resulted in a partnership with many citizens and organizations to save the marsh and restore as much of it as possible to swan habitat. TTSS has received two North American Wetlands Conservation Act grants, the first to replace an aging water control structure with a new one, including a fish ladder, and the second to restore open water habitat for swans (Washington Swan Working Group 2002). Two of our many partners in this project, Columbia Land Trust and the Washington State Parks and Recreation Commission, will present papers at this conference. Swans returned to the marsh in January 2003 ending a 40-year absence.

Lead poisoning continues to be a serious cause of Trumpeter Swan mortality in northwestern Washington. In the last three winters, over 700 Trumpeter Swans have died of lead poisoning. This winter, as of 23 January 2003, 75 Trumpeter Swans have succumbed to lead poisoning (Lyke 2003). Subsequent papers will provide more details on the lead poisoning issue.

Oregon

The Oregon Department of Fish and Wildlife does not conduct Trumpeter Swan surveys and did not identify any current management issues specific to Trumpeter Swans (Brad Bales, pers. comm.). Loss of waterfowl wintering habitat due to conversion of pastures to cottonwood plantations along the Columbia River has been an issue. As of 1996, 11,000 acres have been planted in cottonwood on the Oregon and Washington sides of the Columbia River between Longview and Astoria (Washington State University 1996). The loss of dairy farms is also occurring in western Oregon for much the same reasons as in Washington.

CONCLUSION

The expansion of the PCP has been a conservation success story, a testament to the adaptability of the Trumpeter Swan, and a credit to the efforts of TTSS. Serious management issues facing the PCP make its future status less certain. Will the PCP continue to expand in numbers and geographic extent? If it continues to expand, at what rate, and how will the breeding population be monitored? Can adequate high quality wintering habitat be maintained to support a continued population expansion? How should agricultural practices beneficial to swans be supported and encouraged? How long will lead poisoning continue to be a source of mortality and to what extent?

The role of TTSS in ensuring the future of the PCP is as important today as it has ever been. Hopefully, by maintaining a high public profile for Trumpeter Swans and the PCP through public education and involvement, these issues can be resolved to the benefit of swans.

ACKNOWLEDGMENTS

I would like to acknowledge the generous assistance and insights of Ruth Shea, Jim King, Bruce Conant, Don Kraege, and, particularly, Martha Jordan. Bruce provided recent data on Alaskan Trumpeter nesting surveys. Martha provided Washington State data, contact names and numbers, perspectives on current Trumpeter Swan issues, and manuscript review. I would also like to thank Greg Green for technical support and manuscript review. Without their assistance, this paper would not have been possible.

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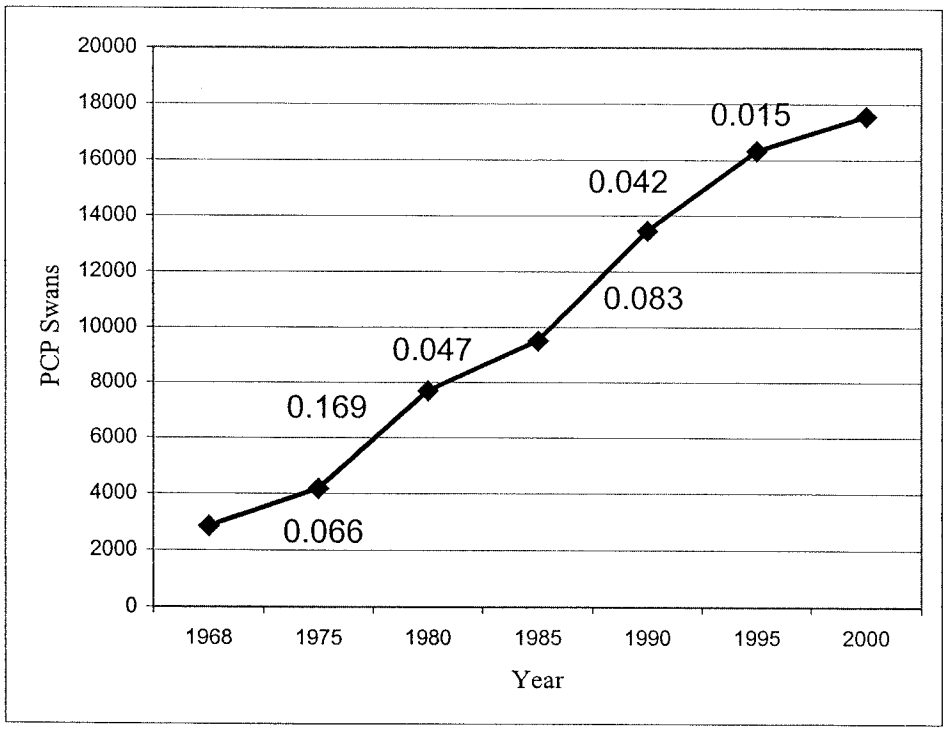

Figure 1. PCP Trumpeter Swan breeding population with average annual growth/survey interval (Conant *et al.* in press; Caithamer 2001).

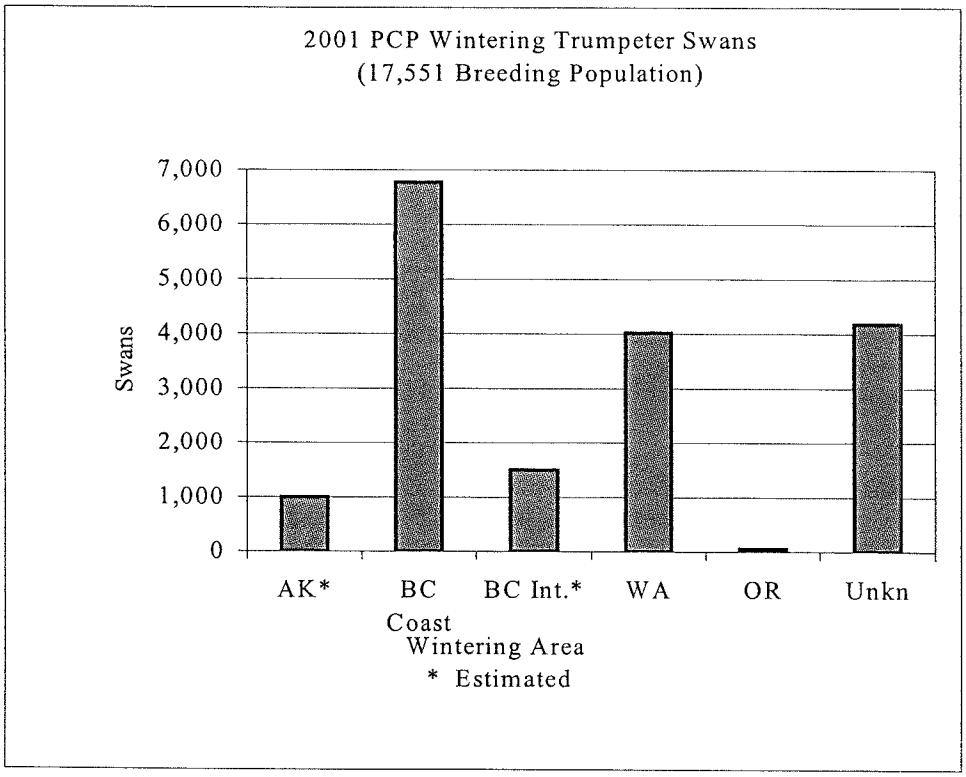

Figure 2. PCP Trumpeter Swan distribution, winter 2001. Populations in Alaska and British Columbia interior (BC Int.) estimated from historical data. Unkn=unknown.

SWAN HABITAT CONSERVATION AND PARTNERSHIPS ON LONG BEACH PENINSULA, WASHINGTON STATE

Glenn Lamb, Columbia Land Trust, 1351 Officers Row, Vancouver, WA 98661

ABSTRACT

The majority of upland bird habitat in North America is privately owned. Private land use decisions have had and will continue to have significant impacts on survival of bird species. Significant upland bird habitat has already been converted to intensive land uses not supportive of birds. Land trusts provide a private, voluntary mechanism for conserving bird habitat together with private landowners.

The 1,200 land trusts in the United States have conserved more than 4 million acres of important private lands. Land trusts conserve land through purchase or donation of conservation easements or fee ownership of land. Land trusts provide significant tax benefits to landowners. Increasingly, land trusts have worked with fish and wildlife agencies to identify and conserve the highest priority bird conservation areas. Private voluntary land conservation is preferred to government ownership in many rural communities because land is kept on the tax rolls and land management remains locally controlled.

Columbia Land Trust has been working with an informal conservation team, including The Trumpeter Swan Society, Grays Harbor Audubon Society, Ducks Unlimited, Inc., The Nature Conservancy, U.S. Fish and Wildlife Service, Washington State Parks, the Pacific Coast Joint Venture, an oystergrowers association, cranberry farmers, and the Washington Department of Natural Resources to conserve critical swan habitat on the Long Beach Peninsula, Washington. The partnership has been successful in securing over $4 million for conservation of interdunal wetlands and forests on the Long Beach Peninsula.

Important aspects of partnership building include:

- **understanding each organization's role;**
- **convening organizing meetings at key points;**
- **making ample use of email and phone;**
- **approaching funders with coordinated projects;**
- **using each group's efforts as match for additional grants;**
- **coordinating publicity and outreach for maximum effect; and**
- **respecting and supporting each group's internal goals (annual campaigns, membership growth, publicity).**

Columbia Land Trust has conserved more than 3,000 acres in the last 2 years through such efforts.

TRUMPETER SWANS WINTERING IN SOUTHWEST BRITISH COLUMBIA: AN ASSESSMENT OF STATUS AND TRENDS

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ABSTRACT

By the late 1990s, approximately 40% of all North American Trumpeter Swans (*Cygnus buccinator*) wintered on the southwest coast of British Columbia, i.e., Vancouver Island and the Lower Fraser River Delta area. Midwinter aerial surveys by the Canadian Wildlife Service (CWS) recorded a dramatic increase from the early 1970s to the present: from only 947 swans in the winter of 1970-71 to a high of 7,111 in 1998-99, followed by a slight decrease to 6,775 swans in 2001-02. A similar trend is apparent in the National Audubon Society Christmas Bird Counts. As the Trumpeter Swan population increased, its distribution in southwest British Columbia also changed. Swan surveys in the 1970s did not include the Lower Fraser River estuary and adjacent farmland because swans were relatively rare there at the time. However, by the mid 1980s, the local swan population had grown to the point where they were counted in CWS' annual midwinter survey for Lesser Snow Geese (*Chen caerulescens*) on the Fraser River estuary. These surveys documented an increase from about 400 birds in the winter of 1987-88 to about 1,300 birds in 1996-97, followed by a decrease in subsequent years. Also, beginning in 1988, the Fraser River Delta and farmland east to Hope were included in the southwest coastal midwinter survey conducted every 3 years. In addition to their traditional coastal marshes, swans "discovered" vegetable fields (e.g., potatoes), pastures, and cover crops concentrated on the east coast of Vancouver Island and in the Lower Fraser River Delta area. These agricultural foods now support the majority of swans wintering in southwest British Columbia. Hence, the combination of being protected from hunting for decades, relatively consistent high recruitment rates, and, in more recent years, access to high quality (farm) foods during winter, cumulatively contributed to the rapid growth of the Pacific Coast Trumpeter Swan Population. Despite the attraction of farmland to swans, the many small estuaries, especially on the west coast of Vancouver Island, support a substantial number of birds. However, these estuaries may be at or near their carrying capacities. CWS will continue to monitor wintering Trumpeter Swans in southwest British Columbia on roughly a 3-year interval and on the Lower Fraser River Delta foreshore annually. Swan flocks will continue to be geo-referenced to specific habitat types, and, whenever possible, photo counts will be used to improve estimates of population size and recruitment rate.

LEAD POISONING OF TRUMPETER AND TUNDRA SWANS BY INGESTION OF LEAD SHOT IN WHATCOM COUNTY, WASHINGTON, USA, AND SUMAS PRAIRIE, BRITISH COLUMBIA, CANADA.

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INTRODUCTION

Poisoning of waterfowl from consumption of spent lead shot has been documented in North America (Bellrose 1959; Sanderson and Bellrose 1986). The use of lead shot for waterfowl hunting was banned in the United States in 1985 and in Sumas Prairie, British Columbia, in 1990. At least 868 Trumpeter Swans (*Cygnus buccinator*) and Tundra Swans (*C. columbianus columbianus*) died from ingesting lead shot in Whatcom County, Washington, and Sumas Prairie, British Columbia, over the past four winters (1999-2003). There was also a die-off involving lead poisoning of approximately 100 swans in the same area in 1992 (Wilson *et al.* 1998). A study was initiated in 2001 to locate the sources of lead and halt the swan mortalities. Preliminary results are presented for field work conducted over the past two winters (2001-02, 2002-03).

METHODS

Immediately upon arrival on the wintering grounds in November and December, 68 swans were trapped, blood sampled, and outfitted with VHF radio transmitters. Blood samples were analyzed for lead burdens to determine if the swans were exposed to lead prior to their arrival. The locations of radio-tagged swans were recorded each day and night throughout the winter to locate forage areas and roost sites. Habitat use patterns of the lead-poisoned and apparently healthy individuals were then compared in order to identify potential source areas. Swan population roadside surveys were conducted in Whatcom County and Sumas Prairie twice a week from October through December. Agricultural fields used by swans were identified and the number of swans was counted. Areas of high swan use were assessed for lead shot by collecting core samples. Shot density was calculated for 12 forage fields, eight roost sites, and a temporary roost site (an agricultural field that flooded temporarily during winter months and was used by swans as a roost site). All forage fields were located in Sumas Prairie. Based on an assessment of hunting activity, a sampling location was selected and 30 cores collected in a 25-meter-grid pattern. Of the eight roost sites assessed, four were in Sumas Prairie and four were in Whatcom County. At the Sumas Prairie roosts, core sampling was conducted over the entire roost site in a 25-meter-grid pattern, whereas in Whatcom County core sampling was restricted to the perimeter of the roost. Sick and dead swans were collected at least weekly throughout the winter. Carcasses were necropsied to determine cause of death. Gizzard contents were examined and the number, type, and size of shot recorded.

RESULTS

Of the 26 swans radio-tagged in 2001, 5 died during the winter but only 1 was exposed to lead after capture. In 2002, 42 swans were tagged (of 43 trapped) and 16 of the previously tagged swans returned resulting in a total of 58 swans being monitored. Only 1 of those 58 swans died of lead poisoning. Preliminary analysis of the telemetry and survey data has identified areas of high swan use and several potential sources of shot. Assessment of areas used by the lead-poisoned and apparently healthy individuals is ongoing.

Analysis of lead from blood samples suggested that 84% of the swans arrive on the wintering grounds with low lead levels reflective of natural background exposure (mean=0.061 mg/g wet wt, SD=0.042, range 0.025-0.188, n=57). However, 11 of the 68 swans tested had levels over 0.2 mg/g wet wt (mean=0.628 mg/g wet wt, SD=0.549, range 0.210-1.972), the threshold for sub-lethal exposure (Wilson *et al.* 1998). Trapping occurred over an approximate 37-day period each winter.

Locating the sources of lead was complicated because most (89%) poisoned swans were retrieved from night roost sites away from foraging areas. Shot was detected in only 1 of the 12 forage fields examined. A total of two shot was found, which equated to a density of 33,280 shot/acre. Lead shot was detected at the four Sumas Prairie roosts and two

of the Whatcom County roosts. Mean density of shot was 58,264 shot/acre with a maximum of 153,753 shot/acre. A small amount of exploratory sampling was conducted at the temporary roost site in Whatcom County. Results suggest that this site had higher shot density than all other roosts and forage fields sampled. However, because that area was quite large, excessive costs prohibited intensive mapping of lead shot density by core sampling. Future work will focus on the monitoring of radio-collared swans in order to link site use to mortalities.

DISCUSSION

The monitoring of swan mortalities and examination of shot recovered from the gizzards suggested the following findings:

1. Poisoned swans likely died of acute, not chronic, lead toxicity. Of the 237 swans examined and found to contain shot in 2001-02, an average of 36 shot was found in each gizzard. Eighteen swans had more than 100 shot/gizzard; one bird had 328 shot. The U.S. Fish and Wildlife Service estimates that a waterfowl which has ingested 1-2 shot would die approximately 21 days after consumption.
2. The sources of lead shot are likely areas historically and presently hunted for waterfowl. Preliminary assessment of shot from the gizzards showed that 75% was lead with the remainder nontoxic (steel or equivalent). The size of shot suggests that skeet shooting and upland game hunting are not likely sources.
3. Most poisonings started in late November shortly after the arrival of swans on the wintering grounds. Mortalities peaked in early January, approximately 2-4 weeks after the majority of swans arrived. Mortalities declined by mid-February when many swans appeared to move to more southerly areas, such as Skagit County.
4. The majority (70%) of poisoned swans was recovered in the U.S., the remainder in Canada. In 2001-02, of the 325 mortalities, 207 were in the U.S., 118 in Canada. In 2002-03, of the 182 mortalities, 150 were in the U.S. and 32 were in Canada. Population surveys conducted in October through December showed that more swans were present in Whatcom County compared to Sumas Prairie (77% in 2001-02, 84% in 2002-03).
5. Although more swans were recovered in the U.S. compared to Canada, the proportion of mortalities in the two areas showed that a significantly higher proportion of swans died in Sumas Prairie compared to Whatcom County in both 2001-02 and 2002-03 ($p<0.01$). The confidence of these statistics is limited because the calculations are based on the number of mortalities that occurred while population surveys were conducted (October–December), but the majority of mortalities occurred when population surveys were not conducted (January–February).

It is unclear why poisonings occurred in 1992 and again during the last four consecutive winters. There could be a recent increase in illegal use of lead shot for waterfowl hunting. However, there may also have been a shift in the habitat used by swans which now permits them access to spent shot, which has persisted in the environment. Swan populations wintering in the Pacific Northwest are estimated to have increased exponentially at 7% per year during the last 3 decades (Boyd 1994). It appears that swans may have expanded inland into the Whatcom County and Sumas Prairie areas, and they are now using new habitat, which may contain significant amounts of spent shot.

Annual precipitation rates may affect the extent of annual mortalities observed in the Whatcom County and Sumas Prairie areas. For instance, the temporary roost site that was identified as a potential source of shot in 2001-02 was not flooded most of the 2002-03 winter due to low precipitation rates. This change to the habitat, which results in fewer swans routinely using the area, may be one reason why 44% fewer mortalities were recorded in 2002-03 compared to the previous year.

Preliminary results suggest the sources of lead shot responsible for the swan mortalities in the Whatcom County and Sumas Prairie areas are likely local. The main sources of lead shot may be either in Whatcom County or Sumas Prairie, possibly near the border.

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TRUMPETER AND TUNDRA SWAN MORTALITY IN WASHINGTON STATE, USA, AND BRITISH COLUMBIA, CANADA, 2000-02

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ABSTRACT

An unprecedented number of swans died in northwestern Washington (Whatcom, Skagit, and Snohomish Counties) and Sumas Prairie area, British Columbia, during the winters of 2000-01 and 2001-02. At least 633 swans died during this period and 517 were necropsied, including 401 from Washington and 116 from British Columbia. Washington birds were necropsied by personnel from North Carolina State University and volunteers from Washington State, and Canadian birds were necropsied by personnel from the British Columbia Ministry of Agriculture, Fisheries and Food, and Canadian Wildlife Service. Approximately 92% of the necropsied birds were Trumpeter Swans (*Cygnus buccinator*) (n=475) and 8% were Tundra Swans (*C. columbianus columbianus*) (n=42), which approximates the relative abundance of each species in the local population. The sex ratio was similar, with 51% males (n=262), 47% females (n=241), and 2% sex undetermined (n=14). Adults represented 43% (n=225) of the total, while subadult and juvenile swans comprised 57% of the total (36% subadults [n=185] and 21% juveniles [n=107]). Approximately 82% (n=422) died from lead poisoning following ingestion of lead shot. Lead poisoning was diagnosed in swans with liver lead levels exceeding 20 ppm dry weight [d/w]. If liver tissue was unavailable, other corroborating

evidence was used to make a presumptive diagnosis of lead poisoning (i.e., nine swans with missing liver were diagnosed as lead poisoned based upon high lead shot numbers recovered from their ventriculus [mean 43.6 lead shot; range 10–142]). Subclinical lead poisoning was diagnosed in 4% (n=19) of the birds. Aspergillosis as the primary cause of death (non-lead-poisoned swans) was diagnosed in 23 swans (4%). Another 44 swans with mild to severe respiratory aspergillosis also had lead poisoning. Trauma (including power line strikes/electrocution, and gunshot) accounted for 7% (n=36) of mortalities. The cause of death was undetermined in 3% (n=17) of the swans. Most shot collected from gizzards was lead (mean ± SD: 24.0 ± 7.8; range 0-381); the remainder was nontoxic shot (mean ± SD: steel shot 8.0 ± 1.4; range 0-311; other nontoxic shot 0.7 ± 0; range 0-22). One swan collected in 2001 in Whatcom County had 692 lead and steel shot in its gizzard. Lead-poisoned swans had very high liver lead levels, compared to subclinical lead-poisoned and non-lead-poisoned swans (63.1 ± 39.8 ppm; 10.9 ± 0.4 ppm; 0.3 ± 0 ppm, respectively [d/w]). Most swans (89%) from Whatcom County were lead poisoned (291 of 327). Other locations of lead-poisoned swans included Sumas Prairie area (111 of 116), Skagit County (16 of 61), and Snohomish County (2 of 8); five swans were recovered from other areas, or the recovery location was not reported. More swans were necropsied in 2001-02 (59%, n=307) than in 2000-01 (41%, n=210). Likewise, more birds died of lead poisoning in 2001-02 (61%, n=259) than in 2000-01 (39%, n=163). A huge collective effort on the part of many agencies and volunteers made this mortality study possible. The information gained will add to our understanding of swan diseases and contribute to the efforts to find the sources of lead shot responsible for the swan mortality in this area.

DEVELOPMENT OF A DETAILED LANDSCAPE PLAN TO SUPPORT OVERWINTERING AND MIGRATING WATERFOWL FOR THE FRASER RIVER DELTA

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ABSTRACT

Ducks Unlimited Canada (DUC) over the last 4 years has gone through a very thorough planning process to develop a "Vision and Strategies" within all of our Eco-Regions (Eastern, Mississippi, Prairie, Western Boreal Forest, Intermountain, and British Columbia Coastal). Once the strategies were developed, the highest priority areas had to be identified. Then, detailed Landscape Plans were developed complete with the necessary tools to achieve our objectives. The planning process looked at all the variables (limitations, threats) on the landscape together with immediate and potential future problems. The process also incorporated energetic modeling (Mark R. Petrie, DUI) to estimate available food versus rate of depletion on farmlands. The process incorporated input from all our partners: federal, provincial governments, and other nongovernment conservation organizations. The completed plan identified seven key tools to be implemented (On-farm Planning, Conservation Covenants, Conservation Agreements, Farm Land Acquisition, Extension/Education, Research/Evaluation, and Policy/Influence) and habitat objectives to be achieved. At present, similar Landscape Plans are being developed for the east coast of Vancouver Island, the Fraser River Valley, and North Puget Sound. Through additional research and evaluation of our programs, objectives will be fine tuned and strategies refined.

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SPATIAL AND TEMPORAL USE OF ESTUARY AND UPLAND HABITAT BY WATERFOWL WINTERING ON THE FRASER RIVER DELTA AND NORTH PUGET SOUND

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ABSTRACT

Ducks Unlimited Canada (DUC) and Ducks Unlimited, Inc. (DUI) cooperatively have developed a 3-year research project that began in the fall of 2002. The project will begin field studies in the Fraser River Delta in 2002-03 and will expand to the North Puget Sound region in 2003-05. The project will incorporate both radio telemetry and the measurement of food depletion in the intertidal and adjacent agricultural habitats. The information will provide both spatial and temporal information at three scales (agricultural field, estuary, and ecosystem) that will allow habitat managers to better understand how waterfowl make foraging decisions during the winter period as well as refining habitat objectives for DUC and DUI conservation programs. In addition, the information will lead to the development of a joint DUC-DUI conservation plan for the Fraser River Delta–North Puget Sound ecosystem as birds routinely use habitats on both sides of the United States–Canada border to meet their daily and seasonal resource requirements. Failure to plan at this landscape scale would ignore how the birds use this system, and would represent a missed opportunity to coordinate habitat programs along a shared border.

WINTERING TRUMPETER AND TUNDRA SWANS IN THE SOUTHERN INTERIOR OF BRITISH COLUMBIA

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ABSTRACT

Midwinter censuses from 1974 to 2003 indicate that what was likely a stable and unique wintering population of Tundra Swans (*Cygnus columbianus columbianus*) in the interior of British Columbia has become a mixed species assemblage of Tundra and Trumpeter (*C. buccinator*) Swans during that time period. Trumpeters increased dramatically beginning in 1984 while Tundras declined, but a causal link was not demonstrated. Observations of collared birds indicate that the study area was populated by Trumpeters from both Alaskan and Rocky Mountain stocks. Carrying capacity (K) estimates corroborate historical information that circa 400 swans can winter in the study area, with recent data suggesting that the number of swans of all species has remained fairly stable. This phenomenon may remain as a permanent displacement, although the relative proportions of both species could fluctuate within a theoretical carrying capacity that is unlikely to exceed 600 birds. Evidence indicates that this population shift has likely occurred as a result of the natural growth of Trumpeter Swan populations and perhaps as a result of translocation efforts to lessen die-offs and habitat damage in the northern tier states.

INTRODUCTION

Both the Trumpeter Swan (*Cygnus buccinator*) and the Tundra Swan (*C. columbianus columbianus*) occur as migrants through the south-central interior of British Columbia. Both species can be found wintering together in traditional, scattered locations where open water permits foraging. The South Thompson River near Kamloops has been the only major wintering site for Tundra Swans in the interior of the province. We examine data from 1974 to 2003 and document relative changes in numbers of the two species and comment on the likely origins of the expanded Trumpeter population wintering in the area. As well, we estimate carrying capacity using the logistic population dynamics model and compare this with historic and recent observations of swan numbers.

STUDY AREA

The study area extends from 49° to 51° North latitude and from 118° to 121° West longitude (Figure 1) as described by Howie (1993). The surveyed areas comprise the drainages of the South Thompson, Shuswap, Okanagan, Kettle, Similkameen, and Nicola Rivers. The river elevations range from 277 to 375 m geodetic above sea level and all have gentle grades with extensive areas of slow moving water. January temperatures are more continental with a mean at Kamloops of minus 10° C. Periodic southward flows of arctic air masses can cause periods of temperature extremes reaching minus 30° C to minus 40° C. Temperatures in the southern portion of the study area are somewhat milder. All areas are subject to influences from Pacific air masses.

METHODS

Howie coordinated annual censuses by volunteers in mid-January from 1974 to 2003 using methods previously described (Howie 1993). The censuses were conducted on the ground using binoculars and telescopes, with no corroborative aerial counts to determine if all birds had been found. Strong attempts were made to find every bird, determine the species, and to assign each to an adult or juvenile age class. We noted the number of juveniles present over the entire count area with no attempts made to determine family groupings. Most sub zones of the study area were surveyed annually with minor exceptions in areas where traditional swan usage is low. The presence or absence of ice that could affect foraging opportunities was noted in a subjective way. Water levels were not recorded during the surveys, but subsequent analysis of the potential influence of water depths in the South Thompson River was undertaken (Adamski 2001).

Bison derived the carrying capacity estimates based on data obtained during this recent 30-year-census period.

Because of the apparent contrast in the Trumpeter Swan time series, we used a deterministic logistic model in the form:

$$N_{t+1} = N_t + rN_t\left(1 - \frac{N_t}{K}\right)$$ to estimate population carrying capacity (K) and an intrinsic rate of population growth (r). We assumed observation error was log-normally distributed and therefore our observation model took the form:

$$N_{obs,t} = N_t + e^{v_t}$$

where v_t is normally distributed with a mean of zero and the standard deviation is assumed known. The likelihood function used to fit the model to the data was calculated as:

$$L = (s^2)^{-(n-1)/2}$$

where s^2 is the sum of squared differences between log of the observed and predicted values of N (Walters and Ludwig 1994). Population parameters K, r, and starting population size were then estimated using the non-linear search routine Solver, Microsoft Excel 97. Posterior probability distributions for K and r were then calculated by dividing the likelihood of a parameter value given the data by the sum of likelihoods over all parameter values admitted (Walters and Ludwig 1994). Confidence intervals for parameters K and r were then read directly from these probability distributions.

The deterministic logistic model was also fitted to the Tundra Swan time series as described above, except we included a species interaction coefficient (d) under the assumption that Trumpeter Swans have a negative influence on the Tundra Swan population. Therefore, the logistic model for Tundra Swans was:

$$N_{t+1} = \left[N_t + rN_t\left(1 - \frac{N_t}{K}\right)\right]e^{dD_t}$$

where Dt represents the abundance of Trumpeter Swans and is calculated as the normalized deviations about the mean. Method of calculating likelihoods, fitting of the model, and calculation of posterior probability distributions for parameters of interest (K and r) were as described above for Trumpeter Swans.

RESULTS

The results of 29 surveys over a 30-year period are presented in Table 1. Data for 1975 were not available.

Trumpeter Swans

Trumpeter Swans were not detected annually until 1984. A trend developed to a peak of 693 birds in 1994 and from then until 2003, numbers varied between 258 and 490 birds, annually. The 5-year moving average showed a distinct upward trend for 13 years, peaking in 1998 at 426 birds, followed by a dip in 2000, and then a rebound to about 370 birds (Figure 2). The percentage of juveniles recorded is given in Table 2. Subsequent to 1991, when the wintering population had increased to 171 birds, the variation in the number of juveniles in the population tended to move in parallel with the number of wintering adults (Figure 3). For just the years when Trumpeters were recorded, the simple average for juveniles was 18%, but the 5-year moving average suggests it may be somewhat stable in the 14-17% range.

Tundra Swans

Tundra Swans were likely present during all 30 years of the count, but data for 1975 were not available. The 5-year moving averages increased for the first 11 years of the count and peaked in 1985 at 537. From 1988, they have declined to a low in 2000 followed by a slight rebound (Figures 2 and 4). The percentage of juveniles recorded is given in Table 2. The simple average for juveniles in the wintering population was 22%. However, the 5-year moving average shows a consistent negative trend from a high of about 31% early in the survey period to a low of 15% at the end.

All swans

When the number of both species of swans was lumped together, the annual total ranged from 130 to 1,012 birds with a simple annual average of 484 birds. The 5-year moving average indicates a slightly increasing trend or perhaps a stable variation approaching 550 birds (Figure 2). The percentage of juveniles recorded is given in Table 2.

Table 3 shows the maximum and minimum numbers of swans recorded on any one count. The highest counts ever for Trumpeters or Tundras were almost identical and neither species ever reached the combined total of both species when 1,012 birds were observed in 1994. That is, the highest total wintering population of swans ever recorded was not comprised of just one species. Both species have cohabited on the wintering grounds every year since 1984.

Banded swans

Between November 1993 and October 1998, we observed two leg-banded and 12 collared Trumpeter Swans in the Kamloops area. Some were seen during migration and not on the mid-January census. Nine of the collars were green and one was blue. A yellow-collared bird was seen in 1988. Details of the observations and alphanumeric codes are noted in Table 4. Three additional blue-collared Trumpeters were reported from the study area during the winter (King 1993). A single blue-collared Tundra Swan was observed in the study area on 14 March 1986.

Population model

The Trumpeter Swan data have good contrast as the time series spans the entire period of colonization and population growth including recent counts that suggest the population is stabilizing (Figure 5). Therefore, the empirical estimates of carrying capacity (K) and population growth rate (r) appear informative. The best fit parameter estimate for K was 391 and the 95% confidence interval was estimated to be 250-680 (Figure 6). The best fit parameter estimate of r was 0.49 and the 95% confidence interval was estimated to be 0.35-0.66 (Figure 7).

The Tundra Swan data, assuming the population is influenced by Trumpeter Swans, were informative with respect to K, but not informative with respect to *r*. Best fit parameter estimate for K was 336 and the 95% confidence interval was estimated to be 200-600, roughly similar to the carrying capacity estimate for Trumpeter Swans (Figure 8). The best fit parameter estimate for *r* was 0.27, but uncertainty was large as it was apparent that *r* and the species interaction coefficient *d* were confounded. Higher values of *r* implied that the species interaction had to be stronger in order to explain the decline in Tundra Swans over time, and vice versa (Figure 9).

DISCUSSION

Estimates of population size and carrying capacity

Is there other evidence to suggest that the derived K of 391 is a reasonable number, and how does it compare to historical and recently observed populations? The presence of about 400 wintering Tundra Swans south of 51° N was documented in literature (Bellrose 1976) for an area which roughly corresponds to the current study area. The Trumpeter Swan data strongly suggest a carrying capacity which corroborates the Bellrose data. No Trumpeters were noted as wintering within the same area. Data for that publication were collected from 1955-74. In the current study from 1974 to 2003, 5,071 Trumpeter Swans and 8,943 Tundra Swans for a total of 14,014 swans were counted in the study area. The simple average of 483 birds is exceeded by the moving average, which may be stable around 550 birds. The predicted carrying capacity based on the logistic population growth model may, in fact, be closer to the observed averages, but insufficient information about sources of error was available to speculate on these apparent differences.

Population composition

Stable numbers of total swans over time combined with the relative changes in numbers suggests that an interaction between the species may exist. But a mechanism for this is not known and, therefore, the causal relationship between Tundras and Trumpeters, if any, remains uncertain. Interspecific aggression has not been observed, but competition for food seems plausible. Removal of count data collected in years when ice formation apparently forced swans to leave the South Thompson River may improve estimates of K and r and may reveal a stronger correlation between the species. Removal of data from years of increased flow levels in the South Thompson River may also be of interest in this regard (Adamski 2001).

Sources of error

The most likely source of error in the data is species misidentification. Likely, there should have been a category for unidentified swans in the data analysis process. High level of observer confidence in separating the species may be unwarranted, but it is our opinion that the trend information is still valid. Species misidentification error is likely less than 10% with a possible tendency to put uncertain birds into the Trumpeter category. Another source of error relates to the assumption that all birds were counted. We do not believe this to be a major source of error in comparison to events such as ice formation or increased winter flows on some rivers (Adamski 2001). Given that observation, proficiency was not likely perfect and that the data contained years when stochastic weather events may have had negative influences, empirical estimates of carrying capacity (K) could be biased downward. We believe this to be a relatively small difference, but we are unable to be precise in the estimate.

Origins of wintering swans

Banded swan observations suggest that some of these newly established wintering Trumpeters belong to the Pacific Coast Population (PCP) and perhaps the Canadian Breeding Segment of the Rocky Mountain Population (RMP) that breeds in northeastern British Columbia, the Yukon Territory, Northwest Territories, and central Alberta. Between 1974 and 1997, the RMP/Canadian Breeding Segment increased from 127 to 2,500 birds (Shea 1999) with a current population estimate of 3,928 birds (Olson 2002). This growing population traditionally migrated from the Canadian breeding grounds to a relatively confined wintering area in the Tri-state region of Idaho, Montana, and Wyoming. This resulted in overcrowding on the winter habitat used both by the Canadian flocks and the resident Tri-state flocks. The Canadian birds showed no inclination to disperse to other wintering habitats (Shea 1999).

It seems likely that most of the RMP/Canadian Breeding Segment was migrating east of the Rocky Mountains through Alberta, as there were very few observations of Trumpeters in migration through the Kamloops - South Thompson River area prior to 1984. This is also the year when small numbers appeared amongst the flocks of wintering Tundra Swans on the South Thompson River. Habitat concerns in the Tri-state area led to the initiation of swan relocation efforts commencing in 1987 and continuing until 1996 (Shea 1999; Anglin 1999). Trumpeters from unknown origins started to appear near Kamloops three winters prior to the Tri-state management initiatives. More aggressive translocation efforts were undertaken from 1990 to 1992, which included the moving of birds westward from the Tri-state area to Summer Lake in south-central Oregon. Summer Lake lies southwest of the Kamloops - Shuswap area, whereas all of the other release sites lie southeast of this area. The natural flyway from areas to the southeast back to the natal areas in northeastern British Columbia would not bring birds past Kamloops. From 1993 to 1998, green-collared swans were seen in the Kamloops vicinity both during migration and during the winter (Table 4). Alphanumeric codes were obtained from five of the nine bands indicating that all of the birds had been released at Summer Lake in previous years. One of the birds had been banded as a juvenile near Grande Prairie, Alberta, in 1992 (S. Bouffard, pers. comm.). It was during this period of intense relocation effort that the Kamloops - Shuswap wintering Trumpeter population reached its peak (Figure 10). The yellow-collared bird may have been from the central Alberta flocks being translocated as part of restoration initiatives there (G. Beyersbergen, pers. comm.).

The general area around Grande Prairie is a breeding nucleus for some of the Canadian birds. The South Thompson River - Shuswap Lake area lies directly along a straight flight line projected between Summer Lake, Oregon, and Grande Prairie. Some or all of the transplanted birds migrated along this general flight path and may have short-stopped on their return fall migration and established a new wintering area in this portion of British Columbia. Birds migrating into northeastern British Columbia and the Yukon from Summer Lake could also follow this general flight path and pass through the South Thompson River wintering site. As well, birds wintering at new sites in California could pass the Kamloops area, as the general flight corridor into the Canadian breeding area is similar, although it is known that at least some birds move eastward in the United States before entering Canada, and follow a similar return route in the fall.

There have been no sightings of collared birds at Kamloops since 1998. Migrants pass the area in spring and fall, so wintering locations for these birds are still of interest. It is possible that some of the original birds displaced from the Tri-state area may now be wintering in the Kamloops - Shuswap area of British Columbia. However, wintering birds remain abundant in the Greater Yellowstone Tri-state region suggesting that most relocated birds reverted to their traditional migration routes.

The blue-collared Trumpeters observed in 1984, 1988, 1989, and 1997, add further information about the origins of the local wintering birds. All of these birds were banded in Alaska (King 1993; R. W. McKelvey, pers. comm.). An interior migration route for PCP Trumpeters was described by McKelvey and Burton (1983) and King (1993). This route is generally northwest of Kamloops and is traveled by birds that winter in the vicinity of Prince George (circa 53° N) as well as coastal British Columbia. Some birds move south through this corridor and encounter suitable wintering conditions near Kamloops and the south Okanagan. While the southern interior wintering group may be comprised of birds from both the Pacific Coast and Rocky Mountain Populations, the relative proportions are not known. Perhaps the initiation of growth in the southern interior wintering population had its origins from the burgeoning PCP birds as they occupied the most logical flyway leading to the Kamloops - Okanagan area. Later, following translocation of the Tri-state birds, a new, but perhaps temporary, flyway

was established leading to supplementation by birds from the Rocky Mountain Population. A single, blue-collared Tundra Swan observed near Kamloops in March of 1986 was from Alaska (R. W. McKelvey, pers. comm.). It has always been assumed that the origins of migrant and wintering Tundras have been Alaska and the western Canadian Arctic.

Other factors influencing swans wintering in the Kamloops - Shuswap area

The South Thompson River, Shuswap Lake, Shuswap River, and Okanagan Lake generally retain much open water during most winters. Annual southward invasions of arctic air masses can result in extreme temperatures (-25° C) that can produce significant shore ice or extensive freezing that eliminates swan foraging habitat on the South Thompson River. El Niño events during the recent decades have eased the frequency of these influential icing conditions. However, swan numbers have been suddenly depressed from early winter levels due to the quick loss of foraging opportunities. During the first 10 years of the count period when sudden freezing occurred, birds would simply move to the outlet of Shuswap Lake or stretches of the river below the outlet that remained open. This phenomenon has not been noticed for the past 15 years. When icing occurred, Tundra Swans in particular would simply depart the region, possibly flying southwest to the Fraser River Delta, which could be reached within a day's flight. For purposes of this study, the influences of ice on swan numbers were not factored into the analysis. Several periodic declines in numbers over the 30-year survey period may be explained by icing, but it is felt that this has not influenced the overall trends significantly.

In some years, flows in the South Thompson River were above normal for the winter period, leading to speculation that water levels may influence access to aquatic macrophytes, and therefore swan numbers. Adamski (2001) compared January staff gauge heights and wintering swan numbers. Although forage availability was not measured as a correlate with gauge height, a modest negative correlation between gauge height and swan numbers ($r^2 = 0.26$, $p = 0.017$) was demonstrated. When data for years when ice was more extensive was eliminated from the analysis, the correlation ($r^2 = 0.75$, $p = 0.000129$) was stronger. His model concluded that increasing gauge height and therefore water depths would result in reductions in swan numbers. There are no data from the study to indicate that Trumpeters forage more successfully than do Tundras in deeper water.

Even though icing conditions and water depths can both exert negative influences on the numbers and distribution of swans along the South Thompson River and in Shuswap Lake, neither factor appears to have contributed to a long-term decline in the total numbers of wintering swans. Further study is needed to determine whether either factor played a part in the decline in the Tundra numbers, but it seems unlikely. There has not been a trend towards extensive icing or high water levels over the past 3 decades. Unless long-term weather trends turn these stochastic conditions into chronic negative influences, it is likely that the impacts of these two factors will remain episodic.

The availability, productivity, and evolution of the aquatic macrophyte community are obvious factors of influence on wintering swan numbers. No research has been done on this aspect of the ecology of the wintering sites. Species composition and the response to herbivory by swans or external environmental factors such as pollution, nutrient input, water levels, sedimentation, and shifting substrates have not been examined.

CONCLUSIONS

Subsequent to the major decline of Trumpeter Swans throughout their breeding range, the dominant swan wintering in the south-central interior of British Columbia was the Tundra Swan, with a population estimate of 400 birds. A major increase in the numbers of migrant and wintering Trumpeters in the south-central portion of British Columbia is strongly linked to the dramatic growth of both the Pacific Coast Population and the RMP/Canadian Breeding Segment between 1974 and 2003. The appearance of Trumpeters in the Kamloops - Shuswap area also coincided with the translocation of 1,280 birds wintering in the Tri-state area to other wintering sites in the northern tier states, including Summer Lake, Oregon. Observations of collared birds indicated that some migrated from Oregon to the Canadian breeding grounds and passed Kamloops en route. A portion of these birds may now winter in south-central British Columbia, concentrated along the drainage of the South Thompson River. Observations of collared Trumpeters from Alaska suggest that this population also supplied birds that established in the southern interior. The wintering population may still remain as a mixed stock grouping.

Coincidently, a unique population of Tundra Swans wintering in the same area has declined dramatically. Population modeling, recent data, and historical

abundance suggest that there is a carrying capacity of 400 to 500 birds on these wintering grounds and it is speculated that the ratios of Trumpeters and Tundras will remain in some form of dynamic balance within this carrying capacity. A study to determine a mechanism for Trumpeter influence on Tundra numbers would be informative. The translocation program in the Tri-state area was likely influential in creating what may be the only wintering area in southern Canada for birds of the Rocky Mountain Population.

Despite a downward trend in wintering Tundras, the South Thompson River in particular is an important site for two species of swans in the interior of the province and is deserving of protection and further study.

ACKNOWLEDGMENTS

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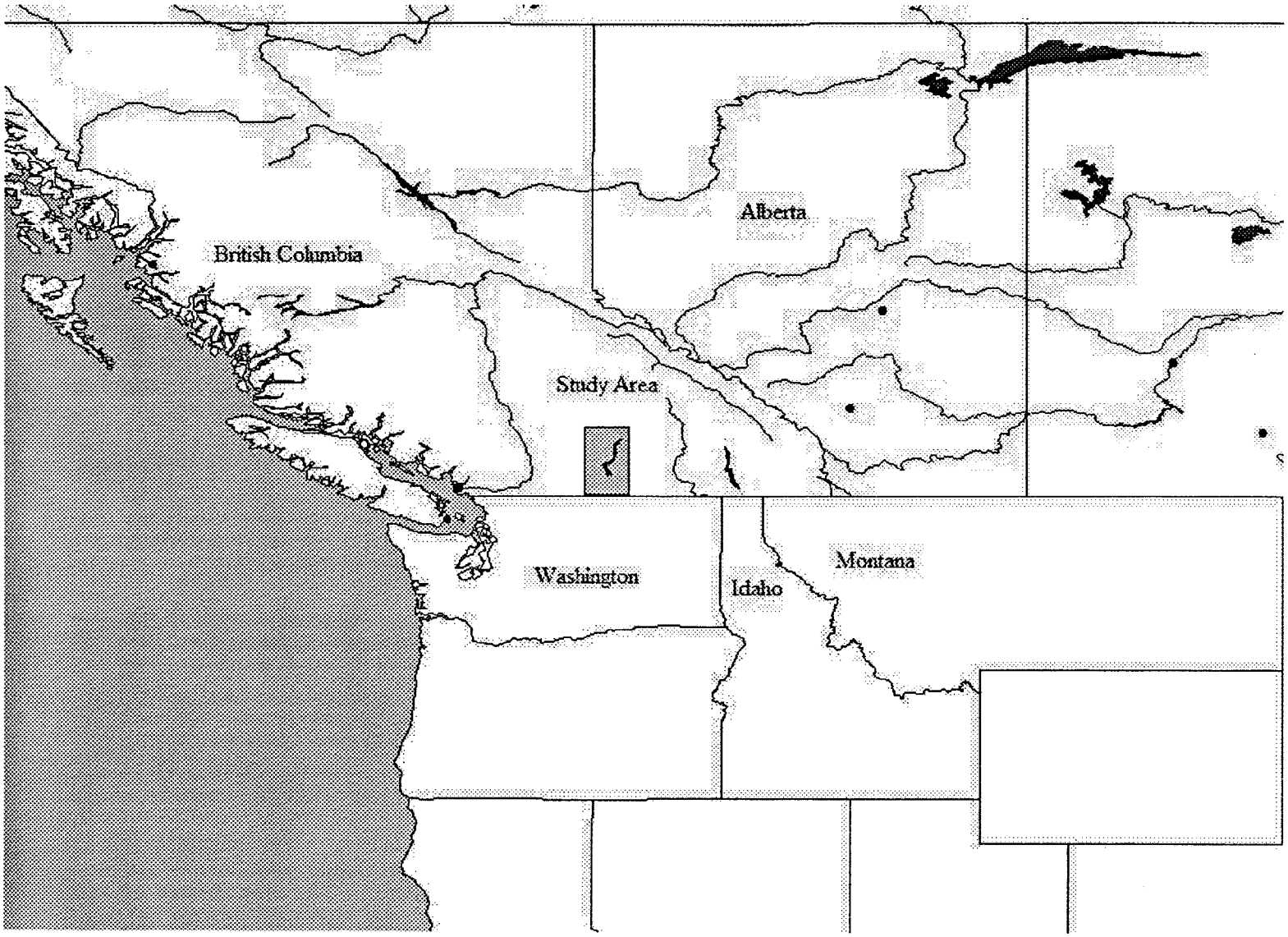


Figure 1. Study area.

Table 1. Mid-January counts of Trumpeter and Tundra Swans in southern interior British Columbia, 1974-2003.

	Trumpeter			Tundra			
	Adult	Juvenile	Total	Adult	Juvenile	Total	Total all
1974	0	0	0	285	no data	285	285
1975							no census
1976	0	0	0	236	123	359	359
1977	2	0	2	461	185	646	648
1978	0	0	0	130	?	130	130
1979	0	0	0	309	?	309	309
1980	0	0	0	219	72	291	291
1981	2	0	2	410	127	537	539
1982	0	0	0	259	117	376	376
1983	0	0	0	481	139	620	620
1984	12	0	12	346	122	468	480
1985	13	3	16	500	185	685	701
1986	49	8	57	83	27	110	167
1987	19	10	29	400	213	613	642
1988	29	22	51	445	200	645	696
1989	94	22	116	328	75	403	519
1990	109	28	137	370	73	443	580
1991	148	23	171	29	11	40	211
1992	226	67	293	420	108	528	821
1993	204	15	219	55	3	58	277
1994	548	145	693	256	63	319	1012
1995	321	91	412	322	58	380	792
1996	205	53	258	66	16	82	340
1997	286	30	316	21	7	28	344
1998	364	88	452	35	8	43	495
1999	227	29	256	64	15	79	335
2000	223	35	258	48	3	51	309
2001	356	48	404	118	27	145	549
2002	426	64	490	153	25	178	668
2003	354	73	427	79	13	92	519
Totals	4,217	854	5,071	6,928	2,015	8,943	14,014
Average			175			308	483

Table 2. Percentage of juvenile swans in mid-January in southern interior of British Columbia. 1974–2003.

	Trumpeter	Tundra
1974	0	no data
1975	no data	no data
1976	0	34
1977	0	29
1978	0	no data
1979	0	no data
1980	0	25
1981	0	24
1982	0	31
1983	0	22
1984	0	26
1985	19	27
1986	14	25
1987	34	35
1988	43	31
1989	19	19
1990	20	16
1991	13	27
1992	23	20
1993	7	5
1994	21	20
1995	22	15
1996	21	19
1997	9	25
1998	19	19
1999	11	19
2000	14	6
2001	12	19
2002	13	14
2003	17	14
Average	12	22

Table 3. Maximum and minimum numbers of swans recorded on any one count, southern interior of British Columbia, 1974 – 2003.

	Min	Max
Trumpeter[1]		
ad	0	548
juv	0	145
lumped	0	693
Tundra		
ad	21	500
juv	3	213
lumped	28	685
Both species		
ad	104	804
juv	18	223
lumped	130	1012

[1] For Trumpeter Swans, the maximum number of adults and juveniles occurred in the same year. This did not happen for Tundra Swans. The "lumped" figures represent the highest and lowest counts for all individuals of both species for all years.

Table 4. Banded Trumpeter Swans observed in the study area, 1984 – 1998.

Date	Collar	Alphanumeric	Leg band	Location
1984	blue[1]	94 EA		South Okanagan
21-Jan-88	blue[1]	27 HC		South Thompson River
06-Feb-88	yellow	not read		Savona
Winter -89	blue[1]	46 HC		South Okanagan
28-Nov-93	green	not read		South Thompson River
28-Nov-93			silver	South Thompson River
16-Jan-94	green	9X0		South Thompson River
16-Jan-94	green	2J9		South Thompson River
24-Mar-94	green	H54	silver	South Thompson River
24-Apr-94	green	1H1		Kamloops
08-Jan-95	green	9X0		South Thompson River
10-Jan-96	green	57V		South Thompson River
10-Jan-96	green	50V		South Thompson River
12-Jan-97	blue	72 AK		Savona
17-Apr-97	green	E33		Stumplake Creek
23-Oct-98	green	not read		Kamloops Lake

[1] King (1993).

Figure 2. Tundra & Trumpeter Swan 5-year moving average, 1974-2003.

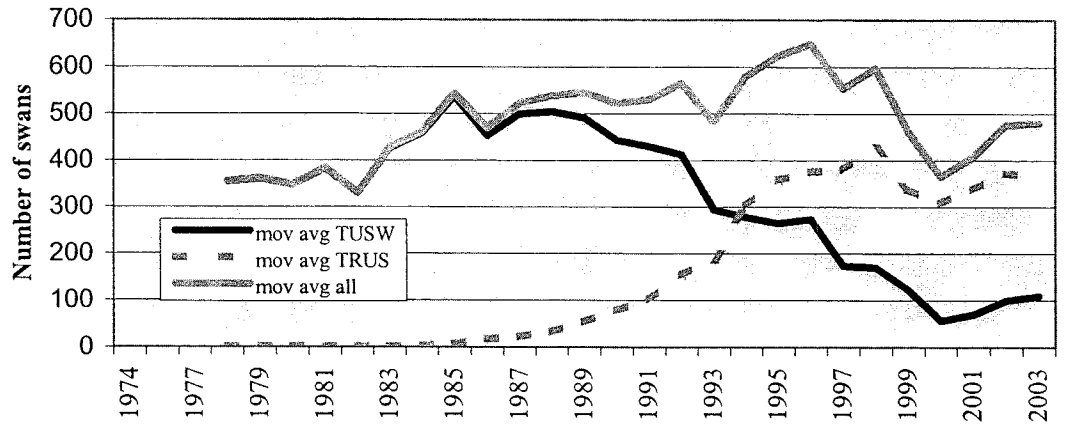


Figure 3. Trumpeter Swan adult and juvenile trends, 1974-2003.

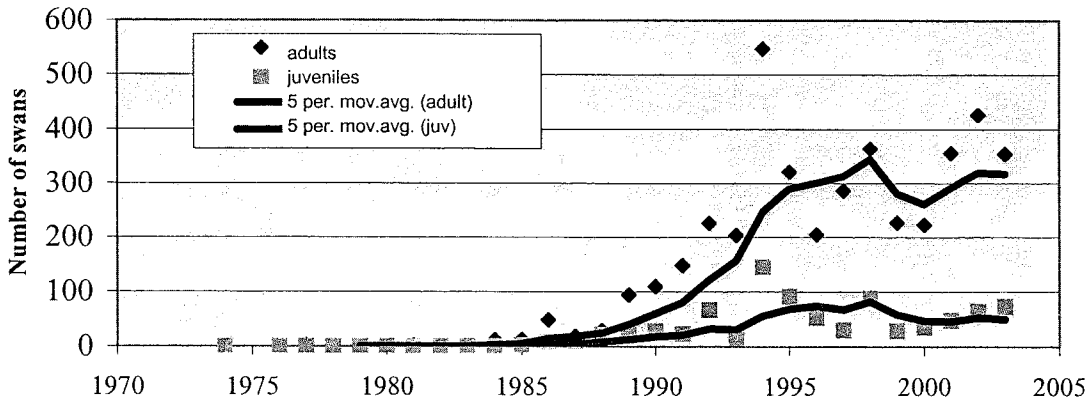


Figure 4. Tundra Swan adult & juvenile trends, 1974 - 2003.

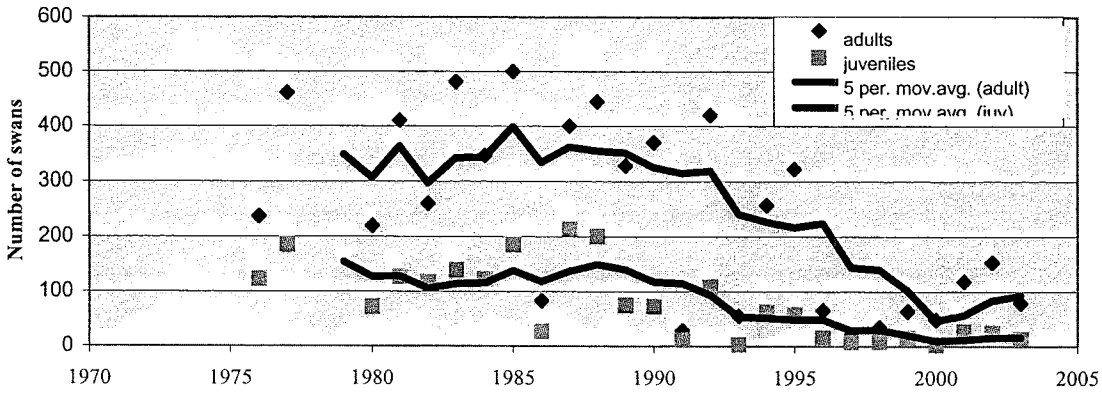


Figure 5. Observed (Nobs) & predicted (Nt) abundance of Trumpeter Swans over time.

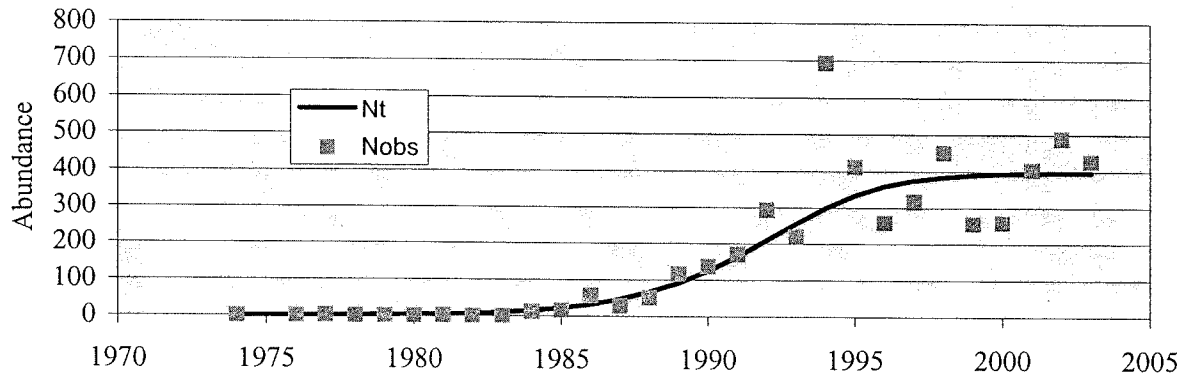


Figure 6. Posterior probability distribution for Trumpeter Swan carrying capacity.

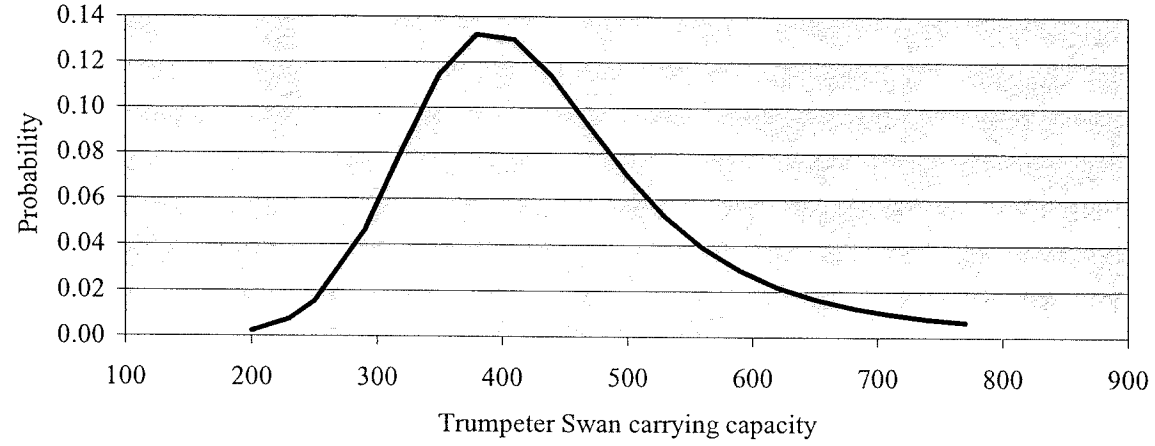


Figure 7. Posterior probability distribution for intrinsic rate of population growth for Trumpeter Swans.

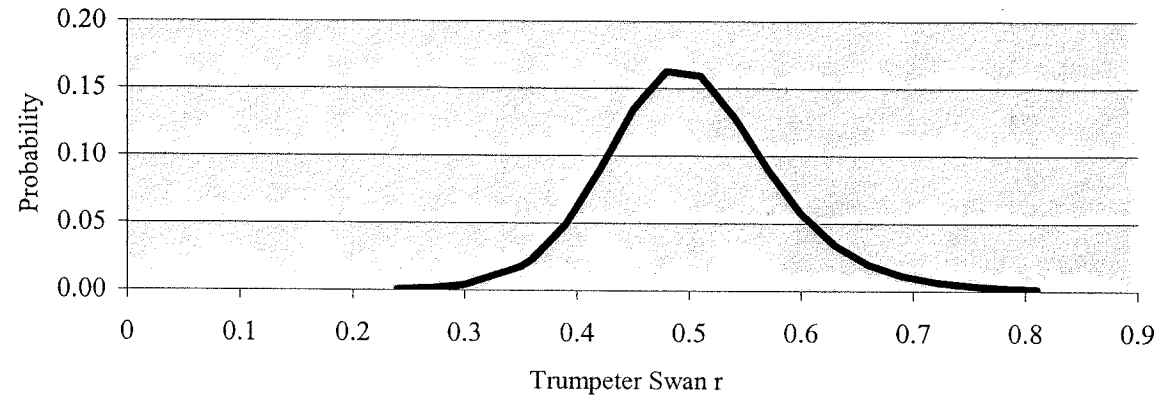


Figure 8. Posterior probability distribution for Tundra Swan carrying capacity.

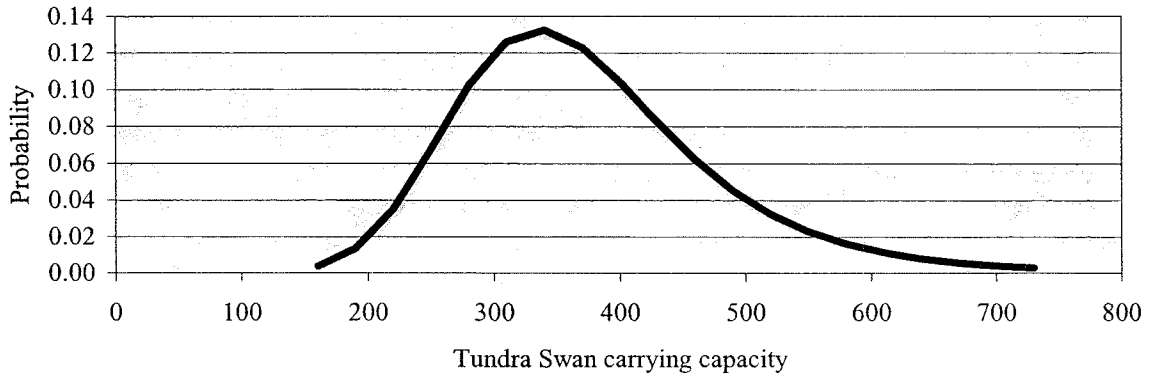


Figure 9. Observed (Nobs) & predicted (Nt) abundance of Tundra Swans and the abundance of Trumpeter Swans (Ntrump).

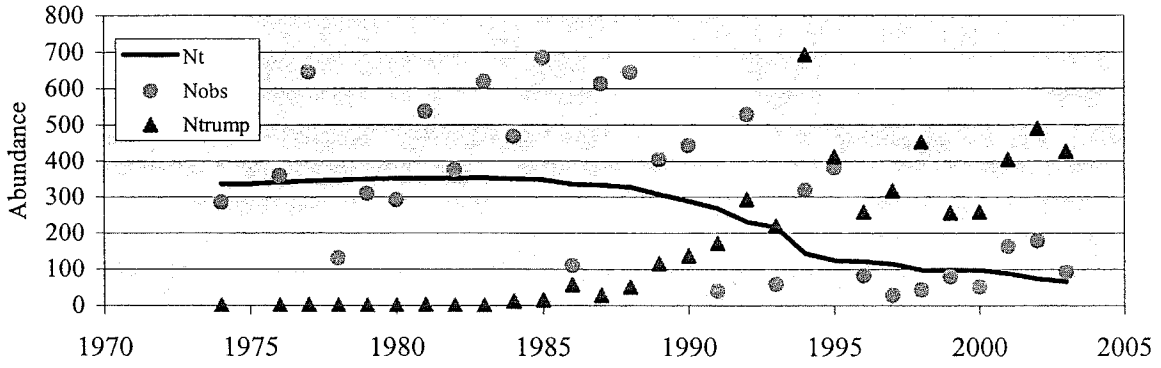
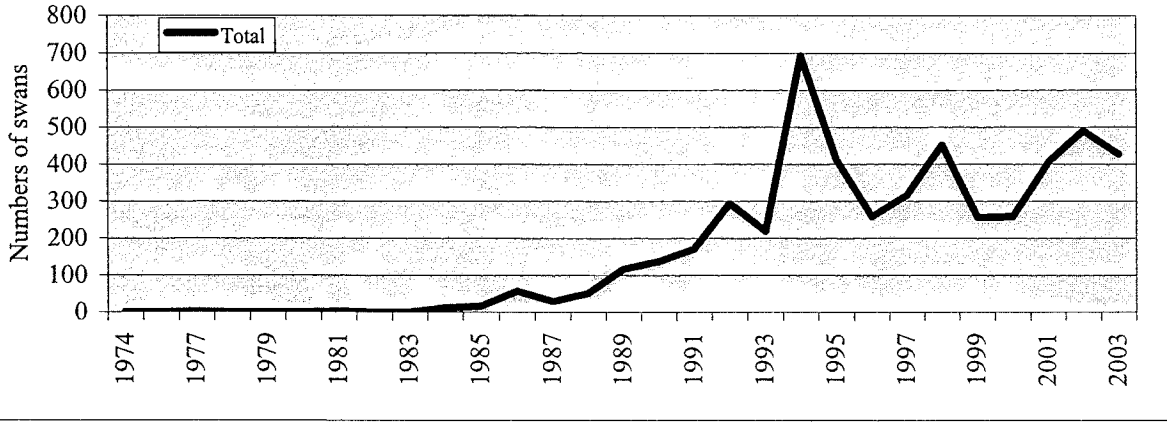


Figure 10. Trumpeter Swan totals, 1974 - 2003.



ONE YEAR OF SATELLITE TELEMETRY DATA FOR FOUR ALASKAN TRUMPETER SWANS

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INTRODUCTION

Trumpeter Swans (*Cygnus buccinator*) are North America's largest waterfowl species. At the turn of the 20th century, extremely low numbers of Trumpeters sparked concern regarding their population viability. Evidence for a steep population decline during the 19th century was provided through a decline in the number of Trumpeter Swan skins sold yearly by the Hudson's Bay Company (Bellrose 1976). By 1932, biologists knew of less than 70 Trumpeter Swans in the wild (Rosenberg and Rothe 2001).

Trumpeter Swans had been observed in Alaska as early as 1850, but the first Trumpeter was not documented on its Alaskan breeding ground until 1954 (Monson 1956; Rosenberg and Rothe 2001). In 1968, the U.S. Fish and Wildlife Service (Service) conducted its first survey of swan breeding habitat in Alaska, and counted 2,844 Trumpeter Swans. Surveys of breeding Trumpeter Swans were again conducted in Alaska in 1975 and every 5 years thereafter (Conant *et al.* 2001; Rosenberg and Rothe 2001). During the Service's fifth Alaska survey in 1990, more than 13,000 Trumpeters were counted; in 2000, over 17,000 were counted (Conant *et al.* 2001). During the summer breeding season, Alaska's Trumpeter Swan population accounts for over 80% of the world's population (Rosenberg and Rothe 2001).

Wintering grounds for Trumpeter Swans have been reported from southern-southeastern Alaska to the Columbia River along the Washington-Oregon border (McKelvey 1989; U.S. Fish and Wildlife Service 2001). However, less well known publications report small numbers of Trumpeters wintering as far west as the Bristol Bay region, the Copper River Delta, and Kenai Peninsula in south-central Alaska, and Petersburg in central-southeastern Alaska (Hughes 1981; Isleib 1981). Approximately 300 wintering Trumpeter Swans were reported from Prince of Wales Island (POWI) in southern-southeastern Alaska in the 1940s (Gabrielson and Lincoln 1959). That number of swans wintering on POWI has remained stable over time (USDA Forest Service, Tongass National Forest, Ketchikan, Alaska, unpubl. data) (Figure 1).

Little is known about the ecological requirements of Trumpeter Swans wintering in Alaska. During winter, they prefer both coastal and freshwater habitats that remain ice-free (McKelvey and Burton 1983). Overwintering habitat can be natural or artificial, created by heated-water outflows, hydroelectric sites, and fish hatcheries (Hughes 1981; Isleib 1981). Furthermore, Trumpeters reportedly winter wherever suitable or even marginally suitable habitat exists (Isleib 1981).

Although half of the world's Trumpeter Swan population winters in British Columbia (McKelvey and Verbeek 1988), a substantial number of Trumpeters are known to winter in southeast Alaska. Prince of Wales Island provides wintering habitat for 60% of those birds wintering in southeast Alaska (Hodges 2001). Records of wintering swans on POWI indicate that the largest number of Trumpeters occur on three large lakes (Sweetwater, Sarkar, and Luck).

In Alaska, the largest known population of breeding Trumpeter Swans occurs between the Copper River Delta and Yakutat Bay (Hansen *et al.* 1971). Other breeding populations in Alaska include: Gulkana Basin, Tanana-Kantishna River valleys, Cook Inlet-Susitna Basin, Kenai Peninsula, and Copper Canyon (Bellrose 1976). They are also known to breed in northwestern British Columbia and in southwestern Yukon Territory (Garbrielson and Lincoln 1959).

Southeast Alaska is an integration of the Pacific's climate, flora, and fauna, with many species reaching either their northern or southern limits (Cook *et al.* 2000). This region is made up of over 2000 islands and is unique not only to Alaska, but also to North America. Prince of Wales Island, the third largest island in North America, is the largest in a series of islands in southeast Alaska known as the Alexander Archipelago. The island comprises more than a million acres of coastal rainforest speckled with ponds, lakes, and large lake complexes, and has been heavily exploited for its timber resources. Indeed,

entire watersheds have been stripped of centuries old trees and now suffer mass wasting.

Many of the lower 48 states that fell within the historical range of the Trumpeter maintained this bird under state Rare or Endangered Species status during recent decades (Rosenberg and Rothe 2001). The USDA Forest Service (USFS), Tongass National Forest, designated the Trumpeter Swan a Sensitive Species in 1990, and developed a draft management plan to identify potential impacts and to manage local populations (Farley and Doerr 1990). Management objectives stated in the plan included monitoring swan numbers and identifying threats in their key habitats.

Using satellite technology, we attempted to monitor swans wintering on POWI. The objectives of this study were to determine annual migration patterns and to describe winter habitat use.

METHODS

Trumpeter Swans were first located by air then captured by boat using a night lighting method described by Drewien *et al.* (1999). Swans were approached by boat at night, spotlighted using a 6-million-candle-power light powered by a generator, and captured with a dip net. Captured swans were processed and released at their capture location. Sex and age were recorded for each bird. They were marked with a Service leg band and fitted with a color-coded collar with a 30-g *Microwave Telemetry* satellite radio transmitter (PTT) attached.

Transmitters were programmed with a duty cycle set to switch on for 6 continuous hours every 54-hour period. Data were collected through the ARGOS system. Raw ARGOS data were formatted and filtered to weed out implausible locations using SAS (SAS institute) programs developed by Douglas (2002). This paper reports data filtered with a program that picks the best location of each satellite overpass using redundancy, maximum sustainable rate of movement, and ARGOS location class filters. Data were analyzed spatially using ARCVIEW, and home range calculations were performed using the Animal Movements extension of ARCVIEW (Phillip Hooge, USGS, BRD, Juneau). Home range size was estimated using the minimum convex polygon technique and primary and secondary zones within a home range were identified using Kernel home range analysis (Grayson 2003).

RESULTS

Swan OR1

Juvenile female Trumpeter Swan OR1 moved a total distance of 288 km during this study (Table 1). She remained primarily in the vicinity of Naukati Bay (as depicted in the Kernel analysis; Figure 2) and the lake complex surrounding Sarkar Lake where she was captured. She occasionally traveled to Staney Creek, a large and heavily harvested watershed, and Honker Lake within the nearly pristine Honker Divide watershed. Transmissions were received from this swan until 13 June 2002, and the final transmission was from the Naukati Bay area where she either died or the transmitter malfunctioned.

Swan OR2

OR2 was detected on POWI or nearby Tuxekan Island from November 2001 through December 2002. In February 2002, this adult female Trumpeter moved from POWI to Karheen Lakes on Tuxekan Island and remained there through the summer and fall (Figure 3). Kernel home range analysis indicates that at least 50% of the filtered locations were from Karheen Lakes on Tuxekan Island. Although OR2 traveled roughly the same total distance as OR1, her home range size was three times smaller than OR1 (Table 1).

Swan OR3

Adult female Trumpeter OR3 remained in the Sarkar Lake area of POWI until mid-April of 2002, when she migrated northward (Figure 4). She traveled 465 km in less than 4 days, resting at Dry Bay near Yakutat, then Yakutat Bay on 22 April. She was next observed on the Kenai Peninsula on 25 April, 582 km from Yakutat Bay, followed by a 118-km move to Bachatna Flats on 27 April.

On 2 November 2002, OR3 flew from the Bachatna Flats to the Kenai Peninsula until sometime after 6 November when she flew 613 km to Dry Bay, arriving on 13 November and staying for 2 more days. On 17 November, OR3 was located in the Sarkar Lake area on POWI, 457 km south of Dry Bay.

Swan OR4

Adult male Trumpeter OR4 remained on POWI until early December when he migrated 996 km south to Vancouver Island (Figure 5). He remained in the

Vancouver Island area until 30 March 2002 when he migrated north. On 3 April, OR4 stopped at Dry Bay until 16 April when he moved 410 km to Hawkins Passage in Prince William Sound. On 26 April, OR4 arrived at Bantashna Flats and remained there through 7 October 2002. The total distance of OR4's northward migration was 2,301 km, or nearly 40% of the total distance he traveled in more than 1 year (Table 1).

On 7 October 2002, OR4 began his southward migration, stopping on the Kenai Peninsula and the Copper River Delta. He then flew 1,496 km, nonstop, to mainland British Columbia, arriving on 20 December, and finally arrived on Vancouver Island on 22 December. The total distance of OR4's southward migration was 1,961 km. Home range was 488,223 km^2, three times larger than that of OR3.

Performance of the PTTs

Of the downloads received from ARGOS, 14% met the plausibility requirements of the data filter (Table 1). With a 6-hour-on, 48-hour-off duty cycle, the battery life of the PTTs was expected to last 9 months. However, after 12 months, data were still being received from three of the four transmitters.

DISCUSSION

Data from satellite technology have provided great insight into little known movements of avian species (Peterson *et al.* 1999). However, due to the expense of the technology, tradeoffs are often made between accuracy and precision. That is, sample size is often small and conclusions regarding population movements are weak, but data on those few individuals marked are precise. Conclusions drawn from this study were made from the movements of four swans captured from Sarkar Lake on POWI on 16 November 2001. Although these data told us much about the four swans, we realize that their patterns may not accurately represent the patterns of the more than 300 Trumpeter Swans that winter on POWI.

Based on data from four Trumpeter Swans, there are two types of annual movement exhibited by swans using POWI during winter, resident and migratory. Half of the swans marked remained on POWI or a nearby island during all seasons, and half traveled long distances between winter and summer seasons. The explanations of these differences in movement are unclear, however increased population and subsequent exploitation of new breeding habitat seems plausible.

Two of the four swans marked at Sarkar Lake on POWI migrated to the Bachatna Flats area on the western side of Cook Inlet during summer 2002. Trumpeter Swans breeding on the west side of Cook Inlet were first described in 1958, when 112 swans were counted (Hansen *et al.* 1971). On the nearby Kenai Peninsula, incubation may begin as early as 1 May and hatching may occur through the first week of July (Hansen *et al.* 1971). Swan OR3 arrived at Bachatna Flats on 27 April 2002 and remained there through 28 September. Swan OR4 arrived at Bachatna Flats on 26 April 2001 and remained there through 9 October. While at Bachatna Flats, the total distance OR4 traveled was no more than 4% of the total distance traveled throughout the year. The average distance per download equaled 5.8 km. Based on the tight home range during the breeding season, it is possible that the adult female, OR3, and the adult male, OR4, nested at Bachatna Flats.

Two of the four marked swans (OR1 and OR2) remained on POWI or nearby outside islands for the duration of this study. The subadult female, OR1, maintained a tight home range in the Sarkar Lake area, and either died in June 2002 or the transmitter failed or was lost. Nonbreeding Trumpeter Swans in Alaska molt in June and July (Bellrose 1976). Molt lasts approximately 30 days. During molt, the swans are flightless and use much of their energy stores to grow new feathers and stay warm. Probability of mortality is high during the molting period due to the high energy requirements and the increased probability of predation.

The adult female, OR2, was detected repeatedly at Karheen Lakes on Tuxekan Island during summer and fall 2002. Because Kernel home range analysis suggests a tight association to the lakes during the breeding season, possibility of a breeding event cannot be discounted. Trumpeter Swans are known to breed in the vicinity of Haines in southeast Alaska, and their range appears to be expanding further south (Conant *et al.* 2001). Potential breeding habitat on this heavily forested island that is intermixed with muskegs, ponds, and lakes, seems lacking. However, beaver lodges, which are commonly observed on Tuxekan Island, are often used as nesting platforms by Trumpeter Swans nesting in south-central Alaska.

In 2000, a total of 17,155 Trumpeter Swans were counted along the Pacific coast of Alaska, which marked a continuous and steady increase in the summering population (Caithamer 2001; Conant *et al.* 2001). Indeed, the Pacific coast population grew 8% over a 5-year period. As the summering population expands along the Pacific coast of Alaska,

use of nontraditional summer habitat has been noted and is attributed to range expansion resulting from good production and population increases through time (Conant 1990).

In 1989, 2,722 swans were seen on Vancouver Island, and 17.6% of those birds were cygnets. That was a two-fold increase over a survey conducted 10 years prior (McKelvey 1989). With a vast area of summer habitat available to Trumpeter Swans in Alaska, the summering population is expected to increase to 34,000 white swans by the year 2050 (Conant *et al.* 1994). As the population expands, habitat that previously was considered peripheral (either summer or winter) may soon be productive swan habitat.

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Table 1. Summary of Argos downloads for four Trumpeter Swans marked with satellite transmitters on Prince of Wales Island, Alaska, on 16 November 2001.

Swan ID	No. downloads	No. filtered downloads	Date last position	Total distance traveled (km)	Max. distance traveled (km)	Home range size (km^2)[1]
OR1	336	54	06/13/02	288.11	19.88	232
OR2	650	104	12/22/02	299.78	14.14	666
OR3	836	119	12/05/02	3144.2	612.78	151,873
OR4	950	113	12/26/02	5868.51	1495.9	488,223

[1] Home range calculated using Minimum Convex Polygon technique.

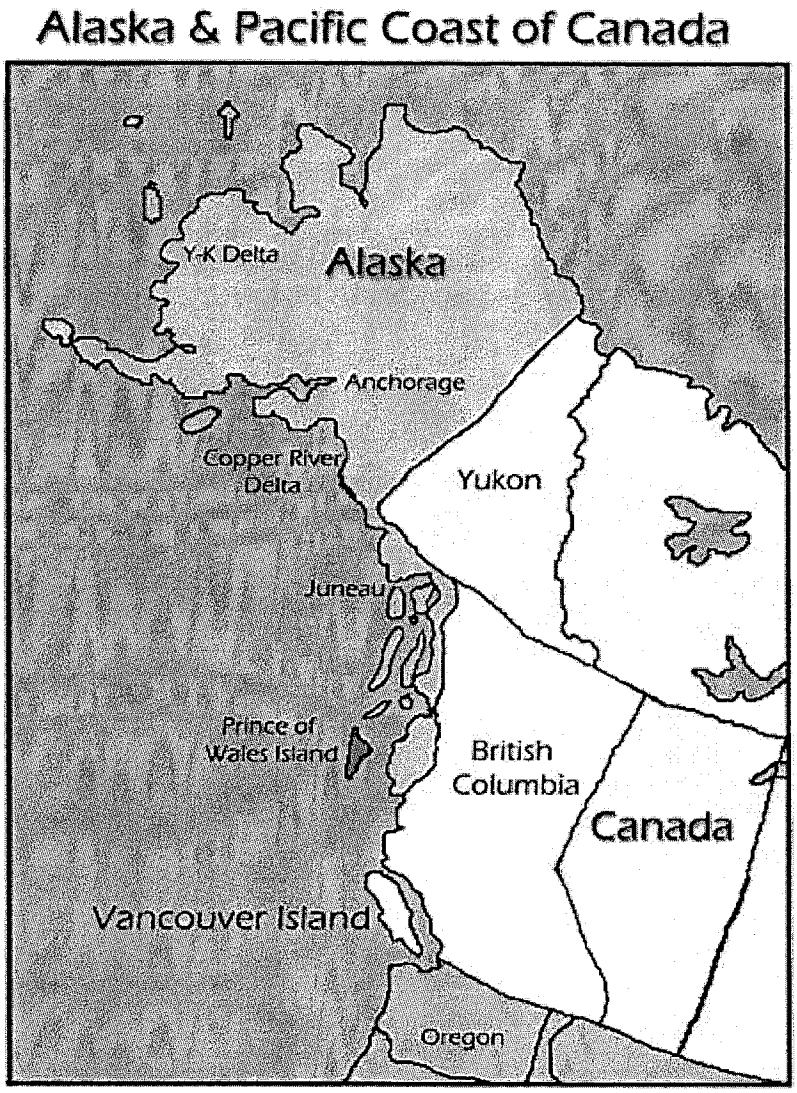

Figure 1. Swan capture occurred on Sarkar Lake, Prince of Wales Island, in southern southeastern Alaska.

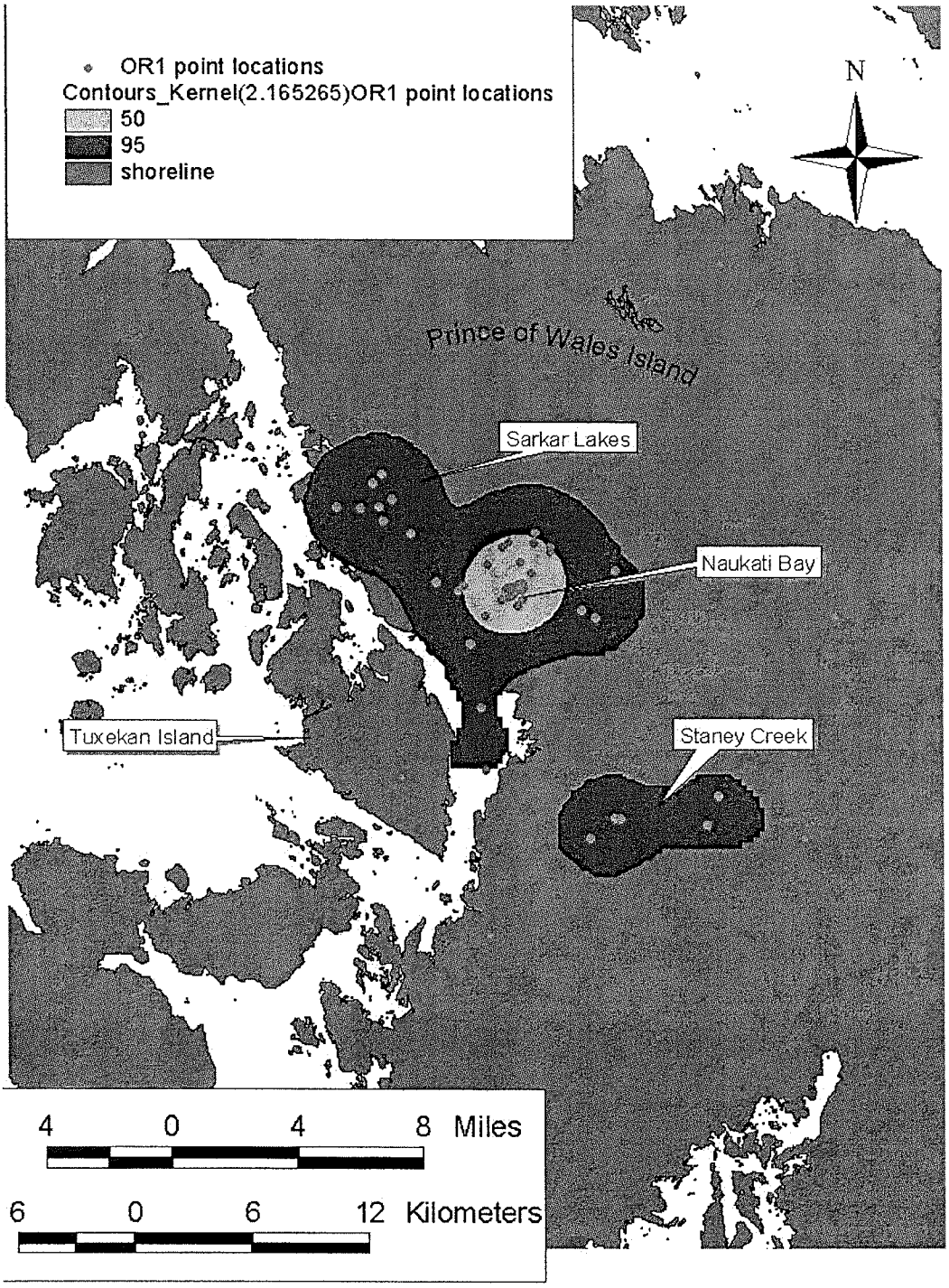

Figure 2. Kernel 50% and 95% ellipses from satellite PTT downloads for Trumpeter Swan OR1. This subadult female did not leave Prince of Wales Island during the period of PTT operation.

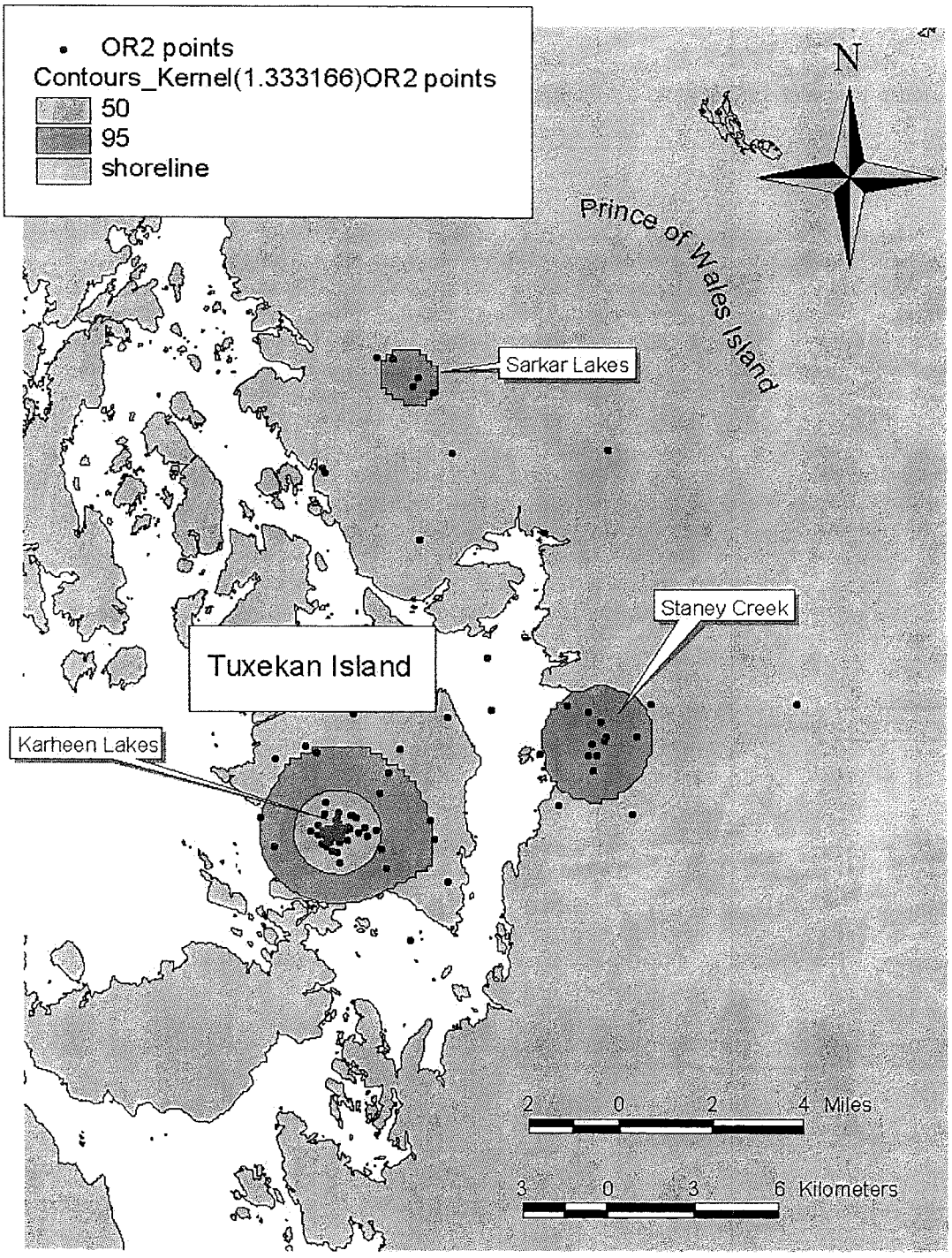

Figure 3. Kernel 50% and 95% ellipses from satellite PTT downloads for Trumpeter Swan OR2. This adult female remained on Prince of Wales and nearby Tuxekan Island for the duration of this study.

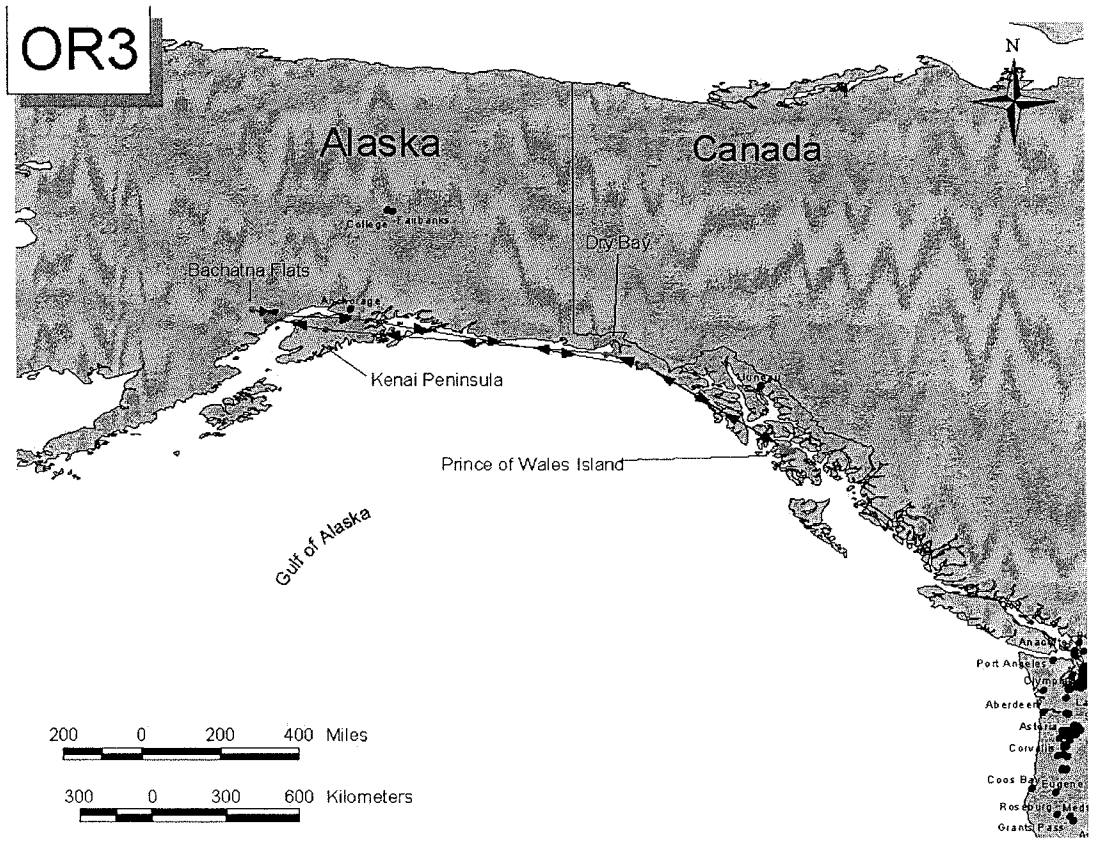

Figure 4. Migratory pathway for OR3 from 16 November 2001 through December 2002. This adult female Trumpeter Swan was marked on Prince of Wales Island in November 2001, migrated to Bachatna Flats in spring 2002, and migrated back to Prince of Wales Island in fall of 2002.

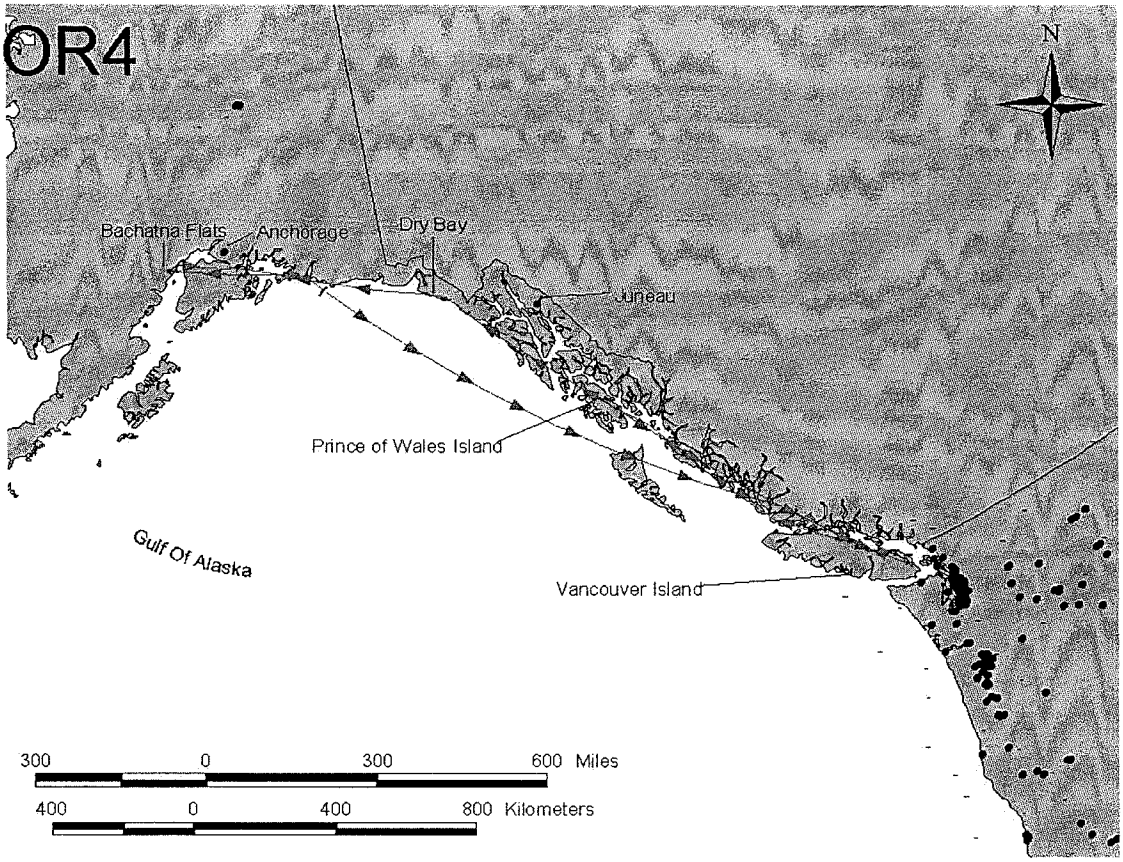

Figure 5. Migratory pathway for OR4 from 16 November 2001 through December 2002. This adult male Trumpeter Swan was marked on Prince of Wales Island in November 2001, migrated to Vancouver Island for the winter of 2001-02, migrated to Bachatna Flats in spring 2002, and migrated back to Vancouver Island without stopping on Prince of Wales Island in fall of 2002.

CONNECTING STUDENTS AND SWANS

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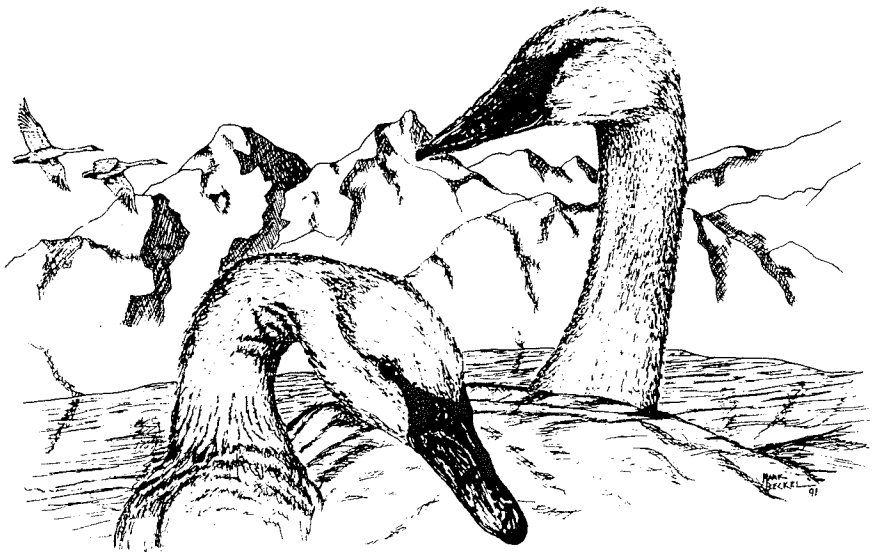
ABSTRACT

An apparent increase in the number of Trumpeter Swans (*Cygnus buccinator*) in the remote Kuskokwim Valley of Alaska's southwest interior gave rise to an investigation called "Trumpeter Swan Biology" conducted by a group of school students in the small town of McGrath, Alaska. Students conducted extensive research on many aspects of Trumpeter Swans. Reference books, the Internet, field trips, and dialogue with waterfowl managers produced much information on the topic being studied. As questions arose regarding where these birds go for the winter, the project took a turn toward a more "hands on" approach. Over a 2-year period, students were able to capture four adult nesting Trumpeter Swans and follow them on their migration routes. A grant from the Alaska Science and Technology Foundation along with much cooperation from the U.S. Fish and Wildlife Service, Alaska Department of Fish and Game, and many other agencies allowed the students to track the birds by satellite telemetry. From their studies, students learned that three of the four swans generally followed a coastal migration route and spent the winter in northern Washington and southern British Columbia. The fourth swan flew north to the Tanana River and may have been following a more inland route but died in western Yukon Territory, Canada. While the routes were similar, the timings of the migrations were quite variable. In addition to the biological data collected, there were many educational gains. Students who typically were less successful in the classroom found success and a new sense of confidence. The project also brought the community into the school, which enhanced the educational process.

ROCKY MOUNTAIN POPULATION/CANADA



SATELLITE TRACKING TRUMPETER SWANS FROM THE YUKON TERRITORY

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ABSTRACT

In 2002, The Trumpeter Swan Society initiated a multi-year study of the seasonal movements of Trumpeter Swans (*Cygnus buccinator*) that nest in British Columbia, Alberta, the Northwest Territories, and the Yukon Territory. This project is attempting to determine whether all segments of this western Canada breeding population depend upon high-risk winter habitat in the Greater Yellowstone region or whether the population is more dispersed in winter than is currently recognized. This research marks the first time that satellite telemetry has been used to track western Canada Trumpeters and will identify migration routes, important migration stopover habitats that may require management protection, and the timing of local and long-distance movements. In July 2002, we captured and marked 15 adult Trumpeter Swans in the central and southeastern Yukon Territory using a float plane to approach the birds while they were molting and flightless. Five swans from territories scattered along a 370-mi (595-km) transect were marked with satellite-tracked radios mounted on neckbands and 10 were marked with conventional neckbands with unique alpha-numeric codes. The five radioed swans initiated migration between 3 and 22 October and four birds arrived at wintering sites in the Greater Yellowstone ecosystem within 15 to 40 days. The fifth radioed swan migrated to within 100 mi (161 km) of Greater Yellowstone before dying in a power line collision in Montana on 31 October. Although their summer territories were widely dispersed, all five radioed swans followed a narrow migration corridor that passed through northeast British Columbia to Grande Prairie, Alberta, and then followed the east front of the Rocky Mountains across Montana to wintering sites in the eastern Idaho portion of Greater Yellowstone. Nine of the 10 conventionally neck-banded Trumpeters were also resighted in winter and all were found in the same vicinity in eastern Idaho. Distances moved during fall migration ranged from 1,354 mi (2,179 km) to 1,648 mi (2,652 km). Important migration stopovers included two areas in the Yukon, three in Alberta, and one in Montana. Sample size is currently inadequate to formulate population level conclusions. However, the lack of observed diversity in migratory patterns and wintering areas among these Yukon-nesting swans heightens concern for the population's winter vulnerability in Greater Yellowstone.

RECORDS OF TRUMPETER SWANS IN THE DUCKS UNLIMITED CANADA WESTERN BOREAL PROGRAM, 2000-2002

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ABSTRACT

Trumpeter Swans (*Cygnus buccinator*) were surveyed throughout the open water season at three separate locations within the boreal forest of western Canada. Surveys were conducted from aircraft in the Southern Lakes region of the Yukon Territory (2000-02), in the Utikuma Lake area of north-central Alberta (2000-02), and in the Pasquia Hills/Duck Mountains area of Manitoba and Saskatchewan (2001-02). Preliminary results indicate an increase in the number of observations of Trumpeter Swan pairs in all three project areas. Brood and individual observations increased in two of the three project areas.

INTRODUCTION

In recent years, increased activity by forestry, oil and gas, mining, hydroelectric, agriculture, and recreational interests has greatly expanded the potential for impacts on the Western Boreal Forest (WBF) ecosystem. The consequences of these impacts on wetland systems remain largely unknown. Waterbird information for the WBF is scarce, with linkages to the underlying habitats poorly defined. To address the paucity of information on wetlands and waterbirds in the WBF, Ducks Unlimited Canada initiated a series of projects in collaboration with several partners throughout various regions in the WBF. The Southern Lakes project area, Yukon Territory, the Utikuma Lake project area, Alberta, and the Pasquia project area, bordering Saskatchewan and Manitoba, were three regions selected for collaborative studies (Figure 1).

Manitoba had been devoid of breeding Trumpeter Swans (*Cygnus buccinator*) since the early 1900s, but an increasing number of sightings in the province suggest that Trumpeter Swans in Manitoba are making a comeback. A Trumpeter Swan pair was observed with a single cygnet on the Saskatchewan side of the Pasquia project area (Porcupine Hills) within 50 km of Manitoba. Trumpeter Swan numbers have been increasing in southern Yukon in and around the Southern Lakes project area (Sinclair *et al.* 2003). Several other areas of the WBF have had significant increases in Trumpeters including northern Alberta and northeastern British Columbia in the last decade.

METHODS

Wetland site selection protocol

A TM 5 or 7 Landsat satellite image of each project area was imported into ArcView 3.2a and wetlands suitable for conducting waterbird surveys were determined. Ideally, the wetland sample universe and subsequent random subsample for waterbird inventories would be derived from known wetland attributes (e.g., size, permanency, vegetation community, distribution, abundance) obtained from a supervised Landsat-based classification. Such information should be reflected within the Ecoregion and Ecodistrict classification framework[1] (Wiken 1986; Ecological Stratification Working Group 1996). Unfortunately, this classification requires information that is unavailable for large portions of the WBF.

Wetlands less than 1.0 ha (2.0 ha in the Southern Lakes project) were excluded from the sample universe to reduce risks of misclassification (e.g., terrain shadow, misclassified single and small clusters of pixels). Surveys were conducted over three open water seasons. Twenty percent of the wetlands surveyed from one year were randomly

[1] *Ecodistricts*: Subdivisions of ecoregions, characterised by distinctive assemblages of landform, relief, surficial geologic material, soil, water bodies, vegetation, and land uses.

Ecoregions: Subdivisions of ecozones characterised by distinctive large order landforms or assemblages of regional landforms, small order macro- or meso-climates, vegetation, soils, water, and regional human activity patterns/uses.

selected for repetition in the following year. To determine how many wetlands would be sampled in a given Ecodistrict, the ratio of wetlands per Ecodistrict to total wetlands on the project area was used to determine the proportion of wetlands from each Ecodistrict represented in the sample. Using this proportional allocation protocol, individual wetlands were randomly selected within each Ecodistrict. Wetlands over 300 ha were omitted from the pair and brood-rearing surveys and replaced by the next randomly selected site available. However, these larger wetlands were included during staging surveys.

Aerial survey protocols

Individual wetlands functioned as the unit of measure for recording of all observations. Both ArcView 3.2a software integrated with a Tracking Analyst moving map extension and a global positioning system ensured that all wetlands visited corresponded with predefined coordinates (Environmental Systems Research Institute Inc. 1996). Depending on the size and shape of the wetlands, different flight paths were required to attain 100% coverage based on maximum estimated visibility (i.e., one central transect, circle from shoreline, multiple transects, etc.). The survey crew consisted of a pilot, an observer/navigator seated in the front beside the pilot, and an observer seated in the rear behind the pilot. Both observers were responsible for observations on opposite sides of the aircraft and employed individual micro-cassette tape recorders to record all waterbirds encountered.

Helicopters were used for two pair surveys (May and June) and two brood-rearing surveys (June and July) conducted over the summer to document waterbird productivity. Surveys were flown at a nominal altitude of 35 m. However, the survey elevation was occasionally reduced to between 15 and 35 m above ground level (AGL) as required given shoreline complexity, vegetative cover conditions, or unconfirmed species or sex. Ground speeds did not exceed 100 km/h during the active survey effort; however, over areas with reduced visibility, significantly slower speeds (e.g., 30 km/h) were employed. The same wetlands were surveyed for all breeding pair and brood surveys.

Three staging surveys were conducted (August - October) using a fixed-wing aircraft. The aircraft was flown approximately 100m AGL at a speed of 150 km/h. The number of birds, by species when possible, was recorded for each wetland surveyed. Fixed-wing aircraft were also used when surveying the Saskatchewan River Delta (SRD) and larger lakes in the Pasquia project area. These areas were surveyed by flying transects that covered approximately 5% of the two Ecodistricts that make up the SRD and 10% of the larger lakes in the project area.

RESULTS

Southern Lakes project area

There were 142, 132, and 128 wetlands surveyed during 2000 pair, brood-rearing, and staging surveys, respectively. Two pairs of Trumpeter Swans were observed during pair surveys and four broods were later seen. The broods observed had an average size of 3.8 cygnets. Fifty-five Trumpeters were counted as individuals. These individuals were often observed in groups where pairs could not be confirmed (Table 1).

During the pair, brood-rearing, and staging surveys of 2001, there were 146, 143, and 99 wetlands surveyed, respectively. Five pairs of Trumpeter Swans were observed during pair surveys. Two pairs of adult Trumpeters were observed with broods. Each pair had two cygnets. An additional 71 individuals observed in groups and not holding territory were reported during 2001 (Table 1).

In 2002, there were 148 pair wetlands, 147 brood-rearing wetlands, and 114 staging wetlands surveyed. Sixteen pairs of Trumpeter Swans were observed during pair surveys on the Southern Lakes project area in 2002. Eleven separate broods were observed with an average brood size of three cygnets per pair. One hundred and sixty-seven individuals were observed in groups during 2002 (Table 1).

Utikuma Lake project area

In 2000, there were 167 pair wetlands, 141 brood-rearing wetlands, and 169 staging wetlands surveyed. Only three pairs of Trumpeter Swans were observed during pair surveys, yet five broods were observed later in the season, suggesting that brood dispersal may commonly occur. The Trumpeter Swan broods observed had an average size of 3.2 cygnets per pair of adults. A total of 478 Trumpeter Swan individuals that did not appear to be holding breeding territories in the project area was also counted during 2000 in the Utikuma project area (Table 2).

There were 162, 159, and 155 wetlands surveyed during 2001 pair, brood-rearing, and staging surveys, respectively. One lone pair was seen during 2001,

but three broods were later seen on the study area, again suggesting that dispersal in this area is common. Only 21 other individuals not appearing to hold territories were observed in 2001. This is much lower than the number of individuals observed in either of the other 2 years (Table 2).

During the pair, brood-rearing, and staging surveys of 2002, there were 160, 160, and 157 wetlands surveyed, respectively. Six pairs of Trumpeter Swans, eight broods with an average size of 2.5 cygnets, and 177 individuals were observed during 2002 (Table 2). This was the greatest number of pairs and broods observed on the project area in the 3 years of surveys.

Pasquia project area

In 2001, there were 327 pair wetlands, 310 brood-rearing wetlands, and 197 staging wetlands surveyed, as well as 496,553 ha of transects flown in the Pasquia project area. Transect surveys were flown primarily in the Saskatchewan River Delta, portions of Lake Winnipegosis, and selected larger shallow lakes. One pair of Trumpeter Swans, 1 brood with 1 cygnet, and 13 individuals were observed during these surveys (Table 3).

During the 2002 pair and staging surveys, there were 348 and 290 wetlands surveyed, respectively, plus 372,415 ha of transects. No brood surveys took place on the Pasquia project area in 2002 due to budget constraints. Three pairs of Trumpeter Swans and 23 individuals were observed during 2002 (Table 3).

DISCUSSION

The Southern Lakes project area saw an increase in the number of pairs, broods, and individuals observed from 2000 to 2002. In 2000, 2 pairs, 4 broods, and 55 individuals of Trumpeter Swans were observed. Those results are eclipsed by the 2002 observations of 16 pairs, 11 broods, and 167 individuals. Trumpeters are known to be on the increase in northern British Columbia and southern Yukon (Sinclair *et al.* 2003), yet such substantial increases in just a few years are unlikely to be uniform across the landscape. These results may indicate a redistribution of pairs within the project area or a selection of more wetlands preferred by Trumpeter Swans in 2002.

The Trumpeter Swan population in Alberta has made a significant recovery since the early 1900s. Population estimates at the turn of the 20th century where less than 100 individuals for the Province of Alberta (Mackay 1978). Surveys completed in 1995 show a population total of 779 Trumpeter Swans for the province (James 2000). The Utikuma project area saw an increase in number of pairs and broods observed from 2000 (3 pairs and 5 broods) to 2002 (6 pairs and 8 broods). It is unclear if these results represent an increase in the number of breeding swans or a change in their distribution on the landscape. One interesting result from the Utikuma project surveys was the observation of more broods than pairs every year, although the same wetlands were surveyed for both pairs and broods, suggesting that Trumpeter Swan broods in the Utikuma area disperse from their natal wetlands. Individuals not associated with either a pair or brood (likely failed breeders, staging, or molting birds) at the Utikuma project area decreased over these same years.

Trumpeter Swans were extirpated in the early 1900s from the Pasquia project area, but recently have reestablished themselves and are now showing signs of persistence. Trumpeters have never been reintroduced to either Manitoba or Saskatchewan, although several pairs have been observed in both provinces during recent waterbird surveys. Three pairs were observed during 2002 surveys, while only a single pair was observed in 2001. Individual observations also increased between 2001 and 2002 from 13 to 23 individuals. Several other Trumpeter Swans were anecdotally observed on the project area on basins not surveyed during 2001 and 2002. We anxiously anticipate the first observations of young Trumpeters produced in Manitoba in almost a century.

ACKNOWLEDGMENTS

Ducks Unlimited Canada thanks the following partners for their financial and in-kind support for these projects: Weyerhaeuser, Saskatchewan Environment and Resource Management, Manitoba Conservation, Yukon Fish and Wildlife Enhancement Fund, U.S. Forest Service, Yukon Renewable Resources, Ducks Unlimited, Inc., Alberta Sustainable Resource Development, University of Alberta, SASK Power, Tembec, Yukon Energy, Canadian Wildlife Service, Teslin Tlingit Council, The PEW Charitable Trusts, Louisiana Pacific, Champagne Aishihik, Alberta Pacific Forest Industries, Inc., and North American Wetlands Conservation Act.

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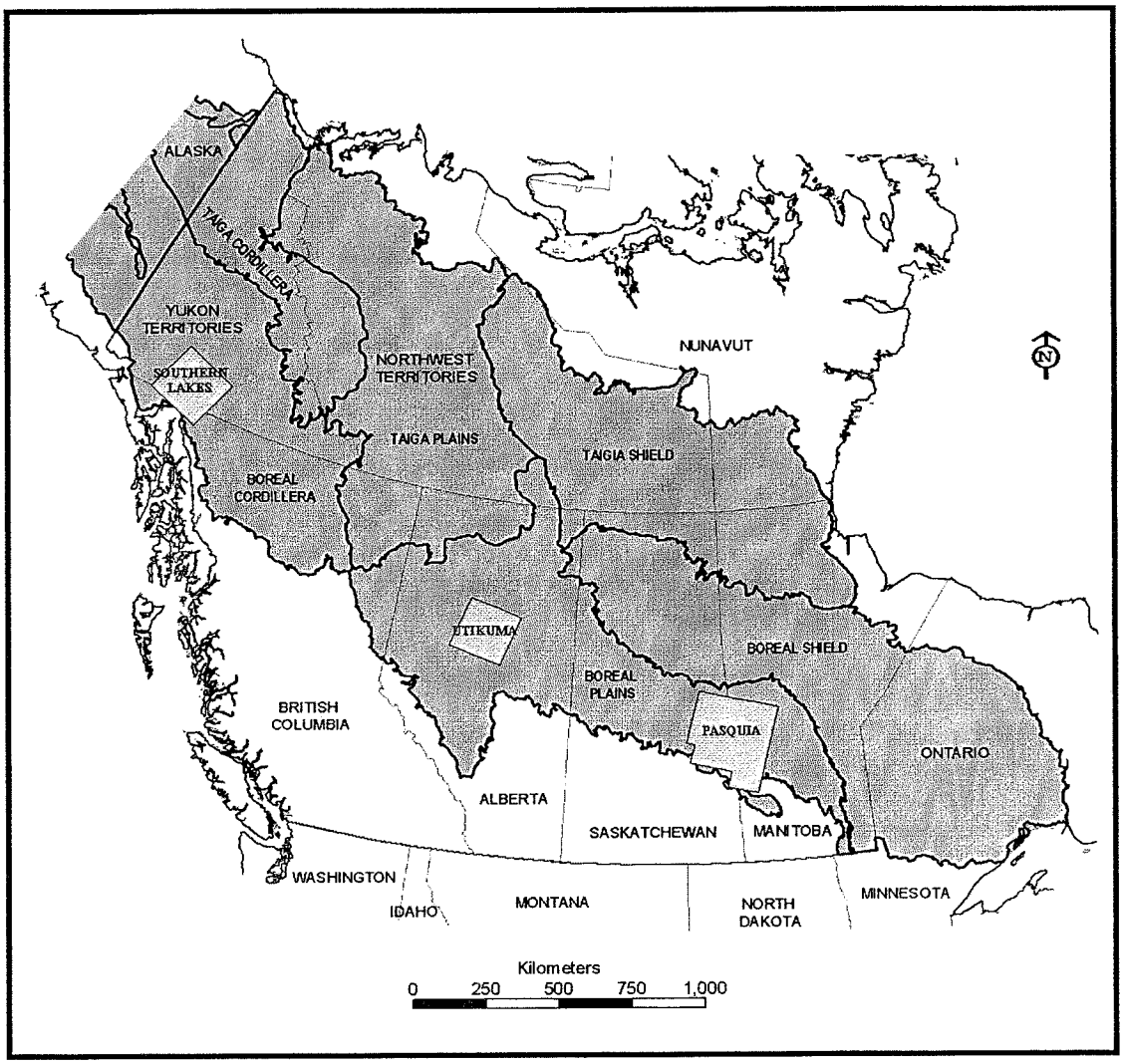

Figure 1. Canadian Boreal Ecozone map containing the three project areas included in this report; from west to east, the Southern Lakes project area, the Utikuma Lake project area, and the Pasquia project area.

Table 1. Trumpeter Swan counts from spring, summer, and fall aerial surveys of the Southern Lakes project area, Yukon Territory, 2000-02.

	Pairs	Broods	Average brood size	Individuals
2000	2	4	3.8	55
2001	5	2	2.0	71
2002	16	11	3.0	167

Table 2. Trumpeter Swan counts from spring, summer, and fall aerial surveys of the Utikuma Lake project area, Alberta, 2000-02.

	Pairs	Broods	Average brood size	Individuals
2000	3	5	3.2	478
2001	1	3	3.0	21
2002	6	8	2.5	177

Table 3. Trumpeter Swan counts from spring, summer, and fall aerial surveys of the Pasquia project area, Saskatchewan and Manitoba, 2001-02.

	Pairs	Broods	Average brood size	Individuals
2001	1	1	1.0	13
2002	3	0[1]	N/A	23

[1] No brood/summer survey flown.

ELK ISLAND NATIONAL PARK TRUMPETER SWAN REINTRODUCTION - 2003 UPDATE

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ABSTRACT

The Trumpeter Swans (*Cygnus buccinator*) at Elk Island National Park (EINP) and adjacent area have been monitored annually since the first reintroduction in 1987 to identify marked swans and define total population and cygnet production. The number of adult and subadult swans returning to the park and local cygnet production has increased each year during the last 4 years. In 2002, a high of 18 adults and subadults (including three breeding pairs) was recorded in the spring. Additionally, a high of 10 cygnets fledged and migrated south from the park in the fall. With increased production at EINP, the relocation of cygnets from the wild flock of Trumpeter Swans in the Grande Prairie area has been reduced. Future relocations will be dependent on annual production in the park and adjacent area. The continued increase in cygnet production in conjunction with the increasing number of adults is steadily moving the project forward towards its goal of 10 breeding pairs in the Elk Island National Park area.

INTRODUCTION

The reintroduction of Trumpeter Swans (*Cygnus buccinator)* to Elk Island National Park (EINP) began in 1987 as a partnership program directed at restoring the Trumpeter Swan as a breeding population in EINP and surrounding area and expanding its present summer range in Alberta. The status of the program to 1999 has been detailed in reports (Shandruk and Winkler 1988; Kaye and Shandruk 1992; Beyersbergen and Kaye 1995; Beyersbergen and Kaye 2000; Kaye 2002). The recent breeding success of Trumpeter Swans in EINP has resulted in an increased monitoring effort throughout the annual period while the swans are resident in the park. There has also been a reduction in the survey effort in the Grande Prairie area (site of the host flock for cygnets to be relocated) and reduction in the number of cygnets relocated to the park. Winter and migration monitoring of EINP swans is conducted through partnerships with other jurisdictional wildlife agencies and volunteers in Canada and the United States. This paper provides a review of the progress of this project between spring 1999 and winter 2002-03.

METHODS

Grande Prairie production surveys

Fixed-wing aerial surveys using a Cessna 210 were conducted in early September of 1999 and 2001 on select lakes in the Grande Prairie area. In 2000, during the International Trumpeter Swan Survey, all known and potential swan lakes were surveyed. Surveys were conducted along designated routes 100-150 m agl (at ground level) at 150-200 kph (Shandruk and Winkler 1988; Beyersbergen and Kaye 1995). These surveys provide estimates of total adult swans (paired and flocked birds) and annual production (number of cygnets, broods, and mean brood size). The locations of lakes with potential cygnets to be selected for relocation are identified at this time. No aerial surveys were conducted in 2002. However, a selection of lakes in the agricultural zone around Grande Prairie, accessible from the ground, was visited in the middle of August.

Elk Island National Park monitoring

Trumpeter Swans were monitored in an area that included Elk Island National Park, Blackfoot Grazing, Wildlife and Provincial Recreation Area, and numerous lakes and wetlands within a couple of kilometres of the park boundaries (Figure 1). Swans were monitored upon arrival in the park, normally, around mid-April. Initial efforts were conducted on foot while high concentrations of Tundra Swans (*C. columbianus columbianus*) staged in the area. By mid-May, only Trumpeter Swans were present and aerial surveys, using a Cessna 172, were conducted. Swans observed during aerial surveys were checked by ground monitoring to confirm aerial observations. Ground monitoring was usually conducted by two personnel on a daily basis for 2-3 weeks in the spring until all expected swans had returned and been

identified. Identification of marked adults, family groups returning, pair bonds, and location of nesting and nonbreeding staging lakes was recorded during monitoring.

Once nesting lakes were identified, monitoring focused on these sites and was primarily conducted on foot to reduce potential for disturbance. Information was collected on breeding behaviour, dates the pair began nest construction, and approximate egg laying and hatch dates. Initial brood size for each pair was recorded and cygnet survival monitored throughout the summer.

An aerial survey was conducted in late June to establish the number and distribution of nonbreeding adults and yearlings (break up of family groups observed in the spring) in the park and adjacent areas. This was followed up by ground monitoring to establish which lakes were being used as moulting sites.

Monitoring efforts of all swan-occupied lakes continued into the fall period, primarily on foot but included a single aerial survey prior to Tundra Swan arrival in late September. Monitoring for cygnet fledging was the primary focus during this period. Swans were monitored throughout the fall until they departed around the time of lake freeze-up in late October to early November.

If cygnets were to be relocated from the Grande Prairie area, traditional fall staging lakes in EINP were monitored regularly during August and September for consistent use by nonbreeding adults which may act as foster parents. After the relocation, the lake with released cygnets was checked daily.

Area closures were implemented in the park on several lakes to reduce disturbance to nesting pairs. In 2000, when cygnets were relocated from Grande Prairie, Astotin Lake was closed to boating activity from early September through freeze-up to allow the transplanted cygnets and the nonbreeding adults to establish a close bond. In addition, an active public relations program was implemented by Parks staff and the Friends of Elk Island Society to raise awareness and reduce human disturbance on the swans, especially on nesting lakes.

Trumpeter Swan cygnet capture and relocation

Trumpeter Swan cygnets were captured during the first half of September when they were approximately 80-90 days of age. Cygnets were captured with a large fish dip net using a Jet Ranger 206B helicopter equipped with low skid gear following procedures described in Shandruk and Winkler (1988). The helicopter capture team consisted of the pilot and the individual who netted the cygnets. The ground team consisted of three individuals who marked and processed the cygnets for relocation (Beyersbergen and Kaye 2000). The cygnets, transported in large plastic kennels, were released later that same day on a select lake in EINP.

Trumpeter Swan banding program in the park area

During the early years of the reintroduction program, the potential for cygnet mortality as well as breeding pair and nonbreeding adult disturbance resulted in the decision to not band any of the adults or locally produced cygnets in EINP. However, the increasing EINP Trumpeter Swan population and the current transplant program on the wintering areas required that EINP swans be marked to improve monitoring and to ensure EINP swans were not affected by the wintering transplant program. In 2002, a program to capture, band, and colour mark (tarsal bands) moulting nonbreeding adult and yearling Trumpeter Swans was established in EINP and surrounding area. Aerial and ground searches were conducted in late July to identify lakes where moulting swans could be captured and marked. Canoes and small Zodiacs with outboard motors were used to approach the swans, which were captured using large fish dip nets (Shandruk and Winkler 1988). Captured swans were sexed, weighed, and banded with U.S. Fish and Wildlife Service (USFWS) metal bands and red plastic tarsal bands (alpha/numeric/numeric), then released on the lake together.

Migration and winter observation program

A cooperative program of observing and reporting marked Trumpeter Swans is ongoing in conjunction with the winter transplant program in the Greater Yellowstone/Tri-state region (Montana, Wyoming, Idaho). A network of wildlife agency personnel and volunteer observers in Canada and the United States report marked swans to the transplant project coordinator (Steve Bouffard, USFWS), who maintains the project database and forwards reports to the appropriate agencies. Winter and migration information on EINP Trumpeter Swans was collected through this program.

RESULTS

Grande Prairie production surveys

Table 1 presents the survey results for all lakes between 1999 and 2002. Not all lakes were surveyed each year and several new lakes were occupied by swans in recent years. The variability in number of lakes surveyed made it difficult to compare or detect trends in adult numbers and productivity. In 2000, as part of the international 5-year survey for Trumpeter Swans, the survey area and number of lakes checked were increased for this year only. Wetland and environmental conditions were more favourable in 2000 than 1999 as lake occupancy increased by almost 25% and mean brood size increased by 0.5 young/brood. The limited survey efforts in 2001 and 2002 precluded making comparisons with previous years.

During the aerial surveys conducted in 1999 through 2001, the same 43 lakes were surveyed each year. A comparison of population dynamics for these lakes is recorded in Table 2. The number of pairs was almost identical for all 3 years. However the number of cygnets and average brood size varied among the 3 years. Occupancy rate is quite similar for each of the 3 years and only six lakes were unoccupied during all 3 years. Several of the lakes surveyed are considered traditional staging lakes. The high number of "Other Adults" in 2001 using the staging lakes indicated high nest failure or total cygnet loss by breeding adults on territorial lakes in the area (Beyersbergen and Kaye 2000).

Elk Island National Park monitoring

Monitoring activities, especially in the spring, were increased in an effort to locate and identify the return of breeding pairs of Trumpeter Swans and previous year cygnets.

In 1999, three pairs of swans returned to the park area as well as one yearling (released as a cygnet in 1998) and, potentially, one locally produced yearling (Table 3). In 2000, three pairs of Trumpeter Swans returned to their respective territorial nesting lakes. Two other swans were observed and possibly one cygnet from the 1999 production year in the park. There was a slight setback in 2001 when one of the pairs lost a mate during the winter and migration period. However, the returning male was observed paired with an EINP-marked adult swan. The same three nesting territories were occupied again this year. There was the successful return of two EINP-produced cygnets, which were observed with the marked adults upon their arrival in the spring. One other adult completed the contingent of returning swans.

Early spring monitoring in 2002 recorded 18 Trumpeter Swans, the highest return in the history of the reintroduction program. The previous year's three breeding pairs were observed on their respective nesting lakes and five other adult swans were noted on several other lakes. Two of the breeding pairs returned with complete broods (4 and 3 cygnets, respectively, from the fall of 2001). They were initially observed as family groups upon their arrival in the park area. Later, the yearlings were observed dispersed on other lakes when breeding activity resulted in the breakup of the family. These increased levels of return or recruitment are critical for the growth of the breeding flock in EINP.

Breeding occurrences and fledging success

Breeding activity by Trumpeter Swans in EINP and surrounding area was documented in 1990, 1995, and 1998 (Beyersbergen and Kaye 2000), and continued in the park in each of the next 4 years of monitoring: 1999-2002. The south park area lake pair, which successfully hatched and fledged cygnets in 1998, continued nesting on their established territory. They hatched and fledged cygnets in 1999 and 2000 (Table 4). In spring 2001, the female of the pair failed to return and the male was observed on the territorial lake paired with another marked EINP adult. The pair nested and hatched cygnets in both 2001 and 2002, but only fledged young in 2002. The north park area lake pair hatched young in all 4 years of monitoring, but only fledged cygnets in the last 3 years. The Running Dog Lake pair exhibited breeding behavior, including courtship and nest construction, in 2000, however egg laying did not occur. The pair has subsequently hatched and fledged cygnets in the last 2 years of observations.

Trumpeter Swan cygnet relocation

Relocation of cygnets from Grande Prairie was limited to 1 year (fall of 2000) between 1999 and 2002. Astotin Lake was identified as the primary release site in EINP (Beyersbergen and Kaye 1995). On 22 September 2000, four female cygnets (red tarsal bands A25-A27, A29) relocated from the Grande Prairie area were released on the lake. All four cygnets fledged and were observed several times in the presence of the north park area pair with their young, and later with Tundra Swans (*C. columbianus columbianus*) staging on the lake until they migrated south in the fall. These four swans did not return the

following spring nor have they been observed in subsequent years in the park.

Trumpeter Swan banding program in the park area

In 2002, three yearling swans, Running Dog Lake cygnets from 2001, were captured on West Sawmill Lake in the Blackfoot Grazing, Wildlife and Provincial Recreation Area south of EINP on 22 July (Table 3) and fitted with U.S. Fish and Wildlife Service metal bands and red plastic tarsal bands (A17-A19). Then, 2 days later, a nonbreeding pair of Trumpeter Swans was captured on Blackfoot Lake at the southeast boundary of EINP and marked with metal bands and red plastic tarsal bands (A30, A31). The other nonbreeding adults and yearlings that moulted in the park were located on lakes not accessible for launching of canoes to facilitate capture, so were not marked. Program components in future years will focus on capturing and marking more Trumpeters in the park to facilitate monitoring.

Migration and winter observations

Trumpeter Swans relocated to EINP traditionally migrated to the Greater Yellowstone/Tri-state region (Montana, Idaho, Wyoming), but some of the relocated cygnets had established new migration routes and wintering areas in Oregon and California (Beyersbergen and Kaye 2000). However, recent observations (Table 5) showed EINP adults and family groups wintering only in the Greater Yellowstone/Tri-state region.

The wintering area of Red A23 is currently unknown and it could be the last migration link between wintering areas in California and EINP. The potential role of Tundra Swans as guide birds for relocated Trumpeter Swan cygnets migrating to the wintering areas has been discussed (Beyersbergen and Kaye 1995). 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; Ely *et al.* 1997). Trumpeter Swan "A23," relocated as a cygnet in 1998, was last observed with Tundra Swans on Astotin Lake before the fall migration and returned to EINP in the spring of 1999. It is possible, as in previous EINP-released cygnets, that "A23" may have wintered in Oregon or California, but there are no observations currently to support this.

CONCLUSIONS

Recruitment is essential for building the EINP flock. Breeding pair survival in the park, increased nesting and fledging success, and increased return rate for yearlings and nonbreeding adults resulted in the 2002 high of 18 swans in the EINP flock. This steady increase has occurred without cygnet relocation from Grande Prairie. Future levels of breeding success within the park will factor into the decision for future relocation efforts.

It appears that the EINP flock link with the wintering area in California may have been broken and with it, the breakdown of the migration tradition to these new wintering areas. The increased effort to mark resident swans in EINP may provide for the opportunity of future observations and give further insight into wintering locations of EINP swans.

Future recommended actions in the reintroduction project include:

1) Continue monitoring at the current level of effort to ensure that all returning swans are located and identified in Elk Island National Park and surrounding area.

2) Continue marking of all Trumpeter Swans in EINP to assist monitoring efforts in the park and to ensure that EINP swans are not affected by relocation efforts on the overcrowded wintering areas of the Greater Yellowstone/Tri-state region.

3) Regulate the level of relocation from the Grande Prairie flock by the level of breeding success in the park and by the availability and behaviour of foster parent guide birds on staging lakes in EINP.

4) Continue a public information program and area closures, under park policy, to minimise human disturbance during critical times for Trumpeter Swans in EINP.

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capture at Grande Prairie. Monitoring in EINP was conducted primarily by coauthor Rob Kay and Denise Hammel with additional assistance from the Friends of Elk Island Society. Helicopter pilot, Doug Parrish, made the capture in 2000 as successful as possible. Special thanks to Steve Bouffard for all the effort and information provided from the Trumpeter Swan observation database. Review of the manuscript was provided by Loney Dickson and Dave Duncan. Final thanks go to the Friends of Elk Island Society who provided the major funding support for the reintroduction program.

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Table 1. Summary of Trumpeter Swans observed for all lakes checked during aerial surveys in the Grande Prairie, Alberta, area, 1999-2002.

	1999	2000[1]	2001[2]	2002[3]
Paired adults (with cygnets)	92	118	24	10
Paired adults (no cygnets)	68	106	20	14
Other adults	117	180	205	25
Total adults	277	404	249	49
Cygnets	136	204	41	26
Total swans	413	608	290	75
Number of broods	46	59	12	5
Mean brood size	2.96	3.46	3.42	5.20
Lakes surveyed	182	329	43	20
Lakes occupied (% of total surveyed)	86 (47.3)	234 (71.1)	28 (65.1)	16 (80.0)

[1] *International Trumpeter Swan survey covering all areas potentially/historically occupied by swans.*
[2] *Limited aerial survey to identify lakes with cygnets that could be captured and marked for special migration study.*
[3] *Minimal number of lakes along roadside checked (14-15 August 2002) in agricultural area from land vehicle.*

Table 2. Comparison of 43 lakes surveyed in each of 3 years (1999 to 2001) for Trumpeter Swan use and numbers in the Grande Prairie, Alberta, area.

Year	Pairs with cygnets (adults)	Pairs with no cygnets (adults)	Cygnets (broods)	Other adults	Total swans	Mean brood size	Lake occupancy (number lakes)
1999	14 (28)	9 (18)	43 (14)	106	195	3.07	62.8% (27)
2000	16 (32)	7 (14)	59 (16)	124	229	3.69	62.8% (27)
2001	12 (24)	10 (20)	41 (12)	203	288	3.42	65.1% (28)

Table 3. Trumpeter Swans observed in Elk Island National Park, Alberta, and surrounding area (1999 through 2002).

Year	Marker	Age	Sex	Lake name	Comments
1999	Yellow 53AC	Ad.	M	North park area	Bred and hatched two cygnets, which
	Yellow 28AC	6	F	lake	perished within 24 hours during severe storm.
	Yellow 20AC	12	M	Running Dog Lake	
	Unmarked	Ad.			
	Marked (metal band)	Ad.	M	South park area lake	Bred and hatched 7 cygnets, observed on 1 July (1 week old); 3 on 15 September.
	Unmarked	Ad.	F		
	Red A23 (tarsal)	Yr.	F	Astotin Lake	Unmarked yearling- possibly cygnet, hatched in south park area previous year.
	Unmarked	Yr.	?		
2000	Yellow 53AC	Ad.	M	North park area	Bred - 3 cygnets hatched on 24 June; all 3
	Yellow 28AC	7	F	lake	fledged on 27 August; staged on Astotin Lake in fall.
	Yellow 20AC	13	M	Running Dog Lake	Exhibited breeding behaviour; may have
	Unmarked	Ad.	F		built nest but did not sit on it.
	Marked (metal band)	Ad.	M	South park area lake	Nested on beaver lodge at north end of lake; hatched 4 cygnets on approx. 15
	Unmarked	Ad.	F		June; fledged 1 cygnet.
	Red A23	2	F		Observed in company with yearling on several lakes in southern part of park and on Astotin Lake.
	Unmarked	Yr.	?		Observed in company with A23 red tarsal throughout park; believed to be one of cygnets fledged by pair on south park area lake in 1999.
2001	Yellow 53AC	Ad.	M	North park area	Bred - 4 cygnets hatched on 14 June;
	Yellow 28AC	8	F	lake	fledged 4 cygnets.
	Yellow 20AC	14	M	Running Dog Lake	Bred - 5 cygnets hatched 20 June or later;
	Unmarked	Ad.	F		nested on beaver lodge; fledged 3 cygnets.
	Marked (metal band)	Ad.	M	South park area lake	Unmarked bird of pair did not return and new pair bond formed between metal-
	Red A23	3	F		tarsal-banded bird and A23; bred and hatched 1 cygnet 8 July -- lived only few weeks.
	Unmarked	Ad (2)	?	Flyingshot Lake	Potentially bird that was associated with red A23 in 2000 and hatched by south park area lake pair in 1999.
	Unmarked	Yr.	?	Unnamed lakes,	North park area lake pair (53/28) yearlings
	Unmarked	Yr.	?	Moss Lake area	observed with pair in spring on Astotin Lake and moved around lakes in north end of park.

Table 3. continued.

Year	Marker	Age	Sex	Lake name	Comments
2002	Yellow 53AC	Ad.	M	North park area	Bred - 5 cygnets hatched on 22 June;
	Yellow 28AC	9	F	lake	male and 2 cygnets missing 30 June; fledged 3 cygnets.
	Yellow 20AC	15	M	Running Dog	Bred - 4 cygnets hatched on 29 June;
	Unmarked	Ad.	F	Lake	fledged 4 cygnets.
	Unmarked	Ad.	M	South park area	Bred – 3 cygnets hatched on 1 July;
	Red A23	4	F	lake	fledged 3 cygnets.
	Unmarked	Ad (3)	?	Astotin Lake	Potentially bird associated with red A23 in 2000 and hatched by south park area lake pair in 1999.
	Unmarked	Ad (2)	?	Unnamed lake	Likely 2 young reared by north park area
	Unmarked	Ad (2)	?	(Moss Lake area)	lake pair (53/28) in 2000; observed on same lakes used in 2001.
	Unmarked	Yr.	?	Astotin Lake	Yearlings of north park lake area pair
	Unmarked	Yr.	?		(53/28) hatched in 2001; observed on
	Unmarked	Yr.	?		variety of lakes in north and south areas
	Unmarked	Yr.	?		of park.
	Red A17 (tarsal)	Yr.	M	East Sawmill	Yearlings of Running Dog Lake pair
	Red A18 (tarsal)	Yr.	M	Lake	hatched in 2001; banded on 22 July;
	Red A19 (tarsal)	Yr.	F		observed on several lakes in area of capture.
	Red A30 (tarsal)	Ad.	F	Blackfoot Lake	Unknown adults captured and marked on
	Red A31 (tarsal)	Ad.	M		24 July; potential breeding next year?

Table 4. Trumpeter Swan cygnet production, fledging and returning yearlings in Elk Island National Park, Alberta, and environs.

Lake site	Pair (marker identification)	Year of production	Number cygnets hatched	Number cygnets fledged	Returnees (yearlings)
Running Dog Lake	20AC - 03AC	1990	2	0	0
	20AC - unmarked female	2001	5	3	3
		2002	4	3	?
North park area lake	53AC - 33AC	1995	5	0	0
	53AC - 28AC	1999	2	0	0
		2000	3	3	2
		2001	4	4	4
		2002	5	3	?
South park area lake	Unknown metal band - male Unmarked female	1998	4	4	1
		1999	7	3	1
		2000	4	1	0
	Unknown metal band - male A23 female	2001	1	0	0
		2002	3	3	?
Total			49	27	11 +

Table 5. Wintering areas and migration observations of Elk Island National Park, Alberta, Trumpeter Swans.

Marker (collar)	Other swans	Date	Location
		1999	
Yellow 20AC (Running Dog Lake male)		1 & 19 January	Sheridan Lake, Idaho
		17 February	Henry's Fork (Texas Slough), Idaho
		5 & 10 March	Ennis Lake, Montana
Yellow 20AC (Running Dog Lake male)		2000 10 January - 8 February	Sheridan Lake, Idaho
Yellow 20AC (Running Dog Lake male)		2000 20 November – 7 December	Sheridan Lake, Idaho
		2001 2 January - 13March	Sheridan Lake, Idaho
Yellow 20AC (Running Dog Lake male)	Unmarked adult 3 cygnets	2001 19 November	Henry's Fork, Cartier Slough, Idaho
Yellow 53AC[1]	2 cygnets	2000 13 December	Snake River, Jackson, Wyoming
Yellow 28AC (northern EINP pair)		2001 31 January - 16 March	Snake River, Jackson, Wyoming
Yellow 53AC	3 cygnets	2001 25 December	Snake River, Jackson, Wyoming
Yellow 28 AC (northern EINP pair)		2002 23 February	Snake River, Jackson, Wyoming
Yellow 28 AC	3 cygnets	2002 16 November	Snake River, Jackson, Wyoming

[1] First observations on the wintering area at Jackson, Wyoming, of this pair of Trumpeter Swans.

SPRING AND FALL MIGRATION AND POND USAGE BY TRUMPETER SWANS, COCHRANE AREA, ALBERTA, CANADA, 2002

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ABSTRACT

Trumpeter Swans (*Cygnus buccinator*) have been observed resting and feeding on 35 ponds during spring migrations in the past 11 years. During the fall migration, they have been observed utilizing the same ponds in significant numbers only in 1997 and 2002. Of the 35 ponds utilized, 7 carry the majority of birds, 4 periodically have significant numbers but are not used on a year-to-year basis, and 23 are used sporadically. Ten of the latter have dried up in the past 3 years. The earliest arrivals, generally paired adults, arrived on 25 March in 1993, and then progressively later in subsequent years, the latest being 13 April 2002. Peak migration is consistently in the 15-27 April interval regardless of the time of the first arrivals. Juveniles arrive later, accompanying adults, and increase in numbers towards the end of the migration, often accompanied by a single or three adults and remain later with a single adult, their parents having moved on without them. Fall migration starts in early October and continues until late November stopping only if feeding ponds are open. Migration during the spring and fall of 2002 will be used to demonstrate timing, pond use, and number of juveniles in spring and cygnets in fall. Collared and leg-banded, and radio-collared individuals will be used to assess length of stay.

INTRODUCTION

I first observed Trumpeter Swans (*Cygnus buccinator*) on Jumpingpound pond in 1990 at what appears to have been mid-spring migration. Topographic maps were examined and additional ponds were identified as potential locations for Trumpeter Swan visitation in the area. These were examined with mixed results. The following year, a more detailed survey was conducted and it became apparent that a number of ponds had visitations but were not consistently used. This paper presents the results for the spring and fall surveys, including location, timing of migration, collars, juveniles, cygnets, and swan days for 2002.

METHODS

Surveys

Initially, surveys were not conducted in a systematic fashion. However, it became apparent that only through daily visitation could one obtain data on time of arrival. Subsequently, twice daily trips have become the norm (7:30-10:30 a.m. and 5:00-9:00 p.m.). Daily surveys began on 25 March and continued until 3 to 5 days after the last Trumpeter was seen to check for stragglers and from about 1 October to freeze up in the fall.

Swan days

Swan days were calculated by assigning an arbitrary 12 hours per bird sighted on the first and last usage days and an average of birds between the first and second day and third and fourth day, etc. If there was discontinuous use, reappearance was treated as a first day. LaMontagne (2000; 2002) provides additional data on the characteristics of pond use by Trumpeter Swans. LaMontagne *et al.* (2001) discuss Trumpeter Swan behavior during spring migration. Hills *et al.* (1995) describe spring migration and utilization of small ponds in the Cochrane area.

Juvenile-cygnet counts

Although it is easy to count the number of juveniles or cygnets present, it is difficult to translate these numbers into actual number of individuals observed from day to day, because of possible movement from one pond to the next or exit from the area. Several criteria were used to try and arrive at an actual number sighted. These criteria included: 1) collared birds with cygnets, which eliminated duplicate counts; 2) brood size; 3) feeding station (individual family groups tended to remain at a good feeding location); and 4) changes in numbers combined with brood size. Once changes occurred on one pond, then attempts were made to determine if there was a corresponding change on one of the other ponds

being examined that would reflect the observed changes. Once the total data base was examined, a probable number of juveniles or cygnets and parentage was determined.

Table 1 outlines changes in parent and cygnet populations between 15 and 18 October 2002, with calculation of total observations and probable pair and cygnet numbers for Cochrane Lake and the method used. On 15 October, there was a total of 13 cygnets assignable to seven pairs. On the 16th, it appears that seven cygnets had left (1, 2, 2, 2) and seven cygnets (3, 4) had been added, thus the number of cygnets remained the same on the 2 days, but in fact there had been significant turnover. Four pairs and seven cygnets had left and were replaced by two pairs with a combined seven cygnets that had arrived. On the 17th, the numbers had changed again with the addition of a pair with two and another pair with four; hence, six new cygnets and two new pairs. On the 18th, 11 swans had left, one pair with one cygnet, and two pairs with two cygnets each, and no new pairs with cygnets were added. The above counts of cygnets alone can be misleading and to be useful for population numbers, there must be additional evidence such as brood size and whether or not they are accompanied by a single or two adults.

Cochrane Lake wetlands was surveyed first in the fall as it is the northernmost pond of those surveyed and it is assumed that departing birds will move south or southwest to more southerly ponds. Therefore, once departure occurred as explained above, corresponding arrivals were looked for on more southerly ponds. If there was no corresponding increase in more southerly ponds, it was assumed that birds departing Cochrane Lake wetlands had left the study area. If new arrivals of corresponding composition on more southerly ponds were observed, they were considered possible repeat counts. This would have been reflected in probable total cygnets minus the possible recounts; e.g., 20 – 4 indicates 20 cygnets observed but may include 4 repeats. No apparent pond shifts took place in fall 2002; therefore, individual pond totals were treated independently and the final totals are those of the individual ponds.

Similar logic was used during spring migration except that new arrivals at Cochrane Lake wetlands possibly received Trumpeter Swans from more southerly ponds in the study area that had already been counted. Another means of identifying repeat observations in the spring was to observe "family" groups, which often consisted of three adults and associated juveniles. As these groups tended to stay close and remain in a restricted area of a pond they could be identified from day to day and hence be eliminated from double counts. During the period of observations, the breeding pair would often leave but the single adult and juveniles would remain at the same location, sometimes for several days. Another situation occurred when Green N24 and N25 abandoned three juveniles on a small pond just east of Sibbald pond east. The juveniles remained on the pond for a day then left. The day they left, three juveniles appeared on Pile of Bones pond and joined with a single adult that had been there by itself for about 7 days. These would be classed as juveniles already counted and therefore not added to the total. Note: no family groups of three adults with cygnets were observed in the fall; however, family groups with a single adult are often seen in the fall. Therefore, three adults with juveniles appears to be valid for spring identification only.

Probable counts of adults will not be attempted here, as unpaired, uncollared individuals are impossible to track.

Location of the study area and ponds surveyed

Figure 1 outlines the study area and Figure 2 identifies the key ponds. They are west of Highway 22, west of Cochrane to Highway 1, west to Sibbald pond, north to the Indian Reserve, south of the Bow River, and north on Hwy 22 to Cochrane Lake wetlands. No major continuous pond utilization has been noted north of the Bow River except at Cochrane Lake wetlands.

Note all pond names are informal except for Cochrane Lake.

Jumpingpound

Figure 2 gives the general location of Jumpingpound. It is situated just north of Highway 1 and west of Shell Road. The intersection between Highway 1 and Shell Road is an overpass and a complex of ramp roads; therefore, Jumpingpound pond is in a high traffic area. The area immediately to the north is a spring cow calving area for CL Ranches. Grasslands surround the north and west side of the pond. Initially, this was the most heavily utilized pond but it has been replaced by Dave Copithorne's pond. Birds utilizing this pond do not react to highway traffic, or to even paving crews or ranch hands tending cattle. They are sensitive, however, to vehicles that pull over and stop, resulting in the birds moving to more distal areas of the pond or departing. This pond is noted as the only pond where collared

birds from Elk Island National Park have stopped over in the spring and had the radio-collared bird with Black K07 (Tables 2 and 3). It is noteworthy that when the swans arrived on 12 October, the pond was essentially frozen over with ice about 1 cm thick, but by the 20th, a large feeding area had been created. By the 27th, with dropping temperatures, they were unable to maintain open water and left on the 28th. The pond was also heavily utilized by Tundra Swans (*C. columbianus columbianus*).

Sibbald pond

Sibbald pond is just north of the TransCanada Highway (Figure 2) and next to an underpass onto a secondary road. Recently, mailboxes have been installed next to the pond. The turnout area is often used for parking heavy equipment and because of its easy access, has become a common stopping place for people wanting to view the swans.

Initially, there was a winter feeding area for cattle on the northeast side of the pond. This added substantial quantities of manure to the pond. A request to the ranch operator resulted in the practice being discontinued. Swan feeding was concentrated in the area adjacent to the feeding area and along the periphery of the pond even next to the highway. The pond is bordered by trembling aspen (*Populus tremuloides*) on the west and east. The area along the north is open grassland used for shore resting. This pond carried the second highest numbers of birds when the survey began. However, with removal of the cattle feeding area, use decreased sharply and is now sporadic.

Sibbald pond east

Sibbald pond east is immediately adjacent to a heavily used gravel road (Figure 2). It is bordered by trembling aspen on the west, trembling aspen and white spruce (*Picea glauca*) on the east, and grasslands on the north. The principal resting area is along the north shore within 2 m of it or in shallow water adjacent to the north shore. Feeding initially was along the north and east shore and in the northeastern bay. Subsequent lowering of water levels has allowed the feeding to expand into the centre of the pond. Green N24 and Green N25 frequented this pond almost exclusively. Their landing point was along the north shore from where they and their juveniles would feed along the east margin and next to the road.

This pond initially was ranked #3, but usage has dropped and has become sporadic.

Dave Copithorne's pond

Dave Copithorne's pond (Figure 2), which is a dammed creek, was not in use when the survey first started. It has become the #1 pond in both spring and fall usage. The area to the east is a feedlot with drainage directly into the pond. The shoreline is grass or feedlot for most of the periphery except the north end, which has willows (*Salix* sp.) bordering the shore. Shore resting is rare with a few birds occasionally resting on the west shore. Feeding is over the entire pond except for an excessively deepened area adjacent to the dam (south end).

Ibbotson's pond

Ibbotson's pond (Figure 2) was rarely used until 2000. Since that time, use has increased. It is generally ice covered for much of the spring migration. The increase in swan use corresponds to the fact that it has opened earlier in the last 3 years. Exchange between Dave Copithorne's and Ibbotson's ponds is very common.

It is a natural steep-sided pond surrounded on the north and southeast end by willows and trembling aspen. The west side was fringed by balsam-poplar (*Populus balsamifera*), but these have been felled by beaver (*Castor canadensis*). Swans rest in the water as no suitable onshore resting area is available.

Pile of Bones

Pile of Bones (Figure 2) is a natural pond that has had a dam added to raise water levels. It is surrounded by grasslands for most of its perimeter except the west end where willows border the shoreline. Feeding is along the periphery as water depth is too great for tip-up feeding in the deeper east-west axis of the pond. Trumpeters frequenting this pond tend to be nervous, frequently leaving even when a person stops over 0.5 km away. The pond is used both for feeding and resting on the water or ice.

Shell pond

Shell pond (Figure 2) is bordered on the north by a gravel road and grasslands with sparse shrubby cinquefoil (*Potentilla fruticosa)* on the remainder. It is shallow with most of the pond less than 1 m deep, but with the drought much of the area is 15 cm or less. A barbed wire fence borders the gravel road and a second crosses the pond from north to south. The pond retained sufficient water to attract swans until the end of spring migration but was essentially dry in October.

Barry Richards' pond

Barry Richards' pond (Figure 2) dried up during 2002, however, it had been constantly used during spring migration. The entire pond boundary is grassland used for cattle grazing. Trumpeters were observed on the pond intermittently between 15 April and 15 May. A fluctuation in total numbers and the adult/juvenile populations and intervals when there were no swans present indicates a rapid turnover rate. This pond was dry in the fall of 2002.

Jumpingpound north

Jumpingpound north (Figure 2) is a small pond about 150 x 50 m bordered on the east by the paved Shell Road and grasslands used for cattle grazing on the remainder.

This pond has carried up to 60-70 swans for several days in previous years but was not utilized in the spring of 2002. It had two adults on 12 October and five on 13 October. A single Trumpeter cygnet spent 3 days with a pair of Tundras on this pond in the fall of 2002.

Jumpingpound east

Jumpingpound east (Figure 2) is a small pond in a grassland area utilized for cattle grazing. Feeding and resting occur along the east and south border of the pond in both the spring and fall. Both Trumpeter and Tundra Swans use this pond.

Although consistently used in the spring prior to 2002 it was not utilized in the spring of that year. It was used in the fall of 2002 between 12 and 19 October with 50 birds seen on the 19th. They started leaving at about 4:30 in the afternoon of the 19th and were all gone the next morning.

Cochrane Lake wetlands and Cochrane Lake

Both Cochrane Lake wetlands and Cochrane Lake (Figure 2) have been traditional stops for both Trumpeter and Tundra Swans. However, with recent construction activity, use has become sporadic. Cochrane Lake wetlands are used for feeding, resting, and overnight stays, whereas Cochrane Lake is used primarily for night resting with no feeding observed. Trumpeters will fly over from the wetlands to Cochrane Lake in the evening and return between about 6:00 and 10:00 a.m. to feed. Trumpeters have only been observed on the north and east shores of Cochrane Lake.

The wetlands are comprised of open water and fringing emergent aquatics. Feeding occurs in the open water areas but not within the emergent vegetation. Both Trumpeters and Tundras remain in the water and have not been observed to move onshore on either Cochrane Lake or Cochrane Lake wetlands.

MIGRATION

Migration

Daily surveys began on 25 March and continued until 3 to 5 days after the last Trumpeter was seen. The timing of first arrivals has changed during the progress of this study. A pair of Trumpeters was seen resting on ice at Sibbald pond on 25 March 1993, but generally first arrivals occur on 28 March or later. There has been a trend toward later arrival dates with first arrivals on 13 April in 2002. Fall migration starts about 1 October and ends about 30 November. However, the ponds freeze over normally by November and observations then tend to be birds overflying the area.

Spring migration can be subdivided into three phases: phase 1 is characterized by adult paired birds that stop to rest and/or feed and move on quickly; phase 2 begins with the first appearance of juveniles, which progressively increase in numbers, but the migration is dominated by adults; and, phase 3 occurs during the final stages of migration when juveniles are consistently present. A final observation is that the build up to peak migration normally occurs over a 7- to 14-day period with a similar or lesser tailing off period following peak migration. Spring migration during 2001 and 2002 are definite exceptions to this in that the tailing off period was much longer (3+ weeks) and the first arrivals were on 13 April (Figure 3).

Spring migration 2002 was unusual in that lower numbers of both adults and juveniles were observed. The presence of juveniles with the first arrivals suggests that phase 1 (adults only) was missed, the birds probably having flown over or taken a different route. Peak migration occurred between 15 and 27 April.

The fall migration began on 12 October and ended 29 October (Figure 4). Cygnets were observed throughout the fall migration. The limited time of residency was the result of ponds freezing over on the night of 28 October. The single Trumpeter observed on 29 October was resting on ice.

Figures 3 and 4 outline the cumulative sightings of Trumpeter Swans 25 March - 30 May and October 2002. Figure 3 shows that the peak migration was between 15 and 27 April with a secondary minor peak between 29 April and 2 May. Fall migration was truncated by cold weather resulting in all of the ponds freezing over, which caused the swans to overfly the area.

Spring migration juveniles

Assignment of juveniles to family groups and to singles or pairs is often difficult since they are often only loosely bonded to their parents and may occur with a single adult not of their parentage or as groups of juveniles. The probable number of juveniles observed was 119, but could have been as low as 104 or as high as 132. The total number observed including known repeats was 495.

Cygnets fall 2002

The number of cygnets counted was 220 in 91 family groups; however, this included repeat observations. Based on the criteria outlined above, the probable number was 139 assignable to 67 broods including two families with only one adult. Brood size ranged from one to six.

Collared Trumpeter Swans

Collared Trumpeter Swans stayed in the area (Figure 5) from 1 to 4 days, indicating rapid turnover of the migrants during the spring migration. This is a shorter residence time than in previous years, which sometimes extended to 10 to 15 days (personal data) and is probably related to late arrival. The number of collars observed is also fewer than in previous years and the duration of stay was shorter (Hills *et al.* 1995).

Eleven collared Trumpeters were observed during fall migration (Figure 6). Stays were longer than in the spring ranging from 1 to 13 days. Stay in the area was terminated when the ponds froze over.

Usage in swan days

Tables 2 and 3 outline swan use of the ponds under review. Spring usage of Dave Copithorne's pond at 1,382 is clearly the most heavily used pond in the spring. Conversely, Cochrane Lake wetlands, which had no use during the spring, were heavily used by both Trumpeter and Tundra Swans in the fall. Pile of Bones was the second most heavily used pond by Trumpeters in the spring, but the combined Trumpeters and Tundras shows that Jumpingpound pond was the second most heavily used pond in the spring and that the former was third. In the fall, Jumpingpound was the most heavily used when combined Trumpeters and Tundras were considered. Cochrane Lake wetlands carried the most Trumpeters in the fall, but the combined Trumpeter/Tundra totals indicate that it received slightly less usage than Jumpingpound.

In spite of the differences in individual pond usage, the totals are relatively close at 2,261 swan days in the spring and 2,115 in the fall. Fall usage was truncated by the ponds freezing over, forcing the swans to leave. It is significant to note that over two thirds of Jumpingpound pond was frozen over with thin ice (to ca 1 cm) when the first swans arrived in the fall and that the Trumpeters broke up the ice and expanded the feeding/resting area to include at least two thirds of the pond. Once the ice was broken up, Tundra Swans joined the Trumpeters.

CONCLUSION

The flyway in the Cochrane area carried a significant number of migrating Trumpeters in both the spring and fall of 2002. Ponds utilized are small and relatively shallow making food resources available by tipping up or simply reaching down.

Visitation twice a day allows better control on numbers and movements of flocks and a greater ability to examine recruitment (fall), survivorship (spring), brood size, and behavior. Pond usage was different in spring and fall.

Tundra Swan use is variable from year to year (unpubl. data) but in fall 2002 constituted a major component of the use. However, significantly, it appeared that Trumpeter Swans did most of the breaking up of ice and the Tundra's simply took advantage of the open water and fed in the available shallow water.

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Editors' Note: Additional graphs showing Trumpeter Swan usage of individual ponds are available on file with Alberta Fish and Wildlife and Canadian Wildlife Service. Please contact the author.

Table 1. Changes in cygnets on Cochrane Lake and calculation of probable pairs and cygnets.

Date	Brood size	Total cygnets	Probable new cygnets	Observed pairs	Probable new pairs
15 October	1, 1, 2, 2, 2, 2, 3	13	13	7	7
16 October	1, 2, 3, 3, 4	13	7	5	2
17 October	1, 2, 2, 3, 3, 4, 4	19	6	7	2
18 October	3, 3, 4, 4	14	0	4	0
Total		59	26	23	11

Table 2. Individual pond use in terms of swan days[1] during spring migration 2002.

Pond	Trumpeter Swans	Tundra Swans	Total swan days
Cochrane Lake wetlands	0	0	0
Jumpingpound	238	50	288
Sibbald pond	28	3	31
Sibbald pond east	90	0	90
Dave Copithorne's	1382	3	1385
Ibbotson's	54	7	61
Pile of Bones	268	3	271
Shell pond	28	0	28
Barry Richards'	59	0	59
Jumpingpound north	34	3	37
Jumpingpound east	2	0	2
Other	9	0	9
Total	2192	69	2261

[1] Swan day = 1 swan per day or 2 swans for 12 hours or any combination equating to 24 hours.

Table 3. Individual pond use in terms of swan days[1], fall 2002.

Pond	Trumpeter Swans	Tundra Swans	Total swan days
Cochrane Lake wetlands	454	259	713
Jumpingpound	397	569	966
Sibbald pond	2.5	8	10.5
Sibbald pond east	0	0	0
Dave Copithorne's	98	12.5	110.5
Ibbotson's	71	0	71
Pile of Bones	78.5	13.5	92
Shell pond	0	0	0
Barry Richards'	0	0	0
Jumpingpound north	7	6	13
Jumpingpound east	69.5	0.5	70
Others	67	2	69
Total	1244.5	870.5	2115

[1] Swan day = 1 swan per day or 2 swans for 12 hours or any combination equating to 24 hours.

Figure 1. Study area, Cochrane area, Alberta, Canada.

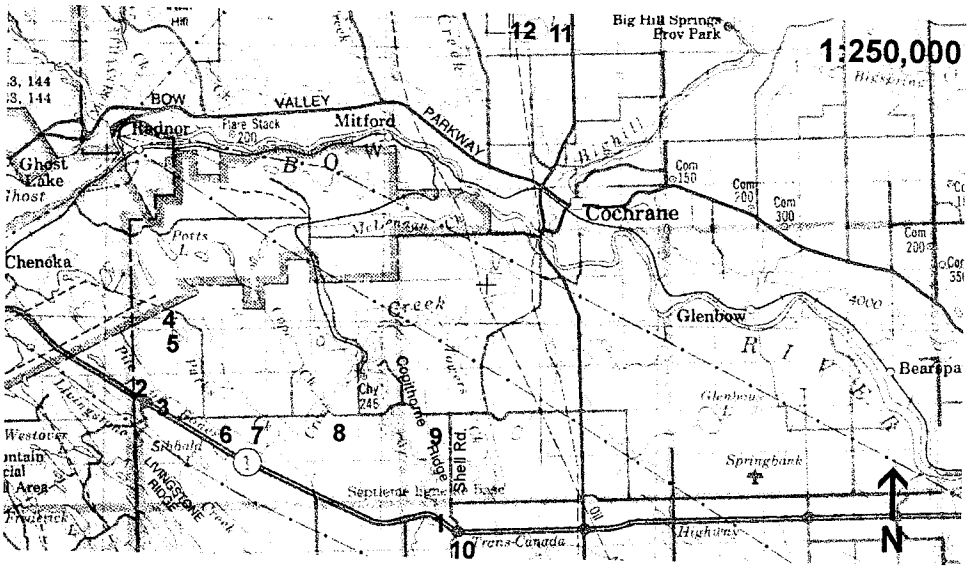

Figure 2. Location of ponds utilized by Trumpeter Swans. Jumpingpound (1) Sibbald pond (2) Sibbald pond east (3) Dave Copithorne's (4) Ibbotson's (5) Pile of Bones (6) Shell pond (7) Cochrane Lake wetlands (11) Cochrane Lake (12).

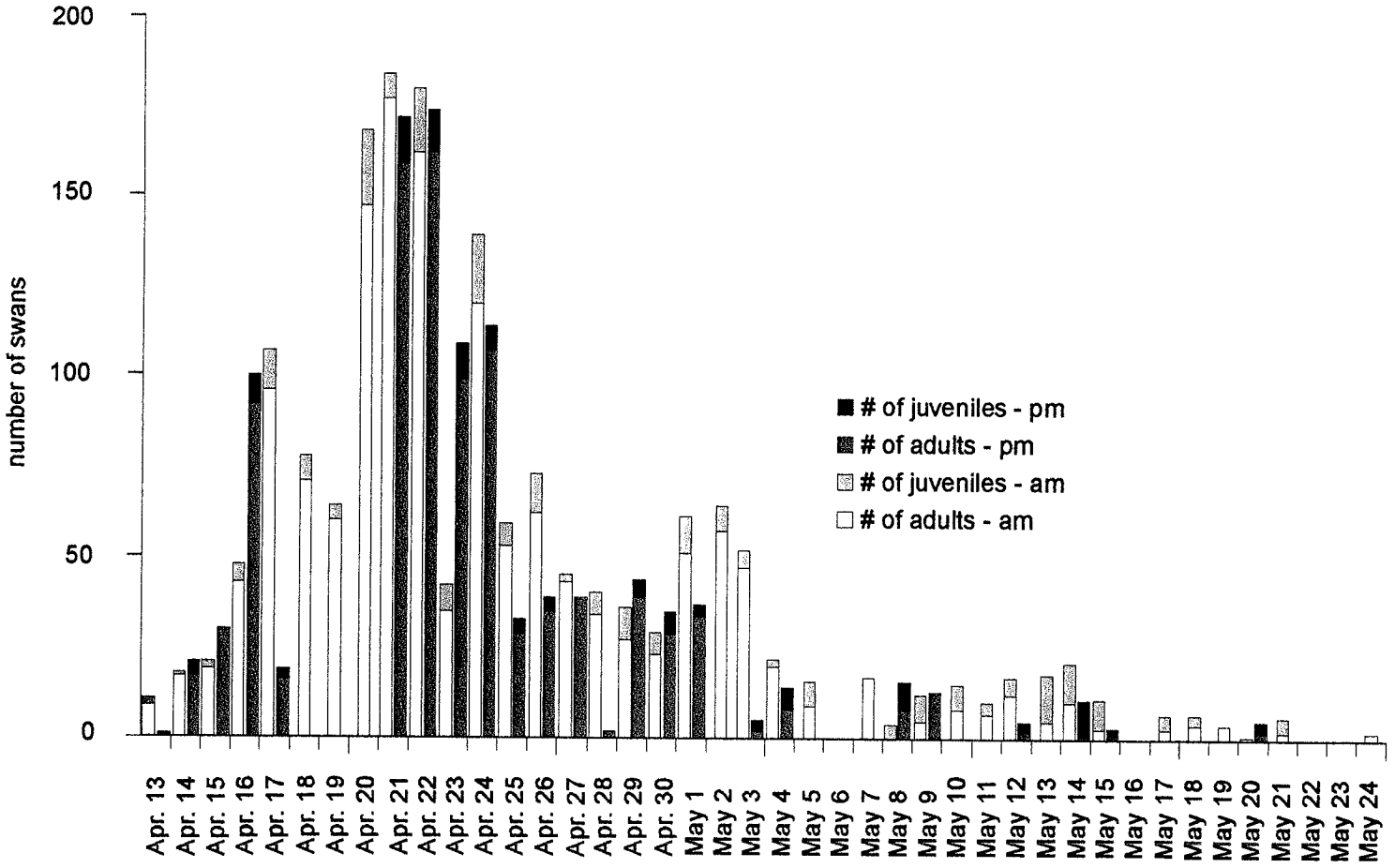

Figure 3. Total Trumpeter Swan usage of all ponds, spring 2002.

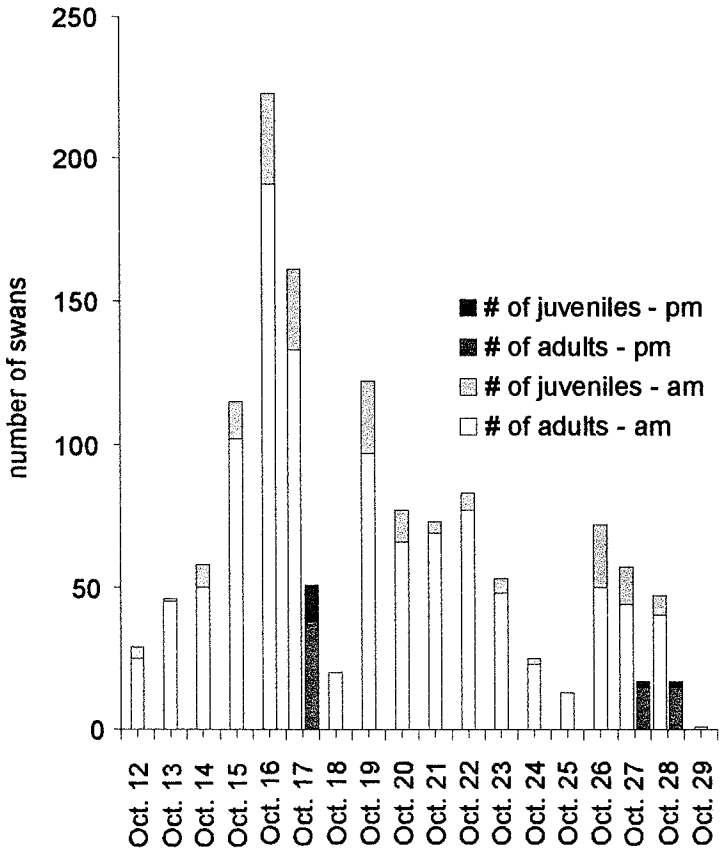

Figure 4. Total Trumpeter Swan usage of ponds, fall 2002.

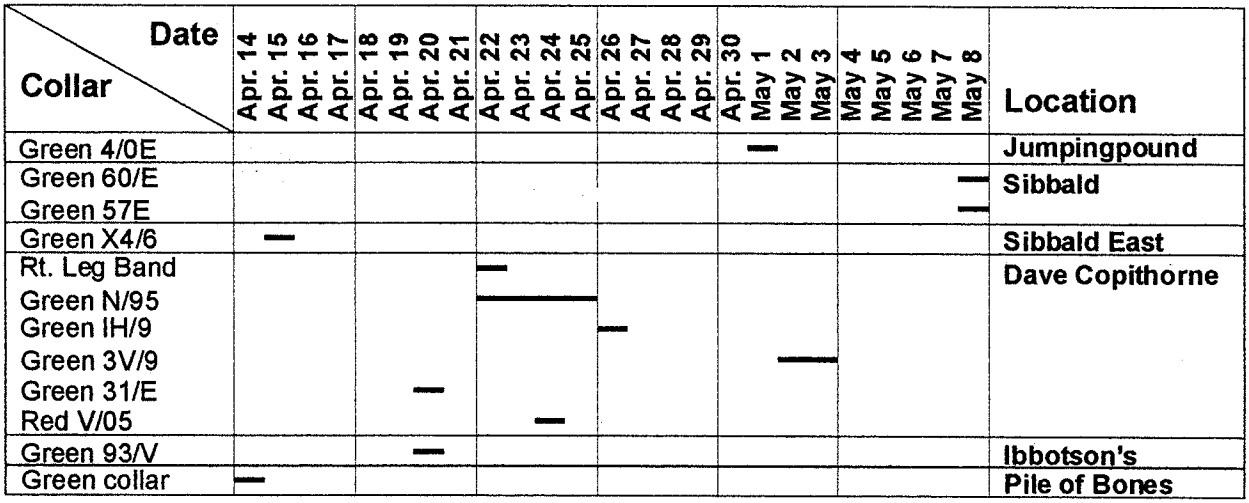

Figure 5. Collars and leg bands recorded, spring 2002.

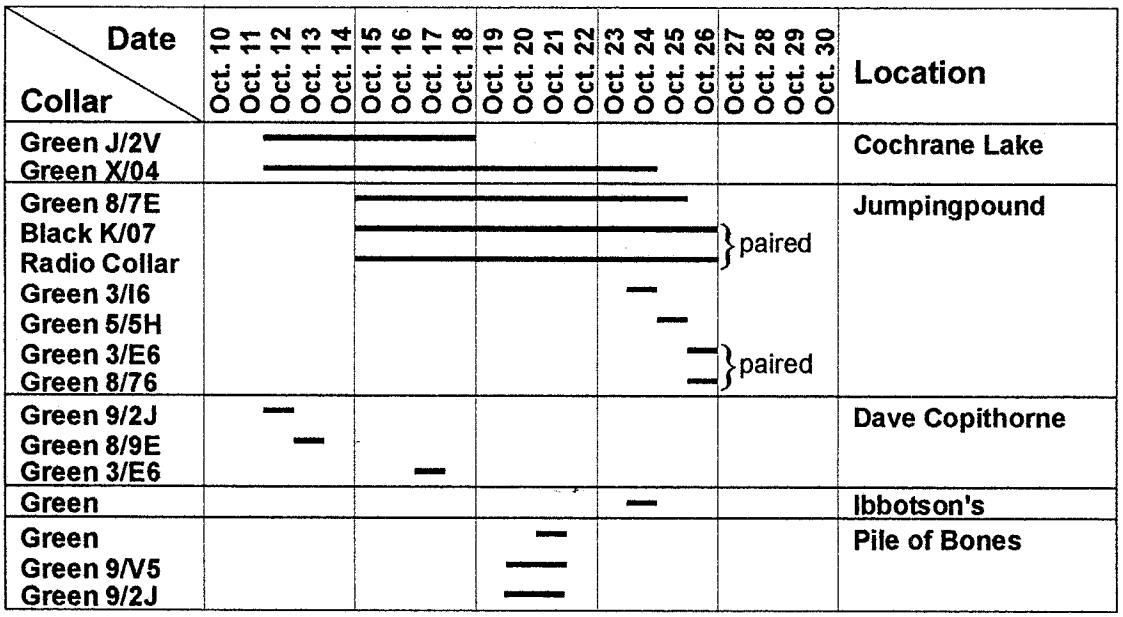

Figure 6. Collars and leg bands, fall 2002.

HABITAT AND MANAGEMENT TRENDS AFFECTING TRUMPETER SWANS IN ALBERTA

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ABSTRACT

This paper provides background and reviews Trumpeter Swan *(Cygnus buccinator)* habitat and management trends in Alberta. Five-year and other censuses reveal that the once remnant Alberta flock is expanding into new habitat from its Parkland core, while pioneer flocks are forming in Foothills, Boreal, and the southwestern Parkland and Montane regions. More apparently good habitat awaits them. The major threat within Alberta to continued recovery is habitat loss or disturbance due to rapid resource-based economic expansion, human population growth, and residential and recreational development. Increasing climatic instability is apparently adversely affecting habitat and limiting the swan's ability to use it successfully. Meanwhile, the swan has benefited from population surveys, reintroductions, and land-use guidelines, and may further benefit from recent affirmation of its provincial legal Threatened status and an Alberta Trumpeter Swan Recovery Plan, which should be produced by the end of 2003. However, current politics are cause for concern and the need for much expanded public awareness and support is crucial to continued Trumpeter recovery in Alberta.

INTRODUCTION

The swans

The Trumpeter Swans (*Cygnus buccinator*) that summer and breed in Alberta winter in the Tri-state area of Montana, Wyoming, and Idaho, in and near Yellowstone National Park. They comprise a third of the Canadian migratory portion of the Rocky Mountain Population (RMP) (Canadian Wildlife Service Waterfowl Committee 2000). The species faced near extinction by 1912 (Banko 1960) and the entire Canadian breeding population was thought extirpated until a small remnant flock was discovered in Alberta's Grande Prairie area in 1918 (James 2000; Mackay 1981). As a result of conservation measures, the 5-year census in 2000 counted 995 Trumpeters Alberta-wide (Hawkings *et al.* 2002).

The habitat

Nesting lakes in Alberta typically have quiet, shallow, stable levels of unpolluted fresh water; submergent and emergent vegetation for food and cover; a muskrat house, beaver dam, or other structure for use as a nest site; and are usually isolated from human disturbance (Banko 1960; James 2000; James and James 2001). Such habitat exists within several of Alberta's six large-scale natural regions (NRs). The rolling aspen Parkland NR (12% of Alberta) provides the core habitat. The colder, wetter Lower Foothills Subregion (SR) of the Foothills NR (16%) is increasingly used; so, too, the Dry and Central Mixedwood SRs of the cold, dry Boreal Forest NR (48%) (Anonymous 1998; Hummel 1995; James 2000; Strong and Leggat 1992; Thomas 1996). In southwestern Alberta, a flock is establishing in the Foothills Parkland SR and the Montane SR of the Rockies NR.

Management background

Jurisdiction over Trumpeters in Alberta is split between three levels of government. The result is a patchwork of acts, regulations, and bylaws (White and White 2000) with some important patches lacking. Also, all three government levels are reluctant to put controls on private land. In practice, dedicated front-line federal and provincial staffs collaborate to manage Trumpeters under the international Pacific Flyway Management Plan for the Rocky Mountain Population of Trumpeter Swans, while Ducks Unlimited Canada does valiant work protecting and managing wetlands under the North American Waterfowl Management Plan. Many habitat decisions, however, flow from the goodwill or otherwise of private landowners.

Federal level

The Migratory Birds Convention Act, 1994 (MBCA), an update of the Act of 1917 enabling the Canada/U.S. Convention of 1916, is the federal source from which Trumpeter Swan management flows. The update states that "migratory bird populations shall be managed ... to provide for and protect *habitat necessary for the conservation of*

migratory birds" (my italics) (Article 2). However, impediments to implementation arise from federal/provincial politics. While the MBCA bestows on the federal government responsibility for and authority over migratory birds and their habitat, the provinces now have authority over 96% of Canada's land. Originally, Canada managed all Crown (i.e., public) land (including "the internal waters of Canada"). But in 1930, it devolved this power to the provinces, except for national parks, MBCA Migratory Bird Sanctuaries (up to high-water mark only), Canadian Forces bases, and the like (4%), and navigable waters.

The Species at Risk Act (SARA), Canada's first, was passed in October 2002 and should come into force in June 2003. It does not apply directly to species already protected under the MBCA, and it applies only to federal lands (the 4%) and species at risk nationally. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC), which it formalizes, listed the Trumpeter as Vulnerable nationally in 1978, but Not at Risk in 1996 (due to growth in Canada's Pacific population) (Mackay 1978). Because SARA applies only to federal lands, the federal/provincial Wildlife Ministers' Council members signed the National Accord for the Protection of Species at Risk in Canada (1996). Under it, each committed to establish complementary provincial legislation and programs for species protection – for which SARA does provide an improved, if imperfect, model. Also, SARA's emergency provisions (Section 80) can be activated if a province fails to enact measures to protect species under its authority. So far, Alberta has not complied.

The National Parks Act says "such Parks shall be maintained and made use of so as to leave them unimpaired...." Two such national parks (NPs) in Alberta host nesting and staging Trumpeters: Elk Island NP in central Alberta and Waterton Lakes NP in the southwest corner. Both are true sanctuaries, having fortunately escaped the metastasizing industrial tourism afflicting Alberta's best-known NPs (where "parks for the enjoyment of people" continues in practice to take precedence over "unimpaired").

No national wildlife refuge legislation or system exists in Canada.

Provincial level

While the federal government remains the lead jurisdiction under the MBCA regarding protection of Alberta's Trumpeters, it is largely left to the provinces to protect the species on private lands and provincial Crown lands within its borders. But, while most nonfederal land in Alberta remains as Crown land in provincial hands, about 40% is now deeded land (private and municipal), regulated (or not) by local municipal bylaws.

Alberta's Wildlife Act, Schedule 6 of Regulation AR 143/97 (Revised 1997) lists the Trumpeter as Threatened – a status equating to Vulnerable: D1 status in the Regional Red List Category (Anonymous 2001). This act was and remains a tool used to regulate game hunting and fishing and protect nest or den sites (White and White 2000). However, following the above mentioned Accord of 1996, the act was expanded to include any relevant plant or animal species. Also, the Endangered Species Conservation Committee (ESCC) and its independent Scientific Subcommittee (SSC) of scientists were created.

Turning to practical matters, the Alberta government has long managed the core Peace River Parkland for farming and, from the 1970s, for very rapid industrial and urban development, which has resulted in less than 5% of the NR remaining in its natural state. The Foothills NR, until 1930 managed federally for watershed protection, is now drastically exploited by the hydrocarbon, mining, and logging industries, and is highly fragmented. This year, 2003, being the International Year of Freshwater, the Alberta government and citizenry are once again focusing on water quality and quantity management issues, generating some hope for improved outcomes for waterfowl as a byproduct.

The Boreal NR was until 1990 considered remote and pristine, hence wilderness protection there was neglected. Then, in recent years, the Alberta government allocated some 85% of it for logging under 20-year renewable "forestry management" agreements with transnational corporations. The government over-allocates available timber by ignoring vast expanses lost to wildfire and oil and gas (O&G) industry activities – despite the existence of an excellent management tool called ALCES designed to manage lands on the basis of cumulative impact awareness (Schneider *et al.* 2003). Furthermore, here, as in the Foothills, the government has largely turned over legal compliance oversight to the corporations themselves.

Indeed, in general, the government's ideology regarding land is one of multiple use, even within so-called parks and ecological reserves, the privatization of public lands, and promotion of recreational use,

especially the motorized kind. All this increasingly invites potential conflict regarding Trumpeter Swan habitat in forest and other settings.

Municipal level

The Grande Prairie region contains many of Alberta's Trumpeter breeding lakes and marshes. These were formerly protected by land-use setbacks under the County of Grande Prairie's Municipal Development Plan, 1984. But this protection was removed when the bylaw was revised in 1998 (White and White 2000). Now, concerned citizens are obliged to monitor and advocate protection for each Trumpeter lake individually if they are to attempt to ward off development disturbance.

HABITAT TRENDS

Wildlife managers generally agree that Trumpeter Swans are expanding both their numbers and range in Alberta. In fall 2000, they occupied 255 locations, up 80 from 1995 (James and James 2001) (Table 1; Figure 1). The main and growing threat facing them is population collapse due to overcrowding, disease, or starvation on their U.S. wintering grounds, a topic addressed elsewhere (Shea 2000). The second greatest threat is habitat loss or disturbance within Alberta. The latter trend is due to the nature and rapid expansion of Alberta's economy and human population with attendant pressures in the form of residential, industrial, and recreational development. Electrocution or other fatal crash injuries due to collisions with power lines is a problem of unknown size. The following is an overview of habitat trends for the eight flocks in Alberta, commencing with the historic core Grande Prairie flock.

Grande Prairie flock

Trumpeter's use of habitat

The latest 5-year late summer survey of the Grande Prairie flock and those flocks dealt with below took place in 2000 (James and James 2001; Norton and Beyersbergen 2000). It found an all-time record of 608 Trumpeters in the Grande Prairie-Valleyview area, including 60 broods. This represented an increase of 93.6% in 10 years. The flock is expanding its use of available breeding range accordingly, from 67 locations to 134, up 97% (Table 2). The expansion is moving beyond the core Peace River Parkland SR, largely onto scattered lakes and marshes of the Boreal Central Mixedwood SR, southeast and east toward Valleyview, especially to lakes north of Sturgeon Lake (Norton and Beyersbergen 2000) – lakes known not to have seen Trumpeters for 40 years or more (Reg Arbuckle, pers. comm.).

Human use of habitat

The human use of Trumpeter Swan habitat in the area (White and White 2000) continues to rapidly intensify. Some lakes and wetlands Trumpeters formerly used are being lost or abandoned. Others, although apparently disturbed, continue to attract Trumpeters. And, yet, others are used some years and not others for reasons unknown (Holton 1982).

Residential development in the City of Grande Prairie and dormitory towns within 30 km of it, along with country estate-lot development on agricultural land, is the most visible cause for concern. The city's Swan City and Crystal Lake developments atop or around Trumpeter habitat are examples. As a result, Trumpeters had ceased breeding on Crystal Lake. But in 2002, a pair nested there once again and hatched four cygnets, most or all of which migrated in the fall. Does this suggest a younger cohort of Trumpeters is becoming more tolerant of human disturbance? Meanwhile, construction of a new subdivision at Clairmont Lake destroyed wet-field habitat Trumpeters used in spring to await lake ice-out. A lot more good farmland and habitat is earmarked to go the same way.

Some agricultural practices are also of concern. Alberta experienced its 4th year of drought in 2002, the worst in living memory. In drought years, some farmers plough to the edge of shallow lakes or sloughs, removing cover, or even filling or draining them. This is illegal in cases where land-use rights extend to normal high-water mark on designated lakes. But some old settlements were granted riparian rights; i.e., right down to the fluctuating water level. Fortunately, many farmers continue to respect and protect swan habitat.

Oil and gas development is booming in the Grande Prairie region (and elsewhere throughout Alberta), especially since the Alliance Gas Pipeline, North America's largest, came on-stream. Flaring has been fairly common and related toxic effects in humans and livestock (stillbirths, abortions, birth defects, etc.) were experienced. Not until public complaint proved futile and several years of industrial sabotage and a homicide occurred did the Alberta government finally act to regulate a reduction in flaring (Nikiforuk 2001). Did Trumpeters suffer also? I do not know. In 2003, an estimated 13,335 new O&G wells will have been drilled in Alberta (Paquin 2003).

Those wells combined with related infrastructure, including some 13,500 O&G industry water wells (for a total of 27,000 wells), access roads, seismic lines, O&G gathering systems, pipelines, batteries, compressor stations, and power lines, will add to the already serious fragmentation of forest and farmland in Alberta.

The O&G industry also now accounts for 29% of Alberta's fresh groundwater withdrawals (Griffiths and Woynillowicz 2003), a figure rising to 50% in the north. The water is pumped down-well to increase pressure in conventional oil wells and as steam to make oilsands flow. Surface waterbodies are intimately linked with aquifers, which, depending on pressure gradients, they can slowly recharge or discharge and vice versa (Anonymous 2003). Larger waterbodies also modify climate. Farmers are alarmed. Should we be concerned regarding Trumpeter habitat? "That's a question begging to be answered," says Gordon Court (pers. comm.), wildlife status biologist at Alberta's Fish and Wildlife Division (F&WD) of the Ministry of Sustainable Resource Development. "Certainly we should be concerned," says Chris Donohue (pers. comm.), water expert in the University of Alberta's Zoology Department.

The logging industry is booming on forested lands in the Grande Prairie area. Some 85% of Alberta's forests are scheduled to be clearcut under 20-year renewable Forestry Management Agreements between the Alberta government and transnationals (largely Japanese and U.S.). At the present rate of cut, all Alberta's old-growth forest will likely be gone in 40 years, and with it the ecological integrity of its forests and watersheds.

Recreational development around Grande Prairie includes a focus on Saskatoon Lake, where Trumpeters stage (and after absences due to disturbance, returned to breed once more in 2002 on the arm called Little Lake). Powerboats and water skiers disturb swans and other waterfowl. Due to exceedingly drastic budget and staff cutbacks, there is a lack of oversight. The problem continues.

All this development means more power lines. Seven collisions with power lines were reported for 2002 for the Grande Prairie flock (Mark Heckbert, pers. comm.) and three have occurred already in 2003, all at Elmworth, south of Beaverlodge (Reg Arbuckle pers. comm.). The full extent of the problem has not been studied.

High Level flock

The August 2000 survey of the Boreal Sub-Arctic SR in northwestern Alberta found 12 Trumpeters. An October flight over land not previously surveyed found another 12 near Spawn Lake, which straddles the Alberta/Northwest Territories (NT) border. The total of 24 swans occupied five water bodies and included 11 cygnets. The swans are expanding their use of habitat north into this area and adjacent NT. The area is vast, remote, and little disturbed.

Peace River flock

Of the 200 Peace River Trumpeters found in the 2000 survey, 59 were cygnets in 20 broods (James and James 2001). The swans were using lakes occupied previously and numbers were little changed from previous years. The flock's range includes the Chinchaga Forest north of Grande Prairie, which is the largest expanse of the Foothills NR remaining mostly intact. However, since O&G development is now fragmenting the forest, along with some logging (White and White 2000), the public sought protection of 5000 ha for the Trumpeter Swan and other ecological values. In response, the government in 2001 designated only 600 ha as the Chinchaga Wildland Provincial Park (Helene Walsh, pers. comm.), an area embracing only half the currently used Trumpeter locations.

Elsewhere, in the southeastern portion of this flock's breeding range, lies Lake Winagami, the north bay of which Trumpeters use for staging (Reg Arbuckle, pers. comm.). But taking advantage of the present drought, a farmer now has about a third of the lakebed ploughed (Joanne of Hillspring on CBC Radio). A little northwest of Winagami is 600-ha Lac Magloire, designated a key habitat under the North American Waterfowl Management Plan and until recently abundant with waterfowl. But a former county reeve and his sons illegally drained it and now farm part of the lakebed. Few waterfowl remain. The law was not enforced (Gillis 2002; Ken Lumbis, pers. comm.; Reg Arbuckle, pers. comm.).

Utikuma-Peerless (High Prairie) flock

The 5-year survey in 2002 expanded the Utikuma-Peerless coverage northward. This is good habitat, unroaded and remote. The trend is to a big expansion of Trumpeter Swan habitat use here. These pioneers are enjoying the highest breeding success of all Alberta's flocks. A total of 72 Trumpeters was counted, 48.6% (35) of them cygnets averaging 5 per brood (James and James 2001). Logging and O&G

activity have started but not reached problem proportions. A more immediate fear is that First Nations or Métis people might expand their extensive cormorant and pelican egg collecting to include Trumpeter eggs (Mark Heckbert, pers. comm.).

Elk Island flock

Because of the continuing threat to Trumpeter habitat around Grande Prairie, an introduced flock (Alberta's only one) was established on federal land in Elk Island NP in the Mixed Drywood SR in central Alberta, starting in 1987 (Beyersbergen and Kaye, in press). In spring 2002, 18 Trumpeters returned there from their wintering grounds – a banner year. Elk Island is off the tourist beaten track but popular with nearby Edmontonians. The main recreation involves beach use, hiking, and wildlife viewing. Trumpeter breeding areas are closed to the public.

Lac La Biche flock

Trumpeters are early pioneers in the Lac La Biche lakeland area of the Boreal Dry and Central Mixedwood SRs. For the first time, the survey in 2000 pushed north to Fort McMurray, hub of oilsands development. Swans occupied five water bodies, near or east of Lac La Biche. Only nine swans were seen, including two pairs but no cygnets (Norton and Beyersbergen 2000).

Considering human use of habitat, the survey necessarily skirted around the western end of the Cold Lake Air Weapons Range. However, a road map reveals a high density of lakes in the survey area and a low density on the range. The swans appear to have chosen quiet, remote lakes and, judging from map symbols, avoided those exposed to recreational use. The biggest problem is lakeshore cottage development and uses, followed by rapid O&G development, both conventional and oilsands. Logging is threatened for Lakeland Provincial Park. As of January 2003, industry had not disturbed any nest sites. Meanwhile, F&WD is doing preemptive work to secure habitat protection (Christine Found, pers. comm.).

Edson-Whitecourt flock

Trumpeter's use of habitat

The Edson-Whitecourt flock's range is largely within the rolling Foothills NR. The coniferous, aspen, birch, and poplar Lower Foothills SR is cooler in summer than nearby Boreal SRs, while the Upper Foothills SR has the highest summer rainfall in Alberta (340 mm). The Athabasca, Berland, and Little Smoky Rivers and countless tributary creeks, wet depressions, and peatlands divide the area into a complex mosaic. The 2000 survey found Trumpeters on 15 assorted water bodies, but even though the survey extent was four times greater than in 1995, the number of swans seen rose only from 28 to 32. Only 3 cygnets were seen in two broods, in contrast with 10 cygnets in 1995, and this flock has the lowest breeding success of all Alberta's flocks.

Human use of habitat

The reasons for this flock's low breeding success and lack of overall flock growth are unstudied (Gerry Beyersbergen, pers. comm.). But the resource-rich Foothills is one of the most heavily developed and least protected NRs in Alberta (Thomas 1996). Having visited extensive clearcuts along its edges and traveled the huge, unpaved Berland Resource (industrial) Road through the horribly scarred middle, I know that much of the area looks like a war zone – the cumulative effect of intensive clearcut logging and O&G development. Could it be that this massive disturbance, destruction, and loss of remoteness is part of the problem? Or, perhaps the cool, wet, peaty environment is naturally unproductive of swans? Or, perhaps both?

Southwestern Alberta (Cardston-Pincher Creek) flock

Lastly, the beautiful southwestern corner of Alberta, including parts of Waterton Lakes NP, is home to a small flock of Trumpeter Swans. They range through mostly private land in the rolling aspen Foothills Parkland SR and into federal land in the Montane SR of the Rockies. In 2001, 21 Trumpeters were found on eight ponds compared to a record 37 (including 10 cygnets in three broods) at 11 locations in 2000; and 20 and 21 in 1990 and 1995, respectively (Taylor 2002). However, cygnet production has been poor since 2000 due to large, early June rainstorms. Because the flock expanded just across the border into Montana in 2000 and 2001, it is recommended that it be managed jointly, cross-border. In 2000, one pair summered on Frank Lake, farther north near Calgary, for the first time (for a total of 39 swans), but not since. This is the first record of Trumpeters using Frank Lake in summer.

The Waterton Lakes NP is small, off the main tourist routes, and affords secluded Trumpeter use areas. The encircling area includes a Blood Indian reserve, a lightly used provincial park, and secluded wetland. The remainder is largely private ranchland, much

held by Cardston County Mormons whose forebears migrated from Utah. Recently, the threat of country estate-lot subdivision has taken hold, notably in that county but also in Pincher Creek County. Concerned citizens and groups are acquiring land to reduce this threat.

Migration staging habitat and routes

Migration staging habitat received little attention until the last decade. Many Canadian RMP Trumpeters use stopover ponds in the Cardston area of southwestern Alberta; those near Calgary; possibly Buck Lake south of Drayton Valley going north; and also Swan Lake near Rocky Mountain House going south (Hills, in press; Len Hills, pers. comm.).

Southwestern Alberta windfarms

A major development in the southwest is that of windfarms on the migration route, this being one of Canada's windiest regions. One new windfarm, which starts electricity generation this spring (2003), comprises 114 tubular turbines each 58 m or more tall. At another in the area, the 60-turbine Castle River windfarm, a recently completed 2-year study of avian mortality shows waterfowl were the least affected and no swans or geese were killed. This finding supports those of other such studies in the U.S. and Western Europe (Justin Thompson, pers. comm.). A 5-year study in the Yukon Territory monitored the threat posed by a single turbine at the edge of a valley used by 10% of the world's Trumpeters. No fatalities were recorded (Mossop 1998). A Danish study of wind turbines and Whooper Swans (*C. cygnus*) found that very tall turbines pose much less of a threat to swans and geese than do shorter models, and that evening flights (in winter) are more hazardous due to poor light conditions (Larsen and Clausen 2002). A word of caution: some published studies are by industry or consultants and are not refereed.

Southwestern Alberta: Calgary area

Trumpeters on spring migration, in particular, stop over at ponds in the Calgary area from early to mid-April or later. On ponds just west of Cochrane (west of Calgary), country residential estate-lot development is proliferating and a new development is underway at Cochrane Lake, which is used by swans (Len Hills, pers. comm.). Trumpeters also use the Glenmore Reservoir, a drinking water supply in the heart of Calgary. There are plans to dredge the reservoir of sediment in the next few years to restore its storage capacity. This plan threatens stopover habitat (Brent Johner, pers. comm.). And southeast of the city, Frank Lake is used by migrating Trumpeters, which were frightened off in fall 2002 by an illegal pheasant hunt on surrounding uplands (D. Bruce Anderson, pers. comm.). This lake often has dried completely in the past, but has been restored using wastewater from a meat-packing plant.

Habitat trends: climate

Global warming and attendant climatic instability have arrived, bad for man and swan alike. Alberta experienced an exceptionally wet decade in the 1970s. It had great floods in 1996 and 1997; then, in 2001 and 2002, record cold, late springs, and major late snowstorms or June rain deluges. These resulted in reduced cygnet production (see "Southwestern Alberta ... flock" above). Alberta has suffered a 5-year drought, the last 3 years of which were the worst on record (i.e., since 1885). Nearly all the province's lakes are at low or very low levels and some have dried up. Grande Prairie Trumpeters survived as the core flock in no small measure due to the area's being very well watered by mountain-fed streams, and, therefore, lake levels fluctuating very little. However, the mountain snowpack in February 2003 was 40% to 80% below normal and glaciers are shrinking rapidly. Other regions further east are not so lucky, the Lac La Biche flock's region being particularly hard hit. However, late spring snow and rains are now improving the situation in southern and western Alberta.

Meanwhile, RMP habitat in southwestern Montana is experiencing the worst drought in nearly 70 years, with many waterbodies and marshes dry and reservoirs very low (Dubovsky 2003).

MANAGEMENT TRENDS

Various positive and negative management trends affecting Trumpeters in Alberta are evident. The 87-year-old ban on any swan hunting remains and, weather and humanity permitting, the RMP Trumpeters are continuing to stage a good comeback. Reintroductions are being monitored (Beyersbergen and Kaye, in press).

Land-use guidelines

Trumpeter swans are sensitive to human disturbance. Therefore, in the late 1990s, in Grande Prairie, F&WD developed a set of conditions covering activities near identified Trumpeter waterbodies (historic and current nesting and relevant staging waterbodies) on provincially managed Crown

(public) lands – which are largely in the "green zone" (i.e., forests). These conditions have now been adopted by F&WD provincewide. F&WD recommends these conditions, shown below, for attachment to land-use permits issued by the Lands Division of the Ministry of Sustainable Resource Development (David Hervieux, pers. comm.; Gordon Court, pers. comm.):

All development

- 1 April to 30 September: no development activity within 800 m of high-water mark.
- 1 April to 30 September: no direct overflights.
- No long-term development (e.g., roads, wells, pipelines) within 500 m of high-water mark.

Geophysical work

- Buffer zones between high-water mark and the following, as shown:
    - Conventional seismic lines (formerly 6-8 m, now averaging 4.5 m wide) .. 800 m
    - Low-impact seismic lines .... 500 m
    - Hand-cut seismic lines .... 100 m
    - Survey lines (0.5 m wide) .... 0 m
- No shot holes where water or ice exists, nor on dry lakes (air/mud guns only).

Grazing

- No new grazing leases around identified Trumpeter waterbodies.
- No range improvements within 500 m of high-water mark.

Logging

- No logging within 200 m of high-water mark.
- Detailed logging plan required for a special management zone from 200 m to 500 m from high-water mark.

Large corporations are typically cooperating well, but the occasional small firm fails to comply (Reg Arbuckle, pers. comm.). Meanwhile, a different situation exists regarding deeded private land – the "white zone" (developed urban and agricultural lands) of the province. The provincial government has no direct authority over these lands, which fall under the jurisdiction of local municipal governments. Nonetheless, adoption of the applicable conditions shown above is being encouraged in this zone, also.

Surveys

The trend regarding the 5-year surveys is toward increased rigor to allow direct comparison between one survey and another. Also, as Trumpeters increase, so does the survey extent (Norton and Beyersbergen 2000), and timing of other surveys is changed to better answer questions arising (Taylor 2002). All this should afford a better picture of trends in Trumpeter use of habitat (but see below).

The Trumpeter's legal status and recovery plan

In August 2001, Minister for Sustainable Resource Development Mike Cardinal responded to recommendations from Alberta's Endangered Species Conservation Committee. He agreed to retain the Trumpeter Swan's Threatened status and wrote: "I look forward ... to the possibility of [delisting] the Trumpeter Swan ... when populations have grown to more secure levels, *and breeding habitat has been* identified and *secured*" (my italics) (Mike Cardinal, pers. comm.).

A recovery team led by Mark Heckbert of F&WD includes representatives from all three levels of government, Ducks Unlimited Canada (DUC), and the Federation of Alberta Naturalists. Ruth Shea of The Trumpeter Swan Society will be involved, as will the author. Also on the team will be the Alberta Energy and Utilities Board (which is 50% funded by industry) and the Alberta government's Energy Ministry (a major influence on government policy). The team will first meet on 25 April and the Alberta Trumpeter Swan Recovery Plan should be produced by December 2003. Clearly, the mandate needs to expand to include other critical kinds of habitat, not just nesting habitat.

Reasons for concern

Government words versus deeds – a continuing trend?

The current political climate is cause for continuing grave concern. The minister's statement (above) is interesting, in light of the government's poor record (–F grade) on threatened species and habitat

protection (Boyd 2002). Do the minister's words represent a change in government policy, wishful thinking, or a continuation of the government disingenuity that has plagued Alberta throughout the current regime? The current political backdrop is one of lacking or weak and unenforced federal, provincial, and municipal laws relating to habitat protection, and poor, unplanned provincial governance, including drastic and continuing provincial staff and budget cutbacks. F&WD staff who remain are aging and retiring; almost no one is being hired to replace them, and of 10 endangered species specialists hired some two years ago, 4 have already unhappily quit (Anonymous, pers. comm.). Other recovery teams and plans lack funding (Tracey Henderson, pers. comm.) and recovery plans are vetted by the politician-chaired ESCC (includes O&G, logging, and cattle interests) (Anonymous 2003; Heather Wheeliker, pers. comm.). All this creates doubt as to the real outcome of the Trumpeter Swan recovery process.

Trend of government erosion and responsibility shifting to the corporate sector and NGOs

Funding for F&WD activities is increasingly sought from environmental nongovernmental organizations (NGOs). The government arranged for F&WD staff to leave and work for DUC instead. Yet Alberta is Canada's richest (O&G revenue-based) province. Meanwhile, much data collection has been shifted to the resource industries themselves. The "Buck for Wildlife" program that provided F&WD with funds from hunting and fishing licenses has been privatized and is run by the not-for-profit Alberta Conservation Association. So now, NGOs such as DUC and The Nature Conservancy of Canada are providing the bulwark against development on private land by buying land and managing it, and arranging conservation easements. (Note here, however, that subsurface rights take precedence over land surface rights.) These groups and others are active in the Grande Prairie and SW Alberta flock areas and elsewhere.

Trend in education

Alberta Environment (from whose name the government has removed the word "Protection") published a Trumpeter Swan leaflet, which states: "The awareness and concern of the public is perhaps the most important factor in restoring the North American Trumpeter Swan population." Yet this March, the government fired the Park Interpreter from Grande Prairie's Saskatoon Island Provincial Park (at the Trumpeter Swan federal migratory bird sanctuary), saying the position is now unfunded. The interpreter has vowed to make the Fifth Annual Grande Prairie Swanfest (26-27 April 2003) the best ever – her swan song (Andrea Barnes, pers. comm.). NGOs and volunteers are trying to educate the public.

SYNTHESIS

In conclusion, while the Trumpeter Swan continues to recover in Alberta due to species protection and recovery efforts, current politics is a cause for grave concern. Dedicated frontline F&WD staff are in dire straits and NGOs are increasing their effort to help protect habitat. The need for much expanded public awareness and support is crucial if this appalling trend is to be reversed and present and future habitat secured for continued Trumpeter recovery.

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* The word "Protection" has since been dropped from this ministry's name and "Natural Resources" has become the new Ministry of Sustainable Resource Development.

Table 1. Trumpeter Swan numbers and range use in Alberta, September 2000.

Flock	Total Trumpeters	Locations occupied
High Level	24	5
Peace River	200	65
Utikuma (High Prairie)	72	16
Grande Prairie	608	134
Lac La Biche	9	5
Edson-Whitecourt	32	15
Elk Island	13	4
SW Alberta (Cardston/Pincher Creek)	37	11
Total	995	255

Table 2. Grande Prairie Trumpeter Swan flock: comparison of locations used and flock size, showing expansion into available range, 1990-2000.

Year	No. of locations	No. of adults	No. of broods	Total swans
1990	67	220	29	314
1995	99	392	41	533
2000	134	404	60	608

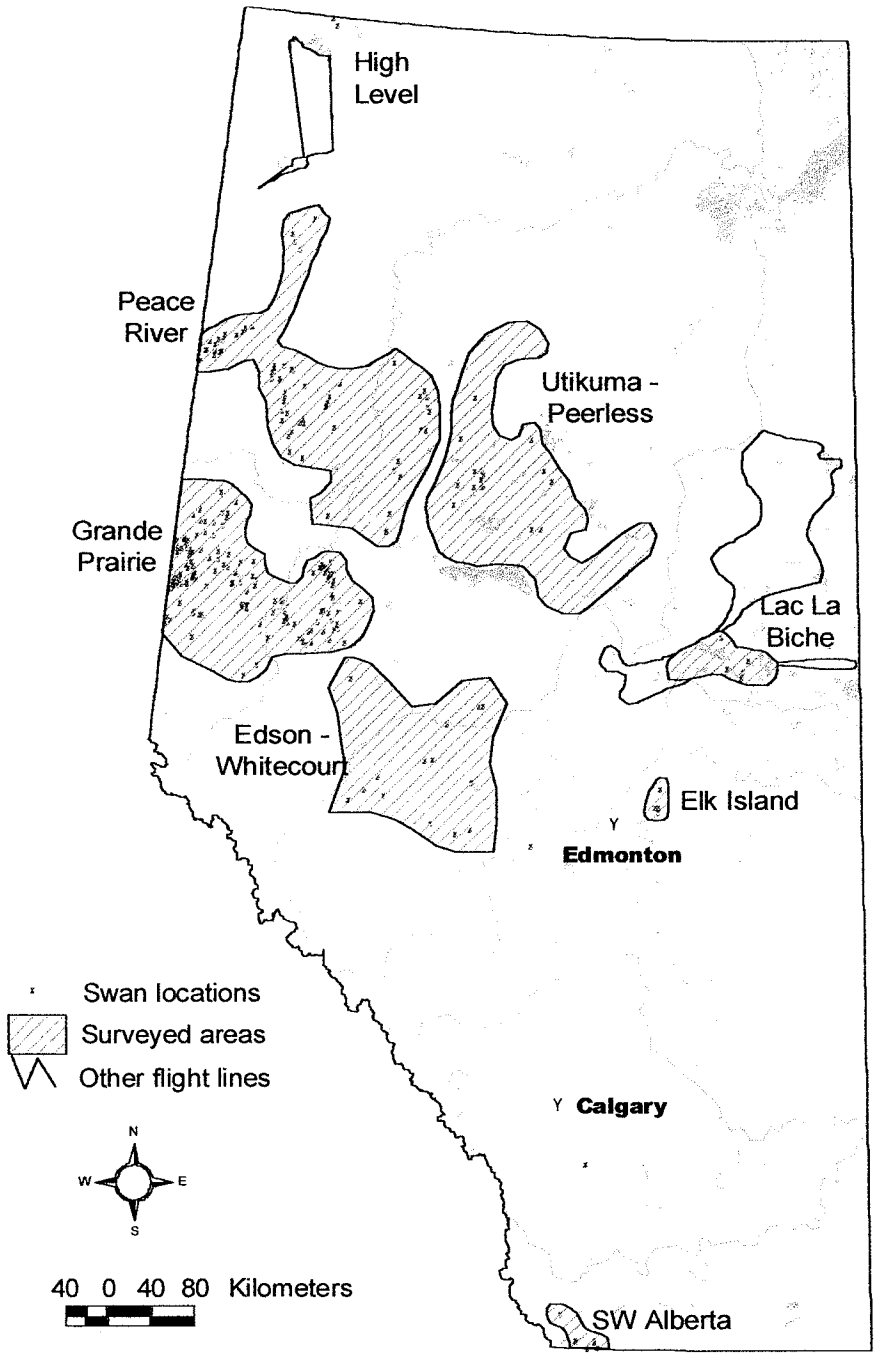
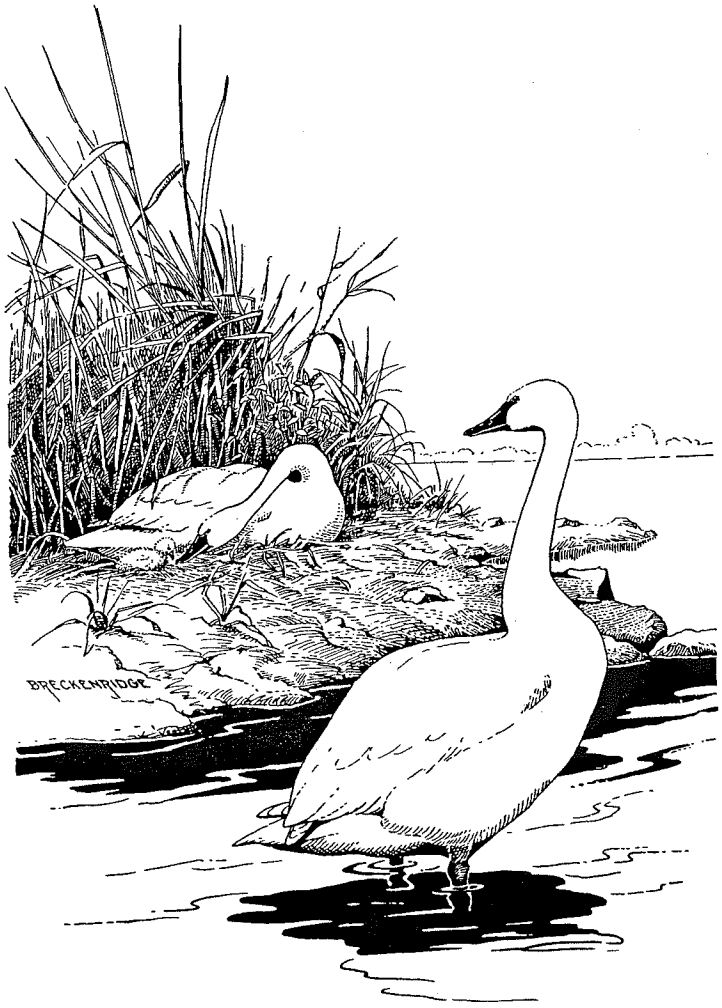


Figure 1. Trumpeter Swan flocks in Alberta: survey areas and swan locations, 5-year survey of August-September 2000 (Norton and Beyersbergen 2000).

ROCKY MOUNTAIN POPULATION/US



STATUS OF TRUMPETER SWANS NESTING IN THE WESTERN UNITED STATES AND MANAGEMENT ISSUES

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ABSTRACT

Although Trumpeter Swan (*Cygnus buccinator*) populations in other portions of North America have experienced substantial growth in recent decades, in the western U.S. the species is less abundant now than in the 1950s and 1960s, and some breeding groups face serious threats to their continued existence. In September 2002, the western states contained three small nesting groups, totaling 311 adults and including only 48 nesting pairs. The Oregon Flock, which has declined by 50% since 1996, contained <25 adults and will likely be extirpated within the next decade unless managers intervene. An immediate program to augment numbers and expand distribution is needed to save this flock and to attain the Pacific Flyway Council's minimum goal of 100 adults, including 25 nesting pairs. In 2002, the Nevada Flock of 24 adults experienced its 3rd consecutive year of unusually poor cygnet production. Research is needed to determine the cause of the recent poor productivity and to understand this flock's winter ecology and interactions with the increasing numbers of migrant Trumpeters that join them in winter. The Greater Yellowstone Population contained only 273 adults in September 2002, after experiencing a 25% decline in 2001-02. This population, which is the only breeding group that was not extirpated from the lower 48 states, is in the midst of a precarious transition period following termination of supplemental feeding at Red Rock Lakes National Wildlife Refuge, Montana. Due to low numbers and diminished distribution, the Greater Yellowstone Trumpeters remain vulnerable to high mortality during severe winters. Unless this population can reestablish secure use of more southerly winter habitats adequate to sustain them during severe winters, further decline is likely. Recent management controversies have resulted from the negative impacts of swan hunting in Utah on southward range expansion efforts and a petition in 2000 to list the population as threatened, which was denied in 2003. The vulnerability of the Greater Yellowstone Population could be significantly reduced by broadening its winter distribution to include historically used habitat at Bear River Migratory Bird Refuge and other portions of northern Utah.

INTRODUCTION

Although near extinction at the beginning of the 20th century, 23,647 Trumpeter Swans (*Cygnus buccinator*) were counted in North America during the summer 2000 rangewide survey (Caithamer 2001). Despite this substantial increase, the species remains much reduced in distribution and abundance compared to its status prior to European settlement. In all of the western U.S., currently there are only three small nesting groups of Trumpeter Swans, which totaled about 311 adults and 60 cygnets in September 2002, and included only 48 nesting pairs (Table 1) (Pacific Flyway Study Committee 2003; U.S. Fish and Wildlife Service 2003). These nesting groups included two very small (<30 adults each) restoration flocks located in southern Oregon (Summer Lake – Malheur National Wildlife Refuge (NWR) vicinity) and eastern Nevada (Ruby Lake NWR vicinity). Both restoration flocks are descended from swans that were translocated from Red Rock Lakes NWR, Montana. The third nesting group resides in the Greater Yellowstone region of Wyoming, Montana, and Idaho, and is the only breeding population in the lower 48 states that escaped extirpation.

Based upon neck band observations, all three of these nesting groups currently winter primarily within their respective nesting areas and appear to be geographically isolated from each other. Although undetected movement of an occasional individual may occur among these three groups, the existing data provide no evidence that any of the groups are benefiting demographically from immigration. Unless immigration increases significantly or birds are added through direct management intervention, the future survival of all three groups will depend upon their own productivity and mortality rates. Due to their very small size, substantial reproductive isolation, and other management problems, all three groups currently are vulnerable to extirpation due to stochastic events, such as an epizootic or extreme weather patterns, habitat degradation, or inadequate productivity.

In large part because of their high vulnerability, these nesting groups have been the subject of substantial

recent management controversy. This paper will discuss the recent status and trends of these nesting groups and the recent management issues.

TERMINOLOGY

The U.S. Fish and Wildlife Service (USFWS) has divided all wild Trumpeter Swans into three major management groups (Pacific Coast Population, Rocky Mountain Population (RMP), and Interior Population) based on the areas in which they nest. Although these names include the word "population," they were not delineated as biological populations based on criteria such as reproductive isolation or genetic differentiation, but were defined primarily for management purposes (Trost *et al.* 2000; Dubovsky and Cornely 2002). To date, none of the agencies involved in management of Trumpeter Swans has recognized any biological populations in North America other than the species in its entirety.

Under the broad RMP designation, the USFWS has lumped together all Trumpeter Swans that nest in Oregon, Nevada, Idaho, Montana, Alberta, British Columbia, the Northwest Territories, and the eastern and central Yukon Territory. Within the RMP, the USFWS officially recognizes three groups that nest in different subareas: the Interior Canada Flock, the Tri-state Flock, and the Restoration Areas Flock (U.S. Fish and Wildlife Service 2001). In recent years, the USFWS has used the term "flock" to refer to breeding groups as large as the entire 3,184 RMP Trumpeters that were surveyed in Canada in summer 2000 (U.S. Fish and Wildlife Service 2001), or as small as the < 30 Trumpeters that exist in Oregon (Dubovsky and Cornely 2002). The Pacific Flyway also has referred to various RMP breeding groups as "flocks," often delineating them by state or other arbitrary administrative boundaries and grouping the U.S. and Canadian flocks into the RMP/U.S. Breeding Segment and RMP/Canadian Breeding Segment, respectively (Pacific Flyway Study Committee 2002).

In this paper, I follow the terminology suggested by Shea and Drewien (1999) and split the RMP into biologically-based groups. I refer to all Trumpeters Swans that summer within the RMP management portion of Canada as the "Western Canada Population" and refer to all Trumpeters that summer in the Greater Yellowstone region as the "Greater Yellowstone Population." "Greater Yellowstone" is the term now in popular usage to refer to the broad region of eastern Idaho, western Wyoming, and southwest Montana that was frequently referred to as the "Tri-state" region in past Trumpeter Swan literature. I refer to the extremely small, and apparently disjunct, restoration groups in Oregon and Nevada as the Oregon Flock and Nevada Flock, respectively. I use this terminology because it portrays the biological significance of these various breeding groups and the interrelationships that have been revealed by marking data since 1949 (Gale *et al.* 1987; Shea and Drewien 1999).

OREGON FLOCK

Status

The Oregon Flock began from transplants of 139 swans (25 adults and 114 cygnets) from Red Rock Lakes NWR, Montana, to Malheur NWR, Oregon, in 1939-61 (Gale *et al.* 1987). The first nesting occurred in 1958 and the flock grew to a peak of 55 adults, including 19 breeding pairs, by 1983 (Ivey 1990). Flooding at Malheur NWR in the mid-1980s reduced swan productivity and allowed large numbers of carp (*Cyprinus carpio*) to invade and degrade wintering sites. As a result, the flock declined to 27 adults in 1990 (Figure 1), and Oregon responded with an attempt to increase the flock and expand its distribution in the early 1990s (Ivey *et al.* 2000).

In conjunction with federal and state efforts to disperse resident swans from Red Rock Lakes prior to termination of supplemental feeding, 4 adults were translocated to Malheur NWR in summer 1991 and 26 adults and 26 cygnets were translocated to Summer Lake, Oregon, in summer 1992 (Shea and Drewien 1999). In addition to the swans that were released in summer, 585 Trumpeter Swans (282 adults and 303 cygnets) were captured at Harriman State Park, Idaho, during early winters 1991-95 and released at Summer Lake. Most of these swans wintered in the Greater Yellowstone region but originated from nesting areas in western Canada. These winter translocations were part of federal and state efforts to diversify the wintering areas and migration routes used by the Western Canada Population and reduce the population vulnerability. Most swans that were translocated to Summer Lake in early winter migrated north to their Canadian breeding grounds during the following spring and returned to traditional wintering areas in Greater Yellowstone in subsequent winters. Neck-band sightings showed that 53 (9%) wintered at Summer Lake during one or more subsequent winters (Shea and Drewien 1999).

The releases in 1991-95 led to a temporary increase in Oregon's summer flock and substantial dispersal into potential nesting habitats in southern Oregon. However, success of the pioneering birds was diminished by severe drought and key breeding pairs

were broken up by mortality, particularly from power line strikes. Without any additional summer releases after 1992, the total number of the widely dispersed swans was inadequate for mate replacement and annual production was inadequate to overcome annual mortality (Ivey *et al.* 2001). Since 1996, the flock has declined by over 50% and now contains < 25adults (U.S. Fish and Wildlife Service 2003).

Management issues

The paramount management issue is the likely extirpation of the Oregon Flock if the recent decline is not reversed and actions needed to save the flock are not implemented.

The current lack of any organized program to halt the decline of the Oregon Flock appears due, in part, to contradictory conclusions regarding its status. In October 2002, the U.S. Fish and Wildlife Service very briefly reviewed its status without making any reference to its recognized problems or recent decline, and inexplicably concluded that "overall, the growth of the flock has increased" (Dubovsky and Cornely 2002). In direct contradiction of this view, the biologists and managers from the Oregon Department of Fish and Wildlife and the USFWS who worked most closely with the Oregon Flock during the 1990s summarized the problems that led to its recent decline and identified the actions needed to prevent its extirpation (Ivey *et al.* 2001). To create a viable flock, they emphasized that annual release of at least 25 swans would be essential to augment the current very low numbers and establish swans in suitable vacant habitats. They also urged that problem power lines in the Summer Lake and Malheur vicinity be removed or modified to reduce mortality from power line strikes.

Although the Pacific Flyway Council has approved a minimum objective for the Oregon Flock (Pacific Flyway Study Committee 1998, 2002, 2003) of 100 adults, including 25 nesting pairs, it has not authorized any actions to accomplish this objective. Proactive efforts to save the flock were omitted from the council's 2002 management plan because Oregon was reluctant to expand the distribution of Trumpeter Swans in that state until litigation surrounding the potential listing of the Greater Yellowstone Population of Trumpeter Swans under the Endangered Species Act is resolved (Pacific Flyway Study Committee 2003). This issue will likely be resolved during 2003.

Although a few Trumpeters may have been overlooked by recent surveys in Oregon, there are no data or incidental observations to suggest that undetected successful breeding is occurring at a significant level or that the observed decline is not real (G. Ivey and M. St. Louis, pers. comm..). If any doubt exists concerning the precarious status of this restoration flock and its recent decline, the U.S. Fish and Wildlife Service should reassess its status immediately and initiate efforts with state and other partners to accomplish the approved objectives. If actions to augment the flock and expand its distribution are not taken soon, the extirpation of the flock within the next decade is likely.

NEVADA FLOCK

Efforts to establish a breeding flock in eastern Nevada at Ruby Lake NWR began in the 1940s with translocations of Trumpeters from Red Rock Lakes NWR (Banko 1960; Gale *et al.* 1987). Jeff Mackay, the biologist currently stationed at Ruby Lake NWR, thoroughly reviewed the history and status of this flock and identified the key management issues in his paper prepared for this conference (Mackay, in press). I will not duplicate his information but only include the September Survey results for reference (Figure 2).

Although there is no historic record of Trumpeter Swans nesting in Nevada (Banko 1960), it is apparent from information recently located by former Malheur NWR biologist Gary Ivey (pers. comm.), that in the recent past Trumpeter Swans summered much further southwest than has previously been recognized. Noted 19th century wilderness explorer and naturalist John Muir specifically noted "trumpeting swans" when he wrote of the bird sounds of the Sierra Nevada Mountains and described "long ranks of snowy swans on the dark water" of Mono Lake, California, on 20 June 1875 (Wolfe 1979). Mono Lake lies approximately 10 miles west of the California-Nevada border and approximately 350 miles southwest of the Ruby Lake area.

As Mackay (in press) described, each winter the resident flock at Ruby Lake is joined by migrant Trumpeters whose numbers have increased in recent years. Although the Nevada Flock contained only 24 swans in September 1999, 63 Trumpeter Swans were present in February 2000. This increase in wintering swans has occurred concurrent with large-scale efforts to disperse wintering Trumpeters from the Greater Yellowstone region, approximately 300 miles to the northeast (Shea and Drewien 1999).

The origin and ecology of the migrant swans that winter at Ruby Lake is a key management issue. Migrants that arrive in September and early October

must be coming from summer areas in the western U.S. because neck-banding data have shown that swans from the Western Canada Population do not enter the U.S. in fall migration until about 15 October (Gale *et al.* 1987; Shea and Drewien 1999). If these migrant swans are coming from dispersed summer territories in Nevada, identification of those sites could aid their long-term protection and possibly lead to actions to increase cygnet production. If these swans are coming from Greater Yellowstone or Oregon summer habitats, confirmation of that possible interaction would have implications for genetic management and ongoing efforts to expand the distribution of Trumpeters in those areas.

Migrants that arrive at Ruby Lake after 15 October may be coming from either Canadian or U.S. nesting areas. If Ruby Lake is part of a currently unknown migration route for Western Canada Trumpeters, identification of this route could help shape ongoing efforts to expand their winter distribution. An influx of Canadian migrants, however, could have negative impacts on the productivity of the Nevada Flock by increasing competition for the limited winter habitat at Ruby Lake and reducing the nutritional condition of resident swans. As Mackay (in press) points out, this may already be occurring. However, if some Canadian migrants are using Ruby Lake en route to other unknown wintering sites, their movements could stimulate greater winter dispersal of the resident swans and have beneficial results. Interactions between the resident nesting pairs and the migrants could have a strong influence on the future of the Nevada Flock. To understand those relationships, it will be essential to mark an adequate sample of the migrants that come to Ruby Lake so that their summer range, migration routes, and habitat use patterns can be determined.

GREATER YELLOWSTONE POPULATION

Status

The near extinction of Trumpeter Swans due to over-harvest has been thoroughly described (Banko 1960; Houston *et al.* 1997; Rogers and Hammer 1998). In the lower 48 states, only one small group persisted into the 20th century and by 1932 this last nesting population had been reduced to only about 60 adults. Most of this remnant nested and wintered in the vicinity of Yellowstone National Park and Red Rock Lakes NWR, although the southernmost adult was found at Bear River Refuge, near Brigham City, Utah, during the 1932 nesting season (Banko 1960). Banko also documented the first 4 decades of efforts to save the Greater Yellowstone Population, its resulting increase, its nesting and wintering ecology, and its key habitats, with particular emphasis on Red Rock Lakes NWR.

More recently, Gale *et al.* (1987) reviewed the history, ecology, and management of the Greater Yellowstone Population and the Western Canada Population and analyzed population-habitat relationships for the period 1932-86. Shea and Drewien (1999) summarized management actions and change in abundance and distribution of both populations for the subsequent period, 1987-99.

In recent years, concerns regarding the vulnerability of the Greater Yellowstone Population have increased, due in part to recent declines (Gale *et al.* 1987; Ball *et al.* 2000; Shea 2000; Pacific Flyway Study Committee 1998, 2002, 2003). Between September 1989 and September 1994, the adult component declined by 53%, from 505 to 239 adults (Figure 3). This abrupt decline was the direct result of summer translocations in 1988-92 in preparation for termination of feeding, mortality associated with termination of feeding, and winter translocations in 1992 (Shea and Drewien 1999). After increasing to 362 adults by September 2001 through natural production and augmentation with captive-reared swans, the Greater Yellowstone Population lost 25% of its adults between September 2001 and September 2002 (U.S. Fish and Wildlife Service 2003).

As of September 2002, the Greater Yellowstone Population contained 273 adults and 53 cygnets (U.S. Fish and Wildlife Service 2003), including 39 nesting pairs (Pacific Flyway Study Committee 2003). Based upon the annual September survey data for the past 20 years (U.S. Fish and Wildlife Service 2003), in the decade prior to termination of feeding (1983-92), annual cygnet production averaged 19.9% (range = 10.5-32.5%) of the September population. In the decade since termination of feeding (1993-2002), cygnet production averaged 18.7% (range = 10.5-35.2%). The recent level of cygnet production should be adequate for population growth if excessive winter mortality can be avoided (Gale *et al.* 1987).

Between 1988 and 2002, translocations and release of captive-reared birds helped the Greater Yellowstone Population reoccupy long-vacant habitat in extreme southeastern Idaho (Fort Hall, Grays Lake, and Bear River drainage) and in western Wyoming (Salt River and Green River drainages). In September 2002, 31% of the Greater Yellowstone Population occurred in these new expansion areas. This southward reoccupation of vacant habitat is beginning to provide the population with greater access to more diverse lower elevation habitats that are milder than in the

core area, within and adjacent to Yellowstone National Park. Much of this newly occupied area, however, will freeze extensively in a severe winter (Shea 2000).

Management issues

The primary management issue is the precarious state of the Greater Yellowstone Population and its vulnerability to high winter mortality. This population faces a substantial risk of further decline and possible extirpation due to its: 1) low numbers and substantial annual fluctuations in productivity and mortality, which increase its vulnerability to stochastic events; 2) diminished winter distribution and resulting heavy dependence upon habitats that freeze in severe winters; 3) reduced breeding distribution and loss of use of lower elevation nesting and prenesting habitats; 4) reproductive isolation from other breeding populations; 5) declining breeding and wintering habitat quality due to the rapid increase of the human population in the Greater Yellowstone region; and 6) increasing competition with Western Canada Trumpeters for winter food resources (Gale *et al.* 1987; Reiswig and Mitchell 1996; Ball *et al.* 2000; Shea 2000; Pacific Flyway Study Committee 1998, 2002, 2003).

Most Trumpeter Swans from the Western Canada Population also winter in the Greater Yellowstone region. During the past 30 years, this migrant population has increased substantially. It also is vulnerable to high mortality when a severe winter strikes the region and freezes most feeding sites (Shea 2000). Due to their strong increase during the past 30 years, Western Canada Trumpeters have the potential to compete with the Greater Yellowstone Population for limited winter food resources. These Canadian migrants appear to have several competitive advantages over the Greater Yellowstone Trumpeters, including access to more diverse prebreeding habitats, higher quality and more abundant breeding habitat, and greater mobility within the wintering area.

The efforts to solve these difficult problems have led to strong partnerships among federal and state agencies, tribal authorities, and conservation groups. Since 1988, key management actions have included termination of supplemental winter feeding of grain at Red Rock Lakes NWR in 1992, summer translocations in 1988-92 to disperse the Red Rock Lakes flock prior to termination of winter feeding, and winter translocations in most years since 1990 to expand the winter distribution of Western Canada and Greater Yellowstone Trumpeters (Niethammer *et al.* 1994; Shea and Drewien 1999; Bouffard 2000).

One particularly difficult issue has been the damage to range expansion efforts caused by Tundra Swan (*C. columbianus columbianus*) hunting. Since 1990, management efforts involved large-scale winter translocations of Trumpeters to reduce population vulnerability by increasing greater southward migration and reoccupation of more southerly habitats. The program quickly ran into serious obstacles, however, because the main southward waterfowl migration route through eastern Idaho led directly into Utah's major Tundra Swan hunting areas (Shea and Drewien 1999). When the presence of the Tundra Swan hunt made it impossible to effectively use key potential habitats in northern Utah as translocation sites, including the USFWS's Bear River Migratory Bird Refuge, considerable controversy ensued.

Located in the Bear River Delta, in the northeast corner of Utah's Great Salt Lake, Bear River Migratory Bird Refuge and other nearby areas provide extensive areas of suitable habitat for Trumpeters (Engelhardt 1997; Engelhardt *et al.* 2000). Bones found in excavations of Native American sites and records of live and dead specimens during most decades of the 20th century confirm that Trumpeter Swans have used the refuge and vicinity for at least hundreds of years (Banko 1960; U.S. Fish and Wildlife Service 1979; Parmalee 1980; Shea and Drewien 1999). In addition to preventing Bear River Refuge from serving as a primary site for southward translocations, the Utah swan hunt also became controversial because it increased the mortality of the few Trumpeters that occasionally attempted to migrate into that region (Shea and Drewien 1999). Since 1995, the swan hunt has been reduced in geographic area and in season length, and a quota harvest of Trumpeters has been legalized (Trost *et al.* 2000). The Utah swan hunt will likely remain controversial as long as it impedes the restoration of a secure Trumpeter Swan migration into this region.

Controversy increased in August 2000, when the Biodiversity Legal Foundation and the Fund for Animals petitioned to list the Greater Yellowstone Population as threatened or endangered. The petition argued that these Trumpeters met the definition of a Distinct Population Segment (DPS) under the Endangered Species Act and listing was warranted due to numerous population and habitat problems, including those mentioned above. In January 2003, the USFWS denied the petition, concluding that the Greater Yellowstone Population did not meet the DPS criteria and therefore would not be considered for listing. The 90-day Finding did not, however,

dispute the seriousness of many of the problems facing these birds (Department of Interior 2003).

The Trumpeter Swan Society (TTSS) did not join in the petition, but strongly urged the USFWS to recognize that the Greater Yellowstone Population is a separate breeding population, even though it does not meet the technical criteria for DPS and does not qualify for listing as threatened. TTSS warned that the population's reproductive isolation was one of the major factors contributing to its vulnerability. TTSS also pointed out problems with some of the biological information used in the 90-day Finding and asked USFWS to undertake a fundamental review of the population data so that future management decisions would be based upon the best available information and all biologists working with the population would have access to the same data (TTSS letter to USFWS Director Steven Williams, 7 March 2003).

CONCLUSION

The recovery of breeding Trumpeter Swans in the western U.S. is currently quite precarious. The Oregon Flock will likely be extirpated within the decade if proactive efforts to reverse its recent decline and achieve the Pacific Flyway Council's approved objectives are not implemented soon. The Nevada Flock may continue to persist at its current low level. However, the recent lack of cygnet production and the increasing influx of winter migrants will likely have substantial impacts on its ecology, and possibly on its future viability. The Greater Yellowstone Population faces numerous problems that threaten its continued existence. Its further decline is likely unless a substantial portion of the population can regain use of lower elevation and more southerly winter habitats in southern Idaho and northern Utah, and find adequate options to survive during severe winters.

With the denial of the petition to list the Greater Yellowstone Population and the resolution of listing issues in 2003, the potential now exists to move forward with efforts to securely restore Trumpeter Swans in the western U.S. Much potential exists to build a vigorous nesting flock in Oregon through augmentation and work toward a broad distribution across Idaho and Montana that would eventually link the Nevada, Oregon, and Greater Yellowstone breeding areas. An important step to that worthy goal would be a thorough review of the existing population, habitat, and marking data to clarify our current knowledge of the demographics of theses various groups, identify any important knowledge gaps, and develop effective restoration strategies. With the many recent advances in conservation biology, the strong involvement of specialists in the restoration and conservation of small avian populations, working in partnership with agency managers and conservation groups, could be very beneficial.

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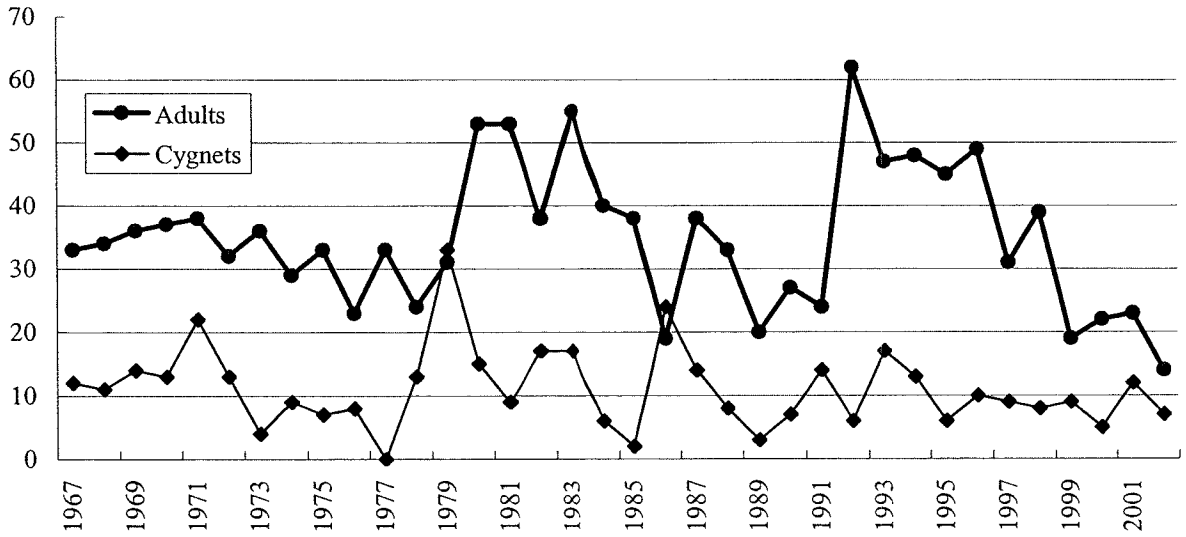

Figure 1. Abundance of adult and cygnet Trumpeter Swans in the Oregon Flock, 1967-2002. Data are from the U.S. Fish and Wildlife Service September Surveys (U.S. Fish and Wildlife Service 2003).

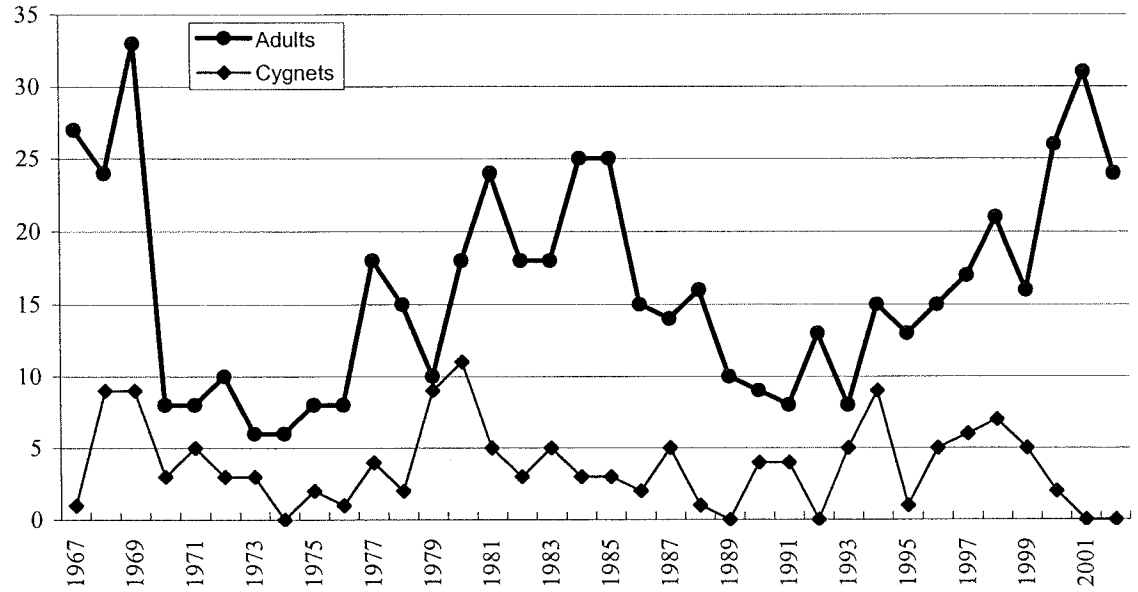

Figure 2. Abundance of adult and cygnet Trumpeter Swans in the Nevada Flock, 1967-2001. Data are from the U.S. Fish and Wildlife Service September Surveys (U.S. Fish and Wildlife Service 2003).

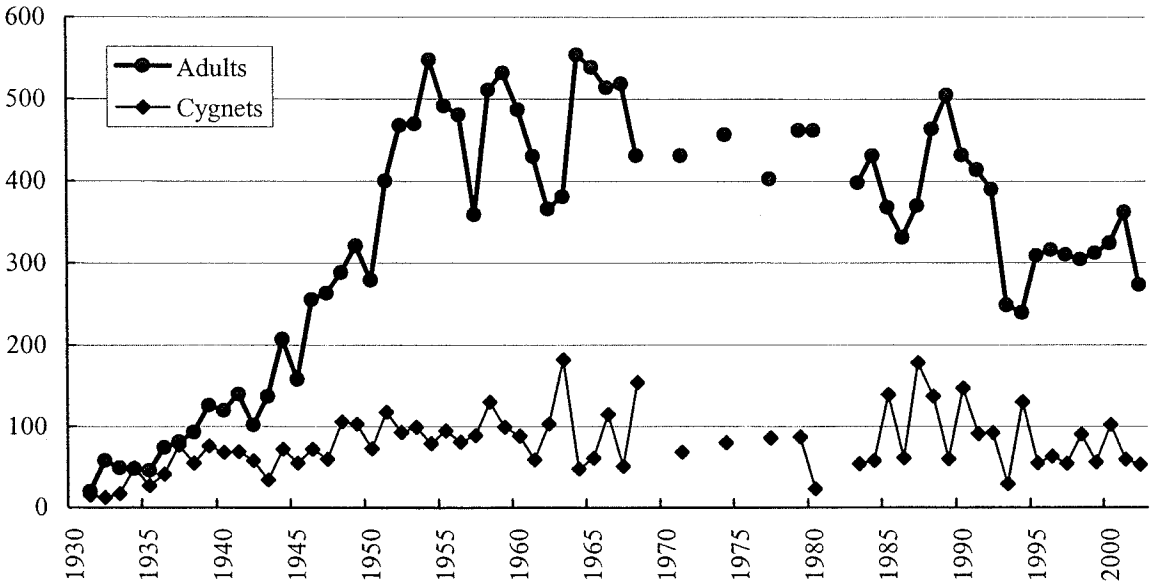

Figure 3. Abundance of adult and cygnet Trumpeter Swans in the Greater Yellowstone Population, 1930-2002. Data are from the U.S. Fish and Wildlife Service September Surveys (U.S. Fish and Wildlife Service 2003).

Table 1. Status of Trumpeter Swans nesting in the western U.S. summer 2002. Data were compiled by the Greater Yellowstone Trumpeter Swan Working Group (Pacific Flyway Study Committee 2003).

Location	Occupied territories	Active nests	USFWS September Survey		
			Adults	Cygnets	Total swans
Montana Flock	19	9	76	18	94
Wyoming Flock	32	14	94	21	115
Idaho Flock	31	17	103	14	117
TOTAL GREATER YELLOWSTONE POPULATION	**82**	**40**	**273**	**53**	**326**
Oregon Flock (Summer Lake area not surveyed)[1]	4	2	14	7	21
Nevada Flock	8	6	24	0	24
TOTAL Restoration Flocks	**12**	**8**	**38**	**7**	**45**
TOTAL WESTERN U.S.	**94**	**48**	**311**	**60**	**371**

[1] When last surveyed in 2001, the Summer Lake area of Oregon contained 12 adults and 0 cygnets, and there were no known occupied territories or active nests.

ANALYSIS OF WINTER SATELLITE TELEMETRY LOCATIONS FROM TRUMPETER SWANS MARKED AND RELEASED AT RED ROCK LAKES NATIONAL WILDLIFE REFUGE, MONTANA

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ABSTRACT

Six male Trumpeter Swans (*Cygnus buccinator*) were each fitted with a satellite transmitter (platform transmitter terminal, Telonics, Inc., AZ), a U.S. Fish and Wildlife Service leg band, and one red patagial wing tag at Red Rock Lakes National Wildlife Refuge, Lakeview, Montana, during July 2001. Transmitters were attached by a Teflon ribbon harness system. Swans were tracked from July 2001 until the transmitters stopped functioning. Data analysis was for the period of winter 2001-02 to spring 2002. This program was initiated to try to determine where swans from the refuge moved during winter and where they spent the pre-breeding season. Between 1 October 2001 and 31 March 2002, there was a total of 477 recorded locations for the six swans, with an average of 80 locations per bird (range = 24-133). Satellite telemetry locations that were classified as having a location error with a radius of <1000 m made up only 23% of all locations during this time period. There was an average of 18 (range = 3-63) locations per bird that had a location error radius of <1000 m. All swans wintered within the Greater Yellowstone Ecosystem of Montana, Wyoming, and Idaho.

WINTER TRUMPETER SWAN MORTALITY IN SOUTHWESTERN MONTANA, EASTERN IDAHO, AND NORTHWESTERN WYOMING, NOVEMBER 2000 THROUGH JANUARY 2003

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ABSTRACT

Seventy-five Trumpeter Swan (*Cygnus buccinator*) mortalities were recorded during the winters of 2000-01, 2001-02, and 2002-03. Carcasses were collected and sites examined for information on causes of death. Cause of death was assigned to 49 (65.3%) of carcasses found. The most common causes of identified deaths were collisions (36.7%), miscellaneous diseases and parasites (26.5%), lead poisoning (16.3%), and predation (12.2%). Mortalities were distributed throughout the Tri-state region, with most found in Idaho. Data are insufficient to test this hypothesis, but we believe that mortality in different areas changed between years as a result of differential swan use, weather, and habitat quality. Temporal analysis of mortalities showed a pattern of low but steady mortality through most of the winter, with a peak in mortality in February and early March.

INTRODUCTION

Seventy-five Trumpeter Swan (*Cygnus buccinator*) mortalities were recorded during the winters of 2000-01 (n=31), 2001-02 (n=34), and 2002-03 (n=10). Most (60%, n=45) of the mortalities were encountered opportunistically by Southeast Idaho Refuge Complex (SIRC) personnel while conducting ground surveys of Trumpeter Swans in southwestern Montana, eastern Idaho, and northwestern Wyoming. SIRC personnel located 5% (n=4) of the mortalities during midwinter Trumpeter Swan surveys. Private individuals found 19% (n=14) of the mortalities and reported them to state or federal agencies. Personnel from other state and federal agencies found 16% (n=12) of the mortalities. Some Tundra Swan (*C. columbianus columbianus*) mortalities were also documented, but are not discussed in this report.

Swan carcasses were observed during routine ground surveys of various wintering sites in the region. Carcasses were collected if possible, and data on the site and condition of the bird were recorded. Carcasses were preserved and sent to the National Wildlife Health Center (NWHC) in Madison, Wisconsin, for necropsy.

Nine swans that were captured alive were also counted in with the mortalities. Four Trumpeter Swans (three adults and one cygnet) were captured with broken wings. The wings of one adult and one cygnet were amputated at veterinary clinics and the birds were rehabilitated and placed on a private pond. Both subsequently died. Two adults were placed on private ponds and are alive at this writing. Five debilitated Trumpeters (two adults and three cygnets) were captured and euthanized at veterinary clinics.

Thirty intact whole carcasses and five livers were submitted by the SIRC to the NWHC for necropsy. Two other intact carcasses were submitted to the NWHC by other agencies and are included in this report. Carcasses of six intact Trumpeters were necropsied by SIRC personnel. Another 25 carcasses ranging from moderately scavenged to skeletal were necropsied or examined by SIRC personnel. Five carcasses were observed but not retrieved because they were not safely or reasonably accessible. Two intact carcasses where the cause of the mortality was obvious were turned over to Idaho State University to be used in a research study. Nine Trumpeter Swan mortalities in this report are based on communications with other state or federal agency personnel and were not examined.

RESULTS AND DISCUSSION

Causes of mortality

Of 75 swans recovered, cause of death was determined for 49 (65.3%). All subsequent discussion concerns only swans for which mortality causes were assigned. These results are summarized in Table 1.

Collisions

Collisions were the largest identifiable source of mortality (36.7%) for Trumpeter Swans during all winters. Swans dying in accidental collisions were probably more representative of the overall population than swans dying of other causes, which usually involved debilitation and emaciation. Although the sample sizes are quite small, intact carcasses of adult female and adult male Trumpeters that died in collisions during the winters of 2000-01 and 2001-02 averaged 3.6 pounds and 2.9 pounds heavier, respectively, than adults dying of other causes. Intact carcasses of female and male Trumpeter cygnets that died in collisions during the winters of 2000-01 and 2001-02 averaged 8 and 7.3 pounds heavier, respectively, than cygnets dying of other causes.

Trumpeter Swans collided with trees (n=2), vehicles (n=4), power lines (n=4), a fence (n=1), and a bridge (n=1). Six collided with unknown objects. Both tree collision mortalities resulted directly from swan capture operations for a translocation study at Harriman State Park, Idaho.

Collisions occurred at Harriman State Park; between Ashton and Roberts, Idaho; on the lower Henry's Fork; on the upper Snake River; on the South Fork of the Snake near Swan Valley; at Big Springs, Utah, south of Bear Lake; on the Bear River in southeastern Idaho; and near Ennis, Montana, on the Madison River.

The common denominator among these mortalities seems to be roads, power lines, and fences crossing narrow linear feeding areas, especially those walled in by trees. A prime example is the small sloughs between Roberts and Menan, Idaho. Three of the mortalities occurred in this area where power lines, roads, and fences parallel each other. It is often difficult to attribute mortality to any one specific terrain feature.

Lead poisoning

During the last three winters, lead poisoning has been identified as the cause of mortality for eight Trumpeter Swans, or 16.3% of 49 swans. Lead poisoning was confirmed in six of the eight cases by liver lead testing at the NWHC. Liver lead levels ranged from 20.01 ppm wet weight in a swan with three eroded lead pellets in its gizzard to 4.22 ppm wet weight in a swan with no lead particles recovered (mean 10.02 ppm wet weight).

During the winter of 2000, one swan was classified as "probable lead poisoning" based on presentation and proximity to another lead poisoning case. Although scavengers eviscerated the carcass, the esophagus remained and was fully impacted with food articles and grit from the proventriculus to nearly the mouth.

Of the eight lead poisoning cases, six were adult males, one was an adult female, and one was an adult of unknown sex. Four of the cases were recovered in Harriman State Park or within 3 km of the park boundary. The other four cases were scattered. One was recovered in Island Park, Idaho, at Elk Creek Lake; another in the bottoms at Fort Hall, Idaho; the third at Market Lake Wildlife Management Area, Idaho; and the fourth on the Teton River in the Teton Basin. Market Lake has traditionally been a "hot spot" for lead poisoning. One swan was collected there with 20 lead pellets in its gizzard in March 2001. Another swan with lead poisoning was collected there in April 2000. Several other Trumpeters were collected there in previous years with lead poisoning. Lower water levels due to recent drought conditions, particularly in Idaho, may have allowed Trumpeters to feed in areas that were previously inaccessible, exposing them to reservoirs of lead that would have been out of reach at higher flows.

Other diseases, parasites, and emaciation

No single disease appears to be having a large effect on the swan population. In most of these cases, a combination of disease, parasites, and emaciation have killed or debilitated those swans affected.

In December of 2000, a 27-lb adult male Trumpeter Swan was recovered near Swan Valley, Idaho, on the South Fork of the Snake. The cause of death was attributed to liver disease caused by aflatoxicosis. This disease is caused by a fungus, usually the genus *Aspergillus,* which grows on corn kernels. A Trumpeter Swan cygnet recovered near Harrison, Montana, on 13 March 2000, had similar lesions on its liver and corn in its gizzard, although it died in a collision with power lines.

During the winter of 2001-02, a homeowner on the Grayling Arm of Hebgen Lake in Montana was observed feeding corn to waterfowl, including swans, at Corey Springs. This is the only known location in the Tri-state region where swans are being fed.

On 12 December 2000, a female cygnet that could barely fly was captured at Harriman State Park. It

was initially treated at a veterinary hospital for a heavy internal and external parasite load, but it died en route to a wildlife rehabilitation facility. Subsequent necropsy at the NWHC showed the cygnet died of acute pneumonitis caused by an extensive infection resulting from the *Aspergillus* fungus. One swan retrieved from Elk Creek Lake in the winter of 2001-02 had a lung infection involving more than half its lung tissue. This cygnet apparently died of aspergillosis.

Two other swans were recovered in the winter of 2001-02, which had signs of aspergillosis. A cygnet with a healed-over plaque in its keel bone that apparently died of a bumblefoot infection was recovered on Silver Lake in Harriman State Park on 9 March 2002. An adult female Trumpeter Swan recovered at Ennis Lake, Montana, on 30 March 2002, had one small greenish-black plaque in the left abdominal air sack. This is consistent with an old aspergillosis infection, according to the pathologist at the NWHC who conducted the necropsy. A mortality cause has yet to be assigned to this swan.

To date, only one dead Trumpeter Swan has been collected with aspergillosis during winter 2002-03.

Six Trumpeter Swans, four adults and two cygnets, were infected with *Sarconema* nematodes. Of the six cases, five were encountered during the winter of 2000-01 and one case the following winter. Infections were usually mild to moderate, but may have played a significant part in two mortalities.

A 14.8-lb male Trumpeter Swan was captured on 6 March 2001 at Chester Dam, Idaho. This swan was weak and made no attempt to fly. It was blind in its right eye, and was euthanized. A NWHC necropsy found that this swan had a heavy heart worm infection with inflammation that may have compromised heart function. Another adult Trumpeter Swan had a heart comprised of approximately 20% scar tissue. In both these cases, there was significant damage to heart muscle that impaired heart function.

Nasal leaches (*Theromyzon* sp.) were found in nine necropsied swans, five adults and four cygnets. The actual infection rate is probably higher since leaches may leave the host after it dies. One swan had an especially severe infestation. The nares of this swan were completely sealed. Fifteen engorged dead leaches were found in the nasal cavity, 11 engorged dead leaches were loose in the oral cavity and upper esophagus, and hundreds of small leaches were found in the trachea.

Thorny headed worms (*Acanthocephalus* sp.) were found in the intestinal tracks of seven Trumpeter Swans, three adults and four cygnets. Thorny headed worm infestations usually consisted of a few scattered worms in the small intestine and 8 to 10 worms in the colon.

Tapeworms were found in the intestinal tracks of five Trumpeter Swans necropsied. All five swans with tapeworms were cygnets. One cygnet had an especially severe infestation, with thousands of worms that looked like a 7-mm twisted rope that extended the entire length of the small intestine.

Schistosome parasites may have been found in two cygnets. The NWHC found one cygnet with spheroid organisms in the vessels of the brain that resembled immature schistosomes. There was no necrosis or inflammation associated with the organisms.

The bacterium *Aeromonas* sp. was cultured from the livers of five swans by NWHC. Raised yellowish lesions were noted on the feet of four of the five swans. According to the NWHC, *Aeromonas* is a common wetland bacterium that can often be cultured out of waterfowl with no associated disease. No necrosis or inflammation was noted in the livers of these swans. The first three cases listed were debilitated swans that were euthanized and immediately mailed to the health lab, leaving little opportunity for contamination.

One intact adult female, which had been dead a few days, was recovered floating in Ennis Lake. No obvious cause for this mortality was found by NWHC. Another fresh intact adult male Trumpeter was found floating in Silver Lake. No obvious cause for this mortality was found by NWHC. The final report on both these Trumpeters is still pending.

Two swans died of infections associated with "bumblefoot."

Predation

Of 49 swans, 6 (12.2%) were classified as being preyed upon by coyotes. To be classified as coyote predation, a good track sequence had to be found at the kill site or the carcass had to have distinct bite marks with subcutaneous hemorrhages. All six instances of coyote predation were on cygnets. Only one of the cygnets was found to be in excellent physiological condition. This cygnet tumbled during take off when it tripped in a ditch. At the other end of the spectrum, one swan was severely emaciated and had a huge parasite load. Although this cygnet

was killed by a coyote, it may have been debilitated. Thus coyote predation may be the proximate, rather than the ultimate, cause of many swan mortalities. No other predator was implicated in any swan mortality.

Fishing tackle

Fishing tackle was retrieved in six swans that were necropsied. Fishing lure parts were retrieved from the gizzards of five other swans. Two swans each had two 2-mm diameter brass rings in their gizzards, which were probably parts of spinners. Another three swans each had ovoid brass- or gold-colored metal objects in their gizzards, which were likely spinner blades. One other swan that died of lead poisoning had a piece of wire, which may have been a streamer weight, embedded in its gizzard. Without a positive conclusion, this swan is not counted in the total.

Cancer

One swan out of 49 (2.0%) died of cancer. This was a 19-lb adult female Trumpeter Swan that was observed in distress on 13 March 2001. This swan was separated from other swans at Sheridan Reservoir in Clark County, Idaho, by about 250 m. Periodically, its head drooped into the water, submerging the nares. Four hours later the swan was dead. Necropsy at the NWHC showed the swan had a malignant tumor in its pituitary gland, which had invaded the bone at the base of the skull and the overlying brain tissue.

Gunshot

Only two swans out of 49 (4.1%) were shot. One was a moderately scavenged male cygnet recovered on the Teton River in Fremont County, Idaho. This cygnet had several #4 steel shot pellets in its left breast with associated infection and was emaciated with an enlarged spleen. It had apparently succumbed to the infection associated with the shotgun pellet wounds. The other was an adult male found dead of an apparent gunshot on the Teton River in the Teton Basin.

Geographic distribution of mortalities

Most swan mortalities were found in Idaho, which should be expected, since that is where most of the Rocky Mountain Population of Trumpeter Swans winter (C. L. Whitman, unpubl. data).

Winter mortalities vary somewhat between years. We suspect this is in response to interactions among differential swan distribution, densities, and body condition, local habitat quality, and weather conditions. However, adequate data are not available for all these parameters and we were unable to test this hypothesis.

The distribution of swan mortalities observed during the winters of 2000-01 and 2001-02 were markedly different. Swan mortalities at Harriman State Park increased from 6 during winter 2000-01 (3 adults, 3 cygnets) to 14 during winter 2001-02 (8 adults, 6 cygnets). To date, in winter 2002-03, only one adult Trumpeter Swan has been found dead at Harriman.

Mortality increased in other survey areas of the upper basins of the Henry's Fork and Madison River as well. Island Park had two mortalities during winter 2000-01 (1 adult, 1 cygnet), four mortalities during winter 2001-02 (1 adult, 3 cygnets), and one during winter 2002-03 to date (a cygnet).

Hebgen Lake had one cygnet mortality during winter 2000-01 and four mortalities during the winter of 2001-02 (2 adults, 2 cygnets).

No swan mortalities were observed at Ennis Lake during winter 2000-01, but three adult mortalities were observed there during winter 2001-02, and another one so far in winter 2002-03.

Trumpeter Swan mortalities decreased on the lower Henry's Fork and upper Snake Rivers. Swan mortalities between Ashton and St Anthony decreased from eight during winter 2000-01 (4 adults, 4 cygnets) to one during winter 2001-02.

Swan mortalities between Rexburg and Roberts decreased from three during winter 2000-01 (2 adults, 1 cygnet) to none observed during winter 2001-02, but increased again to three so far in winter 2002-03.

There seems to be an increase in swan mortalities in the Teton Basin, with three mortalities found to date in winter 2002-03.

Temporal distribution of mortalities

Swan mortalities seem to show the same basic temporal trend in the winters of 2000-01 and 2001-02.

Winter mortality seems to show a basically bell shaped curve, with low mortality early and higher mortality in February and March. Mortalities obviously decline as the majority of swans begin to

migrate north. We would expect a mortality pattern similar to this if forage availability was a primary determinant in survival. Forage availability declines over the course of the winter as it is consumed. There is too much variation between areas and winters to generalize about which month experiences the worst weather conditions (e.g., extreme cold). Likewise, habitat conditions (e.g., water levels that affect forage or ice conditions) are extremely variable. We hope to continue analyses to determine population and environmental factors associated with specific causes of Trumpeter Swan mortality.

Table 1. Causes of Trumpeter Swan mortality in the Tri-state area, November 2000 through January 2003.

Year	Disease and parasites	Capture myopathy	Lead poisoning	Collision	Gunshot	Predation	Fishing tackle	Unknown
2000-01 (N=31)	1 Aflatoxicosis 1 Aspergillosis 1 Sarcoma 1 brain cancer 2 parasites	0	3	3 unknown 2 power line 1 vehicle 1 fence	1	2 coyote	1	11
2001-02 (N=34)	1 Aspergillosis 1 bumblefoot 1 Sarcoma 1 unknown 1 parasites	0	4	1 unknown 3 vehicle 2 tree 1 bridge	0	4 coyote	0	14
2002-03 (N=10)	1 Aspergillosis 1 bumblefoot	1	1	2 unknown 2 power line	1	0	0	1
Totals (N=75)	13 17.3%	1 1.3%	8 10.7%	18 24.0%	2 2.7%	6 8.0%	1 1.3%	26 34.7%

Note: N = 49 (65.3%) assigned to a specific cause of mortality; N = 26 (34.7%) unknown.

SOUTHEASTERN IDAHO TRUMPETER SWAN TRANSLOCATIONS AND OBSERVATIONS 2001-2003 - PROJECT UPDATE

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ABSTRACT

Habitat loss, low productivity, and overcrowding on wintering grounds in southeastern Idaho threaten the overall health of the Rocky Mountain Population of Trumpeter Swans (*Cygnus buccinator*) and the stability of the local nesting population. Dispersing the wintering population and establishing secure use of other parts of southeastern Idaho might lessen impacts on habitat and concern over die-offs in Island Park. Winter translocation efforts up to this time, however, have not adequately achieved the goal of dispersing the population to new wintering grounds. During the winters of 2001-03, a multiagency group captured and marked 173 Trumpeter cygnets at Harriman State Park, releasing 87 on site and moving 86 to the Bear River area in southeastern Idaho. Release sites proved suitable, as over 60% of translocated cygnets remained at the sites throughout much of both winters. During the winters of 2001-02 and 2002-03, at least 15% and 41%, respectively, of the translocated cygnets spent portions of the winter outside the release area. Cygnets migrated to locations as far away as Arizona, California, and the Colorado River in Utah. Sixty-three percent and 79% of the cygnets released at Harriman remained in the general release area throughout portions of the 2001-02 and 2002-03 winters, respectively. There were 3 confirmed cygnet mortalities during the first winter and 16 confirmed during the following winter. Kaplan-Meir survival estimates range from 37.6% (SE=0.08), which assumes all 2001 cygnets not observed after 1 March 2002 were dead, to 91.5% (SE=0.05), which assumes all 2001 cygnets not known to be dead were still alive. Kaplan-Meir survival estimates for 2002 cygnets range from 30.7% (SE=0.07) to 60.7% (SE=0.09). Half of the cygnets captured in 2002 were fitted with radio collars. Continued monitoring of all collared swans throughout 2003 and 2004 will provide additional insight to cygnet and yearling survival and winter movements.

INTRODUCTION

Winter translocation efforts to address Trumpeter Swan (*Cygnus buccinator*) overcrowding in the Island Park area of Idaho began in 1990. The goal of dispersing the wintering population and establishing secure use of other parts of southeastern Idaho was to lessen population impacts on habitat and concern over die-offs in Island Park because of disease or starvation. Dispersal to more southerly wintering areas could also increase early spring food resources for the resident southern Idaho nesting population. Trapping and translocating cygnets without accompanying adults from traditional wintering grounds had not been attempted.

Project objectives were to:

1) Determine survival of marked cygnets released at the trap site;
2) Determine survival of marked cygnets translocated to alternate wintering areas;
3) Assess marked yearling survival and return rate to alternate wintering sites; and
4) Determine suitability of alternate wintering sites and the ability of these sites to support and hold swans throughout the winter.

METHODS

Trapping was scheduled to begin in both 2001 and 2002 as soon as a "large" number (>100) of swans arrived at Harriman State Park (Harriman) (Figure 1). Weather and moon conditions also needed to be suitable for trapping to begin. Ideal conditions include dark moon phase and light precipitation or fog.

All captured cygnets were banded with collars and U.S. Geological Survey leg bands. Half of all marked cygnets were released at Harriman (control group) and half were translocated to southeastern Idaho (Figure 1). Translocation cygnets were color marked with pink dye on the right wing. General morphological measurements were collected along with blood and feather samples, which were transferred to the University of Denver, Colorado, for genetic testing. Gender also is to be tested from the

blood samples to test the accuracy of sex identification of immature birds in the field.

Forty of the 78 cygnets captured in 2002 received collars equipped with 4 x 2.5-cm VHF radios and 41-cm antennae. The collar, radio, and antennae weight was 110 g. Twenty of the control cygnets and 20 of the translocated cygnets were radio collared. Captured cygnets were divided into four groups during each trapping event: control with radio, control without radio, translocation with radio, translocation without radio.

A number of agencies and private individuals contributed cygnet observations throughout the winter. The Southeast Idaho National Wildlife Refuge (NWR) complex hired one technician to monitor adult and cygnet swans in areas of southeastern Idaho and southwestern Montana. This technician attempted to survey Harriman and Island Park weekly, and all other areas biweekly. One Idaho Department of Fish and Game (IDFG) technician surveyed the southern translocation area and areas of southeastern Idaho each week. The technicians conducted routine surveys from November through March.

Observations from a number of agencies and private individuals aided technicians and biologists in following cygnets outside the routine survey areas. These agencies included IDFG, Wyoming Game and Fish, Montana Department of Fish, Wildlife and Parks, Utah Division of Natural Resources, Oregon Department of Fish and Wildlife, Arizona Department of Fish and Wildlife, U.S. Geologic Survey Biological Resource Division, National Park Service, Shoshone-Bannock Tribe, U.S. Fish and Wildlife Service (USFWS) Refuges, U.S. Forest Service, and the Canadian Wildlife Service. News of the translocation effort was printed in local newspapers throughout southeastern Idaho and northern Utah, Audubon Society newsletters, and birding websites.

RESULTS

Trapping and marking

Ninety-five cygnets were captured during 6 nights of trapping in November and December 2001. Seventy-eight cygnets were captured during November and December 2002. Mild winter conditions maintained swans in southwestern Montana later than normal in 2002. Hebgen Lake Trumpeter Swan numbers remained high through January 2002: 494 swans 29 November, 556 swans on 16 December, and 432 swans on 6 January.

Six translocation cygnets were released at Bear Lake National Wildlife Refuge (NWR) (Figure 1) with a resident adult pair and cygnet during November 2001. Forty-one cygnets translocated to the Bear River area were released between Grace and the lower end of Oneida Reservoir (Figure 1) in November and December 2001. During November and December 2002, 39 cygnets were translocated to a gravel pit on the Bear River between Riverdale and Highway 91 north of Preston, Idaho (Figure 1). All control cygnets (n=87) released at Harriman during both winters were released in the immediate area of capture (i.e., Silver Lake, Golden Lake, Last Chance, or Pine Haven) (Figure 1). Trapping at Harriman was delayed at least 1 day after a release to help marked cygnets regroup with adults.

Eight collisions resulting in two mortalities (one adult female and one adult unknown) were documented during the trapping activities of November 2001. Five of these collisions could have been avoided if trapping instructions had been followed by crew members. One adult male was killed after flying into the side of the airboat during December 2002 trapping activities. Another adult was injured after colliding with a tree during a December 2002 trapping event. This swan was rehabilitated and is currently housed at Bill Long's Wyoming Wetland Society facility in Jackson, Wyoming.

Cygnet movements and wintering locations

Cygnets translocated to the Bear River were not released in areas with adult swans since no adult Trumpeter or Tundra (*C. columbianus* columbianus) Swans were present in the area prior to releases. Many of these cygnets, however, formed groups (2-10 cygnets) that remained together throughout the winter near the general release area. One group of four 2001 cygnets moved south to the Colorado River, Utah, in January 2002. One group of 10 cygnets collared in November 2002 was observed at the Bear River Migratory Bird Refuge, Utah, in late November. The collar from one of these cygnets was found north of the refuge later in the winter, but the nine others were not observed again. Birders at the Cibola NWR on the California/Arizona border observed three pink-winged cygnets on the refuge in late December 2002.

Summary of 2001 translocated cygnet movements and wintering locations:

- 32 of 47 (68%) translocated cygnets were observed during at least a portion of the winter (more than one observation) in the southern release area and not observed in other areas until late spring. (Note: This area includes Bear Lake NWR, all of Bear River, Soda Springs (Idaho), the northern portion of Bear Lake, and Big Springs, Utah.)
- At least seven of the translocated cygnets spent portions of the winter in areas outside the release area including the Teton River (Idaho), Idaho Falls (Idaho), southern Utah, and Arizona.
- There were no observations of translocated cygnets back in the Island Park area prior to spring migration.

Summary of 2002 translocated cygnet movements and wintering locations:

- 24 of 39 (62%) translocated cygnets were observed during at least a portion of the winter (more than one observation) in the southern release area and not observed in other areas until late spring. (Note: This area includes all of Bear River, Soda Springs (Idaho), the northern portion of Bear Lake, and Big Springs, Utah.)
- At least 16 of the translocated cygnets spent portions of the winter in areas outside the release area including northern Utah, Bear River Migratory Bird Refuge, and Cibola NWR.
- There were no observations of translocated cygnets back in the Island Park area.
- Two translocated cygnets were not observed after release in late December until 5 March at Pineview Reservoir in northern Utah.

Note: Two 2002 translocation cygnets were observed at Camas NWR, Idaho, in late May. Both cygnets wintered in the Bear River area. An additional translocation cygnet was identified by its pink wing and green collar in late April in the Lowe Lake, Grande Prairie area of Canada. These spring observations are not included in the below analyses.

Summary of 2001 control cygnet movements and wintering locations:

- 30 of 48 (63%) cygnets released at Harriman were observed for at least a portion of the winter (more than one observation) in the Island Park area and not observed in other areas until late spring.
- At least 10 of the cygnets spent portions of the winter in areas outside of Island Park including the Madison River (Yellowstone National Park), South Fork of the Snake River (Idaho), Fort Hall Indian Reservation (Idaho), Silver Creek Preserve (Idaho), Camas NWR (Idaho), Seedskadee NWR (Wyoming).
- There were no observations of cygnets released at Harriman south of the Fort Hall Indian Reservation (Idaho).
- Eight control cygnets were observed alone for at least a portion of the winter.

Summary of 2002 control cygnet movements and wintering locations:

- 31 of 39 (79%) cygnets released at Harriman were observed for at least a portion of the winter (more than one observation) in the Island Park area and not observed in other areas until late spring.
- At least five of the control cygnets spent portions of the winter in areas outside of Island Park including the South Fork of the Snake River (Idaho), Teton Valley (Idaho), and Roberts, Idaho.
- There were no observations of control cygnets south of the Snake River (Idaho).
- 16 control cygnets were observed alone for at least a portion of the winter.

Note: One 2002 control cygnet was observed in late May 2003 at Harriman. This cygnet was observed alone at Harriman throughout much of the winter. This spring observation is not included in the below analyses.

Cygnet survival

Nine of 47 (19%) cygnets released in the Bear River area were never observed after their release in 2001 and 6 of 39 (15%) translocated cygnets were never observed after their release in 2002. Two of 48 (4%) and 2 of 39 (5%) cygnets released at Harriman were never observed after their release in the winters of 2001-02 and 2002-03, respectively. Search effort was significantly higher during the period of November through February in both years. Two 2001 cygnets and four 2002 cygnets were not observed after release until late March or early April of the respective years. These "first" observations so late in the winter indicate cygnets wintered outside the survey area. These observations also show that an "unobserved" bird does not equate to a mortality.

Increased search effort during March and April may result in higher survival estimates.

There were three confirmed mortalities of 2001 collared cygnets during the winter of 2001-02. An additional two mortalities of 2001 cygnets were identified in the winter of 2002-03. There were 16 confirmed mortalities of 2002 cygnets during the winter of 2002-03. Two unconfirmed mortalities were also reported. An IDFG officer in southeastern Idaho received a report of a "gray, pink wing swan" lying dead in a duck hunter's decoys on the Bear River. The source was deemed reliable, but no carcass or collar was ever recovered. The case is still open. A second hunting mortality was reported in Arizona near Cibola NWR. The source of this information was never identified, nor was a carcass or collar recovered. The reliability of this report is still under investigation. Mortality dates were estimated in a number of cases (Table 1) due to decomposure or lack of remains.

Kaplan-Meir survival estimates for all cygnets, control cygnets only, and translocation cygnets only are comparable among groups and between years (Figure 2). The minimum survival estimates assume all birds not known alive after 1 March are dead. The maximum survival estimates assume all birds not confirmed dead by 1 April are alive. The 2002 unconfirmed mortality on the Bear River was included in the "known" dead estimate.

Minimum estimates of mortality are influenced by reduced survey effort during the month of March and the initiation of spring migration, particularly in the Bear River area. Birds began migrating north earlier during the spring of 2003 than in 2002, thus, fewer translocation birds were observed after 1 March 2003.

Radio telemetry (winter of 2002-2003)

Radio signal performance was less than expected. Reception of signals from the air ranged from 3 to 5 km. Ground reception was less than 3 km. Regardless, 9% of all cygnet locations (n=590) were collected by radio telemetry without a visual observation. "Radio only" locations were collected on 25 individual cygnets. Ten of the 16 confirmed mortalities were located when the radio mode switched to mortality (i.e., rapid signal). Fifteen of the 16 confirmed mortalities were radio-collared cygnets.

Yearling observations

Six (13%) of the 2001 control cygnets and 15 (32%) of the 2001 translocation cygnets were observed during the winter of 2002-03 as yearlings. The six control yearlings spent portions of the winter in five different Idaho locations: Harriman, Ashton-Henry's Fork, Rexburg, Fort Hall Bottoms, South Fork of the Snake River, and Jackson, Wyoming. The one control yearling that spent the winter on the South Fork of the Snake River was found dead near Menan, Idaho, in late March 2003.

Four of the translocation yearlings spent portions of the winter on the South Fork of the Snake River and in Swan Valley. Four others spent portions of the winter in the Bear River or Soda Springs, Idaho, area and three wintered at Harriman. One yearling was observed at Camp Verde, Arizona, in late December. Three other translocation yearlings were located only once each in late March or April of 2003 in three separate locations: Red Rock Lakes NWR, Hebgen Lake (Montana), and Island Park Reservoir. Three of the translocation yearlings observed this past winter were not observed any time after their release in 2001. These observations suggest these swans wintered outside the survey area during the winter of 2001-02. Observations of three other yearlings for the first time in late March or April of 2003 support this idea.

Yearling survival

There was one confirmed 2001 translocation cygnet mortality and two 2001 control cygnet mortalities during the winter of 2001-02. One 2001 control cygnet collar was found by a duck hunter in a Sand Creek Wildlife Management Area pond in Idaho in the late fall of 2002. No remains were found with the collar. There was only one confirmed 2001 control yearling mortality during the winter of 2002-03. The identified cause of death was Aspergillosis infection.

CONCLUSIONS

Observations of cygnets as far away as Arizona, Bear River Migratory Bird Refuge, Cibola NWR, and the Colorado River in Utah, along with observations of cygnets for the first time in early spring suggest some translocation cygnets do winter outside the survey area. These observations also suggest that mortality may not be as high as observed in some other translocation efforts (an "unobserved" bird does not equate to a mortality). The range of Kaplan-Meir survival estimates argues the need for an improved

monitoring technique over an extended search area. Radio collars with mortality mode proved useful in finding cygnet remains and collars. Refinement of the radio telemetry equipment and methods may increase location and movement data. An IDFG and USFWS project is being conducted during the summer of 2003 at Bear Lake NWR to investigate alternate radio and antennae configurations for future project needs.

The return of four 2001 translocation yearlings to the Bear River area this past winter indicates some level of project success. Four other translocation yearlings that wintered in the Bear River area during 2001-2002 spent the winter of 2002-2003 in areas south of Harriman, again indicating translocation efforts may be dispersing wintering birds at Harriman. Capture and translocation efforts will continue during the winter of 2003-2004.

Editors' Note: Data for the full winter 2002-03 were included in the paper to enable comparison between the two winters. If the 2003 mortality data were analyzed only through 1 February 2003, it would not have been meaningful.

Table 1. Documented mortalities of marked Trumpeter Swan cygnets captured at Harriman State Park, Idaho, during the winters of 2001-02 and 2002-03.

Mortality date	Release site	Sex	Collar	Mortality cause	General location
Cygnets captured in November and December 2001					
01/07/02	BR[1]	F	26E	Vehicular collision	Big Springs, UT
02/12/02	HSP[2]	M	78E	Coyote predation	Yellowstone NP
02/27/02	HSP	M	75E	Disease	Yellowstone NP
11/01/02???	HSP	M	15E	Unknown - collar only	Sand Creek, ID
03/20/03	HSP	F	79E	Disease - Aspergillosis	Menan, ID
Cygnets captured in November and December 2002					
11/12/02	BR	F	6E3	Collision	Bear River, ID
11/20/02	HSP	M	7E5[3]	Coyote predation	Harriman, ID
12/01/02	BR	M	6E1[3]	Unknown - collar only	Conde Reservoir, ID
01/08/03	HSP	F	97E	Infection - collar injury	Island Park, ID
02/01/03	BR	F	7E9[3]	Unknown - collar only	Bear River, ID
02/13/03	HSP	F	7E4[3]	Unknown	Harriman, ID
02/22/03	HSP	M	6E3[3]	Unknown - collar only	Harriman, ID
02/24/03	HSP	F	66R	Unknown - collar only	Harriman, ID
02/24/03	HSP	M	7E7[3]	Unknown - collar only	Harriman, ID
02/24/03	HSP	F	8E2[3]	Unknown - collar only	Harriman, ID
02/24/03	HSP	M	7E3[3]	Unknown - collar only	Harriman, ID
02/25/03	HSP	M	8E7	Unknown	Harriman, ID
03/05/03	HSP	F	7E5	Emaciation / Bumble Foot	Harriman, ID
03/11/03	HSP	F	9E0[3]	Unknown - collar only	Harriman, ID
03/12/03	HSP	F	8E4[3]	Unknown - collar only	Harriman, ID
05/02/03	BR	F	7E0[3]	Investigation underway	Missoula, MT
12/27/02	BR	?	?	Unconfirmed - hunting	Bear River, ID

[1] Bear River, Idaho.
[2] Harriman State Park.
[3] Collar or remains were located with radio telemetry.

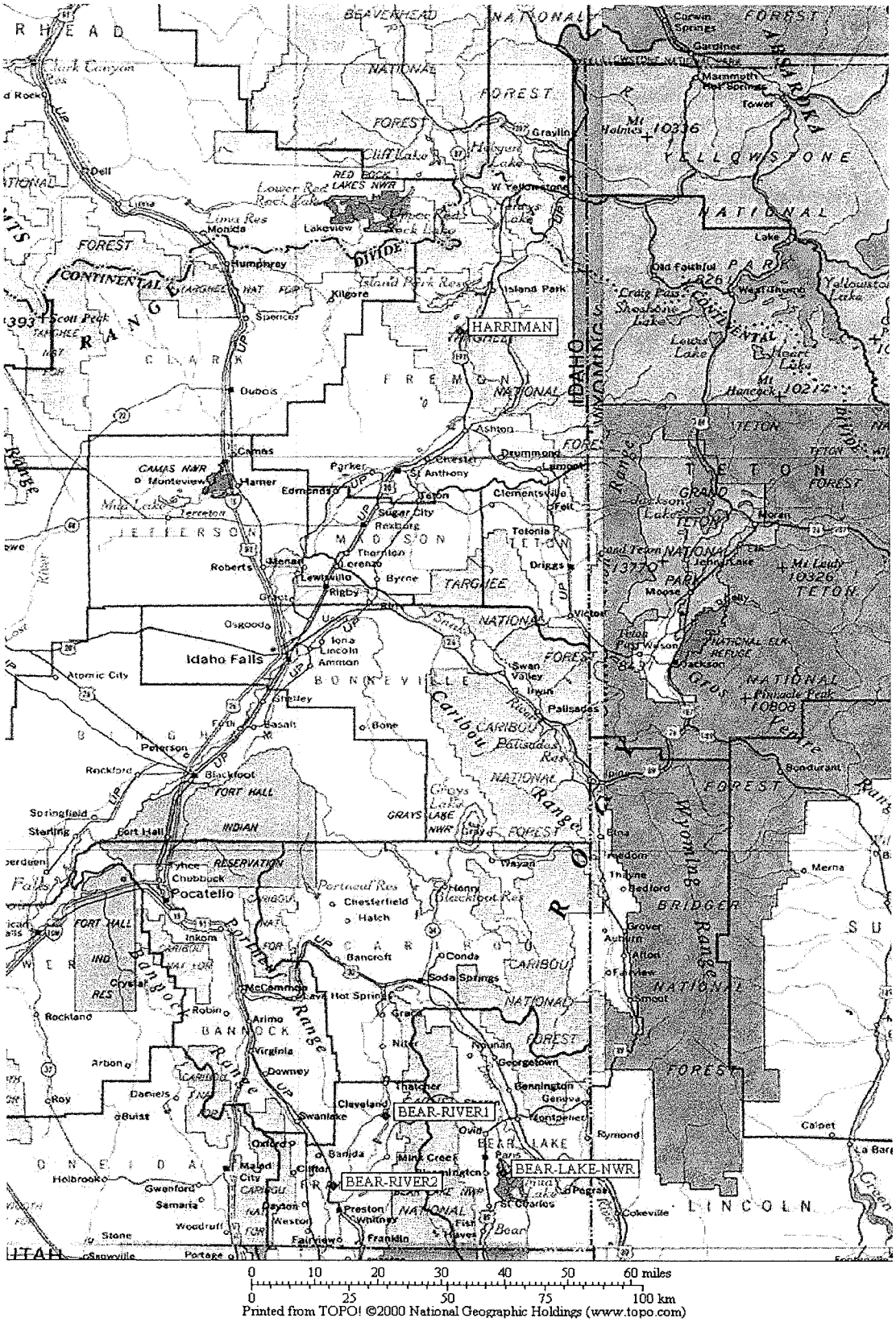

Figure 1. Study area for the southeastern Idaho 2001-2003 Trumpeter Swan translocation project. Harriman State Park was a trapping and release site. Bear River1, Bear River2, and Bear Lake National Wildlife Refuge were translocation release sites only.

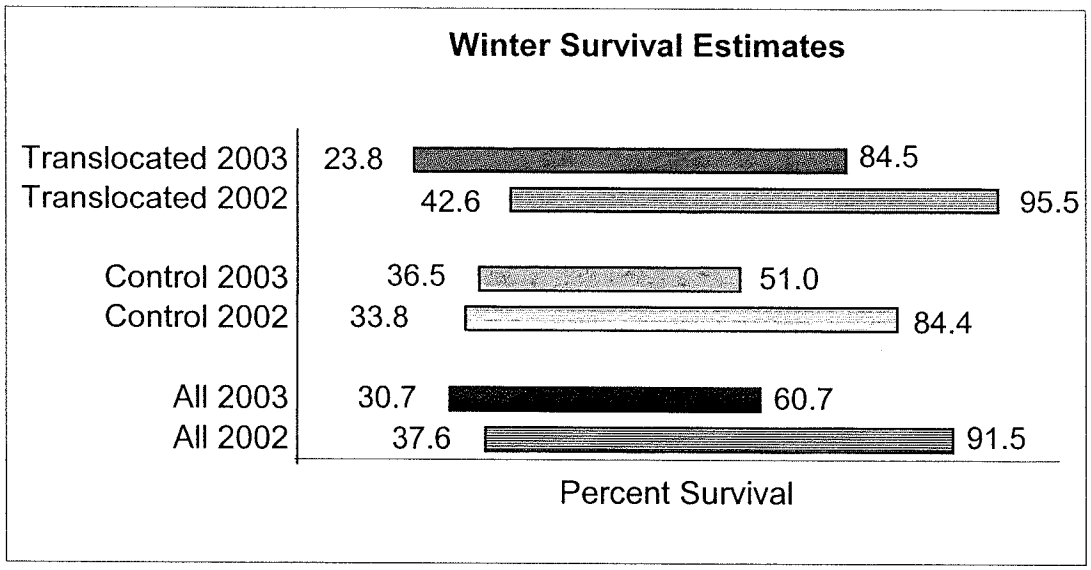

Figure 2. Minimum and maximum winter survival estimates for all Trumpeter Swan cygnets captured in the winter of 2001-02, the winter of 2002-03, and the experimental groups captured in each winter.

TRUMPETER SWAN RESTORATION AT GRAYS LAKE NATIONAL WILDLIFE REFUGE, IDAHO

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ABSTRACT

Sixty-seven Trumpeter Swans (*Cygnus buccinator*) were translocated from Red Rock Lakes National Wildlife Refuge in southwestern Montana to Grays Lake National Wildlife Refuge in southeastern Idaho between 1988 and 1991. Capture, handling, transportation, and release procedures worked very well. New, thicker collars worked better than older, thinner collars or patagial tags for marking. The translocation was successful and most swans survived, moved to suitable wintering habitat, and returned to Grays Lake. Most birds wintered on the Salt River, Wyoming, Swan Valley, Idaho, and/or near Soda Springs, Idaho. Flock size increased from 0 to 50 swans in 1991, then declined and stabilized at about 28 (range 18-32) swans. Translocated swans reproduced for the first time in 1990. Grays Lake Refuge and vicinity now have 5-10 nesting pairs/year. However, cygnet survival has been very low. Consistently low water conditions in late summer, due to drawdown for irrigation, are a major impediment to increasing local recruitment. Eggs are currently salvaged from nests and captive-reared for use in other range expansion projects. If water management improves, Grays Lake has the potential to become one of the most important Trumpeter Swan breeding marshes in the Tri-state area.

INTRODUCTION

Trumpeter Swans (*Cygnus buccinator*) once nested and wintered across much of North America (Banko 1960; Palmer 1976; Rogers and Hammer 1998; Lumsden 1984). Populations were decimated by hunting for quills and down (Banko 1960; Houston *et al.* 1997) and subsistence (Banko 1960), and by loss of habitat (Banko 1960; Rogers and Hammer 1998). Since the 1930's, small flocks have been restored throughout northern portions of their historic range (Hull 1939; Monnie 1966; Hansen 1973; Fjetland 1974; Bartonek *et al.* 1981; Shea *et al.* 1991). These restoration projects used a variety of techniques (e.g., age of source birds, capture, marking, transport, and release). Much can be learned by critical reviews of previous translocation projects (Griffith *et al.* 1989; Shea *et al.* 1991; Mitchell 1993; Engelhardt *et al.* 2000) and lessons should be applied to new programs. This paper reviews the reintroduction techniques used to reestablish a breeding flock of Trumpeter Swans at Grays Lake National Wildlife Refuge (NWR), summarizes seasonal movements, documents subsequent flock growth, reviews some of the problems encountered, and suggests some solutions for those problems.

STUDY AREA

Grays Lake NWR is located in southeastern Idaho at an elevation of 6,385 feet above sea level. The "lake" is actually a large 22,000-acre marsh dominated by emergent plants, primarily hardstem bulrush (*Scirpus acutus*) and some cattail (*Typha latifolia*). The marsh and adjacent uplands exhibit a complex land ownership pattern typical of the western United States. Private landowners and public land management agencies, including the U.S. Fish and Wildlife Service (FWS), Bureau of Indian Affairs (BIA), Bureau of Land Management, and Idaho Department of State Lands (IDSL), own various and manage lands within and adjacent to the refuge.

Grays Lake NWR was established in 1965. The original purpose was to "restore waterfowl productivity" (Peck 1980) in a marsh already severely impacted by water withdrawals. In 1972, the approved refuge boundary was expanded for the purpose of "protection and management of habitat for nesting and migrating waterfowl, especially Western Canada Geese" (*Branta canadensis moffitti*), and "maintaining the . . . Sandhill Crane (*Grus canadensis*) population, and relieving site depredation on local grain fields" (Peck 1980).

The majority of water rights on Grays Lake proper is owned by the Shoshone-Bannock Tribes (SBT) and managed by the BIA in trust for the Tribes. The BIA uses control structures at the north and south ends of the marsh to control water levels. Water is withdrawn through Clark's Cut on the south end of the marsh to Blackfoot Reservoir and thence to Fort Hall Indian Reservation. Drawdowns are based on a 1964 water management agreement between BIA and

FWS. Drawdowns usually begin in late May or June, depending on water levels and the need for irrigation water. By August, much of the marsh has very low water levels, or is actually dry.

Land use on the surrounding uplands is limited to cattle grazing. The refuge also farms about 128 acres of barley and wheat to provide additional forage for Sandhill Cranes.

HISTORICAL TRUMPETER SWAN OBSERVATIONS AT GRAYS LAKE

Trumpeter Swans were native to Grays Lake and the surrounding area (Banko 1960). Swans were mentioned in one Oregon Trail diary and Banko (1960:13) noted breeding accounts for Grays Lake in 1923 and 1924. There were several other sightings of Trumpeter Swans in eastern Idaho from the 1920s through the 1950s, but none at Grays Lake (Banko 1960). Elwood Bizeau, who worked at Grays Lake for several years, beginning in 1949, was quoted in the North American Management Plan for Trumpeter Swans as saying that Trumpeters "nested regularly at Grays Lake" before that time (U.S. Fish and Wildlife Service 1984:34). None of the biologists working at Grays Lake between 1940 and 1950 mentioned Trumpeter Swans (Oster 1942; Williams 1950; Bizeau 1951). In fact, neither Bizeau (1951) nor Steel (1952) record swans in their bird checklists, although other rare species (e.g., White-fronted Goose [*Anser albifrons*]) are noted. Longtime local residents do not recall any Trumpeter Swans present at Grays Lake during this time frame either (M. Sibbett, pers. comm.; L. Sibbett, pers. comm.). Therefore, I presume Trumpeters disappeared as a breeding species from Grays Lake by the late 1920s and did not breed there again until the late 1960s.

The next records of Trumpeter Swans at Grays Lake are from refuge files. From June through November 1968, refuge staff saw two adults and one "juvenile" (a cygnet?) at Grays Lake. No nest was observed, but this suggests a breeding pair was present and successful. In 1969, two Trumpeter Swans were present from 30 March through 30 August, and five from 6 to 19 April, but no mention is made of nesting or cygnets. A nest with four eggs was found in 1970, but was apparently abandoned. Four migrants were noted as late as 3-9 November 1970 as well. A pair nested again in 1971 and 1972. In 1971, they produced two cygnets. From 1973 through 1980, only occasional single birds or pairs were noted. After 1980, no Trumpeters were observed at Grays Lake. Dave Lockman from the Wyoming Game and Fish Department (WGFD) moved two young sibling Trumpeter Swans to Grays Lake in 1986, but these birds soon disappeared and no further information is available.

THE RESTORATION PROJECT

The 1984 North American Management Plan for Trumpeter Swans (U.S. Fish and Wildlife Service 1984) called for establishing new breeding sites. Since Grays Lake NWR had a record of breeding Trumpeter Swans, and was < 20 air miles from suitable wintering habitat, it was selected as one restoration site. No prerelease habitat surveys were conducted and no formal analyses of the number of swans needed for release were made.

On 9 July 1988, personnel from Red Rock Lakes NWR, WGFD, Idaho Department of Fish and Game, and the SBT captured 28 second-year (SY) Trumpeters during their flightless molt at Upper Red Rock Lake.

We used the refuge airboat to approach flightless birds and grabbed them by hand. Captured birds were placed in mesh bags with a drawstring to prevent them from backing out. A corner was cut out of the bag as an opening for the head and neck. Once we had four to six birds in the boat, we brought them back to shore where crews sexed, aged, banded with FWS bands, and marked them with a red and yellow wrap-around patagial marker (Young and Kochert 1987). We had experienced personnel present to teach the less experienced people proper procedure and techniques, had several people available at each "work station," and used an "assembly line" approach. After processing, the birds were placed in ventilated wooden crates or plastic dog kennels and put in the shade. Thirteen of the swans captured in the afternoon were driven to Grays Lake. (The other 15 went to Fort Hall Reservation.) They were "hard released" at Beavertail Point on the south end of Grays Lake.

On 12 July 1989, 15 molting nonbreeders were captured at Red Rock Lakes NWR. Ten were SY and five were after second year (ASY) birds. They were handled as before, except blood was taken. They were marked with red collars, transported, and "hard released" at Beavertail Point.

On 11 July 1990, 10 molting nonbreeders (all ASY) were captured at Red Rock Lakes NWR. Because of problems with the old red collars used in 1989, we used new green collars with matching tarsal bands. ASY birds were used for translocation because the 1989 production at Red Rock Lakes NWR was poor

and we did not want to deplete the cygnet cohort further. They were hard released at Grays Lake Outlet on the north side of the refuge.

The last release of Red Rock Lakes swans occurred on 16 July 1991, with 18 SY and 11 ASY birds captured during their flightless molt. These birds were handled and marked as in 1990, with green collars and matching plastic leg bands in addition to the FWS aluminum bands. They were hard released at Grays Lake outlet.

A total of 67 Trumpeter Swans (41 SY and 26 ASY) was released at Grays Lake over 4 years. It is important to note that beginning in December 1989, Trumpeter Swans were captured at Red Rock Lakes and Harriman State Park for translocation to various other wintering sites. Some of these birds were moved to the Salt River in Wyoming and others to Ft. Hall, Idaho, and subsequently showed up at Grays Lake. Some birds from these other translocations were sighted at Grays Lake in subsequent years. So, there was some recruitment to the Grays Lake flock from these translocations as well.

RESULTS

Translocations

Capture, handling, marking, transport, and release

The captures, handling, transport, and releases went very well with no loss of birds. Fairly large crews were present, all assigned to a specific task (e.g., capturing; aging and sexing; banding and collaring; boxing and transporting). All were experienced at their assigned task or worked with an experienced person. In addition, all staff were taught how to complete multiple tasks. There were no injuries to the swans or personnel during capture, handling, marking, transport, or release. Birds were kept cool after capture by keeping them in the shade, hosing down the transport boxes during transit, and adding ice to the transport boxes when it got hot.

The wrap-around patagial markers used in 1988 were not satisfactory, because the birds often preened them under the secondary and tertial coverts. The red collars used in 1989 were of an older type. The thinner (2 mm) plastic came in flat pieces and had to be heated and formed around a mandrel before putting them on the swans' necks. These were brittle and often did not last long, although some lasted at least 4 years. The green collars used in 1990 and 1991 were purchased commercially, were 3 mm thick, used a different plastic, and were much more durable.

Survival of translocated birds

Refuge narrative reports (Peck 1989; Fisher 1990) mention the impact of drought conditions on survival the first 2 years of translocation. In 1988, two dead swans were found near Clark's Cut on the south end of the refuge. Another dead swan was found on Palisades Reservoir within 2 weeks of release. No necropsies were conducted. In 1990, one swan was found dead several weeks post-release. It apparently struck a wire fence.

I have not calculated formal (e.g., Kaplan-Meier) survival estimates for all the birds released. The following estimates are based on resightings of marked birds only, and, therefore, represent minimum estimates. Survival was variable, with some swans dying only weeks after release and others living for at least 11 years post-release.

At least 46% of the swans translocated in 1988 survived at 8 months. One bird survived at least 11 years post-release. About 47% of the swans released in 1989 survived at least 1 year; 47%, 2 years; 33%, 3 years; and 7%, 5 years. Wide dispersal of these birds due to drought conditions (see below) and poor collar durability probably reduced subsequent sightings and, therefore, lowered survival estimates. A minimum of 30% of the 1990 group lived at least 1 year; 30% past 2 years; 20% to 5 years; and 10% to 9 years. Conversely, 90% of the birds moved in 1991 lived at least 1 year; 68%, 2 years; 52%, 3 years; 42%, 4 years; 32%, 5 years; 26%, 6 years; 16%, 7 years; 13%, 8 years; and 3%, 10 years.

Movements of translocated birds

1988 release. A technician followed these patagial-tagged birds from the ground. He noted some movement at Grays Lake that he attributed to rapidly receding waters in late July and August (Fisher 1990). By 18 August, only seven swans were still on the refuge, and a week later, on 25 August, only five were present. On 31 August, two were seen on the refuge, two were on Poison Creek west of the refuge, and two were on Meadow Creek several miles south of the refuge. By February 1989, three swans from this release were known to be dead, seven were wintering on the Salt River in Wyoming, and three were unaccounted for. By April 1990, five swans had returned to Grays Lake, five were known to be dead, and one remained on the Salt River. Two were unaccounted for (Shea *et al.* 1991).

1989 release. Another drought year with low water caused many of the translocated birds to move shortly after they completed their molt. Most birds (35%, N=6) from this release ended up wintering on the Salt River. Others showed up at Red Rock Lakes NWR, Montana (6%, N=1); Harriman State Park, Idaho (12%, N=2); Fort Hall, Idaho (6%, N=1); and Daniel, Wyoming (6%, N=1). Four (24%) dispersed 500 km southwest to Fish Springs NWR, Utah, the first winter after release.

1990 release. Four of the birds from this release shifted back and forth between the Salt River and Swan Valley, Idaho, to winter.

1991 release. Again, most birds from this release wintered on the Salt River (29%, N=8) and in Swan Valley (4%, N=1) or both (40%, N=11). At least 63% (N=17) of the birds used several wintering sites over the course of a single winter or subsequent winters. Other wintering sites included near Soda Springs, Idaho, Fort Hall, and Red Rock Lakes NWR.

Choice of winter sites was complex. All told, translocated swans wintered at seven different sites, singly or in combination. Seventy-eight percent (N= 33) used Swan Valley and Salt River at some point. An additional four (9%) used the area around Soda Springs, and four (9%) wintered at Fort Hall. Three (7%) returned to Red Rock Lakes at some point post-release.

Several swans from the translocations now summer at wetlands around Soda Springs, about 35 miles south of Grays Lake. Although no production has been documented in this area yet, this is an important location for Trumpeter Swans in southeastern Idaho.

Flock growth and demographics

Fall counts for the southeastern Idaho area are shown in Table 1. The flock grew fairly steadily during the period of releases, and then declined for 2 years after the releases stopped. Since 1994, the flock increased again and has fluctuated around a mean of 28 birds (range 18-32). This includes a period of severe drought since 2000.

The first nesting since 1971 occurred in 1990. The nest had five eggs, hatched at least three cygnets, and at least one cygnet survived to fledging that year. In 1991, there was another nesting attempt with two cygnets hatched, but none fledged. At least one cygnet survived until fledging in 1992. Six pairs established territories in 1993, but no nests were observed and no cygnets were produced. At least nine territories were established in 1994, and at least eight clutches of eggs hatched. At least 24 cygnets survived to fledging, although 15 of these had to be captured and translocated to Crane Reservoir due to extremely low water in the marsh. This is the first year since the translocation project that Grays Lake produced something near its potential number of fledged cygnets.

Since 1994, the pattern at Grays Lake has been much the same. Swans have initiated between 5 and 10 nests each year (mean = 6) and hatched a minimum of 133 cygnets (13-26/year). However, only 43 cygnets (32%) have fledged. The number of cygnets fledged/year has ranged from 0-16 (mean = 5.3).

It is important to note that at least 24 (15 in 1994 and 9 in 1996) of the fledged cygnets fledged only after they were captured during late summer at Grays Lake and moved to other areas within the marsh, or to other wetlands. These captures were necessitated by extremely low water conditions in the marsh. Without the cygnet rescues, Grays Lake would have fledged only 19 cygnets in 9 years, or 2.1 cygnets/year. Only in 1998 did the swans at Grays Lake produce anything near their potential, with nine nests producing at least 22 cygnets, of which 16 (73%) fledged.

Analysis of periodic cygnet counts consistently shows that most cygnets die between mid-July and mid-August. Between 1994 and 2001, only 37% of the cygnets present in early July were still present in September.

Eggs are being salvaged from nests at Grays Lake and placed in a propagation facility in western Wyoming to be hatched and raised to 1 year of age. These yearling birds will then be translocated to suitable habitats in southeastern Idaho. Currently, these birds are being moved to Bear Lake NWR on the Utah-Idaho border. Four birds were released at Bear Lake in May 2002.

One egg is left in each nest to help the breeding pairs maintain some nest site fidelity. If possible, the Trumpeter pairs are permitted to raise these cygnets without further intervention. However, in some extreme drought situations, as in 2002, these cygnets are also captured and moved to Bear Lake NWR. Two cygnets were moved in July 2002 and placed near the breeding pair currently nesting at Bear Lake. These cygnets were both adopted by the local pair.

Once the Bear Lake translocation is complete, yearlings will be placed at other sites. When recruitment at Grays Lake becomes normal, we will reevaluate using eggs and cygnets from this flock for other translocation projects in southeastern Idaho, or elsewhere in the Tri-state area.

DISCUSSION

Translocation

The translocations went well. I recommend other capture operations consider duplicating the processing procedures we used. No birds were lost due to capture or handling, post-release survival was fair to good, and the translocation flock grew.

Relative habitat quality is a significant predictor of translocation success (Griffith *et al.* 1989). Neither Bizeau (1951) nor Steel (1952) found any significant impact of water withdrawal on nesting geese, ducks, and cranes at Grays Lake. However, these species either nest, hatch, and fledge quicker and earlier than swans, or, as in the case of Sandhill Cranes, move their young to upland habitats. Therefore, they do not require deep water as late in the year as swans do. Even with those advantages, Steel (1952) opined that waterfowl habitat and productivity at Grays Lake would improve with better water conditions and management.

In retrospect, the project would not have benefited from a rigorous evaluation of the habitat at Grays Lake. Such an analysis would have shown no history of complete drawdowns resulting in water levels too low to successfully raise cygnets to fledging. It is also important to note that changes in the outlet structure were made in the late 1980's. These allowed the BIA to withdraw more water faster (R. C. Drewien, pers. comm.) than when Bizeau and Steel were working there. In any event, inadequate water has resulted in poor habitat conditions, which have reduced the value of the translocation.

Collars are recommended for marking translocated swans. Patagial markers are less disruptive, but the swans preened them into their wing coverts and they were hard to see. We received a remarkable number of post-release sightings that allowed us to determine some crude estimates of survival rates and document some movement patterns. Radiotelemetry would offer significant improvements in monitoring swan movements and document survival rates and causes of mortality, but will generally be prohibitively expensive.

Flock demographics

The growth of the Grays Lake flock has been good. Survival rates were adequate to develop a population of 50 Trumpeters by the 4th year of translocation. Since the translocations ended, the flock has maintained itself at between 12 and 32 adult and subadult birds in spite of poor local recruitment to date. While a low 2002 fall count (13 white birds) is cause for concern, the flock is expected to maintain itself around its recent mean numbers for at least a few more years. However, unless local recruitment increases, the long-term outlook is not good.

In spite of normal clutch sizes and hatching rates, reproduction and recruitment are very low. One expects cygnet mortality during summer months in this region, because of extreme weather events (Gale *et al.* 1987), occasional predation, accidents, parasites, disease, and other natural causes. However, it appears that most of the mortality at Grays Lake can be linked directly to poor water conditions in the marsh. The most consistently successful territories are in the Big Bend Marsh and outlet areas on the north side of the marsh and on Brockman Creek, located north of the refuge. Water persists longer in these areas than in other portions of the marsh, which allows cygnets time to fledge.

The annual drawdown of Grays Lake is a serious concern and must be remedied before we can expect to produce significant numbers of cygnets there. Since other breeding parameters (i.e., nest densities, nest initiation dates, clutch sizes, eggs size and volume, hatching success) at Grays Lake are normal, once water conditions improve, we can expect cygnet survival, fledging rates, and recruitment into the Grays Lake flock to increase. A small increase in the number of breeding pairs is expected as well. The flock should grow slightly, and some birds should naturally disperse to other suitable habitats nearby. Others may be used for additional translocation projects.

It was recently decided to use eggs salvaged at Grays Lake for building Trumpeter Swan flocks in other areas within southeastern Idaho. There seems to be little point in continuing to let pairs at Grays Lake incubate, hatch, and raise cygnets only to have them inevitably die. Our primary management goal is to restore nearly natural marsh function at Grays Lake, but this will require time-consuming and complex negotiations with local landowners, IDSL, BIA, and SBT. Until that happens, these eggs can be used, or the cygnets that hatch from them, in other areas.

We also believe that it is appropriate to capture and translocate Grays Lake cygnets doomed to die because of drought. Unlike some pairs, the pair at Bear Lake seems to be willing to adopt cygnets. This technique will continue to be used as necessary.

Drought, water conditions, and habitat

Drought has been a major factor in Trumpeter Swan population dynamics in the Tri-state region. For example, the May Palmer Drought Index for southeastern Idaho shows that since 1980, 11 years have been drought years. This includes the period from 1987 through 1994 when swans were being translocated to Grays Lake. Drought conditions have also prevailed since 2000. Many wetlands in the region are smaller or have dried up. Some nesting areas are no longer suitable because of no water, low water, lack of nest security, or lower quality and quantity of forage. This has obvious impacts on swan nesting and productivity. Since many of these birds also winter in this region, low water and poor aquatic vegetation resources probably also impact winter distribution, condition, and survival. Swans that survive the winter in poor condition are unlikely to recoup body reserves on drought-stressed wetlands in time to produce large, healthy clutches. This exacerbates poor reproduction and recruitment.

Water management can exacerbate drought conditions. The current water drawdown schedule calls for Grays Lake water to be at an elevation of 6,386.0 feet by 24 June. At this level, only the deepest areas have any standing water, and nearly everything but the canals, Big Bend Marsh, and the outlet are dry. The southern portion of the refuge is considered to be dry at 6,385.5 feet elevation, so, under the current drawdown schedule, only 6 inches of water are left in the marsh to last for another 2.5-3 months until cygnets fledge. With high evapotranspiration rates, under the present water management scenario, it is a given that the water levels in the marsh are going to be low under the best of conditions. Therefore, even in good water years, the current drawdown schedule negotiated by the FWS and BIA is inadequate to secure sufficient water in the marsh to allow Trumpeter Swans, as well as numerous other waterfowl and water birds, to successfully raise their young. In 7 of the 11 drought years referred to above, most of Grays Lake was actually dry before cygnets could fledge.

It is imperative that the FWS begin discussions with the BIA and the Shoshone-Bannock Tribes as soon as possible in an attempt to renegotiate their water management practices, so that adequate water remains in Grays Lake until late September or October, at least in most years. This should ensure the fledging of most cygnets. Water management would assist in restoring marsh function and provide for higher waterfowl, water bird, and muskrat populations, better vegetation-water ratios, and more diverse and robust submerged aquatic plant communities.

CONCLUSIONS

Despite some problems, the translocation of Trumpeter Swans to Grays Lake NWR has been a qualified success. With the exception of inadequate release site evaluation, the translocation procedures worked very well. The translocated swans survived, found suitable wintering sites, returned to summer at Grays Lake, and reproduced. Unfortunately, the habitat conditions at Grays Lake have not been amenable to maximizing production and recruitment. Thus, flock growth and expansion to other suitable wetlands in southeastern Idaho has not met expectations. The current salvage of eggs and cygnets for other local translocation projects will help ameliorate this condition in the short term.

It is hoped that the FWS will be able to modify the existing water management scenario at Grays Lake in such a way that adequate nesting and brood rearing habitat is ensured for Trumpeter Swans and the other marsh-dependent wildlife that inhabit the refuge. If cygnet survival can be improved and about 10 active nests maintained each year with normal clutch sizes, 20-30 cygnets/year reasonably should be expected to fledge. If this is done, Grays Lake swans can be expected to become one of the most important breeding flocks in the Tri-state population.

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Table 1. Fall Trumpeter Swan counts from Grays Lake National Wildlife Refuge and vicinity.[1]

Year	Grays Lake and vicinity[2]	Other[3]	Totals
1988	1 white bird[4]	4 white birds	5 white birds
1989	17 white birds	3 white birds	20white birds
1990	20 white birds, 3 cygnets	11 white birds	31white birds, 3 cygnets
1991	50 white birds	0	50 white birds
1992	23 white birds, 1 cygnet	6 white birds	29 white birds, 1 cygnet
1993	13 white birds	0	13 white birds
1994	25 white birds, 24 cygnets	0	25 white birds, 24 cygnets
1995	34 white birds, 1 cygnet	1 white bird	35 white birds, 1 cygnet
1996	33 white birds, 1 cygnet	7 white birds	40 white birds, 1 cygnet
1997	29 white birds, 6 cygnets	2 white birds	31 white birds, 6 cygnets
1998	31 white birds, 16 cygnets	2 white birds	33 white birds, 16 cygnets
1999	35 white birds, 2 cygnets	0	35 white birds, 2 cygnets
2000	34 white birds, 5 cygnets	0	34 white birds, 5 cygnets
2001	22 white birds, 2 cygnets	4 white birds	26 white birds, 2 cygnets
2002	18 white birds, 4 cygnets	8 white birds	26 white birds, 4 cygnets

[1] Data are from the annual Tri-state Trumpeter Swan Surveys.
[2] Includes Crane Reservoir, Brockman Creek, and Chubb Springs.
[3] Other sites include Meadow Creek, Blackfoot Reservoir, Chesterfield Reservoir, Alexander Reservoir, Portneuf River, and ponds near Soda Springs.
[4] "White birds" include adults and subadults in white plumage, in contrast with gray-plumaged cygnets.

SUMMARY AND UPDATE OF TRUMPETER SWAN RANGE EXPANSION EFFORTS IN WYOMING, 1988-2003

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Wyoming Game and Fish Department (WGFD) initiated a Trumpeter Swan (*Cygnus buccinator*) range expansion project in 1988 with the objective of expanding both summer and winter distribution of swans in Wyoming in conjunction with the Pacific Flyway Rocky Mountain Population (RMP) Tri-state Range Expansion Program (Luttschwager 1988). Specific goals for Wyoming outside of Yellowstone National Park (YNP) were to: 1) establish a new wintering area in the Salt River (SR) valley, and 2) establish an expanded nesting population of at least 10 pairs in the Green River (GR) basin that would utilize new wintering areas outside of traditional use areas in the core Snake River drainage. Prior to releasing Trumpeter Swans in range expansion areas, WGFD personnel conducted extensive habitat evaluations. Lockman (1990) estimated that the SR could support up to 133 swans in winter and up to 10 swans in the summer. Stevenson in 1992 surveyed 29 potential nesting areas in the upper GR drainage and developed preliminary management plans (WGFD records).

Initial range expansion efforts focused on the SR area (1988-90). WGFD released a total of 14 captive-raised and salvaged cygnets (67-80 days old) in 1987 (n=5), 1988 (n=7), and 1990 (n=2). The main purpose of these releases was to establish decoy groups to attract migrating wild swans into new wintering habitat (Lockman 1991; Shea *et al.* 1991). In winter 1990, the U.S. Fish and Wildlife Service (FWS) translocated 30 wild Trumpeter Swans from Harriman State Park (HSP) and Red Rock Lakes NWR (RRLNWR) to the SR (Shea and Drewien 1999). Between 1988 and 1991, an additional 67 swans were translocated from RRLNWR in summer to Grays Lake NWR in Idaho (38 km west of the Salt River release sites). Decoy groups were immediately successful in attracting wild swans and numbers of wintering swans began to increase. Between 1993 and 2002, an average of 63 Trumpeter Swans (range 40-94) has been documented in the SR area during the annual Tri-state midwinter aerial surveys. In winter 2002, total swans in the SR valley comprised 15.8% (75/473) of swans wintering in Wyoming outside of YNP. Based on collar resightings, wintering swans included a majority of the summer flock now established at Gray's Lake NWR as well as some Canadian migrants (Shea and Drewien 1999; WGFD records). Cygnets comprised on average 16% of wintering swans. Few winter mortalities resulting from power line strikes and shooting have been reported (WGFD records). Much of the river remains open even in extremely cold winters. Wintering swans leave the valley by the end of March. Only one nesting pair has become established in the SR. A collared pair (summer releases 1991Gray's Lake NWR) produced young in 1998 at the north end of the valley near Alpine. The male hit a power line and was killed in 1999. A new unmarked pair took over the territory the following year. One or two subadult swans have summered in recent years at the Alpine Wetland on Palisades Reservoir, 2 km north of the established nest site.

Wyoming range expansion efforts since 1992 have focused in the GR drainage and initially involved the release of wild Trumpeters translocated from RRLNWR. WGFD translocated 25 swans in summer 1992 to three sites in the Upper GR Basin (10 cygnets and 15 yearling/adults) (WGFD records). That same summer, FWS translocated 10 swans to Seedskadee NWR (SNWR) (5 cygnets and 5 yearling/adults) (Shea and Drewien 1999). An additional 57 swans were translocated from HSP to SNWR in the winters of 1992 and 1993. All translocated swans were marked with green coded collars. WGFD requested that FWS halt winter translocations to SNWRS after 1993 to prevent a large influx of Canadian winter migrants from competing with an expanding resident swan population for limited winter habitat. The majority of translocated wild swans showed little fidelity to release sites and most were not resighted in the GR area after initial year of release. Out of 54 winter releases, only 3 returned at least two winters to SNWR out of 24 known survivors (Shea and Drewien 1999). Three summer releases were also resighted and one, a leucistic adult female, became the first swan to nest at SNWR in 1997 (WGFD records). Some translocated swans migrated long distances. Reports of collared swans or collar recoveries were documented from as far south as Mexico, Texas, New Mexico, Colorado, and northern

Arizona (Drewien and Benning 1997; WGFD records).

Starting in 1994, WGFD began releasing captive-raised swans obtained from the Wyoming Wetland Society, a nonprofit with rearing facilities in Jackson, Wyoming (Long and Stevenson 1999). All swans released during the period 1994-2002 (n=71) were produced from eggs either salvaged from wild swans or produced by captive swans of Tri-state genetic origin. Between 1994 and 1997, WGFD released 37 cygnets (70-80 days of age) at wetland sites north of Pinedale. Released cygnets were marked with FWS leg bands, colored anodized aluminum leg bands, and pink dye on one wing. Cygnets were released into pens at release sites and provided food until capable of flying. They migrated south in November and December and were resighted along the Green River in Wyoming at SNWR and Flaming Gorge Reservoir. Longer distance migrations to southwest Utah (1994, 1995) and the Grand Canyon (1996) were also documented with some birds returning the following spring to release areas. Due to rapid color fading of aluminum leg bands, it was not possible after a few years to track movements and survivorship of swans by year of release or age class. By fall 1998, total number of swans in the Green River basin had increased to 22, including 15 adults north of Pinedale and 4 adults and 2 cygnets at SNWR (WGFD records).

After 1998, WGFD switched from releasing captive-raised cygnets to yearlings that were held over winter at captive rearing facilities in Jackson prior to release. Based on data collected on wild swans in Wyoming, yearlings should have higher rates of survival and also be more capable of carrying permanent markers such as collars or patagial tags (Lockman 1987). Between 1999 and 2002, 23 molting yearlings were released in July and early August in wetlands north of Pinedale. They were released directly into ponds with enough natural forage to support them until molt was complete.

Different marking methods were tested on yearlings: pink-dye (n=3, 1999), patagial markers (n=12, 2000), satellite transmitters attached with backpack harnesses (n=3, 2001), and satellite and VHF transmitters attached to collars (n=5, 2002). All released yearlings were double leg banded (color band and FWS band), but in 2001 we began using plastic color-coded leg bands in place of aluminum bands. Yearling swans initiated migratory movements south in late fall just prior to the first major winter storms moving into the area (mid-October to mid-November). Although detection rates for different marking methods varied, based on resightings, a survival rate of 32% (9/28) was estimated after the first winter following release. Of the 11 known causes of mortality, 3 were caused by collisions; 3 by shootings; 2 by attacks of territorial swans; 2 by predation (coyote and fox); and 1 by starvation. Long-distance migrations outside of Wyoming by yearlings have not been documented. Wintering areas used include SNWR, Flaming Gorge National Recreation Area, and a spring creek complex near Daniel, Wyoming. In 2000 and 2001, additional releases included 11 cygnets (1-2 days old) placed with a nesting pair north of Pinedale that had failed to hatch eggs in two previous nesting attempts. Survival rate of day-old cygnets placed with one nesting pair (based on resightings of yearlings the following spring near the nest area) was 82% (Bill Long, pers. comm.; WGFD records).

Numbers of swans both in summer and winter in the GR basin have continued to increase since the mid-1990s following releases of captive-raised swans, and released swans have pair bonded and established nesting territories. A few marked swans have been observed paired with swans in the Jackson core area indicating that some degree of connectivity exists between the GR expansion area and the core nesting population in the state. Between 1998 and 2002 in the GR basin, an average of 29 (standard deviation (SD) =7) swans has been tallied during the September fall survey flight and 34 (SD=17) during the February winter survey. Over this same time period, pairs occupied on average 6.2 nest sites/year (SD=1.3) and produced a total of 26 cygnets. Young have been produced at four territories, but one pair at SNWR accounted for 73% (n=19) of fledged young. Molting swans have occupied at least 10 different potential nest sites in the basin. In fall 2002, adult swans in the GR area comprised 29.8% (28/94) of the total swans found in Wyoming or 38.9% (28/72) of adult swans outside of YNP.

As the number of swans continues to increase in the GR drainage, managers need to make sure that adequate nesting and transitional wetland habitat exists to accommodate new nesting pairs. WGFD obtained a federally funded Wildlife Diversity Grant to conduct additional wetland surveys and assessments in the basin in 2004. Our goal is to work with landowners, public land agencies, and a newly established regional land trust to develop management plans, prioritize wetland projects, and obtain needed funding to provide critical habitat in future years for this expanding population.

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COMPARISON OF TRUMPETER SWAN POPULATIONS USING NUCLEAR AND MITOCHONDRIAL GENETIC MARKERS

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ABSTRACT

Once abundant, habitat destruction and overharvest have led to the significant reduction of Trumpeter Swans (*Cygnus buccinator*). In the coterminous United States, only one group of Trumpeter Swans survived overexploitation near what is now Red Rock Lakes National Wildlife Refuge, Montana. These birds (the "Tri-state" birds) were believed to be the only remaining free-ranging Trumpeters until the mid 1900s when Trumpeter Swans were found nesting in Canada and Alaska. The Rocky Mountain Population (RMP) therefore consists of birds comprising two flocks, the Tri-state birds and another group that nests in Alberta, British Columbia, the Yukon Territory, and the Northwest Territories. Although the two flocks comprising this population are spatially disjunct during the nesting season, they are sympatric during winter in the Tri-state region. Although the population as a whole has been increasing, most of the growth has occurred in the Canadian flock. The existence or extent of genetic interchange between these two groups remains unknown yet may influence management practices and whether the flocks should be managed as an aggregate or as two distinct entities. Further, the amount of genetic distinctness among Trumpeter Swans rangewide is an important parameter to understand given the increasingly complex level and patterns of restoration efforts that often involve translocations of swans and swan eggs. The objective of this study is to determine whether there are genetic differences among some of the different sample locales that would justify their treatment as discrete biological populations. To address this issue, sequence analysis of a rapidly evolving mitochondrial region and fragment analysis from several polymorphic nuclear microsatellites in Trumpeter Swans will be conducted using samples from across their range.

WETLAND CONDITION ON THE CARIBOU-TARGHEE NATIONAL FOREST, IDAHO AND WYOMING

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ABSTRACT

In response to prolonged stable water levels and vegetation communities dominated by water lily (*Nuphar polysepalum*), the U.S. Forest Service installed water control structures on two wetlands in the Caribou-Targhee National Forest to facilitate habitat management on Trumpeter Swan (*Cygnus buccinator*) breeding areas. Water level manipulations were intended to improve wetland condition and mimic the natural hydroperiod, creating conditions that are favorable to diverse native plant communities, and therefore enhance or restore overall functions and values of wetlands. We assessed the response of waterbirds and vegetation to physical conditions and water level manipulation on three different wetland types in the Caribou-Targhee National Forest during summer 2002. Information was collected on wetland hydroperiod characteristics, waterbird abundance, vegetation community composition, water chemistry, soils, historical wetland condition, and germination of new emergent vegetation. Because Trumpeter Swans are sensitive to human disturbance during egg-laying and nesting, the response of incubating swans to research activities also was recorded. Field work will continue during summer 2003 and information will be compiled in a master's thesis upon completion.

THE RUBY LAKE TRUMPETER SWAN FLOCK: ITS HISTORY, CURRENT STATUS, AND FUTURE

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ABSTRACT

Trumpeter Swans (*Cygnus buccinator*) from Red Rock Lakes National Wildlife Refuge in Montana were transplanted to Ruby Lake National Wildlife Refuge in Nevada in an effort to establish a restoration flock. A resident breeding population was created at Ruby Lake from adult and juvenile swans transplanted between 1947 and 1958. The breeding population is small and has remained mostly stable for several years even though adequate emergent marsh habitat exists to support a higher number of nesting pairs. Production of cygnets was first documented in 1958. Annual production has been variable since then and has rarely exceeded 10 cygnets in any give year. The Ruby Lake swan flock increases in winter with the arrival of immigrant Trumpeter Swans. The winter swan population has increased during recent years and is likely approaching the maximum carrying capacity due to limited winter habitat. It has been observed that cygnets produced by resident swans depart the area in spring. It is believed that these juvenile swans are emigrating with the wintering migrant swans. The annual departure of cygnets has minimized the potential for recruitment and, consequently, has limited the increase in the number of breeding pairs. Opportunities to increase the amount of winter habitat and the quality of nesting habitat should be investigated.

INTRODUCTION

It is believed that the historic breeding range of the Trumpeter Swan (*Cygnus buccinator*) does not include areas of Nevada. Tundra Swans (*C. columbianus columbianus*) are known fall and winter migrants in Nevada and, although data are lacking, it is possible that Trumpeter Swans were also historic migrants in the state. The Ruby Lake Trumpeter Swan flock was established from transplanted birds and the flock has been producing cygnets in northeast Nevada since 1958. The flock now consists of resident breeding birds and migrant wintering birds. Until 1990, the Ruby Lake flock was placed in the Pacific Coast Population of Trumpeter Swans for administrative purposes. The resident swans are now recognized as part of the Rocky Mountain Population (RMP) of Trumpeter Swans/U.S. Breeding Segment (Pacific Flyway Subcommittee 2002). The migrant wintering swans are also likely part of the RMP. However, it is not known if these birds are from the Canadian or the U.S. Breeding Segment. It is unlikely that the migrant wintering birds are Alaskan Trumpeter Swans, although recent observations indicate that Alaskan swans are present in small numbers in the Tri-state region (McEneaney *et al.* 1986; Gale *et al.* 1987; Shea 2000).

Ruby Lake, located on the Ruby Lake National Wildlife Refuge (NWR) in northeast Nevada, is the primary Trumpeter Swan use area in Ruby Valley, although swans use nearby Franklin Lake when it is flooded. Ruby Lake is approximately 20,000 acres when fully flooded and consists of emergent (hemi-) marsh (14,000 acres) and playa (6,000 acres). The actual surface acreage varies annually because of annual variation in the snow pack in the Ruby Mountains. Franklin Lake is located 2 miles north of Ruby Lake. The southwest portion of Franklin Lake is within the Franklin Lake Wildlife Management Area (WMA) and is managed by the Nevada Division of Wildlife. The remaining area of Franklin Lake is privately owned and on land under the administration of the Bureau of Land Management. Franklin Lake is a shallow seasonal wetland and is often dry. It is approximately 20,000 acres when fully flooded and consists of playa (11,000 acres), open water (+/-7,000 acres), and emergent marsh (<2,000 acres). It is only during years with heavy snow pack in the Ruby Mountains that the lake is flooded, otherwise it is dry or only partially flooded. Both lakes are highly productive and support a large diversity of birds during migration and the nesting period.

HISTORY (1947-1989)

Ruby Lake was one of three national wildlife refuges selected as a restoration site for Trumpeter Swans in response to concern over the potential loss of the Rocky Mountain Population/U.S. Breeding Segment in the Tri-state region. Trumpeter Swans were transplanted from Red Rock Lakes National Wildlife Refuge in southwest Montana to Ruby Lake NWR

between 1947 and 1958. A total of 96 Trumpeters was moved to Ruby Lake NWR including 37 adults and 59 cygnets. However, seven birds died prior to release (Ruby Lake NWR 1947-1958). Additional minor mortality of swans was observed during the months following their release.

The size of the Ruby Lake flock fluctuated annually during the transplant period (1947-58). Surveys conducted during this period indicated that some of the released swans disappeared. Some birds were known to have died, but the disappearance of others could not be explained fully. It was discovered eventually that a few swans were moving to areas surrounding Ruby Valley. In 1957, reports were received by refuge personnel of observations of swans on reservoirs during summer within 90 miles of Ruby Lake (Ruby Lake NWR 1957). Although these swans were not marked, they were most likely from the Ruby Lake flock because, at the time, Trumpeter Swans were not known to be present in Nevada during summer. It was also speculated by refuge personnel that some birds may have been departing with Tundra Swans during their fall migration. Ivey *et al.* (1999) reported long-range movement of Trumpeter Swans, especially cygnets separated from their parents. However, the total number of swans missing from the Ruby Lake flock could never be accounted for by these observations and speculations. It was not known if Ruby Lake swans moved to areas outside of Nevada during the transplant period.

Paired Trumpeter Swans were observed on Ruby Lake as early as 1950, but no attempts were made to determine if these birds nested. Observations of paired swans continued annually but nesting was never confirmed. During an October 1953 aerial survey of Ruby Valley, a pair of Trumpeter Swans with one cygnet was observed on Franklin Lake. Although it was believed at the time that this pair nested on Franklin Lake, no swans were observed there during a mid-April aerial survey. Given that nesting by this pair was not confirmed visually and considering the reported movement of swans within northeast Nevada, it cannot be determined that this cygnet was hatched in Ruby Valley. It was not until 1958 that successful nesting was confirmed in the Ruby Lake flock. A pair of Trumpeters nesting on Ruby Lake hatched and fledged six cygnets.

Breeding pairs are the core of the Ruby Lake Trumpeter Swan flock. These adult swans are year-long residents. During the first 32 years (1958-1989), following the last release of transplanted swans, the number of Trumpeter Swan pairs either exhibited periods of fluctuation or exhibited relatively stable periods (Figure 1). From 1958 to 1969, the number of pairs fluctuated between four and eight. From 1970 to 1976, the number of pairs was relatively static and ranged from three to four. Swan pairs began increasing in 1977 and from 1978 to 1982 the number of swan pairs ranged from 9 to 12. In 1981, swan pairs began decreasing and from 1983 to 1989 ranged from three to eight. The mean number of swan pairs in the Ruby Lake flock during the 32-year period 1958 through 1989 was 6.2.

The success of the Trumpeter Swan transplant project can be measured by the consistent production of cygnets from the Ruby Lake flock. Between 1958 and 1989, production of cygnets occurred in 29 out of 32 years. The number of cygnets fledged annually fluctuated so widely during this period that an apparent trend is not visible (Figure 2). The Ruby Lake flock fledged a total of 148 cygnets between 1958 and 1989. The number of cygnets fledged annually ranged from a low of one (2 years) to a high of 13 (1979). The mean number of cygnets fledged from the Ruby Lake flock during the 32-year period 1958 through 1989 was 4.6.

In addition to the resident breeding pairs, the Ruby Lake flock includes migrant swans that are thought to be descendents of Ruby Lake birds. It has been observed that fledged cygnets produced by resident pairs of the Ruby Lake flock disappear from Ruby Valley at the time when migrant wintering swans depart in spring. Although it seems unlikely given the perceived strength of swan family bonds, it is presumed that the fledged cygnets are departing with the migrant swans. The destination of both the migrant swans and fledged cygnets is not known. Assuming normal migration behavior, these cygnets would then return to Ruby Valley as part of the migrant wintering population. The winter population, thus, consists of the resident swans, their fledged cygnets, and migrant swans.

Migrant swans, including both adult and juvenile birds, begin arriving during September. From 1958 to 1989, the fall Trumpeter Swan population experienced nearly continual fluctuation (Figure 3). From 1958 to 1965, the fall population experienced sharp fluctuations following the transplant period. The fluctuations were likely due to normal movements of translocated birds. Between 1965 and 1970, the fall population appeared to stabilize. Starting in 1971, for unknown reasons, the fall population declined sharply through 1974. Between 1975 and 1980, the fall population increased. From 1981 through 1989, the fall population again

experienced a gradual decline. The variability in the annual fall swan population over time is likely somewhat normal because of the timing of fall surveys and the status of swan migration in any given year. The fall population is further influenced by annual production within both the resident and migrant flocks given their small population sizes. The fall population between 1958 and 1989 ranged from a low of 6 birds (1974) to a high of 42 (1969). The mean fall population size from 1958 through 1989 was 22.6 birds.

By December, the arrival of migrant swans has ceased and the swan flock is at its highest number. Both resident birds and migrant birds are forced to mix because of the limited amount of winter habitat. Depending on weather conditions, migrant swans may begin departing as early as the end of January. By late March, the departure of migrant swans has ended. Overall, during the first 32-year period, the winter Trumpeter Swan population appears to have exhibited a slight increasing trend (Figure 4). From 1958 to 1972, the winter swan population increased and peaked at 41. In 1973, the population decreased and from 1974 to 1981, two relatively static periods occurred. The population then increased sharply in 1982 only to experience a decreasing trend from 1983 through 1989. The annual fluctuation in winter swan numbers is due to the annual fluctuation in cygnet production and the fluctuation in the number of migrant swans returning annually to Ruby Valley. The mean winter population size of the Ruby Lake flock during the 32-year period 1958 through 1989 was 26.7.

CURRENT STATUS (1990-2002)

The Ruby Lake Trumpeter Swan breeding population exhibited an increasing trend between 1990 and 2002 (Figure 1). The number of breeding pairs increased from a low of four in 1990 to a high of eight in 2001. This trend began during a severe drought when habitat conditions were poor. The increase in pair numbers continued as habitat conditions improved. It is thought that birds responsible for the increase were from the migrant wintering population. Although the age of these birds is not known, they likely are young swans just reaching reproductive maturity. Adult swans from the migrant wintering population would have territories established in their nesting areas (presently unknown) and would be less likely to abandon them. The mean number of swan pairs in the Ruby Lake flock during the 12-year period 1990 through 2002 was 5.8, which is a slight decrease from the first 32 years.

Since 1990, the Ruby Lake breeding population has produced cygnets in all but 2 years. A total of 52 cygnets fledged during this period. Cygnet production initially continued to fluctuate but not as widely as in the first 32-year period (Figure 2). Cygnet production peaked at nine in 1994 and since 1998 has been decreasing. No cygnets were fledged in 2001and 2002 although the number of breeding pairs was among the highest and habitat conditions were good during the period. The mean number of cygnets fledged by the Ruby Lake flock during the 12-year period 1990 through 2002 was 4.0, which is slight decrease from the first 32 years.

I suggest two theories for the recent decline in productivity. From a breeding bird nutritional perspective, resident swans may have been in poor condition and, hence, were not able to endure the high energy requirements for successful nesting. Cold weather conditions during the nesting period could negatively affect nesting success. It has been observed that most swan pairs occupied nest sites each year but that not all pairs initiated nesting. Additionally, some pairs abandoned nests before their eggs hatched. Poor body condition could influence pairs to forego nesting or abandon nests. A second theory is that if the breeding population now includes young birds, their lack of experience may result in unsuccessful nesting and/or poor survival of their young. Data on nest success has been collected only infrequently because of concern over the effect of disturbance to nesting swans. However, pre-fledging age cygnets were observed in 2001 but not in 2002. Late spring snow storms experienced during 2002 could account for the absence of cygnets.

Beginning in 1990, the fall swan population experienced a reverse of the decline observed during the 1980's. From 1990 to 2002, the Trumpeter population fluctuated annually; however, overall, the population showed an increasing trend (Figure 3). The increase in the fall population is likely due to an increase in the number of winter migrant swans and a larger resident swan population. The fall population ranged from a low of 12 swans in 1991 to a high of 31 in 2001. The mean fall swan population during the period was 20.8, which is a slight decrease from the previous 32 years.

Between 1990 and 2002, the winter swan population reversed the decline observed during the 1980s and has shown an apparent increasing trend (Figure 4). The winter population ranged from a low of 15 in 1990 to a high of 63 in 2000. The increase in the winter population is a combination of a larger breeding population and a larger number of migrant

wintering swans. The mean winter population size of the Ruby Lake flock during the 12-year period 1990 through 2002 was 36.4, which is a large increase from the previous 32 years. Although encouraging, this significant increase is cause for concern due to the potential impact to the nutritional levels of both the resident breeding swans and the migrant wintering swans during the nesting season. The larger winter swan population may have resulted in a shortage of high quality forage near the end of winter because of the limited availability of winter habitat. A shortage of forage would have forced birds to utilize foods of lower nutritional quality. Swans in resulting poor condition are less able to nest successfully.

FUTURE

The Ruby Lake Trumpeter Swan flock has existed for 56 years and has fledged 200 cygnets. Surprisingly, some members of the flock developed migratory behavior that has now become a traditional pattern. This was unexpected and most likely exceeded original expectations. This traditional behavior has not been reported for other restoration flocks.

The Ruby Lake flock remains important relative to the original objective especially given the apparent decline in the RMP/U.S. Breeding Segment It is expected that the flock will persist well into the future under the present management programs on both Ruby Lake NWR and Franklin Lake WMA, assuming that swans remain productive and that pairs are replaced as they die. It is entirely possible that the size of the flock could be increased through management actions. There are, however, issues of concern that could comprise the ability of the small Ruby Lake flock to persist. These concerns include winter habitat availability, poor recruitment, quality of nesting habitat, and missing biological information.

Availability of winter habitat

Foraging habitat in Ruby Valley is limited in winter because both Ruby Lake and Franklin Lake freeze. Winter habitat on Ruby Lake is restricted to a few spring ponds and areas of flowing water in the marsh. Consequently, the availability and quantity of food is limited. The situation is likely further exacerbated when the winter swan population exceeds the carrying capacity of the habitat. As discussed above, the reduced quantity and quality of food in winter can result in birds entering the nesting season in poor nutritional condition. The lack of adequate winter habitat has the potential to negatively impact nesting swans and the survival of their cygnets. There are opportunities on Ruby Lake NWR to increase the quantity of winter swan habitat.

Poor recruitment in the resident population

Although production has been consistent for 56 years, growth of the Ruby Lake breeding population has been well below potential. The lack of growth is a direct result of a very low recruitment rate. Fledged cygnets appear to be less inclined to become resident birds once they become migratory. Additionally, migrant wintering adult swans apparently have found suitable nesting habitat at other sites, which reduces the opportunity for nesting in Ruby Valley. This low recruitment rate in the Ruby Lake flock is poorly understood. Additional information is needed before solutions to the problem can be provided. Given the complex nature of the issue, increasing the breeding population may be more successful if addressed through other means.

Quality of nesting habitat

The current Ruby Lake Trumpeter Swan breeding population is below historic high levels (12 pairs) and appears to be well below the potential carrying capacity. The failure of the breeding population to remain at high levels may be related to habitat conditions. During recent years, the number of breeding pairs in the Ruby Lake flock has been increasing. This increase is thought to be related to improving habitat conditions on Ruby Lake following a severe drought. Some areas of Ruby Lake are overgrown with hardstem bulrush (*Scirpus acutus*). These areas no longer provide feeding habitat for swans. Consequently, nesting sites in these areas remain vacant. Restoration of overgrown areas would restore habitat quality and may result in an increase in the breeding population. Further, an increase in the breeding population would increase the potential for greater annual production rates. Restoration of overgrown areas would require creation of open water near potential nesting islands. In some areas of the marsh, prescribed fire could be used to create open water. In other areas, application of herbicides may be the only successful method available for creating open water due to thin stand densities or permanent flooding. The use of heavy equipment would be feasible in small areas but not in large areas due to high costs.

Missing biological information

Additional biological information is needed to effectively manage the Ruby Lake Trumpeter Swan

flock and to achieve Trumpeter Swan restoration and management goals for the RMP/U.S. Breeding Segment (Pacific Flyway Subcommittee 2002). There are several gaps in our knowledge regarding this unique flock. We lack information about the functional factors that contributed to the migratory behavior of some members of the flock. This information may aid present efforts to restore migratory behavior in the RMP/ U.S. Breeding Segment. We lack information about the breeding ecology of the migrant wintering swans in the Ruby Lake flock. In fact, we lack even basic information such as the locations of their summer use areas. This information would increase our knowledge of swan biology and aid in management of this species. We lack information on the effect of narrow genetic diversity in a small breeding swan population on reproductive success and the survival rate of cygnets. This information would be useful in management of small or isolated Trumpeter Swan flocks. Some information could be obtained through simple marking studies, but other information could only be provided by in-depth comprehensive research.

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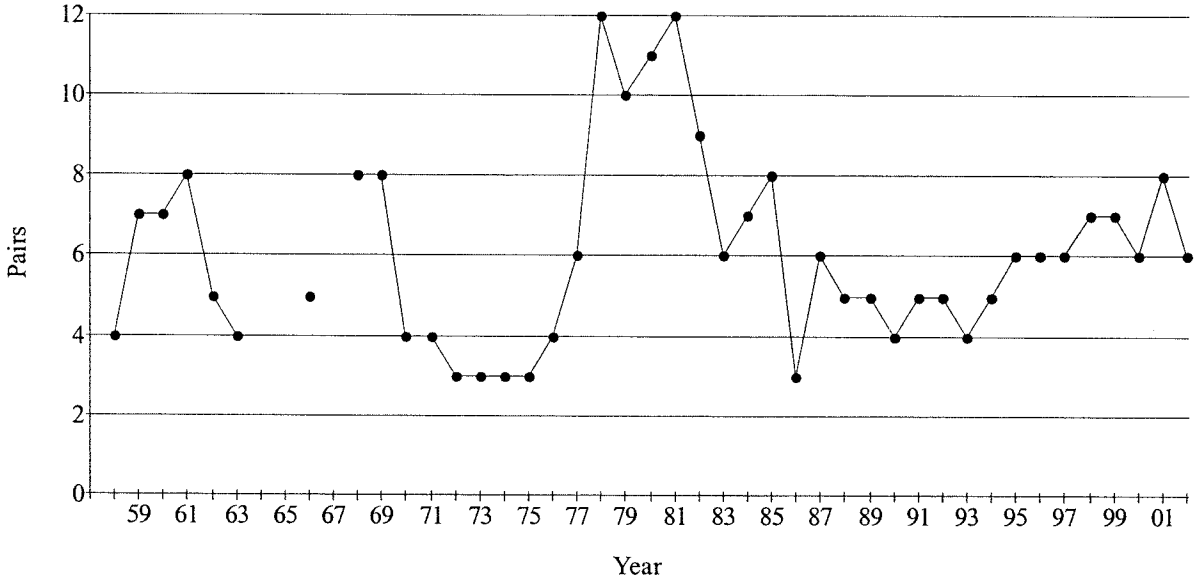

Figure 1. Summary of Trumpeter Swan pairs in the Ruby Lake flock, 1958-2002.

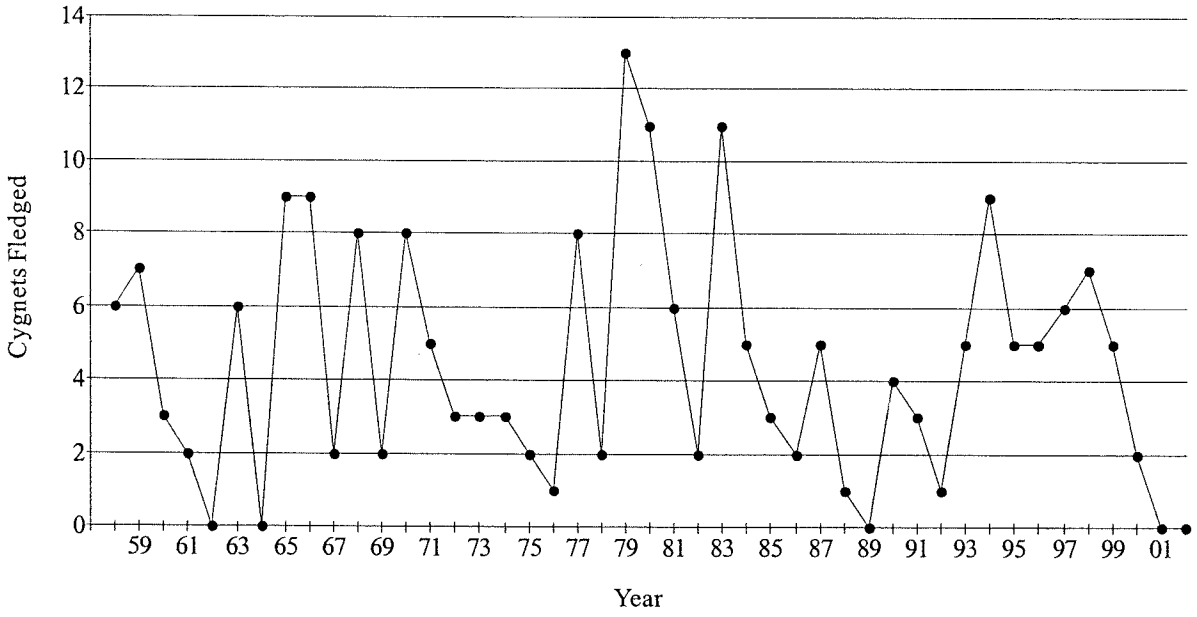

Figure 2. Summary of Trumpeter Swan cygnets fledged from the Ruby Lake flock, 1958-2002.

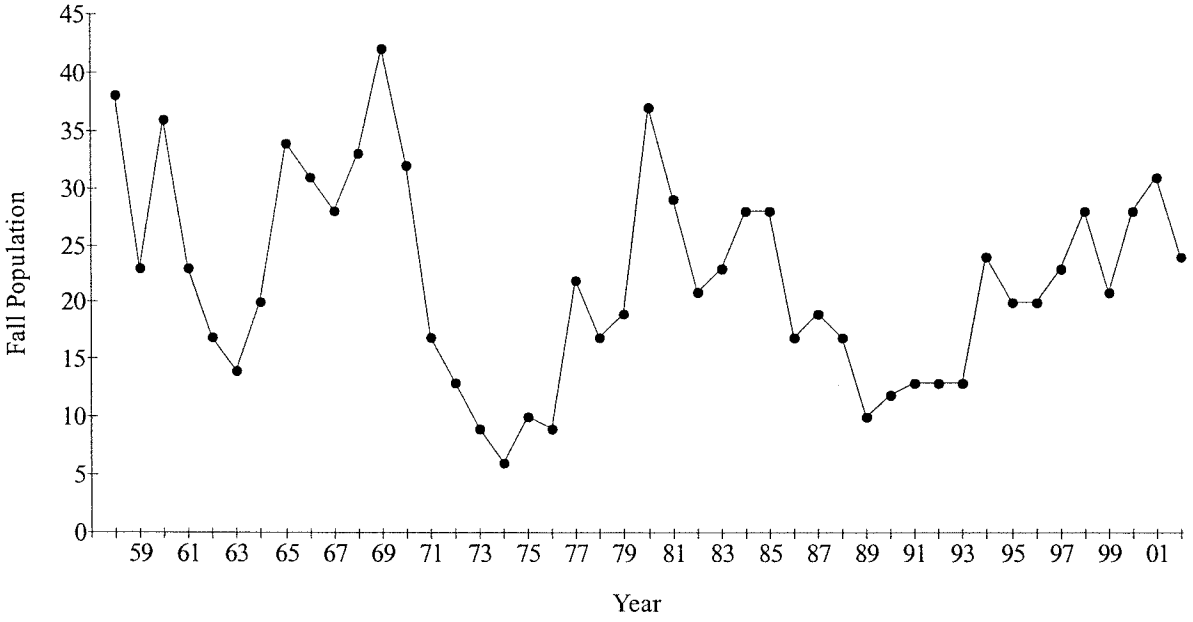

Figure 3. Summary of the fall population of the Ruby Lake Trumpeter Swan flock, 1958-2002.

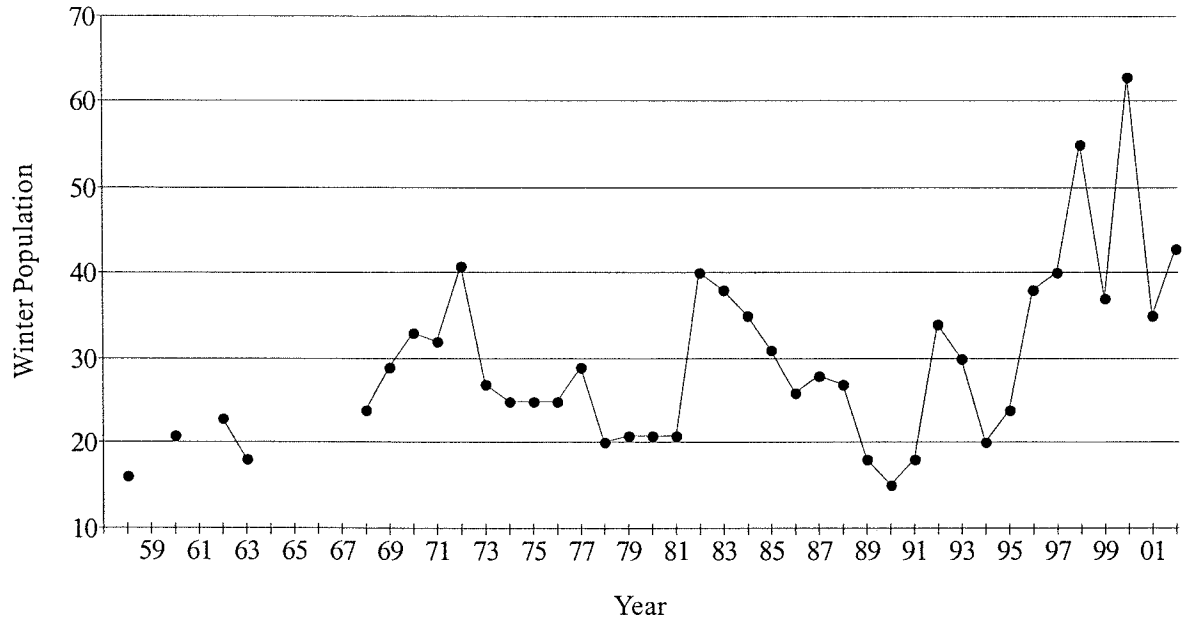

Figure 4. Summary of the winter population of the Ruby Lake Trumpeter Swan flock, 1958-2002.

TRUMPETER SWAN REINTRODUCTION ON THE FLATHEAD INDIAN RESERVATION – AN OVERVIEW AND UPDATE

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INTRODUCTION

The Flathead Indian Reservation (Reservation) encompasses approximately 500,000 ha. The Reservation was established in 1855 by the Treaty of Hellgate between the United States and the Salish, Pend O'Reille, and Kootenai Tribes as the permanent homeland of these tribes. The Reservation was opened to homesteading by non-Indian settlers in 1910. Since that time, many changes have taken place, the most notable of which is conversion of much of the lower elevation valley habitat from grassland and wetlands to agriculture. A substantial expansion of the human population has also occurred. With these changes came substantial changes to the habitats of the Reservation and its native flora and fauna.

Trumpeter Swans (*Cygnus buccinator*) were apparently present as a breeding bird in western Montana prior to settlement of the area. The primary reference on Trumpeter Swans for western Montana and surrounding areas is Banko (1960). He noted a reference by Father Jean DeSmet in 1842, who observed that swan eggs were collected by an Indian hunting party near Flathead Lake (Thwaites 1906). Presumably, this reference dealt with resident breeding Trumpeter Swans. Other references of Trumpeter Swans in western Montana included observations by E. S. Cameron in 1881, which include descriptions of nesting Trumpeters on the Thompson River in 1871 and on the South Fork of the Flathead River in 1889 (Coale 1915; Bent 1925; Banko 1960). Apparently, there is little other early documentation of breeding Trumpeters in northwestern Montana during presettlement times.

Trumpeter Swans, whatever their historical status in the Flathead River drainage, were apparently extirpated as breeding birds in the early days of settlement, probably being used for subsistence by settlers and Native Americans alike. The market for swan pelts and feathers also played a role in their decline, as evidenced by the Hudson Bay Company engaging in commercial hunting for swans (Linduska 1964). That author discussed the fact that during the period of 1823-80, some 108,000 swans were harvested as compared with only 57 during the period of 1888-97. Presumably, a substantial number of the swans harvested were Trumpeters. The Hudson Bay Company maintained a trading post on the Flathead Indian Reservation until the mid 1800s. Whether swans from the area were exported or market-hunted locally is unknown.

Disturbance and changes in the breeding habitat of Trumpeters that occurred during the settlement period also undoubtedly played a role in their demise locally. The abundant wetlands of the Reservation were often drained and converted to agricultural fields and pastures.

The Confederated Salish and Kootenai Tribes (CSKT) of the Flathead Indian Reservation have developed a strong environmental protection and restoration record over the past decades. The CSKT, through the Tribal Wildlife Management Program (TWMP), have taken a strong, proactive approach with regard to wildlife management issues. One aspect of this approach is the CSKT's efforts in rare species management. Tribal wildlife management personnel have been active managers of rare species ranging from amphibians to large carnivores.

Tribal wildlife management efforts have also focused on opportunities to reintroduce extirpated species where current habitat and other conditions allow. These efforts have been successful for Peregrine Falcons (*Falco peregrinus*). Other projects to reestablish locally extirpated species are also underway. These projects include reintroduction or population augmentation of the northern leopard frog (*Rana pipiens*) and planning for the possible reintroduction of Columbian Sharp-tailed Grouse (*Tympanuchus phasianellus columbianus*). This paper is an overview of efforts by the CSKT and other cooperating entities to reestablish the Trumpeter Swan as a breeding species on the Reservation. The CSKT view these lost species as missing pieces of the natural environment. The reintroduction project discussed here is a means to reestablish this lost component.

PROJECT OVERVIEW AND UPDATE

Interest in the reintroduction of Trumpeter Swans in western Montana has been increasing for years. The development and subsequent revisions of the Management Plan for the Rocky Mountain Population of Trumpeter Swans (Plan) provided a template for current reintroduction efforts (Subcommittee on Rocky Mountain Trumpeter Swans 1992, 1998). The Plan recommends actions that could be undertaken by wildlife management agencies and private organizations to reestablish the species throughout its original breeding range and coordinate these efforts in the development of a comprehensive approach to population surveys, population management activities (including population augmentation and reintroduction activities), public education, and research needs. Additionally, interagency efforts to refine the focus of the Plan have resulted in the Trumpeter Swan Implementation Plan (TSIP). The Flathead River drainage is included in the discussion of potential reintroduction sites in both documents.

CSKT efforts in the reintroduction of Trumpeter Swans on the Reservation officially began with Tribal Council approval of a reintroduction proposal in 1996. The completion of an environmental assessment for the project by the TWMP and Montana Fish, Wildlife and Parks (MFWP) provided an opportunity for public review of the proposal, which resulted in an immediate and enthusiastic response and support from an interested public.

Initial efforts centered around the selection of suitable reintroduction sites on the Reservation. Wetland habitat there is diverse in nature and status. Wetlands range from small depressions with little or no seasonal water present to large reservoirs dedicated primarily to irrigation. These sites are owned and managed by the CSKT, MFWP, U.S. Fish and Wildlife Service (FWS), and private landowners. In addition, concerns related to the potential for illegal shooting, hunter misidentification, fluctuating and unpredictable water levels, food availability, power line and fence collisions, lead poisoning, landowner concerns or opposition, and other possible threats were evaluated as possible obstacles for the successful completion of the project.

Pablo National Wildlife Refuge (NWR) was chosen as an initial release site because of its seclusion, the presence of abundant natural food resources, and its controllable water levels. The refuge is situated on land owned by the CSKT and administered by the FWS under an easement. Wildlife management activities on the refuge are coordinated by both entities. Refuge lands encompass a large irrigation reservoir and include a smaller adjacent impoundment constructed by Ducks Unlimited, Inc. in the late 1980s to maintain water during the irrigation season. Surrounding habitat is largely mixed grassland interspersed with native and introduced tree species.

Initial reintroduction efforts began in 1996 with the relocation of 19 Trumpeters from Summer Lake in south-central Oregon. These birds originally were captured at Harriman State Park in northeastern Idaho during the previous winter and relocated to the Summer Lake Wildlife Management Area. All had previously been fitted with collars and standard FWS leg bands. These birds were captured by personnel of the Oregon Department of Fish and Wildlife (ODFW) and the TWMP, examined by a veterinarian, and transported to the Reservation.

All of the swans arrived at the Reservation in good physical condition and were released at Pablo NWR in May 1996. The status of the swans was monitored by the TWMP staff. They acclimated to their new home immediately and thrived there throughout the summer.

Although the public was not allowed close access to the release site, the swans were often visible from a public road located approximately 0.8 km to the west. Each evening and weekend, interested members of the public were able to observe the swans from the road. Periodic progress reports to the local media kept the public apprised of the swans' status.

In early October, the swans began to leave the area. Some apparently left quickly, but three ranged between the refuge and a wetland area about 16 km northwest for several weeks before leaving the valley. Most of these swans apparently ranged northward. Later observations of marked swans from the project indicated that most had moved into the migration path between northern Alberta and eastern Idaho. None returned to the Reservation.

Although the first reintroduction effort proved unsuccessful in reestablishing breeding Trumpeter Swans on the Reservation, it did indicate that the reintroduction site was a good location, providing the factors necessary for future efforts. However, the need to reevaluate the types of swans used in the project was obvious. Of the 19 swans released, 11 were adults, and the remaining 8 were 1-year-olds when released at Pablo NWR. The presence of the adults was likely a problem due to their apparent

affinity to their natal areas in Alberta. The younger swans were probably affected by the activities of the adults, since they followed the adults' lead and left the area.

With the factors and experiences already discussed in mind, the project methods were reevaluated by the cooperating agencies. The decision was made to obtain Trumpeter Swan cygnets from the breeding population in the vicinity of Grande Prairie, Alberta. This strategy was based upon the assumption that in subsequent years, the swans would tend to return to the area from which they had fledged to breed.

The reintroduction site at Pablo NWR was also reevaluated. It had proven to be satisfactory for all factors involved. It was decided to continue to use the location in future reintroduction efforts.

Discussions with the Canadian Wildlife Service (CWS) and the Alberta Department of Forestry, Lands and Wildlife, Fish and Wildlife Division (ADFLW) were initiated in early 1997 in an attempt to obtain Trumpeter Swan cygnets from the Grande Prairie area in September of that year. Permits from the applicable state, federal, and provincial agencies were obtained, and logistical planning for the project continued. Unfortunately, surveys by CWS personnel in early September indicated depressed reproductive success, probably due to weather conditions that summer. As a result, no reintroduction activity took place in 1997.

Activity in 1998 again centered on obtaining cygnets from the Grande Prairie population. The September flights by the CWS indicated improved reproductive success over that of 1997 and 10 cygnets were made available for translocation to the Reservation. These birds were captured with the assistance of CWS personnel and Friends of Elk Island Society, examined by a veterinarian, and transported and released by the TWMP staff at Pablo NWR.

The 10 cygnets developed normally and thrived at the refuge. In early November, they began to leave the refuge. Efforts to follow their movements proved unsuccessful. In late November, five were observed at the Lee Metcalf NWR in the Bitterroot Valley, approximately 145 km south of the release site (S. F. Browder, pers. comm.). Other sightings of collared swans were reported from the lower Flathead River (approximately 60km southwest of the release site), but the identity of these swans was not verified. No further observations of the other five cygnets were reported. One of the swans at Metcalf NWR was subsequently found dead due to a collision with a power line.

No additional observations of the other nine swans were reported during the remainder of the winter of 1998-99. In May 1999, one of the swans observed previously at Metcalf NWR was seen in the company of an unmarked swan near Bigfork, Montana (approximately 65km northeast of Pablo NWR). No further observations of that bird or any of the others from the 1998 reintroduction project have been reported.

Reintroduction efforts in 1999 were to involve Grande Prairie cygnets, but, once again, due to low reproductive success, none occurred. The inability to obtain swans for the project and the limited numbers of available birds in 1997 and 1999 was an obstacle to the momentum and success of the project. Reevaluation of the entire project clearly indicated a continuing strong interest by all of the partners and the public, but it also indicated a need to develop some means of insuring a more stable and reliable source of swans each year.

In September 1999, the agency partners in the project agreed to develop a cooperative relationship with the Trumpeter Swan Fund (Fund) in Jackson, Wyoming. The Fund had a strong track record of captive reproduction of Trumpeter Swans and subsequent introduction of captive-reared swans to the wild. With the assistance of the Lower Flathead Valley Community Foundation, the Fund was able to locate 24 adult and subadult Trumpeter Swans at a waterfowl breeding facility in Montana that were for available for purchase. These birds were of Rocky Mountain Population origin and had come from the Tri-state area. These swans were desirable as breeding birds to supply cygnets for the Reservation project. Under a contract with the Fund, the CSKT was able to provide funding to purchase the birds and to assist the Fund in upgrading its facilities to expand its captive breeding efforts.

To address concerns about the potential health of the captive swans, each bird was examined closely upon capture, blood samples were drawn from each for analysis, and all were quarantined before being allowed to come in contact with other captive or wild swans. After the birds were found to be in good health, their genetic relationship was evaluated. Some were considered as surplus birds due to their close relationship with others in the group. As a result, some of the swans originally acquired were traded for other captive Trumpeter Swans to reduce

genetic duplication within the birds used in the project.

Captive breeding success was rapid, with two pairs of swans breeding in the spring of 2000. Fifteen cygnets were produced. In an effort to increase survival, these birds were held at the Wyoming facility during their first year for a planned release at the Reservation during the summer of 2001. The release was postponed because satellite transmitters were not available when needed. As a result, the birds were wing-clipped and held in captivity for release in the summer of 2002.

Twenty cygnets were produced during the 2001 breeding season. In addition, a pair of Trumpeter Swans held at the Montana Waterfowl Foundation facilities at Pablo, Montana, produced four eggs, but none were viable. Another pair held at that facility did not produce because of the death of the female.

Plans were made for the release of the 2000 and 2001 progeny during the summer of 2002. Given the number of swans available for release, additional release sites were investigated. A wetland complex located on the Crow Waterfowl Production Area (WPA) was evaluated, as were three sites located on private lands. Each of these areas exhibited secure habitats with abundant food resources and reliable water supplies.

The swans were captured at their holding areas in Wyoming by Fund and TWMP personnel in early July and transported to the Reservation the next day. All were examined prior to transport by a veterinarian experienced in avian veterinary medicine and specifically experienced with Trumpeter Swans.

All swans were fitted with standard U.S. Fish and Wildlife Service aluminum leg bands and red plastic collars and leg bands with corresponding white alphanumeric codes of T00-T99, as approved by the Bird Banding Laboratory. Fifteen of the birds were fitted with collars equipped with Telonics, Inc. ST-19 satellite transmitters with flexible whip antennas mounted on the collars.

Following the releases, the swans remained at the release sites through late July. At that time, several had completed molting and began to fly and range outward from the release sites to adjacent wetlands. These exploratory flights were important in familiarizing the swans with the features and resources of their habitats.

By early October, all of the birds were still alive. The first known mortality occurred in early October, with the death of one of the 2-year-old birds. The cause of death was not determined, although the swan appeared to be in very good condition. Another 2-year-old swan was killed colliding with a power line in late October. A third bird, a yearling, was found dead after colliding with a barbed wire fence in early November. Additional reports of observations of three swans colliding with power lines and of another probable collision were reported by members of the public. The birds survived, but these incidents and the mortality underscore the potential hazards of overhead power lines for swans in the area. Cooperative projects with two local utilities are underway to examine strategies for burying some lines and developing markers for others to make them more visible to flying swans.

Observations during the post-fledging period indicated that most of the swans were taking regular exploratory flights of varying distances from their release sites. Most of the birds were regularly observed, and their condition was judged to be good. Normal behavior was observed in all birds except in the one that collided with the fence. That swan did not associate with others and tended to be reclusive, coming out of tall vegetation only to feed.

Tundra Swans (*C. columbianus columbianus*) began to migrate through the area in late October. Their migration generally passes in a relatively short period, but the 2003 fall migration spanned the period of late October through mid-December, probably due to warm temperatures, abundance of open-water feeding sites, and attendant abundance of food resources. Some mingling of released Trumpeters and migrant Tundras was observed, but these observations were limited. A few observations of wild Trumpeter Swans were noted, but these occurred sporadically. No mingling of released and wild Trumpeters was recorded.

Most wild swans of both species had apparently passed through the area by late December. The released Trumpeter Swans remained in the area following the departure of the migrants. By late December, a total of 30 of these birds still remained in the area. At that time, eight swans remained on Pablo NWR and two remained at one of the privately owned release sites. Seven birds had moved approximately 25 km southwest to the Flathead River by early December and remained there. An additional 13 swans were observed at sites within 12 km of their release.

Satellite transmitters placed on selected birds provided only limited useful data. Of the 15 transmitters placed on released swans, three were taken out of service by October with the deaths of the three swans discussed above. Two transmitters did not provide any location data. Data received from the others was sporadic. By January 2003, satellite transmissions had been received by at least one transceiver on 42 dates. Seven (17%) of these dates exhibited only invalid location data and no usable locations. An additional eight (19%) dates exhibited valid data, but no estimates of location accuracy. Twenty-seven dates (64%) had at least one location for which location accuracy could be determined. Valid locations were limited to 74 (20%). Of those, 22 had an error rate of >1000 m, 2 had error estimates of 350-1000 m, 7 had error estimates of 150-350 m, and 7 had error estimates of < 150 m. The most useful transmitter had valid locations on 23 of 42 dates, although nine of these locations had unknown accuracy. The remaining 12 collars had less than 12 valid locations and less than 9 locations with known accuracy. Ten of these collars had less than five locations with known accuracy.

DISCUSSION

The project has met with good success since the captive propagation program began. Initial cygnet production has increased and is expected to continue to do so. Cygnet production by captive propagation in 2003 is anticipated at between 20 and 30 birds. These cygnets will likely be held in captivity during their first winter and then released on the Reservation during the summer of 2004.

In the future, the potential exists to place some non-flighted, paired captive adults at selected sites to establish breeding pairs. The potential for doing so is being examined, and discussions with interested landowners are underway. This technique has worked well in Iowa (R. Andrews, pers. comm.) and Ontario (Lumsden 2000.). For the Reservation reintroduction project, it may provide an additional tool to more quickly establish Trumpeters.

Although the released swans had not migrated by the end of December 2002, this is not viewed as a setback. The lack of movement from the Reservation could be expected, given that there were no swans among the released birds that had migrated before. In addition, mild weather conditions, availability of a substantial number of open-water areas, and an abundance of aquatic plant food resources provided good fall habitat for the birds.

Although the satellite telemetry provided some useful data, the amount of usable data was quite limited. This was due to the short transmission times of the transmitters. Additional evaluation of the transmitters is presently underway by the manufacturer to improve the data quality in the future. Transmitters recovered from dead swans also are being examined.

The results of the reintroduction project to date are encouraging. Continuing efforts may well result in the establishment of the first breeding pairs of wild, free-ranging Trumpeter Swans on the Flathead Indian Reservation in over a century.

ACKNOWLEDGMENTS

The Flathead Indian Reservation Trumpeter Swan Reintroduction Project is undertaken with the use of funding derived from the Kerr Dam Mitigation Settlement among the CSKT, PPL Montana, and the U.S. Department of the Interior. The project is a cooperative effort involving the CSKT as the lead agency, MFWP, FWS, the Trumpeter Swan Fund, the Lower Flathead Valley Community Foundation, the Montana Waterfowl Foundation, and the Montana Cooperative Wildlife Research Unit.

Funding for the reintroduction activities was provided primarily by the CSKT, in cooperation with MFWP and the FWS. The 1997 activities were funded by the CSKT in cooperation with the National Fish and Wildlife Foundation, the Liz Claiborne-Art Ortenburg Foundation, and the Summerlee Foundation. Jeff Herbert, MFWP Waterfowl Coordinator, assisted in securing the Pacific Flyway Council concurrence with the proposed project and permits to initiate the project. Dr. I. J. Ball, Montana Cooperative Wildlife Research Unit Leader, provided ideas and advice throughout the project. David Wiseman, Bill West, and Lindy Garner of the FWS provided logistical support and assisted with many aspects of the swan releases. Harold Knapp provided inspiration, ideas, and valuable insight from his many years of interest in Trumpeter Swans and his experience with wildlife management in the Flathead Valley. William Edelman of the Lower Flathead Valley Community Foundation assisted with acquisition of the captive swans for the project. Bill Long of the Trumpeter Swan Fund housed and cared for the captive swans, oversaw all aspects of the captive propagation project, and assisted with many logistical issues. John Jarvis of the Montana Waterfowl Foundation was also involved with captive propagation efforts in 2001. Other cooperators included Gerry Beyersbergen of the

Canadian Wildlife Service, the Friends of Elk Island Society, and the staff of the Summer Lake Wildlife Management Area of the Oregon Department of Fish and Wildlife, who provided logistical assistance with obtaining swans for the 1996 and 1998 efforts. The 2002 releases took place on Tribal lands within Pablo National Wildlife Refuge, on the FWS Crow WPA, and on the properties of Jim and Charlyn Rogers, Dwight 'Stocky' and Hope Stockstad, and Ralph and Edeltraud Stockstad.

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THE TRUMPETER SWAN IMPLEMENTATION PLAN - AN OVERVIEW

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ABSTRACT

The Pacific Flyway Council adopted the most recent revision of the Management Plan for the Rocky Mountain Population (RMP) of Trumpeter Swans in 1998. This plan includes various objectives and strategies to manage RMP swans but lacks specific timelines and assignments. In 2001, the Council assigned the Pacific Flyway Study Committee to develop a more detailed document to assign specific tasks and schedules for management actions. The process used by the Study Committee to develop the plan was inclusive and invitations were sent to all groups known to have interest in the issue. The first work session was held in June 2001 and three additional meetings were held in October and December 2001 and February 2002. After several draft documents, the Council released the Trumpeter Swan Implementation Plan (TSIP) for formal public review in May 2002. After final revisions, the Council adopted the TSIP in July 2002. The final plan covers the 5-year period 2002-2007 and assigns 67 specific tasks to various agencies and groups. Schedules for completion of the tasks are also included. TSIP requires the Pacific Flyway Study Committee to provide annual reports to the Pacific Flyway Council each July on the progress of tasks identified in it.

INTRODUCTION

In 1998, the Pacific Flyway Council (PFC) adopted the most recent update of the Management Plan for the Rocky Mountain Population (RMP) of Trumpeter Swans (Subcommittee on RMP Trumpeter Swans 1998). This population of Trumpeter Swans (*Cygnus buccinator*) includes birds that nest in the Tri-state area of Wyoming, Idaho, and Montana, small areas in eastern Oregon, and northern Nevada as well as parts of interior Canada. The plan includes five objectives: (1) to redistribute wintering swans, (2) to rebuild the U.S. breeding flocks, (3) to encourage the growth of Canadian flocks, (4) to increase the abundance of desirable submersed macrophytes in the Henry's Fork of the Snake River, and (5) to monitor the population. In early 2001, the U.S. Fish and Wildlife Service (Service) completed a draft concept plan outlining potential activities to benefit swans within the National Wildlife Refuge System. In April 2001, the PFC assigned the Pacific Flyway Study Committee (PFSC) to develop an implementation plan for the 1998 RMP plan that included specific assignments and schedules for their completion.

METHODS

Efforts to develop this planning document began in early 2001 when the U.S. Fish and Wildlife Service completed a draft concept plan outlining potential activities to benefit swans within the National Wildlife Refuge System. The PFC then requested other interest groups, including federal, state, and nongovernmental organizations, to collaborate on the creation of an overall Trumpeter Swan Implementation Plan (TSIP). The TSIP was envisioned to include portions of the refuge concept plan and also to address habitat and resources outside of the refuge system. Separate subcommittees of the TSIP working group were formed in June 2001 and specific action items were developed by the subcommittees to address the objectives listed in the 1998 Management Plan. The entire TSIP working group met in June, August, and December 2001, with a final meeting in February 2002 to review the draft documents being developed.

After revisions by the PFSC in March 2002, the Pacific Flyway Council reviewed and released the TSIP for formal public review in May 2002. After final revisions, the PFC adopted the TSIP (Pacific Flyway Study Committee 2002) in July 2002.

RESULTS

The adopted plan is tiered to the 1998 RMP Management Plan and includes updated objectives, strategies, and tasks. It has a 5-year scope from 2002 to 2007. The plan includes 67 specific tasks assigned to seven different state agencies, four federal agencies, one tribal nation, and three nongovernmental organizations. The Service commitments include actions on 12 refuges in three different Service regions. Schedules for completion of the tasks are included. TSIP also requires the

Pacific Flyway Study Committee to provide annual reports to the Pacific Flyway Council each July on the progress of tasks identified in it.

A brief summary of the tasks identified in the plan:

Population management

Objective 1. Redistribute wintering swans.

- Reduce habitat at Harriman State Park by manipulating water (2 tasks).
- Release captive-raised cygnets and yearlings (1 task).
- Increase, protect, and enhance winter habitat (2 tasks).

Objective 2. Rebuild U.S. breeding flocks to at least 141 nesting pairs.

- Increase the size of the Tri-state flocks (16 tasks).
- Decrease the mortality of Tri-state swans (4 tasks).
- Augment the U.S. breeding flocks (8 tasks).
- Increase the number of birds wintering south of traditional areas (4 tasks).
- Maintain existing flocks in Oregon and Nevada (1 task).
- Establish a new restoration flock in Montana (4 tasks).

Objective 3. Encourage growth of Canadian flocks.

- No action (the Canadian flock is expanding adequately without additional management).

Objective 4. Manage water flows to decrease swan use on the Henry's Fork and address winter emergencies.

- Reduce flows during the fall and store water (4 tasks).

Objective 5. Monitor the population.

- Survey RMP Trumpeter Swans (6 tasks).
- Develop an operational banding program (4 tasks).
- Develop a formal adaptive management strategy for TSIP objectives (1 task).
- Inventory seasonal habitats throughout the range of RMP Trumpeter Swans (3 tasks).

Public information

Objective 1. Provide accurate information in a timely manner.

- Develop an effective public information program (3 tasks).

Research

Objective 1. Conduct research to improve management of RMP swans.

- Design and implement needed research projects (4 tasks).

Twenty-two tasks were identified for completion by the end of 2002. Review of these 22 tasks show that 20 have been started and 5 have been completed. The rest of the projects are in progress and should be completed within 6 months or be ongoing efforts. Thirty-one tasks are ongoing in nature and include surveys and other routine work. Six projects are scheduled for completion in 2003, seven in 2004, and three in 2005.

DISCUSSION

All planning efforts must include a commitment to accomplish the actions identified in the plan. The use of letters of endorsement and level of concern about this population makes it likely that this commitment will continue. The annual progress report for the Pacific Flyway Council should help ensure that progress continues in a timely manner. An annual coordination meeting between the cooperators involved in this effort might also help this management effort be effective and efficient.

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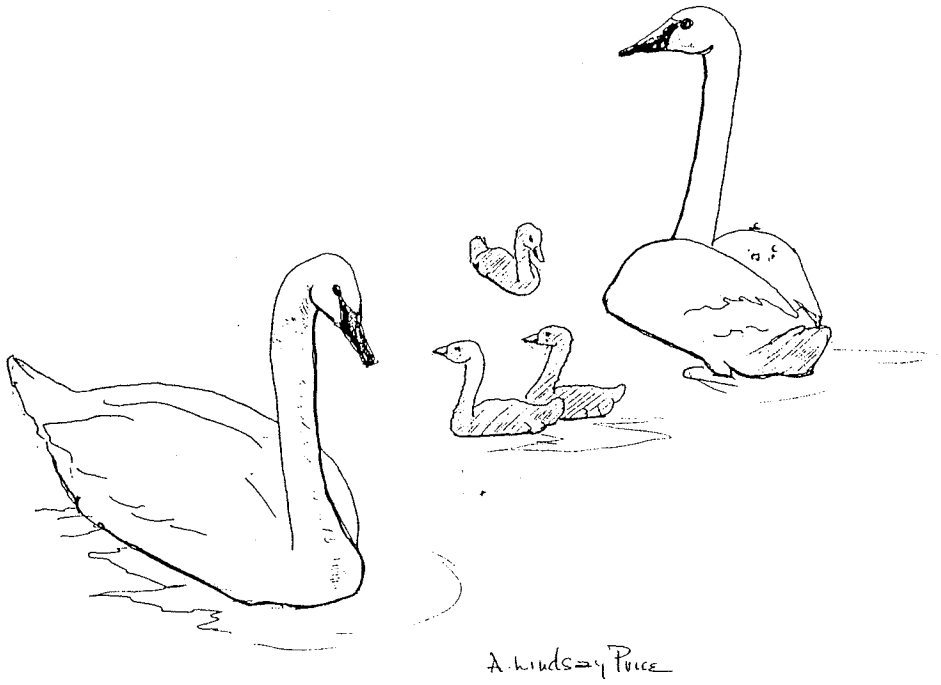
THE INTERIOR POPULATION



POPULATION STATUS AND MANAGEMENT OPTIONS FOR THE INTERIOR POPULATION OF TRUMPETER SWANS

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INTRODUCTION

Trumpeter Swans (*Cygnus* buccinator) were extirpated east of the Rocky Mountains by the beginning of the 20th century. All of the Trumpeter Swans now present in the interior part of North America are a result of various restoration projects. Although Delta Waterfowl Research Station in Manitoba pioneered captive breeding efforts, the first successful release of Trumpeters into the wild began at Lacreek National Wildlife Refuge (NWR) in Martin, South Dakota. Transfer of cygnets from Red Rock Lakes NWR to Lacreek NWR was initiated in 1960. Table 1 lists the restoration programs that have resulted in the Interior Population (IP) of Trumpeter Swans with their respective dates of initiation. The date of initiation reflects when eggs were collected or cygnets were obtained for future release or captive breeding. While the dates are self-explanatory, a few comments are in order. For a thorough review and history of highlights of IP restoration programs, see Compton (1996) and Johnson (2000).

In 1994, the Lacreek Flock was renamed the High Plains Flock by Rolf Kraft since the swans were spreading into western South Dakota and eastern Wyoming as well as south into Nebraska where many swans also spend the winter (Burgess 2001). Hennepin County Park Reserve District (HCPRD), in east-central Minnesota, was next to initiate Trumpeter Swan restoration when it obtained swans from Red Rock Lakes National Wildlife Refuge in 1966. However, initial releases failed and emphasis was changed to a captive breeding program. Releases did not start up again until the late 1970s. HCPRD was later renamed Hennepin Parks, which, in turn, was renamed Three Rivers Park District in 2002. Also, due to the increasing numbers of unmarked swans and the intermingling of swans at wintering sites, Hennepin Parks and the Minnesota Department of Natural Resources (DNR) combined their flocks into one single "Minnesota Flock" in 1996 for reporting and monitoring purposes. Traditionally, the Ontario Trumpeter Swan restoration program, the only private program, has been counted as part of the Interior Population. At some future date, when an Atlantic Trumpeter Swan Management Plan is approved, eastern Ontario Trumpeter Swans may be shifted to the Atlantic population of Trumpeter Swans. Ontario is still isolated enough by the Great Lakes that there is minimal mixing of Ontario birds with birds from other restoration programs, except perhaps for a few free-flying Trumpeters in New York and Ohio. Finally, in 1995, the Ohio Division of Wildlife became the latest program to undertake Trumpeter Swan restoration in the Interior Population.

BREEDING STATUS OF INTERIOR POPULATION 2002

Data compiled by W. C. Joe Johnson for the Swan Committee of the Mississippi Flyway Council Technical Section shows that the goal of 2,000 Trumpeter Swans by 2001 was surpassed (Figure 1). The 2001 fall estimate was 2,923 birds. The 2002 fall flight for the IP was estimated to be 3,414 birds (Joe Johnson, pers. comm; Table 2). The annual September survey relies on a variety of survey techniques to produce a best estimate of a fall flight for the total IP. Clearly, a breeding population has been successfully restored to the Midwest. As of 2002, the IP had 292 breeding pairs, which is 162% of the 2001 goal (Joe Johnson, pers. comm; Table 2). Figure 1 shows a graph of the annual population estimates of the IP, 1985-2002. The population growth is obvious and greater than earlier predictions.

In 2002, there were an estimated 1,036 wild cygnets. Figure 2 compares released birds vs. cygnets born in the wild. Production is increasing in the wild, although there is still significant mortality from lead poisoning and power line collisions, especially among yearlings exploring new areas (Hennepin Parks swan files). Figure 3 gives the numbers of birds released by project in 2002 (Joe Johnson, pers. comm.). Managers of the High Plains Flock have not released swans since the early 1960s. Hennepin Parks conducted small releases, averaging 12 birds per year, from 1979 through 1996 (Compton 1996). Releases were discontinued in 1996, since most suitable park wetlands were occupied by territorial swans. The Minnesota DNR Nongame Wildlife Program conducted larger releases annually from 1987 through 1994 in northern Minnesota, but, in

1995, switched to small (10-12 birds) releases along the Minnesota/Iowa border. Appendix C of the Mississippi and Central Flyway Management Plan for the Interior Population of Trumpeter Swans (IP Plan) gives details on releases per project per year (Ad hoc 1998). In Minnesota, the flock has matured with good survival of the young as counted at wintering sites (Sheila Lawrence, pers. comm.; Steve Kittelson, MN DNR unpublished records). Ontario and Iowa continue to release relatively large numbers of swans. As shown in Figure 3, Iowa released the greatest number of swans (105) in 2002, with the total state population estimated to be 220 swans. Thus, in contrast to several of the older programs, Iowa's flock is still one of mainly young birds, the majority of which has been captive raised. Age of cygnets at release has varied anywhere from 4 months to 2 years. Minnesota, Michigan, and Ontario have generally released 2-year-old birds while Iowa releases mostly 1-year olds.

This 2002 IP estimate does not include New York's approximately 20 free-flying Trumpeters, which are the result of birds escaped from private propagators since the early 1990s. Most Trumpeter Swans in Minnesota are unmarked. The total given is an estimate. Due to budget uncertainties, a winter aerial survey had not been conducted in Minnesota as of 31 January 2003, but there are reliable ground counts at major wintering locations on larger rivers where duplicate counting is unlikely (Steve Kittelson, pers. comm.). Wisconsin and Ontario have a higher percentage of marked swans, since both programs place a priority on banding their birds.

THE WINTERING CHALLENGE

As can be seen from the preceding tables and figures, Trumpeter Swans are doing very well in the Midwest, at least as far as the breeding population is concerned. Although all of these flocks, with the exception of Ontario, were established through state or federally supported programs, most of the winter care for the swans has been provided by private citizens and private donations, which has proven to be critical for the rapid growth and survival of the birds.

The goal of the IP Plan is "to restore a self-sustaining, migratory metapopulation of Trumpeter Swans in the Central and Mississippi Flyways." Objective 2 states, "Encourage the development of migratory behavior by IP swans in response to suitable habitat and climatic conditions" (Ad hoc 1998).

Table 3 shows the latest population estimate for each state or provincial flock along with an estimate of the percentage of birds that migrate out of each state in winter. This table shows that most Trumpeters in the Midwest do not migrate to southern locations. Only three flocks have significant numbers of Trumpeters that migrate beyond state boundaries. However, most of the High Plains Flock undertakes only a very short flight from southern South Dakota to northern Nebraska, and many of these swans are also nesting in Nebraska. Iowa is still releasing young birds, which wander widely in search of suitable habitat, but most have not established a southward migratory tradition. Only the Trumpeter Swans from Wisconsin have established a migratory tradition that moves a significant number of the birds south to sites on the edge of the freeze line, primarily in southern Illinois (Babineau *et al.*, in press). Almost all Trumpeters that spend the winter in northern states are dependent upon supplemental feeding for their survival, but the birds are thriving under these conditions.

Contrary to popular belief, it has not been difficult to get Trumpeter Swans to develop migratory traditions in the Midwest, but it takes time and the techniques that have been used are controversial. Trumpeters will return to a wintering site year after year if they find it attractive and if they survive. Unlike other waterfowl that migrate in flocks, Trumpeters migrate as family units. Adults will bring their offspring with them, and occasionally attract other swans. When a pair of Trumpeters showed up at a ranch owned by Janine Kyler and her husband near Pawhuska, Osage County, Oklahoma, in winter of 1991, she started feeding them. By 1998, the number of wintering swans had grown to 19. She was forced to stop feeding when her house burned down. The birds stopped coming within a year. Most of the birds that could be identified by bands stayed in Minnesota in subsequent years. The Oklahoma Department of Wildlife Conservation did not support developing a migratory tradition to the Kyler Ranch based on supplemental feeding, because it felt there was no natural or agricultural habitat in the area to which the swans could adapt. The wildlife managers did not want to establish a perpetual feeding program.

A similar story unfolded at Perry Linder's farm near Heber Springs, Cleburne County, Arkansas. The first pair of birds showed up at Magness Lake, a private wetland, during the winter of 1992. Mr. Linder fed them, and they returned with their offspring. The numbers grew gradually each year. By the winter of 2001-02, 52 swans were migrating to his place, and they were feeding in adjacent agricultural fields

where Mr. Linder planted winter wheat and rye. Some mixing of swans from the various restoration programs did occur. Marked swans from Wisconsin, Michigan, Minnesota, and Iowa have all been observed at this site. The Arkansas Game and Fish Commission's Nongame Bird Program endorsed the efforts of Perry Linder, and state biologists would like to negotiate an easement for Magness Lake. Each winter, avid birders come from several states to view the swans and local media have done numerous stories highlighting the visiting swans.

Currently, during the winter of 2002-03, there are 45 Trumpeters wintering on the Mississippi River at the U. S. Army Corps of Engineers Riverlands Environmental Area in West Alton, Missouri, across the river from Alton, Illinois. The swans appear to be subsisting entirely on aquatic plants or agricultural waste grains. However, these birds were fed initially by a private citizen on the river during the early stages of establishment at the site (Charlie Deutsch, pers. comm.).

Supplemental feeding appears to be a significant factor in the Midwest in getting Trumpeters to return to a site year after year, at least until they can discover or adapt to other food sources. There has been only one location that has attracted a substantial number of Trumpeter Swans without any known supplemental feeding. There are 77 Trumpeters spending the winter of 2002-03 on a restored coal mining site near Carbondale, Illinois (Babineau *et al.*, in press). The birds subsist primarily by field feeding on winter wheat, corn, and soybeans. The first eight swans were sighted in 1992. They started feeding in the agricultural fields without any association with people. The population has grown continuously since then.

A comparison of three restoration programs in the Midwest demonstrates how important it is for Trumpeter Swans to have secure wintering locations (Table 4). Swan managers in Minnesota have generally encouraged the feeding of swans at safe wintering sites both within the state and at southern locations. Michigan has no policy on feeding, but most of its Trumpeters stay on larger rivers within the state (Joe Johnson, pers. comm.). Michigan also has over 3,000 Mute Swans (*Cygnus olor*) wintering within the state. Wisconsin DNR has repeatedly discouraged people from feeding its swans, either in Wisconsin or in states to which they migrated. As a result, Wisconsin has a higher percentage of Trumpeters that migrate, but their population has not grown as rapidly as have the flocks in the other two states. Michigan and Wisconsin started their programs at about the same time, while Minnesota initiated its program through the HCPRD program many years earlier (Table 1).

Survival of Trumpeters that migrate for the first time is slightly above 60% (Hennepin Parks swan files). This survival rate is not sufficient to sustain a population of swans. Swans that migrate for the first time wander from place to place, and, as they do, they increase the chances that they will be exposed to health risks such as lead poisoning, power line collisions, or other accidents. Mortality remains high until the swans discover a good wintering site and begin to migrate directly to it. Survival of swans that migrate to known destinations like Heber Springs, Arkansas, where there are very few environmental hazards, is probably close to 90%, although solid data is difficult to obtain. It is usually not known how many swans started out on migration, but survival at winter destinations is excellent. Swans that winter in Monticello, Minnesota, have a survival rate of almost 95% starting from when they first show up on the river, typically in November, until they leave in March (Sheila Lawrence, pers. comm.).

At the 16th Trumpeter Swan Society Conference, Madeleine Linck gave the advantages and disadvantages of Trumpeter Swans wintering at Monticello, Wright County, Minnesota, or similar places (Linck 1999). Swans that do not migrate, but stay at one site all winter, have the best survival rate, followed by swans that migrate to known locations. The more time a swan spends at one secure location, the better its chances are for survival. Migration to warmer areas is not critical to the survival of the birds if they receive adequate food.

Figure 4 shows the present breeding and general wintering distribution for Trumpeter Swans in the IP (Johnson 2000). While there is a lot of water in the central Midwest in the form of ponds, lakes, reservoirs, and rivers, they contain very little aquatic vegetation (Gillette 1999). Almost all geese and ducks that winter north of Texas and the Gulf Coast have adapted to field feeding, due in part to a lack of aquatic resources and in part to a preference for some of these other foods. Trumpeters have adapted to field feeding in the Pacific Northwest, but it was a very slow process. Swans have adapted to field feeding to a very limited extent in the lower Midwest, but the conditions in the Midwest are somewhat different (poor condition of winter wheat and rye in winter), which may make it more difficult for the swans to adapt. The process could be accelerated if more birds were attracted to and held in the region.

Eastern and southern Texas may have the best aquatic habitat for Trumpeters. Some reservoirs, farm ponds, and coastal wetlands contain aquatic plants that could be edible for swans, but, to date, few swans have made it that far south. There is no encouragement for those that do, and their food preferences for these southern plants has not been evaluated.

Suggestions to help establish migratory traditions have included use of decoy birds, release of Trumpeters on wintering sites, and providing supplemental food for swans that are wintering in the central part of the Midwest (Gillette 2000). The authors keep emphasizing the use of supplemental feeding, because it is the most effective way to attract and hold Trumpeter Swans on a site until they can adapt to their new surroundings. Waterfowl managers in southern states are reluctant to pursue this option, in part because of potential interference with waterfowl hunting. Since their waterfowl seasons extend into January, feeding Trumpeters could attract other waterfowl, which could be considered to be baiting. There is also the concern that Trumpeters may be confused by hunters with other species of waterfowl. Accidental shootings would reflect poorly on the hunting community. However, in Minnesota, which has more waterfowl hunters than these southern states and an estimated 1,500 Trumpeter Swans, there have been very few shootings and restoration efforts have been supported enthusiastically by waterfowl hunters.

State conservation agencies could do what these private citizens have done, but politics and differing opinions on how wildlife should be managed have prevented it. North American wildlife managers continue to manage wildlife under the premise that there is adequate natural habitat for all species to survive. (Natural habitat and food includes agricultural fields, which may be grown specifically for waterfowl.) It is becoming more apparent every day that this is no longer the case. European and Far Eastern countries have rejected this concept as impractical. From England to Japan, supplemental feeding of wildlife is necessary for the survival of numerous species including swans and cranes. Feeding sites are operated in a manner that provides viewing opportunities for the public while avoiding conditioning the birds to people or subjecting the birds to disease. Trumpeter Swans are a nongame species that could benefit from similar management.

An example of this type of management can be found in Minnesota. Over 600 Trumpeters spend the winter on the Mississippi River at the City of Monticello, Wright County, where the water is kept open by two power plants. The birds are fed daily by a private resident who lives on the river. Other residents feed waterfowl along the river, but not to the extent of the person in Monticello. The river provides a wonderful viewing site with a continuous flow of water, usually in excess of 10,000 gallons per second. The chance of disease is almost nonexistent. The Chamber of Commerce has adopted the swans and uses them to promote winter tourism. The city has developed promotional literature and a park for viewing the swans. It has highlighted the swans on the city Web site, printed postcards with Trumpeter photos, and commissioned a life-size steel sculpture of Trumpeters for its community center. Experiences here and from numerous other sites suggest that there is no relationship between winter feeding and the degree of tameness displayed by the birds during the rest of the year. The birds are extremely wary of any change in their routine at the wintering site and behave in an identical manner on their nesting territories compared to swans that were not fed.

It is ironic that supplemental food is provided for Trumpeters in northern areas where managers do not want the birds to stay, while they discourage providing supplemental food in southern states where they want the birds to go. The authors think that the objective in the IP Plan calling for a migratory population of Trumpeters would have been realized by now if southern states had encouraged participation by the public through supplemental feeding.

MANAGEMENT OPTIONS

It appears that there are three basic options that can be pursued by The Trumpeter Swan Society (TTSS) to help manage IP Trumpeters. They are not mutually exclusive.

1. TTSS can continue to work through the flyway councils to try to get their support for restoration efforts. However, considering their reluctance to do anything (especially in the Central Flyway) and the dismal financial condition of most states, this option seems unlikely.

2. TTSS can work more with private citizens to provide food and to use captive swans as decoys for Trumpeters in southern locations. This is a proven technique, and many of the best sites are privately owned. It would help to have the support of state waterfowl managers, even if they are not involved directly.

3. TTSS can accept the present situation, and continue to encourage supplemental feeding to enable Trumpeters to stay in northern states where restoration programs began. If so, contingency plans should be developed to ensure that food will be provided under all circumstances.

At this time, northern states appear to be the only places really interested in working to reestablish Trumpeter Swans. Waterfowl managers in southern states are reluctant to attract Trumpeters to their states for what the authors consider to be unwarranted concerns. Survival rates are best for Trumpeters that do not migrate. The swans are thriving under existing conditions. The scene in northern areas may be more typical of what exists in Japan or England, which works for both people and the birds. It begs the question, should TTSS and waterfowl managers continue to promote a migratory population as an objective in the Mississippi and Central Flyway Management Plan for the Interior Population of Trumpeter Swans?

It is time for a decision on whether Trumpeters will be welcomed to southern states -- not accepted, but welcomed. If the answer is no, then managers had better acknowledge that supplemental feeding will be used indefinitely and do it in ways that will facilitate observation by the public. If the decision is yes, then an active program is needed to stimulate migration while keeping mortality to a minimum. A public outpouring of support will be necessary in southern states for this to occur. Unfortunately, most southern residents are not even aware that this opportunity exists to enjoy the largest of all North American waterfowl.

ACKNOWLEDGMENTS

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Table 1. Restoration programs comprising the Interior Population of Trumpeter Swans.

Program	Date of initiation
High Plains, USFWS, Lacreek NWR	1960
Hennepin County Park Reserve District, Minnesota	1966
Ontario (private) Trumpeter Swan Restoration Project	1982
Minnesota DNR	1982
Michigan DNR	1986
Wisconsin DNR	1987
Iowa DNR	1993
Ohio Division of Wildlife	1995

Table 2. Interior Population estimate, September 2002.

Program	Successful pairs	Cygnets	Others	Total
High Plains	38	121	188	385
Minnesota [1]	130 [1]	500 [1]	740 [1]	1,500 [1]
Ontario	37	120	237	431
Michigan	34	128	278	474
Wisconsin	34	104	128	300
Iowa	8	23	181	220
Ohio	11	40	42	104
TOTAL	292	1,036	1,794	3,414

[1] Hennepin Parks and Minnesota DNR combined into one flock as of 1996. Data compiled by W. C. Joe Johnson, Swan Committee, Mississippi Flyway Council Technical Section.

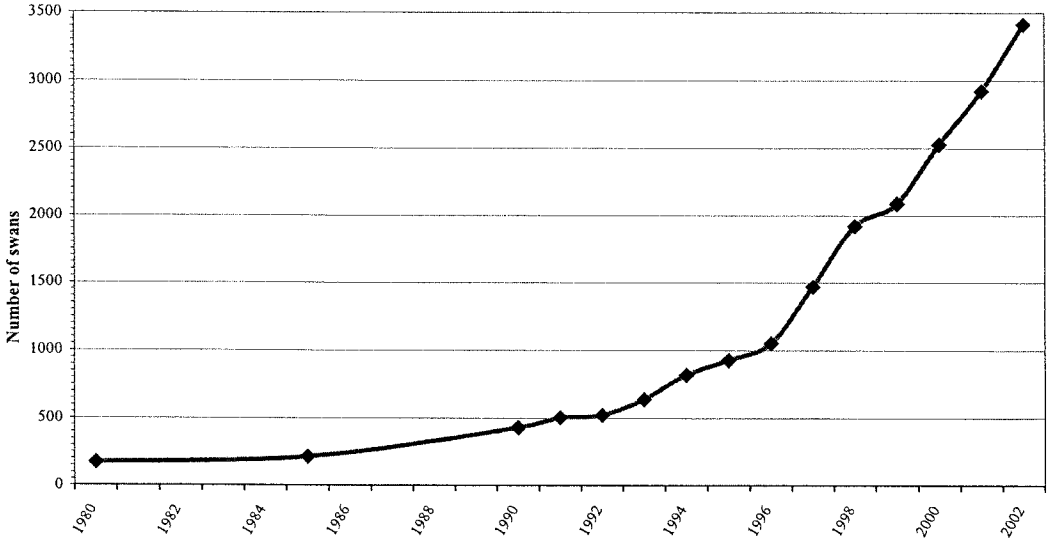

Figure 1. Estimated number of Interior Population of Trumpeter Swans 1980-2002. Data from The Trumpeter Swan Society and W. C. Joe Johnson, Swan Committee, Mississippi Flyway Council Technical Section.

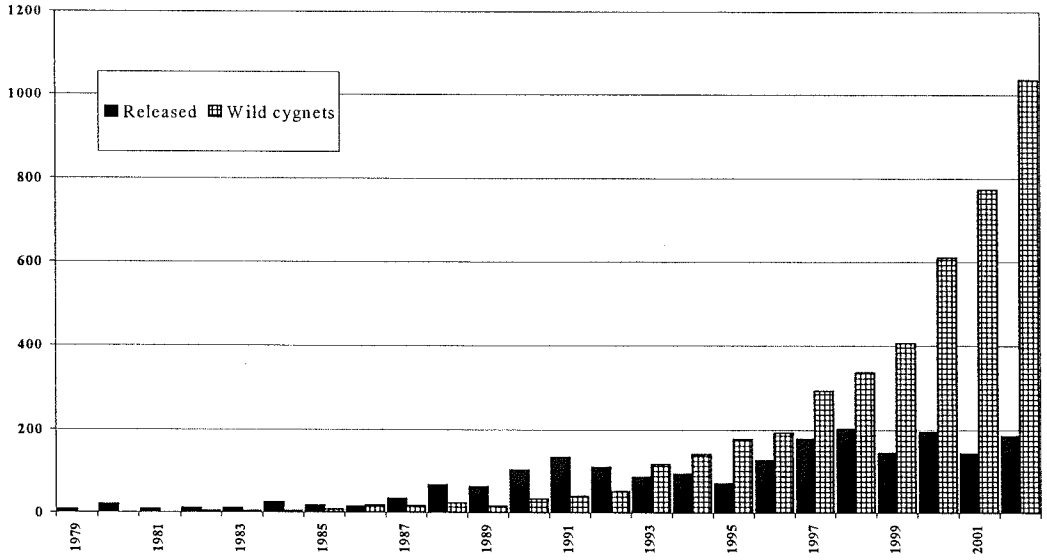

Figure 2. Annual release and wild cygnet production for the IP. Data compiled from W. C. Joe Johnson, Minutes of Swan Committee, Mississippi Flyway Council Technical Section.

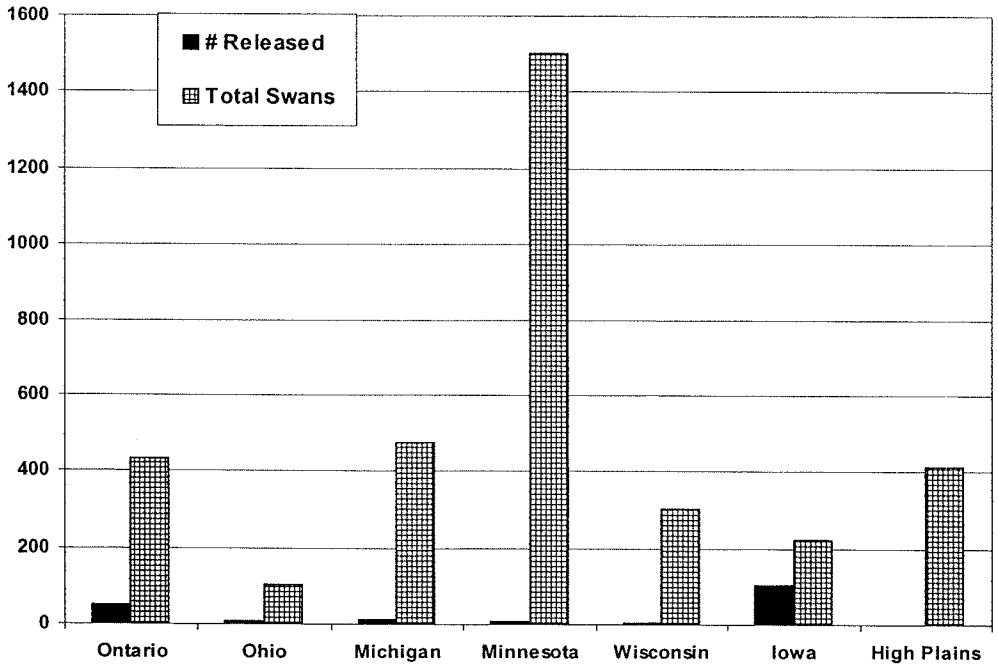

Figure 3. Swans released by program for year 2002.

Table 3. Percentage of IP Trumpeter Swans that migrate to southern locations.

State/Province	Estimated population (2002)	Estimated % that migrate
High Plains	385	~ 95%
Minnesota	1,500	< 10%
Ontario	431	~ 5%
Michigan	474	< 10%
Iowa	220	~ 35%
Wisconsin	300	~ 43%
Ohio	104	< 10%

Table 4. A comparison between the number of Trumpeter Swans released for restoration and the number of swans surviving in 2002.

State	Number of swans released	Estimated population 2002
Minnesota	478	1,500
Michigan	212	474
Wisconsin	392	300

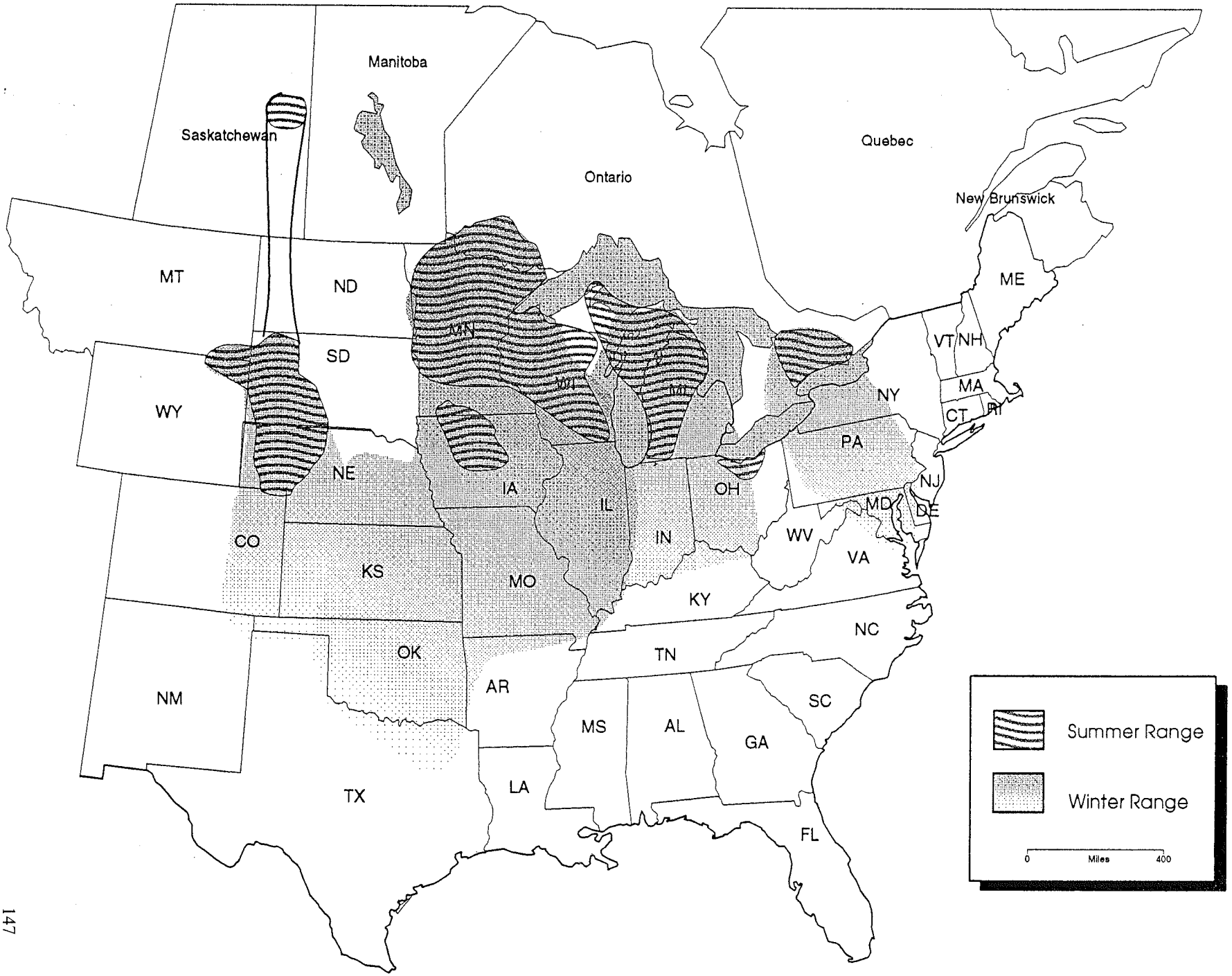

Figure 4. Distribution of the Interior Population of Trumpeter Swans, 1984-98 (Johnson 2000).

STATUS REPORT OF THE LACREEK TRUMPETER SWAN FLOCK FOR 2002

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ABSTRACT

A total of 412 Trumpeter Swans (*Cygnus buccinator*), including 94 cygnets, was observed during the January 2003 midwinter aerial survey following the 2002 summer/fall production season. This compares to 319 Trumpeters, including 45 cygnets, in 2001, and 227 Trumpeters, including 42 cygnets, in 2000. The previous high of 455 Trumpeters, including 101 cygnets, occurred in 1998. The late summer aerial production survey in 2002 recorded a total of 385 Trumpeter Swans, including 67 nesting pairs, 38 broods with 121 cygnets, and 115 nonbreeders in 23 flocks, compared to a total of 222 Trumpeters, including 68 nesting pairs, 18 broods with 45 cygnets, and 34 nonbreeders in eight flocks, in 2001, and 319 Trumpeters, including 56 nesting pairs, 28 broods with 86 cygnets, and 118 nonbreeders in 18 flocks, in 2000. Although production declined from 105 cygnets in 1999 to only 45 cygnets in 2001, production came back to 121 in 2002. With 385 Trumpeters recorded during the 2002 summer breeding survey and 412 Trumpeters recorded during the winter peak population survey, the High Plains Population continues to increase. Lacreek National Wildlife Refuge swan production has declined to almost nothing. Cygnet production was limited to six cygnets in two broods in 2001, but no cygnets have fledged on the refuge in past 4 years. The winter peak population has fluctuated but continues to increase. The steady increase in the summer population indicates the loss is not the result of mortality. It is believed that the winter migration may have expanded outside of the current survey area. The refuge crew banded 33 Trumpeter Swans in 2001 and 6 in 2002. The North American Waterfowl Management Plan goal of 500 birds may be at hand.

POPULATION REPORT

A total of 412 Trumpeter Swans (*Cygnus buccinator*), including 94 cygnets, was observed during the 14 January 2003 midwinter aerial survey following the 2002 summer/fall production season. This compares to a total of 319 Trumpeter Swans, including 45 cygnets, observed during the 10 January 2002 midwinter aerial survey and 227 Trumpeter Swans, including 42 cygnets, observed on 5 January 2001. The 2001 peak population shows a sharp decline from the 1998 peak population of 455 Trumpeters, including 101 cygnets (Table 1). The winter aerial survey includes Bennett County, South Dakota, and Cherry, Garden, Keith, Lincoln, McPherson, Arthur, Grant, Hooker, Thomas, and Blaine Counties in Nebraska.

A total of 385 Trumpeter Swans was observed during the late summer aerial production survey in 2002, including 67 nesting pairs, 38 broods with 121 cygnets, and 115 nonbreeders in 23 flocks. In 2001, there was a total of 222 Trumpeters, including 68 nesting pairs, only 18 broods with 45 cygnets, and 34 nonbreeders in 8 flocks; in 2000, a total of 319 Trumpeters, including 56 nesting pairs, 28 broods with 86 cygnets, and 118 nonbreeders in 18 flocks (Tables 2 and 3).

The production of 121 cygnets in 2002 is an all-time high. The increase is significant because cygnet production increased 269% from the 45 cygnets produced in 2001. The 2001 production is a 57% decline from the previous high of 105 cygnets in 1999. Total adults increased to 235 in 2000 from 206 in 1999, but then declined to 177 in 2001 and increased again to 264 in 2002. The disparity is explained by the 97% increase in nonbreeding birds in 2000 over 1999. There has been a steady increase in nonbreeding swans since 1996 when the number of nonbreeders declined from 61 in 1995 to 23 in 1996, and then increased to 118 by 2000 (Table 3). Even though production declined in 2000, the increase in nonbreeders resulted in an overall population increase for the High Plains flock.

The loss in nonbreeders between the 2000 and 2001 breeding seasons is probably the result of birds wintering out of the survey area as demonstrated by the low winter peak population of 227 in January 2001 and only 177 adults being observed during the 2001 breeding season. The loss in nonbreeders is not considered to be the result of any significant mortality, however, because of the rapid increase in adults to 264 in 2002. Although there has been some fluctuation of nonbreeders, nesting pairs have remained fairly consistent (Table 2).

A few Trumpeter Swans began to show up on Lacreek National Wildlife Refuge (NWR) in early October 2002 with a count of 150 by the end of the month. A cold snap with freezing wetlands dropped the refuge population to 121 in early November, but a thaw reopened refuge wetlands in late November and the swan population rose to 179 in early December. Colder weather and ice reduced the population on the refuge to 149 by late December, but a warm up again increased the count to 186 in early January 2003. The fall/winter weather in 2002 was mild with short periods of hard freezes causing wintering Trumpeter Swans to migrate back and forth between the refuge and the Snake River in Cherry County, Nebraska. During the aerial winter peak survey on 13 January 2003, the refuge population was 144 with 31 cygnets. Most of the High Plains Trumpeters winter in Nebraska on the Snake River and North Loup River drainages in Cherry County, on Blue Creek in Garden County, along the North Platte River below the Lake McConaughy Dam, and up Birdwood Creek in Lincoln and McPherson Counties. This year, with the mild weather, a small group of eight swans was on an open lead in Collins Lake west of Whitman in Grant County (Table 4).

PRODUCTION REPORT

The 2002 aerial production survey was conducted 3-4 September 2002. The survey included Bennett, Shannon, Pennington, Meade, Butte, Perkins, Ziebach, Haakon, Jackson, Mellette, Tripp, and Todd Counties in South Dakota; Cherry, Sheridan, Garden, Grant, McPherson, Hooker, and Arthur Counties in Nebraska; and Crook County, Wyoming. No swans were observed in Pennington, Ziebach, Haakon, or Jackson Counties in South Dakota, or in Hooker County, Nebraska this year. One Trumpeter was observed in Crook County, Wyoming. A total of 385 Trumpeter Swans was observed, including 67 nesting pairs, 38 broods with 121 cygnets, and 115 nonbreeders in 23 flocks in 2002, compared to 222 Trumpeter Swans, including 68 nesting pairs, 18 broods with 45 cygnets, and 34 nonbreeders in 8 flocks in 2001. The 2002 production of 121 cygnets is an all-time high besting the previous high of 105 in 1999 and a remarkable recovery from 45 cygnets in 2001, the lowest production since 1980. Save some occasional interruptions, summer production in the sandhills continues to increase (Table 2).

Swan nesting associated with the Colony, Wyoming, site is apparently in peril. A single Trumpeter with a brood of four was observed in 1997 and a pair without a brood was seen in 1998. No swans were observed in 1999, but there was a pair in 2000 and 2001 and only a single in 2002. Trumpeter Swan production in northwestern South Dakota remains steady while pairs in the South Dakota Badlands and Ziebach County, northeast of Faith, continue to decline as the older pairs die out. We saw a decline in Shannon County north of Rockyford from one in 1999 to zero for the last 3 years. Trumpeter Swan nesting and production has increased in the Nebraska Sandhills since 1997. Cygnet production in Nebraska increased from 60 in 1997 to 90 in 2002, while total adults, including young nonbreeders, increased from 100 in 1997 to 218 by 2002.

REFUGE PRODUCTION

Refuge swan production has declined to almost nothing. Two pairs nested on the refuge in 1999 (a pair in Pool 7 and one in Pool 9), but no cygnets were hatched. The pair in Pool 7 hatched two cygnets in 2000, but none were brought to flight. The pair in Pool 7 (pen 52FA) and another pair in Pool 9 nested in 2001. Both pairs hatched three cygnets each with none surviving to flight. The pen (52FA) that had nested on Pool 7 for many years died on 14 February 2002. Her mate (S-28) remated for the 2002 nesting season, but no cygnets were produced (Table 5). They were the only nesting pair on the refuge in 2002. The primary cause for reduced production on the refuge has been directly tied to disturbance caused from drawdowns used to create winter food resources for the swans, and, potentially, cygnet predation by Snapping Turtles. Even though swan production on the refuge has declined to almost nothing, significant reproduction is occurring in the sandhills. Refuge management has deemed it more important to create wintering habitat for the swans since a large portion of the population overwinters on the refuge.

THE LIFE OF 52FA

52FA was originally captured by refuge staff on the refuge as an "after hatch year" (AHY) bird on 18 July 1988, meaning she was more than 1 year old. She is believed to have been at least 3 years old at the time of banding because refuge records indicate that a single young swan had been observed for at least 2 years in the refuge unit where she was captured. She was banded with an aluminum U. S. Fish and Wildlife Service (FWS) leg band (619-16583) and a yellow plastic collar and leg band inscribed 38FA. She was recaptured on 18 July 1991 with her aluminum leg band intact, but the plastic markers were gone. She was recollared as 52FA. Refuge records indicate that she resided on or around the refuge for most of her life. Though the record is

sketchy, she is believed to have nested in Pool 2 in 1991 hatching one cygnet, but losing it to hail later in the summer. Swan production on the refuge declined from 1990 to 1996 as nesting swans apparently began to move to the sandhills (Kraft 2000). The production record for 52FA is spotty prior to 1996, but she spent the last 6 years of her life on Pool 7 during the nesting seasons. She hatched two cygnets in 1996 and brought one to flight. In 1997, she hatched three cygnets, still had one in July, but lost it in August.

52FA produced three cygnets in 1998, but brought only one to flight. Her mate died in the fall of 1998 of unknown causes. The pen (52FA) remained with her single cygnet over the winter. She had a new mate for the 1999 breeding season. They developed a territory on Pool 7 again, but no young were hatched. Her new mate and her 1998 cygnet were captured and banded on 22 July 1999 as S-28 (FWS band 619-31955) and S-29 (FWS band 619-31956), respectively. It is believed that S-28 was a young cob. 52FA and S-28 nested on Pool 7 again in 2000. The pen laid a clutch of nine eggs, but only two hatched and both cygnets died during their first month. The pair nested again in Pool 7 in 2001 and hatched three, but none survived. . The saga continued when 52FA died on 14 February 2002 at, at least, 15 years of age. S28 remated in the spring of 2002 and the pair established a nesting territory in Pool 7 and was observed pair-bonding during the summer. No cygnets were hatched.

MIGRATION ATTEMPTS

The High Plains Trumpeter Swans apparently began wintering in the Nebraska Sandhills during the early 1990s when winter declines were noticed on Lacreek NWR. The winter migration to the Snake River and Blue Creek in the sandhills was confirmed in 1996. Aerial surveys of the Nebraska wintering area were expanded to include the North Platte River, Birdwood Creek, the Whitman, Nebraska area, and the North and Middle Loup River drainages. The wintering population continued to increase, peaking out at 455 Trumpeter Swans in January 1999, and then began a decline to 374 in January 2000, and down to 227 by January 2001 (Table 6). The January 2002 survey saw an increase to 319 and there was resurgence to 412 in January 2003 (Tables 4 & 7). The January 2000 decline was attributed to mild winter weather that left many sandhill wetlands open. It was believed that the decline in the survey was due to the swans being scattered in the myriad of open water wetlands that were too numerous to include in the survey. However, the major decline to the 227 swans observed during the 5 January 2001 aerial survey, when all sandhill wetlands, except those with running water, were frozen, leaves little doubt that an additional migration beyond the currently observed area is occurring. The aerial winter waterfowl survey conducted by the Nebraska Game Commission, also on 5 January 2001, revealed 15 Trumpeter Swans on the North Loup River just beyond the perimeter of the Lacreek survey area (Nick Lyman, pers. comm.), but no others. With no losses indicated by the increasing summer breeding population, additional winter migration to other areas is certain. A recent report of a fall sighting of Trumpeter Swans on the South Platte River in Colorado near Julesburg (Jack McGrath, pers. comm.) may indicate movement in that direction, but no further reports from that area have been received.

BANDING AND MARKING

Summer banding and marking continues in late June though July when the subadults are flightless. The refuge staff banded 26 Trumpeter Swans in July 2000. In 2001, refuge staff banded 33 swans during the summer. On 30 July 2002, the refuge banding crew, consisting of Refuge Biologist Kim Bousquet, Biological Technician Mike Artmann, and four YCC employees, banded six Trumpeter Swans at Scotchman Lake in Bennett County, South Dakota. Collars and tarsus bands (green w/ white letters) were S70-S75 with FWS #'s 619-27280 to 27285, respectively. An airboat was used to capture the molting swans. Morphological measurements were taken, auxiliary markers applied, and the birds released.

In 2000, the refuge discontinued (for the most part) using the hard plastic collars. The collars have a tendency to ice up during severe winter weather and can lead to unnecessary mortality. Trumpeter Swans were found with iced collars in December 1998. All of these swans were captured, deiced, and released. The collar ice removed averaged 4.4 lbs per bird. The birds could barely keep their heads off the ground. Since 2000, a total of 64 swans has been banded by the refuge. Of the 64 swans, 10 were fitted with collars. Those fitted with collars were located on the edge of their breeding habitats. Refuge managers are interested to know where these birds are wintering. The recent collars that ice up are made of a thick rigid plastic. Earlier collars were thinner and did not have as many icing problems, but were lost more often. The losses could be the result of icing, becoming brittle and breaking. The bird is saved, but the collar is lost. A new flexible collar

design is needed to minimize icing problems while providing high collar observability.

CONCLUSION

The High Plains flock of Trumpeter Swans is becoming self-sufficient by the use of natural wintering areas. Even though there has been a recent decline from the all-time high of 455 swans in the winter population in 1998, the population has rebounded back to 412 in 2002. All indications are that the recent midwinter decline may be the result of expansion of the winter migration outside of the current survey area. The steady growth of the summer breeding population demonstrates that the population is, indeed, increasing, giving no reason to believe that the winter decline is the result of mortality. The population goal of 500 Trumpeter Swans in the High Plains flock by 1990, set by the North American Waterfowl Management Plan in 1986, may soon be realized.

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Table 1. Peak population and production data for High Plains Trumpeter Swans based on the January 2003 winter aerial surveys in South Dakota and Nebraska.[1]

Calendar year	Adults	Cygnets	Total
2002	318	94	412
2001	274	45	319
2000[2]#	185	42	227
1999[3]	294	80	374
1998[2]	354	101	455
1997[2]	239	89	328
1996[4]	163	44	207
1995	118	34	152
1994	144	61	205
1993	122	42	164
1992	138	62	200
1991	105	45	150
1990	164	61	225

[1] This table reflects the wintering population on Lacreek NWR through 1996. An off-refuge wintering population in Nebraska was discovered in 1996.

[2] Includes new wintering areas found in the Nebraska Sandhills from the Snake River in Cherry County south to the North Platte River in Nebraska.

[3] Mild winter conditions resulted in open water on many wetlands. It is assumed that some small flocks were missed in the survey.

[4] Includes 58 adults and 7 cygnets observed on Lacreek NWR and 105 adults and 37 cygnets found on the Snake River in Cherry County, Nebraska.

Comprehensive winter survey -- apparently the swans are wintering beyond the survey area.

Table 2. Breeding performance of South Dakota, Nebraska, and northeastern Wyoming Trumpeter Swans (2002 Summer Survey).

Year	#Adults	#Pairs	#Broods	#Cygnets	Total
2002	264	67	38	121	385
2001	177	68	18	45	222
2000[1]	235	56	28	86	321
1999[1]	206	69	36	105	311
1998	184	62	35	91	275
1997	171	51	29	86	257
1996	129	52	22	78	207
1995	168	48	17	46	214
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

[1] No swan observation in northeast Wyoming.

Table 3. Changes in nonbreeding Trumpeter Swan numbers in the High Plains flock.

Year	# Flocks	# Nonbreeding Trumpeter Swans
2002	23	115
2001	8	34
2000	18	118
999	12	60
1998	9	48
1997	8	41
1996	5	23
1995	9	61
1994	8	47
1993	7	26
1992	5	25
1991	8	45
1990	10	46

Table 4. Winter peak population for the High Plains Trumpeter Swan flock in South Dakota and Nebraska for 2002. Aerial survey of 13-14 January 2003.

Location	Cygnets	Adults	Total
Pool 5[1]	21	72	93
Pool 6[1]		2	2
Pool 8[1]	10	39	49
Johnson			
Micheel			
Todd GMA			
Lacreek Area Total	31	113	144
Snake River	36	121	157
Cottonwood Lake[2]	8	31	39
Blue Creek	1	5	6
Keystone	4	4	8
Birdwood Creek	11	30	41
Whitman	0	8	8
North Loup River 1[3]	3	6	9
North Loup River 2[4]			
Sandhills Area Total	63	205	268
Grand Total	94	318	412

[1] On Lacreek NWR ground survey, total of 10 family groups.
[2] Cottonwood Lake along Hwy 61 about 12 miles south of Snake River (101°42' W, 42°25' N).
[3] Located west of Hwy 83.
[4] Located east of Hwy 83.

Table 5. Production data for Trumpeter Swans on Lacreek NWR.

Year	Nesting pairs	Broods	Hatched	Fledged
2002	1	0	0	0
2001	2	2	6	0
2000	1	0	0	0
1999	2	0	0	0
1998	2	1	3	1
1997	1	0	0	0
1996	2	2	2	1
1995	4	3	14	2
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

Table 6. Winter peak population for the High Plains Trumpeter Swan flock in South Dakota and Nebraska for 2000. Aerial survey of 5 January 2001.

Location	Cygnets	Adults	Total
Pool 7[1]	0	1	1
Pool 8[1]	12	47	59
Johnson	2	1	3
Micheel	0	2	2
Todd GMA	2	5	7
Lacreek Area Total	16	56	72
Snake River	23	64	87
Blue Creek	2	8	10
Oshkosh, NE	0	3	3
Keystone	0	9	9
Birdwood Creek	0	18	18
Whitman	0	0	0
North Loup River	1	27	8
Sandhills Area Total	26	129	155
Grand Total	42	185	227

[1] On Lacreek NWR.

Table 7. Winter peak population for the High Plains Trumpeter Swan flock in South Dakota and Nebraska for 2001. Aerial Survey of 10 January 2002.[1]

Location	Cygnets	Adults	Total
Pool 5	0	3	3
Pool 6	0	15	15
Pool 8	2	8	10
Johnson	4	20	24
Trout Pond #2	0	2	2
Lacreek Area Total	6	48	54
Snake River	26	98	124
North Loup River	6	46	52
Middle Loup River			
Blue Creek	0	14	14
Keystone/Paxton	3	48	51
Birdwood Creek	4	18	22
South Platte River[2]		2	2
Sandhills Area Total	39	226	265
Grand Total	45	274	319

[1] Open water as a result of the mild winter allowed the swans to winter in nontraditional areas that were not surveyed. [2] The South Platte River was flown from North Platte, Nebraska, to Julesburg, Colorado.

THE ONTARIO TRUMPETER SWAN RESTORATION PROGRAM 2002

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ABSTRACT

The Ontario captive Trumpeter Swan (*Cygnus buccinator*) breeding stock had a disappointing year in 2002. Survival of cygnets that were hatched was lower than usual. Six mature birds were lost and there will be fewer breeders than usual in 2003. The production of wild breeders was estimated at 106, which is double that of 2001. Wild-hatched cygnets survive better than those that are captive-hatched and released at 4 to 6 months of age. It appears that the introduction of Alaska breeding stock into the program's Yellowstone captive breeding stock has improved hatchability by about 15% but may not have improved survival of cygnets.

INTRODUCTION

The Ontario Trumpeter Swan (*Cygnus buccinator*) restoration program has been operating for 21 years. The objective is to restore the species to its former range in Ontario. When the production of wild Trumpeters reaching breeding age of 3 to 4 years exceeds annual mortality, the population should be self-sustaining. However, to achieve this goal, annual mortality must be reduced. It is disturbing to see an increase in the number of swans that have been shot. Two were killed and stacked one on top of the other and left on the bank of the Grand River near Glen Morris on 17 December. We have evidence of others that were wounded by hunters.

The flock is spreading out. Over the years, there have been reports of birds as far east as Ottawa, west to the Bruce Peninsula, north to the Hudson Bay Lowlands, and south as far as Virginia. Most of the Trumpeters remain in the area between Sudbury, Georgian Bay, and Lake Ontario.

CAPTIVE PAIR PRODUCTION 2002

There were 23 breeding pairs of Trumpeters in the hands of cooperators in 2002. It was a disappointment that six of these pairs did not nest. Probably the reason for two not nesting was that they were moved in 2001 to a strange pond. Our experience in the past has been that they often take more than a year to settle down and breed when moved. It is unknown why the other four pairs did not nest. Another pair nested on the bank of the pond, not on the raft that was provided for them. The female laid one egg but was killed by a coyote.

Six breeders were lost this year, four females and two males. The oldest was 25 years old and had bred successfully in the program for the past 8 years. Also dead were a 12-year-old male and 17-, 12-, and 10-year-old females. There was one female of unknown age. We shall start 2003 with fewer captive breeders than we have had in the past.

In 2002, altogether, 16 pairs incubated 98 eggs from which 71 (72%) cygnets hatched and 46 (65%) survived to 1 September. Average clutch size was 6.1, slightly below the long-term mean of 6.3. The hatch at 72% was well above the 5-year average of 65%. What really made 2002 a disappointing year was the poor survival of cygnets. In 2001, 10 of 14 (71%) broods contained five or six cygnets, but in 2002, only 5 of 10 (50%) were as large.

In 1993, Trumpeter eggs were collected in Alaska to diversify the gene pool of our inbred captive breeding stock. Hatchability of our birds, most of which came from the Greater Yellowstone area, was about 56% over an 18-year period. The introduction of Alaskan birds into our captive breeding stock has improved productivity, but the survival of cygnets was virtually unchanged. Table 1 summarizes the success rates of the mixed and pure matings. Data from 1993 to 1996 are not included because the data are not strictly comparable. In those years, pairs were double clutched and first clutches were hatched in unreliable incubators.

PRODUCTION OF WILD TRUMPETER SWANS IN SOUTHERN ONTARIO

Surveys by air and on the ground and reports from the public located many wild pairs in 2002. They were widely distributed and most were in habitat that could support broods. A few of these "pairs" cannot be considered potential breeders. Trumpeter Swans seem to like company and siblings, two subadult males or females, may associate through the summer

months. True mated pairs may not nest because of age, disturbance, or proximity to dominant breeding pairs. Some nests were not found and it is uncertain if some apparently barren pairs actually bred, but failed to hatch their eggs or raise cygnets.

Forty-three pairs are known to have laid eggs this year compared to 33 (corrected total) in 2001. Some broods may still appear as they did last year when four turned up after the annual report was distributed. Of the 43 nesting pairs, 34 (79%) succeeded in hatching cygnets compared to 18 (62%) in 2002. This year, 106 cygnets survived until 1 September giving us a mean brood size of 3.1, which is close to the long-term average. In 2001, 50 cygnets were produced and the mean brood size was 3.8.

SURVIVAL AND LOSSES OF WILD TRUMPETER SWANS

In our 2001 report, it was estimated that there were 348 Trumpeter Swans in southern Ontario. After the report was circulated, four new broods turned up numbering 8 adults and 10 cygnets, making the total for 2001, 366 swans. Two of these late migrating broods contained marked adults. The nesting location of these birds is unknown and they have not yet appeared as of late December 2002 on their wintering grounds. Since 2 September 2001, 31 marked swans disappeared, 5 died accidental deaths, 5 were lead poisoned, 2 were found dead, 1 was shot, and 1 was injured and taken into captivity. Thus, there were 44 losses during the year. In addition, there is still one undergoing treatment after having been wounded by a hunter. This bird is expected to recover. The loss for the year was 18%, which is close to the long-term average.

In 2002, the tag numbers of 196 swans were recorded. We estimate from counts at concentrations of swans that another 25% (49) had lost their wing tags or were wild-bred birds that had never been tagged. There were likely 245 survivors in southern Ontario in 2002. To these must be added 49 released birds and 106 wild-bred cygnets produced in 2002. Thus, there was an estimated 400 wild Trumpeter Swans on the 1st of September in southern Ontario.

We trap and colour mark as many wild-hatched cygnets as we can. All captive-raised swans are marked before release. We have found that wild-hatched cygnets breed on average at 3.2 years of age as compared with 4 years of age for those hatched in captivity. There is a statistically significant difference to age 3 in survival between wild- and captive-raised cygnets (Lumsden and Drever 2002). Table 2 suggests that the 47 tagged wild-hatched cygnets may survive better than the 58 tagged captive-raised birds, at least to 4 years of age. Furthermore, it seems likely that these wild-hatched birds will have higher lifetime productivity than their captive-raised competitors. Our capacity to produce swans in captivity is limited and it will not be long before wild-hatched birds will outnumber those released. As this happens, overall productivity of the population will rise until other factors begin to limit population size.

TRUMPETER SWANS IN EASTERN ONTARIO

On Big Rideau Lake, a pair of Trumpeters nested and raised three cygnets. In November, 5 additional swans joined the group making a total of 10. One carried a wing tag indicating that it had been released at the Mac Johnston Wildlife Management Area (WMA). The captive female at the WMA, which was taken over by a wild male in 2001, nested and laid five eggs. She did not use the nesting raft provided and her eggs on the shore were scattered by a predator and failed to hatch.

The Mac Johnston WMA consists of a very large marsh in which it is extremely difficult to count swans. It is likely that most of the swans released in 2000 have survived. Some have spread into surrounding wetlands. Two pairs bred and returned to the marsh with one and four cygnets. There is an estimated 25 swans in eastern Ontario.

TRUMPETER SWANS IN KENORA DISTRICT

We have no information on swans from the Kenora District due to the Ontario Public Service Union strike in the summer and the prevalence of forest fires which occupied Ontario Ministry of Natural Resources staff at the critical period.

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Table 1. Productivity of Alaska X Yellowstone Trumpeter Swan pairs compared with Yellowstone X Yellowstone pairs.

1997-2002	Alaska X Yellowstone	Yellowstone X Yellowstone
6 years	11 pairs[1] 372 eggs	8 pairs[1] 274 eggs
Hatch percent	72%	57%
Survival of cygnets to 1 September	73%	77%

[1] Not every pair bred successfully each year.

Table 2. Survival of colour-marked wild-hatched Trumpeter Swan cygnets compared to those captive-hatched.

	Number in sample	Survival to 1 year	Survival to 2 years	Survival to 3 years	Number in sample	Survival to 4 years
Wild-hatched	47	39 (83%)	33 (70%)	31 (66%)	42	26 (62%)
Captive-hatched	58[1]	47 (81%)	34 (59%)	23 (40%)	54	11 (20%)

[1] Released to the wild during their first fall at 4-6 months of age.

2002 NESTING SUCCESS OF THE TRUMPETER SWAN *(CYGNUS BUCCINATOR)* POPULATION THAT FREQUENTS THE WYE MARSH, ONTARIO

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ABSTRACT

Wye Marsh, located on the southeastern shore of Georgian Bay on the boundary of Midland, Ontario, contains about 500 hectares of provincially significant wetland. The Wye Marsh Wildlife Centre, managed by the Friends of Wye Marsh Inc., has been a main cooperator since 1988 in the Trumpeter Swan (*Cygnus buccinator*) reintroduction program in Ontario, co-coordinated by Harry G. Lumsden. In 2002, 115 individual Trumpeters visited the Wye Marsh; 86 of these are tagged and/or banded. This represents nearly one-third of the total Ontario population, estimated to number 400 swans in 2002. Each year, nesting research is conducted to gather and document data on the local population. Overall nesting success of the Trumpeters within the Wye Marsh study area in 2002 was less than 2001 and slightly better than 2000. In 2002, 13 pairs of Trumpeters are known to have nested in the Wye Marsh and surrounding area, including 3 pairs returning to the Wye Marsh with fledged cygnets, compared to 17 pairs in 2001 and 11 in 2000. Seven of the 10 known nests in 2002 were successful, with an average clutch size of 5.5 eggs (range 3-9) and a hatching rate of 71%, compared to 79% in 2001. In 2001, 11 nests were successful. However, egg counts are available for only five of these nests, which had an average clutch size of 4.8 (range 1-9) and a total of 24 eggs. In 2002, 29 cygnets are known to have fledged, down from 32 in 2001 and up from 26 in 2000. Since 1988, data on over 175 individual Trumpeters have been collected. A project currently underway involves collecting all available data and constructing a Microsoft Access Database. This database will include a list of all Trumpeters, whether still alive or now dead, that were hatched in the Wye Marsh and surrounding area, as well as document those that have frequented the Wye Marsh. Data collected include: tag numbers, year hatched/died, location of hatching/death, parents, siblings, injuries, causes of death, and nest locations and territories. This database will provide a greater understanding of the Wye Marsh Trumpeter Swan population.

INTRODUCTION

Wye Marsh

Wye Marsh is geographically positioned on the southeastern shore of Georgian Bay, nestled in the Wye Valley. Located just outside the town of Midland (a 2-hour drive northwest of Toronto), the Wye Valley includes a 920- hectare provincially owned Wildlife Area and 60 hectares of federally owned property (Bowles 2002). The Wye Marsh Wildlife Centre is situated on federally owned property, in the northeastern portion of the Wye Valley, and provides an access point for many environmental programs and events. The Wye Marsh can be considered outstanding in that three different types of wetlands exist (marsh, fen, and swamp) each adding to the complexity and natural beauty of the marsh. Mud Lake, found within the Wye Marsh, is slowly being filled by floating mats of cattails, the dominant vegetation found in the marsh, but also provides prime habitat for many nesting bird species. The Wye Marsh is also recognized as an Important Bird Area since Species at Risk, outlined by the Ontario Ministry of Natural Resources (OMNR), use the Wye Marsh for nesting and/or staging. These bird species include: the indeterminate Trumpeter Swan (*Cygnus buccinator*), the vulnerable Black Tern (*Chlidonias niger*), the vulnerable Least Bittern (*Ixobrychus exilis*), the endangered King Rail (*Rallus elegans*), and the vulnerable Yellow Rail (*Coturnicops noveboracensis*) (OMNR 2002).

Trumpeter Swans in Ontario

Originally native to Ontario, the Trumpeter Swan became extirpated from eastern Canada roughly 200 years ago primarily due to hunting pressure (Coxon 2002a). Populations remaining in the western prairies were also severely affected by over-hunting and were eventually greatly reduced. These populations have since rebounded to the tens of thousands, while the Ontario population numbered 400 swans in 2002 (Lumsden, in press). The total Ontario population is now estimated at 406 after 6 additional cygnets were reported late in the season (H. G. Lumsden pers. comm.).

In 1982, biologist Harry Lumsden initiated the Ontario Trumpeter Swan Re-introduction Program.

The first captive pair arrived at the Wye Marsh Wildlife Centre in 1988, and were named Big Guy and Lady Girl (or Wye and Marie, to some). In 1990, Wye Marsh staff witnessed the hatching of two eggs, the first Trumpeter Swans produced in the Wye Marsh in over 200 years. A Snapping Turtle predated one of the cygnets shortly after hatching, while the other, a female, survived to become known affectionately as Pig Pen, who in 1993 raised the first known wild family of Trumpeter Swans in Ontario in over 200 years (Coxon 2002a). The Wye Marsh now supports and monitors 115 Trumpeters.

The Trumpeter Swan nest

Female Trumpeter Swans are surprisingly elusive during nesting season. Simply because of the bird's large size and distinctive white colour, one might think it would be easy to find a Trumpeter Swan nest. However, the female usually chooses a nest site within a secluded cattail marsh where she can hide in comfort. Canoeing down a marsh channel you may be lucky enough to spot the territorial male, but while he leads you away from the nest, the female Trumpeter could be concealed in a cattail stand.

The actual Trumpeter Swan nest can reach dimensions of 1.5m by 1.5m and 0.5m high. The nest is constructed by both the male and female, and consists primarily of cattail stalks and lesser amounts of other aquatic vegetation. The female lays three to nine creamy white eggs in a small depression on top of the nest. She will lay one egg every 43 hours beginning in late April or early May, and will not incubate until all eggs have been laid. The male Trumpeter will occasionally tend to the nest while the female feeds; however, most of the time the female will sit and tend the nest. Incubation time of the Trumpeter Swan is approximately 31-35 days from the time the female begins incubation (H. G. Lumsden pers. comm.). The first Wye Marsh cygnets of 2002 hatched on 8 June.

METHODS

Media releases encourage people from across Ontario to call or e-mail the Wye Marsh Wildlife Centre (1-705-526-7809 or www.wyemarsh.com) with Trumpeter Swan sightings throughout the year. These sightings are documented and filed for future reference and monitoring. A large portion of the Ontario Trumpeter Swan population is wing tagged and leg banded. These tag numbers can be read through binoculars. The tag number distinguishes a particular swan, and data for each individual swan are available based on this tag number.

Trumpeter Swans generally mate for life (although separation is known to occur) and one of the difficult tasks is trying to identify these mated pairs, although many pairs have already been identified in previous years' research. The easiest way to identify a mated pair is to observe the pair with cygnets. However, in the interest of finding nests, these mated pairs need to be identified in the spring. After swans are consistently seen together, they are designated as pairs. In some cases, pairs can be observed copulating before moving to their established and defended territories. Once a list of mated pairs is produced, nests and nesting territories need to be found. An aerial survey is one way to find these territories.

In the summer of 2002, two aerial surveys were conducted, one on 16 May with pilot David Killing from the Midland Airport and one on 16 July with pilot Barry Parker from the Collingwood Airport. The survey conducted on 16 May provided the location of five nests in the Wye Marsh and immediate area. Nests are easy to find from the air as the female generally does not leave the nest and her large white body can be spotted easily. When a nest was spotted from the air, a picture was taken of it. This picture was then used for guidance when approaching the nest by canoe. Upon arriving at the nest, the mated pair was identified and an egg count conducted. Nests were visited more than once, unless accessibility proved too difficult. For the purposes of the 16 July aerial survey, it was expected that nests within the Wye Marsh and surrounding area had hatched and family units could be observed from the air. The aerial survey was used to monitor Trumpeter Swan movements and to discover families that had not been discovered during the previous flight.

RESULTS

Wye Marsh nesting pairs

The aerial survey conducted on 16 May recorded four pairs of Trumpeter Swans nesting in the Wye Marsh, down from eight in 2001. A nesting summary is shown in Table 1.

A Trumpeter pair with tags #641 and #438, named Brutus and Amazon, nested in the Wye Marsh Sanctuary. The nest was visible from the walking trails. Amazon produced three eggs, all of which hatched on 8 June 2002. One cygnet went missing and two fledged. This pair has since migrated to the north shores of Lake Ontario near Burlington for the

winter (Figure 1). The family is expected to return to the Wye Marsh Sanctuary in April 2003.

Pair #515 and #516, named Jack and Diane, nested within the Wye Marsh Sanctuary. The nest was only accessible by canoe. Diane laid eight eggs; seven hatched on 11 June. Three cygnets went missing and four fledged. This pair has been observed at the Wye Marsh into December and is expected to stay for the winter.

Pair #538 and #368 (Curly and unnamed) built their nest near the Ste. Marie Dam. The nest was visible from the dam, but only accessible by canoe. Curly laid four eggs; three hatched and one went missing. Two cygnets fledged and are often seen at the Wye Marsh. They are expected to stay for the winter.

An unknown pair, untagged, unbanded, and unnamed, nested in the South end of the Wye Marsh, near the Ducks Unlimited Management Area known as Preston Cell. The female laid three eggs, but due to the nest's inaccessibility, it is unknown whether it was successful. The aerial survey conducted on 16 July showed that the pair had moved into Preston Cell. However, during a canoe visit to Preston Cell on 7 August, the pair was observed without cygnets. It is unknown whether the eggs hatched. The location of this pair was unknown as of early January 2003.

Nesting pairs outside of the Wye Marsh

There are many pairs of Trumpeter Swans that nest outside of the Wye Marsh. Unfortunately, it is difficult to locate them because of the expanse of the study area and available habitat. Each year the study area increases due to an increasing swan population and also overlaps with research conducted by Harry Lumsden who is responsible for all of Ontario. The study area for the 2002 research extends from Penetanguishene in the northwest, to MacTier in the north, to Lindsey in the east, to LeFroy in the south, and to Wasaga Beach in the west (Figure 1). In the 2002 nesting season, seven pairs of Trumpeter Swans (six in 2001) nested successfully outside the Wye Marsh. Additional pairs may also have been successful but their locations are unknown.

Successful nesting pairs

The successful pairs nesting outside the Wye Marsh are summarized in Table 2.

Pair #364 and #341, both unnamed, nested near Port McNicoll, 3 km northeast of Wye Marsh. #341 laid seven eggs (two of which were found outside the nest) and hatched five. All cygnets fledged and migrated to Lake Ontario for the winter.

An unknown pair nested on Matchedash Bay near Waubaushene. The nest was spotted from the aerial survey conducted on 16 May, found and searched 18 June. Shell fragments suggested that nine eggs were laid, and eight hatched. The family was spotted on 18 June with at least six cygnets, suggesting two cygnets were missing. The current location of this family is unknown, although it is possibly one of the families visiting the Wye Marsh on a regular basis.

An untagged and unbanded pair, known as Honk and Weezy, nested on Barnstable Bay, Lake Simcoe. The nest was discovered on 29 May on the north side of the bay and contained nine eggs. A local swan spotter observed the family with eight cygnets on the south side of the bay 6 June. Two cygnets have since gone missing, while six survived to fledge. The current location of the mated pair and four of the cygnets is unknown. Two of the cygnets were caught in late November for treatment of lead poisoning, and subsequently died in late December.

Another untagged, unbanded, and unnamed pair nested in McClaren's Creek near Lindsay. Shell fragments were found in the nest on 29 May suggesting that three eggs were produced. It was confirmed that all three eggs hatched since the family was seen the same day with three cygnets. The current location of this family and the fledging status of the cygnets are unknown.

#370 and an untagged, unbanded mate are known to have successfully nested by their return to the Wye Marsh in late fall with four cygnets. The nesting location of this pair is unknown, but presumed to be Matchedash Bay. This pair also produced four cygnets in 2001.

#367 and an untagged, unbanded mate also returned to the Wye Marsh in late fall with four cygnets. Their nesting location is also unknown. There is no record of this pair nesting in previous years.

A pair of untagged, unbanded swans arrived at the Wye Marsh in late fall with two cygnets. Their nesting location is unknown.

Unsuccessful nesting pairs

In 2002, two pairs, #402/#496 and #390/#396 (Table 2), built nests outside of the Wye Marsh and laid eggs, but both nests failed.

Pair #402 and #496, also known as Tim and Punky, nested on a small pond in the Wye Marsh wetland complex. The pen laid five eggs, but upon return to the nest on 26 July, no eggs or cygnets were found. It is presumed that the eggs did not hatch, as shell fragments could not be found.

Pair #390 and #396 built their nest and produced four eggs on a small pond near LeFroy. A search conducted on 23 July found only one egg remaining, which was taken. Unfortunately, it burst due to pressure within the egg. Evidence of the other three eggs could not be found. The absence of shell fragments indicated that none of the eggs hatched.

Other potential nesting pairs in 2002

Due to time and resource constraints, it is unknown whether other potential nesting pairs were successful. Potential nesting pairs are defined as pairs that have produced cygnets in the past or have established nesting territories. Pair #220 and #366 are known to have established a nesting territory near Penetanguishene. These swans have produced cygnets in previous years. #369 and $456 have established a territory near the Wye Marsh. #455 and #611 are thought to have nested, but their location is unknown. #459 and #460 established a territory on Sturgeon Bay, but it is unknown if they constructed a nest. #487 and $556 nested and produced cygnets in 2001, presumably on Sparrow or Grass Lake, although this is unconfirmed. #504 and #593 may have nested in 2002 near Washago on Lake St. John. #554 and #499 may have nested near Lagoon City. #468 and #620 nested and produced cygnets in 2001 in Tiny Marsh, but did not nest in 2002.

DISCUSSION

Failed nests

The 2002 nesting season research has determined that 3 out of 13 nests were unsuccessful. Harry Lumsden, the head biologist for the Trumpeter Swan Re-introduction Program in Ontario, reported that "the total production by Ontario wild breeders was estimated at 106, which is double that of 2001" (H. G. Lumsden pers. comm.). Swans nesting at the Wye Marsh and surrounding area decreased marginally from 32 in 2001 to 29 in 2002. The difference in the 2 years can probably be attributed to the deaths of two male swans in 2001, which have raised broods in the past. Wye Marsh's captive male was killed in a territorial fight when a younger pair landed inside the captive pairs' breeding pen. The female was moved to another cooperator. This same younger pair also killed swan #309 in a territorial dispute outside of the breeding pen.

Unknown locations of nesting pairs

There were many potential nesting pairs that could have nested in the study area, but due to time and money constraints the nests were not found.

Overall success of 2002

There was a total of 13 known nesting pairs of Trumpeter Swans. However, three nests were not found but known to be successful because three pairs returned to the Wye Marsh with fledged cygnets. Seven of the 10 known Trumpeter nests successfully hatched eggs (70% success rate), while five of the associated Trumpeter pairs raised cygnets to fledglings. A total of 55 eggs were found in 10 nests, giving an average clutch size of 5.5. Thirty-seven of 52 eggs hatched (it is unknown if three eggs hatched from a pair that nested in the Wye Marsh), which is a 71% hatch rate. Twenty of the 37 known-hatched cygnets were classified as missing or lost. Some of these disappearances may be due to predation, but predation was not witnessed in 2002. As of January 2003, there were 27 remaining cygnets, 17 from known nests and 10 from unknown nests that returned to the Wye Marsh in the fall staging area.

2000 – 2002 nesting comparison

The overall nesting of the Trumpeter Swans within the study area in 2002 was less productive than 2001 and slightly better than 2000 (Table 3). In 2000, 11 pairs of Trumpeter Swans were known to have nested in the Wye Marsh and surrounding area; 26 cygnets fledged. In 2001, a total of 17 pairs of Trumpeters nested, but only 11 nests were successful. Egg counts are only available for 5 of the 17 nests in which 24 eggs were found; 10 hatched. A total of 33 cygnets from the 11 nests survived to fledge (Coxon 2002b). In 2002, 13 pairs of Trumpeters were known to nest. Ten of these nests were found and seven were successful. A total of 55 eggs were found, and 37 of these hatched. Twenty-nine cygnets fledged.

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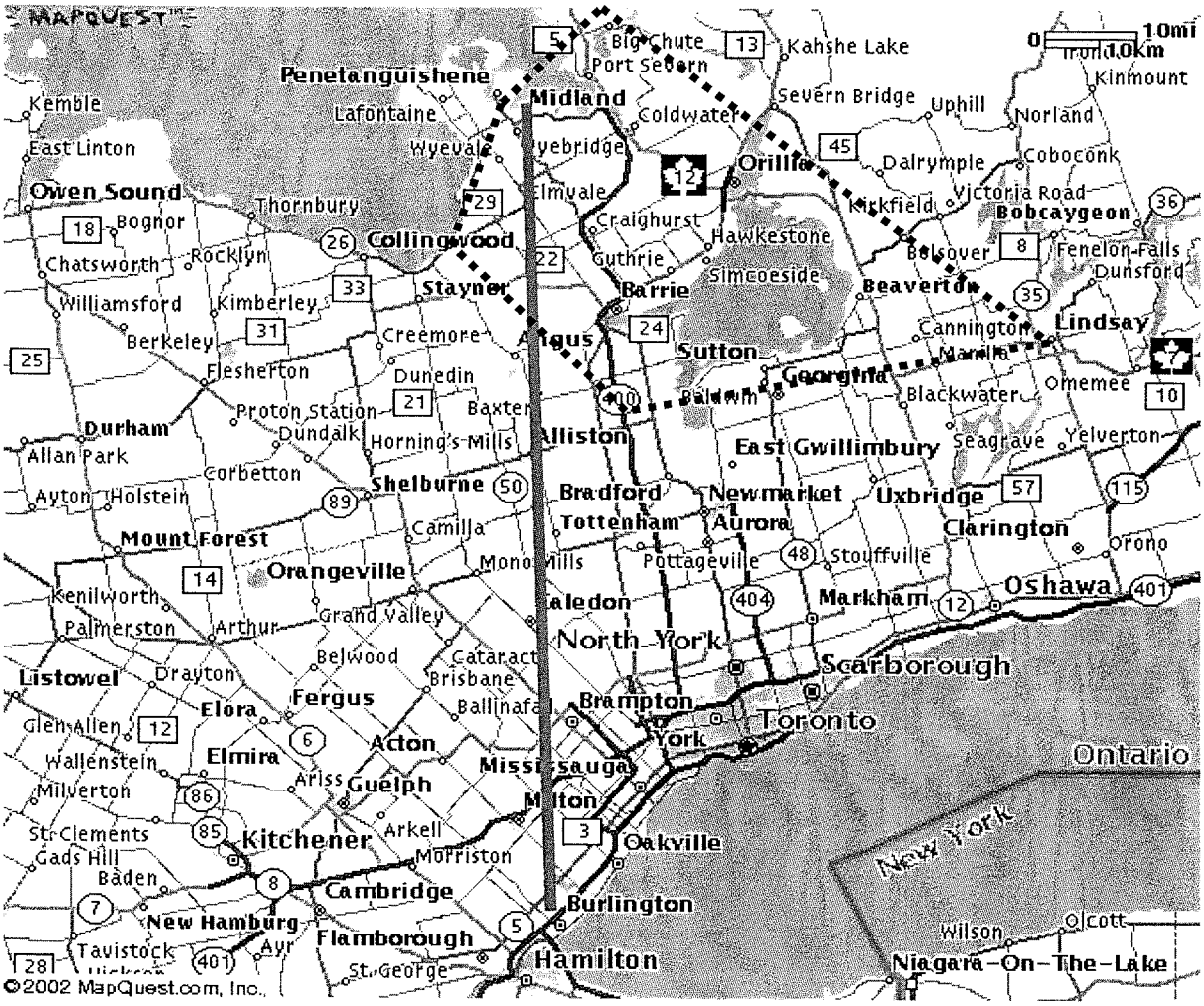

Figure 1. Migration route and study area.

Migration Route (~175km)

Study Area

Table 1. 2002 results for Trumpeter Swan pairs known to nest within the Wye Marsh.

Female tag #	Male tag #	Nest location	Number of eggs	Hatch date	Number of eggs hatched	Number of cygnets fledged	Number of cygnets lost
438	641	Wye Marsh Sanctuary	3	June 8	3	2	1
516	515	Wye Marsh Sanctuary	8	June 11	7	4	3
538	368	Wye Marsh	4	June 17	3	2	1
UTUB[1]	UTUB	Wye Marsh	3	Unknown	Unknown	0	----

[1] UTUB = untagged and unbanded.

Table 2. 2002 results for Trumpeter Swan pairs known to nest outside the Wye Marsh.

Female tag #	Male tag #	Nest location	Number of eggs	Hatch date	Number of cygnets hatched	Number of cygnets fledged	Number of cygnets lost
341	364	Port McNicol	7[1]	June 5	5	5	0
Unknown	Unknown	Matchedash Bay	9	~ June 8	8	Unknown	Unknown
UTUB[2]	UTUB	Barnstable Bay - Lake Simcoe	9	~ June 6	8	6	4
UTUB	UTUB	McLaren's Creek - Lindsey	3	~ May 25	3	Unknown	Unknown
496	402	Pond off Old Fort Rd	5	Failed	0	0	----
396	390	Pond near LeFroy	4	Failed	0	0	----
UTUB	370	Unknown	Unknown	Unknown	Unknown	4	Unknown
367	UTUB	Unknown	Unknown	Unknown	Unknown	4	Unknown
UTUB	UTUB	Unknown	Unknown	Unknown	Unknown	2	Unknown

[1] 7 eggs were laid of which 2 were found outside the nest.
[2] UTUB = untagged and unbanded.

Table 3. Nesting comparison of known Trumpeter Swan nests in the Wye Marsh and surrounding area, 2000-2002.

Year	Number of nests found	Number of nests successful	Nest success rate (%)	Number of eggs	Average clutch size	Range of clutch size	Number of eggs hatched	Hatching rate (%)	Number of cygnets fledged
2000	11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	26
2001	17	11	65	24	4.8[1]	1/9	10	42	32
2002	10	7	70	55	5.5	3/9	37	71[2]	29

[1] Egg counts are available for only 5 of the 17 nests.
[2] 37 of 52 eggs, since hatching status of 3 eggs is unknown.

WINTER DISTRIBUTION AND HABITAT USE OF TRUMPETER SWANS IN ILLINOIS

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ABSTRACT

Efforts to reestablish a population of Trumpeter Swans (*Cygnus buccinator*) in the Midwestern United States have focused mainly on establishing breeding populations. Little effort has focused on the migration and winter period. All records of swans sighted in Illinois were gathered to determine winter distribution throughout the state and changes in distribution across years were reviewed. Swans wintering at a site in southern Illinois were studied for 2 years to determine migration chronology, population size, and habitat use. During 1985-2001, swans (n = 152) were sighted at 109 different locations in 63 of 102 Illinois counties. Four locations that swans have consistently used in Illinois during the past 5 years were identified. In addition, an increasing population of swans has been wintering at the U.S. Army Corps of Engineer Riverlands property in Missouri across the Mississippi River from Alton, Illinois. At Burning Star 5, peak winter counts have increased since 1994 when the birds first arrived. During 2001-02 and 2002-03, peak counts were 71 (48 adults, 23 cygnets) and 77 (59 adults, 18 cygnets), respectively. The increasing populations at all sites suggest they contain suitable habitat to meet the migratory and winter requirements of Trumpeter Swans. Further study of these areas would provide information for developing a sound management plan for wintering Interior Population Trumpeter Swans in the Mississippi Flyway.

INTRODUCTION

Public interest in reestablishing Trumpeter Swans (*Cygnus buccinator*) on traditional parts of their upper Midwest breeding grounds led to reintroduction programs in six states and two provinces starting in 1960. These programs have been successful at rebuilding the population from zero to an estimated 2,430 birds in 2000. Now, these birds are managed as a distinct population, the Interior Population (IP), by the Mississippi Flyway Council (Caithamer 2001). Ultimate success of this program will depend on establishing a self-supporting migratory population. However, only a small proportion of the reintroduced IP Trumpeters migrate south of 40° N. In fact, some states discourage migration in an effort to prevent winter mortality (Gillette 1997). Because food resources are unpredictable in northern latitudes during winter, state agencies and the public have developed supplemental feeding programs which, as of 1998, were estimated to feed greater than 80% of the IP population (Ad Hoc Swan Committee 1998).

Efforts to reintroduce Trumpeter Swans in the Midwestern United States have focused mainly on establishing breeding populations. Little effort has focused on the migration and winter period. As a result, we know little about what comprises suitable habitat during migration and winter, the location of stopover sites during migration, the timing of arrival and departure on winter sites, and swan distribution during winter. Historically, birds relied on foliage, rhizomes, and tubers of aquatic vegetation, but such habitat is no longer common within the IP's wintering area. Tundra Swans (*Cygnus columbianus columbianus*) have adapted to human influences by feeding extensively in agricultural fields for waste grain. However, this behavior has not been commonly observed for introduced Trumpeter Swans in the Midwest and it is unclear how migrating swans are using the landscape. While some aspects of how the Pacific Coast and Rocky Mountain Populations of Trumpeters use their wintering grounds are known, the Midwest provides habitat and weather conditions not found in these regions. Therefore, information collected in those areas may not be applicable to the Midwest.

Because information on winter distribution and habitat use are lacking, there is no consensus on how to manage for wintering swans in the Mississippi Flyway (Ad Hoc Swan Committee 1998). Furthermore, it is unclear if sufficient winter habitat exists to support management plan goals, it is difficult to manage habitats during migration or

winter to support Trumpeter Swans, and it is difficult to identify new areas possibly suitable for supporting wintering swans. Information on swans that are naturally pioneering new wintering traditions provides the opportunity to fill these information gaps thereby enabling state and federal agencies to develop management plans for migrating Trumpeters as specified in the 1998 Mississippi Flyway Council Management Plan. In this study, we gathered all records of swans sighted in Illinois since reintroductions began to characterize their winter distribution in the state and look at changes in distribution across years. In addition, we report data on arrival and departure dates, length of stay, and habitat use for a naturally pioneering population of swans wintering on a reclaimed surface coal mine in southern Illinois.

STUDY AREA

Land cover in Illinois consists primarily of row crop (77.5%; primarily corn and soybeans) and pasture (Luman *et al.* 1996). Wetlands (including shallow marsh/wet meadow, deep marsh, bottomland forest, swamp, and shallow water) cover 3.2% of Illinois and open water (rivers and lakes) comprises 2.1% of Illinois surface area (Luman *et al.* 1996). The remainder of the state is covered by forest (11.3%) and 4% urban areas/developed (Luman *et al.* 1996). Public land in Illinois comprises 2.1% of total area and includes 8 national wildlife refuges (66,960 ha), 64 state parks (42,466 ha), 22 state fish and wildlife areas (40,047 ha), 25 state conservation areas (32,107 ha), 253 nature preserves (13,646 ha), 1,080 natural areas (119,880 ha), 6 state forests (7,921 ha), and other federal land (387,036 ha) (IDNR 1996).

Data on migration chronology, population size, and habitat use were collected on Burning Star 5 (BS5), a 2,025-hectare reclaimed surface coal mine located in Jackson County (Figure 1). Mining on BS5 ceased in 1989, and subsequent reclamation created 111 ha of wetlands, 81 ha of deep water lakes, 243 ha of native upland cover, and 1,590 ha of agricultural crops. Deep water included final cut and incline lakes that resulted from mining practices. These lakes were >30 m deep and typically did not freeze during winter. Submergent vegetation occurred in a 2-meter-wide strip along the shore of the incline and final cut lakes. Plant species in that zone included *Potamogeton americanus*, *Potamogeton* spp., *Chara* spp., *Ceratophyllum* spp., *Isòetes* spp., and *Jussiaea diffusa*. Crops on BS5 included corn (*Zea mays*), soybean (*Max glycine*), milo (*Sorghum* sp.), and winter wheat (*Triticum aestivus*). Public access to BS5 was restricted, although limited waterfowl and deer hunting did occur. BS5 supported large numbers of other waterfowl during winter, including as many as 50,000 geese (IDNR, unpubl. data). Average temperature for the area during November-March (2001-02 and 2002-03) was 3.22° C; average precipitation was 9.40 cm (Illinois Water Survey).

METHODS

To determine change in population size and distribution, data was gathered on all swan sightings from the 102 counties of Illinois during 1985-2001. Swans were recorded by Illinois Department of Natural Resources (IDNR) personnel during aerial surveys designed to monitor Canada Goose (*Branta canadensis*) populations. In addition, the database included all sightings reported by the public.

At BS5, we began reading collars during winter 1999, and collected data on habitat use and chronology at BS5 and surrounding areas during winters 2001-02 and 2002-03. To determine migration chronology, species composition, and temporal population changes of swans wintering in southern Illinois, several methods were used. First, we conducted weekly surveys of agricultural fields and wetlands on BS5 from 15 November to 15 March 2001-03. Surveys were begun at sunrise to ensure birds were still on their night roost and to minimize the likelihood of double counting individuals. Second, aerial surveys were conducted of the areas around BS5 in late winter (February 2002 and March 2003) to determine if swans missing from BS5 were in the area or had begun migration. Finally, all locations were visited in southern Illinois located south of Interstate 64 where swans were sighted either by the public or during aerial waterfowl surveys conducted by IDNR. If the swans could be located from the ground at these sites, we would visit once a week until the swans departed. For all surveys on BS5 and elsewhere, a 20-60x spotting scope was used to read collars, count swans by species (*C. olor, C. c. columbianus,* or *C. buccinator*), determine age composition of flock (adults and juveniles), and determine habitat being used (aquatic, agricultural). Juveniles of all species were identified by their gray plumage.

To determine habitats used by Trumpeters, the day was divided into 2-hour-time periods (0.5 hr before sunrise to 0800, 0800-0959, 1000-1159, 1200-1359, 1400-1559, and 1600-0.5 hr after sunset). Swans were located in three randomly chosen time periods each day. All locations were at least 2 hours apart from each other. During each time period, all radio-collared swans were located and roads driven on the

study area until all swans known to be in the area were located or until the 2 hours were over. When a flock was located, we recorded habitat type (aquatic, agriculture) and plotted its location on a map of the study area. Habitat use was summarized as the percent of all flock locations occurring in each habitat type.

RESULTS

The majority of collared Trumpeters identified in Illinois were banded in Wisconsin; a few birds originated from Minnesota, Michigan, and Iowa. Seventy-three different collared individuals were identified at BS5. All birds originated in Wisconsin (40 (55%) were banded in Wood County approximately 730 km from BS5). The remainder were banded in Ashland (3 swans), Bayfield (4), Burnett (1), Iron (3), Jackson (4), Juneau (10), Marathon (2), Polk (1), and unknown (5) Counties. In January 2003, one collared Trumpeter, which originated in Iowa, was observed at Union County Conservation Area, located approximately 45 km southwest of BS5.

During 1985-2001, sightings (n=152) were reported at 109 different locations in 63 of 102 Illinois counties (Figure 2). Observations of swans in the mid-1980's, prior to release of swans in Wisconsin, were primarily restricted to the northern tier of counties (Figure 2). After Wisconsin began releasing swans, 5-year trends of county use suggest a widening distribution in Illinois (Figure 2). Sightings during 1990-1994 were of small groups of birds typically using small farm ponds and lakes (IDNR, unpubl. data). Of all swan sightings, 50% occurred on 43 different publicly owned properties. The number of swans sighted in Illinois since 1985 has increased from 1 in 1985 to 205 in 2001 (Figure 3). Although numbers of swans sighted fluctuated year to year, the 5-year averages clearly indicate an increasing population (Figure 2).

We identified four locations that swans have consistently used in Illinois during the past 5 years. Three sites are publicly owned (Chautauqua and Emiquon National Wildlife Refuges (NWR) in Mason and Fulton Counties, respectively, and Carlyle Lake, a man-made reservoir in Clinton County) and one is privately owned (BS5) (Figure 4). Chautauqua NWR, Emiquon NWR, and Carlyle Lake were used as stopover areas during migration. BS5 was used as a wintering site. Swans began using Chautauqua and Emiquon NWR's and surrounding lakes in the central Illinois River Valley beginning in 1992. Swans were first seen at Carlyle Lake in 1994 and began stopping during migration consistently in 1999. Swans began wintering at Burning Star 5 in 1994 and have been increasing each year. In addition, an increasing population of swans has been wintering at the U.S. Army Corps of Engineer Riverlands property in Missouri across the Mississippi River from Alton, Illinois. The winter population at this site was 65 in 2003 (E. Zwicker, IDNR, unpublished data).

At BS5, peak winter counts have increased since 1994 when the birds first arrived. During 2001-02 and 2002-03, peak counts were 71 (48 adults, 23 cygnets) and 77 (59 adults, 18 cygnets), respectively. The first swans arrived on 10 December in 2001 and 21 November in 2002. Swans reached peak population each winter on 5 January 2002 and 31 December 2002, and began spring migration 14 February 2002 and 17 February 2003. Duration of stay was 88 days during 2001-02 and 112 days during 2002-03. Forty-five swans flew 11.9 km north from BS5 12 March 2003 and remained on private wetlands until approximately 22 March 2003. Seven family groups wintered at BS5 in 2001-02. Of those groups, five had at least one adult collared. All five pairs returned to BS5 in 2002. In 2001-02, 40% of the collared individuals had previously wintered at BS5. In 2002-03, 70% of collared individuals had previously wintered at BS5.

No systematic data has been collected on swan habitat use in the central Illinois valley or at Riverlands. However, anecdotal reports indicate birds used managed moist soil units, deep water habitats, backwater lakes in river floodplains, and agricultural crops. Swans using BS5 were located in aquatic habitat 39% and in agriculture 61% of daylight hours in 2001-02, compared to 2002-03 when swans were located in aquatic habitat 49% and in agriculture 51% of daylight hours. Swans roosted in flock sizes ranging from 1-77 birds, primarily in two incline and two final cut lakes. Swans typically flew from a roost to an agricultural field in the early morning and remained in the field until dark when they flew to a roost site. Distance from roost site to forage field on the mine ranged from 700 to 3,000 m.

DISCUSSION

Swans have been sighted in > 50% of the counties in Illinois, and their distribution within the state has increased since 1985. This is largely attributed to birds reintroduced in Wisconsin that have begun pioneering new migration and wintering traditions. Our data indicate migratory Trumpeter Swans have established wintering and migratory stopover traditions at five locations including two national

wildlife refuges, two U.S. Army Corps of Engineers properties, and one reclaimed surface coal mine (privately owned). These sites all provide large, deep-water habitat for roosting as well as permanent and seasonal wetlands and abundant agricultural crops for feeding. The largest population of wintering swans occurs at BS5, which is relatively free of human disturbance. Several of these populations have been established without assistance from biologists suggesting that, when necessary, IP swans can locate suitable wintering areas.

As many as 200 sightings have been reported during a single winter. There currently is no systematic monitoring program for Trumpeter Swans wintering in Illinois, thus some areas in the state are not surveyed. Swans are counted during existing aerial Canada Goose surveys, but biologists conducting aerial surveys can not distinguish among swan species. Since both Mute Swan (*C. olor*) and Tundra Swan populations may also be increasing in the state, and because current monitoring efforts do not preclude double counting of individuals, statewide sightings should not be considered a population estimate but rather a population index. Our index indicates the winter swan population within the state is increasing.

It is possible there are unknown populations of Trumpeter Swans wintering in Illinois. However, the extensive area covered by bird watchers and IDNR biologists makes this unlikely. Thus, more systematic surveys at the five sites currently used might provide the best opportunity for monitoring species composition and population trends in the state. However, as the IP continues to grow, new populations may become established elsewhere. Therefore, continued monitoring of other likely sites in the state is needed. Survey efforts would be bolstered by the creation of a statewide collar database that would facilitate better tracking of individual birds and provide a clearer picture of swan distribution (and possibly over-winter survival) in Illinois. Additionally, attaching collars to birds that winter on BS5 would increase our understanding about links between wintering and breeding areas.

This study is the first to document extensive use of agricultural crops by wintering and migrating IP swans. Behavioral observations indicate a significant percent of time was spent foraging in these habitats (Faye Babineau, unpubl. data). This behavior has important implications for management of IP Trumpeters. Swans may be able to winter farther north than their historical range and may be less dependent on natural wetlands. Furthermore, it suggests that winter food availability likely should not limit winter carrying capacity for IP Trumpeter Swans and, thus, swan recovery efforts. More important may be the juxtaposition of suitable feeding and roosting habitat or suitable combinations of natural and agricultural foods. Field feeding swans in the Pacific Coast Population have begun causing agricultural damage and landowner conflicts (McKelvey and Verbeek 1988). As the IP grows, the same issues may potentially occur in the Midwest.

State and federal lands provide excellent opportunities to manage for wintering swans. In most cases, little change in existing management techniques would be required. However, further studies are needed to determine favored crops and post harvest methods. Post-law-reclaimed surface mines can also provide excellent winter swan habitat. BS5 provided abundant roosting habitat and agricultural fields for feeding with little human disturbance. In addition, mines reclaimed after the ban of lead shot in the 1990's potentially provide a lead-free environment. This removes a major cause of mortality in wintering swans (Wilson *et al.* 1998). Finally, because BS5 has the largest population of wintering Trumpeters in the Mississippi Flyway, we recommend that IDNR pursue an agreement with Consolidated Coal, the company that owns BS5, to help protect this critical habitat, and suggest that other states with similar properties evaluate their suitability as winter sites for IP Trumpeter Swans.

ACKNOWLEDGMENTS

Portions of the data analyzed for the manuscript were provided by biologists of IDNR and Wisconsin Department of Natural Resources (WDNR). Specifically, we thank E. Zwicker and D. Woolard (IDNR) and P. Manthey (WDNR) for providing aerial survey and collar data. We would also like to thank Consolidation Coal Company for permission to perform the study on Burning Star 5 and Gene Smout for his assistance and insight into swan use of the mine prior to the study. As well, we would like to thank our field technicians Jennifer Triplett and Paul Mathews for their hard work and dedication. This study was funded by the Illinois Department of Natural Resources Federal Aid in Wildlife Restoration W-142-R-02.

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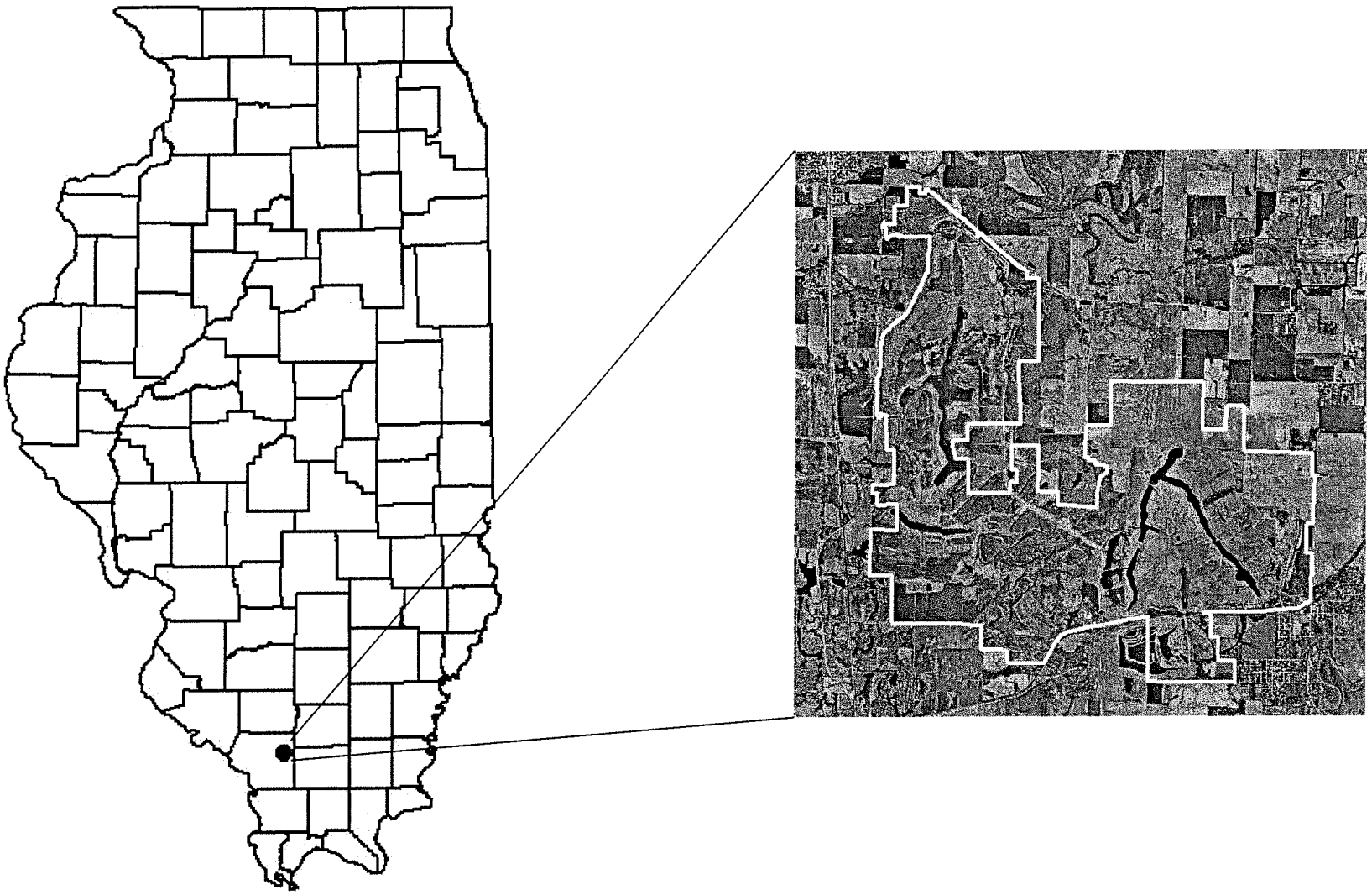
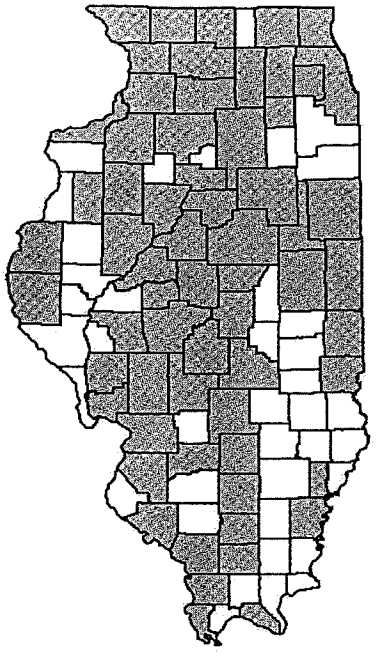
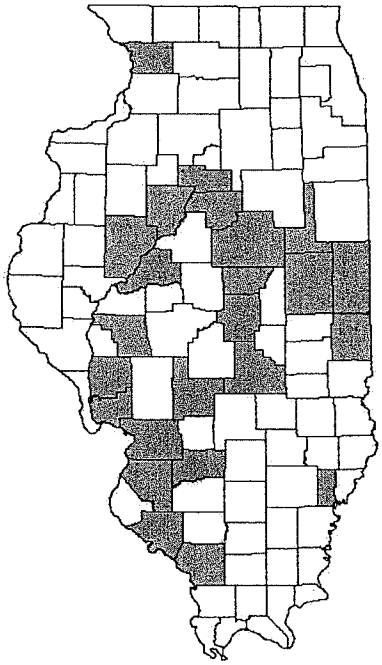


Figure 1. Location of Burning Star 5, Jackson County, Illinois.

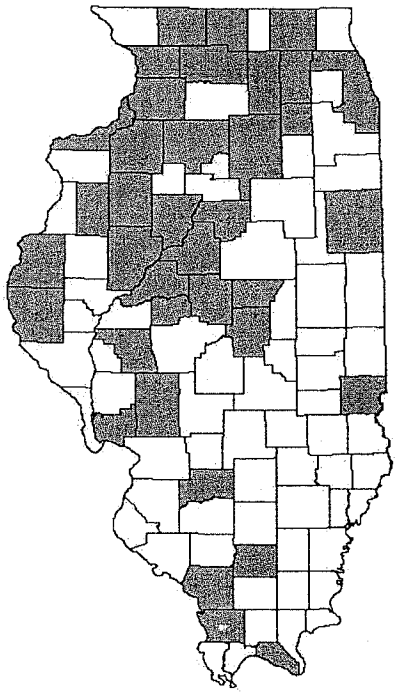


(a)

(b) 5-YPM = 1



c) 5-YPM = 27



(d) 5-YPM = 79

Figure 2. Counties where swans have been sighted (shaded) in Illinois during 1985-2001 (a) and changes in sightings over time: 1985-1989(b), 1990-1994(c), and 1995-1999(d). 5-YPM equals the 5-year mean for total number of sightings during a winter each period.

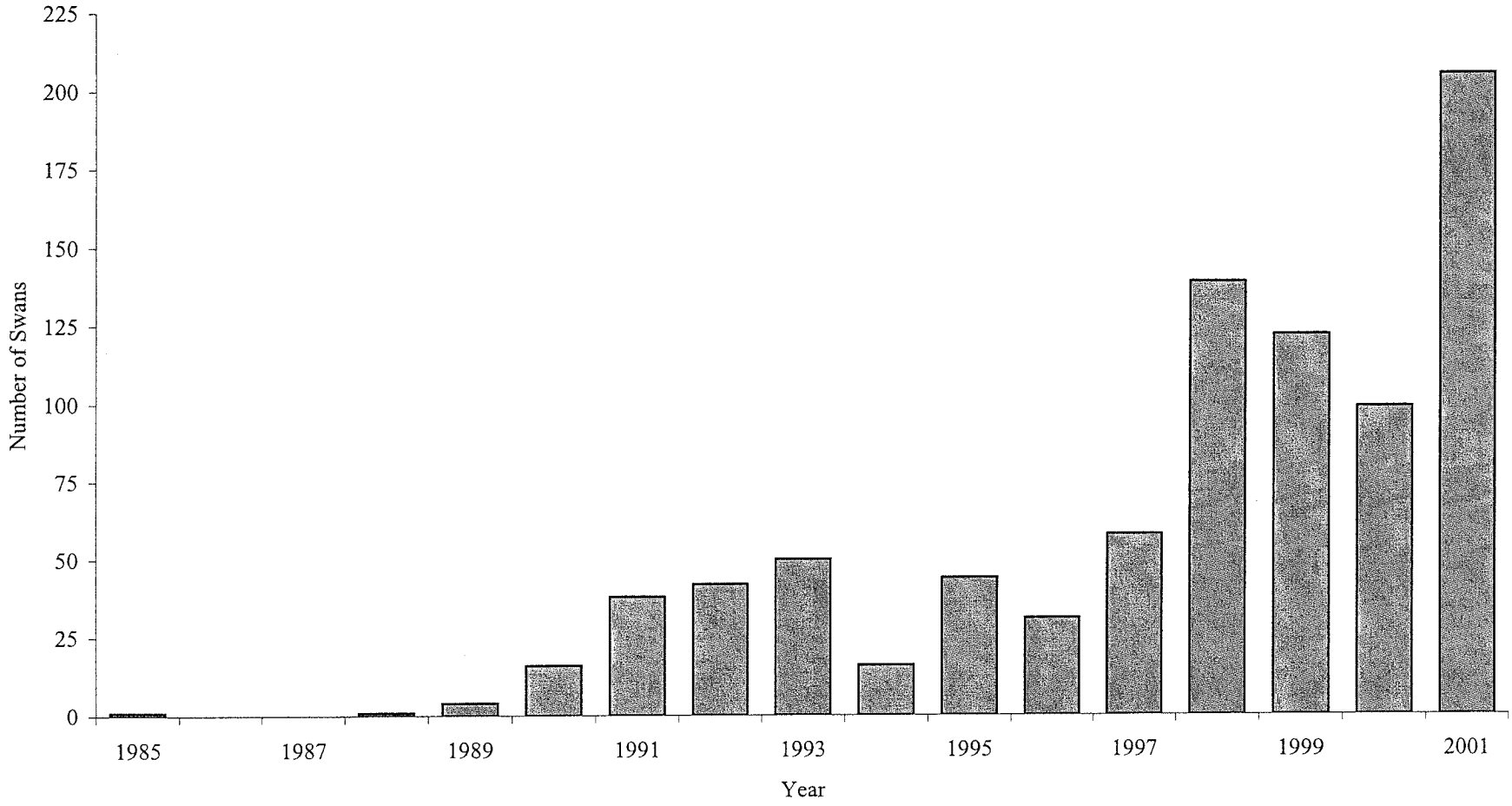


Figure 3. Number of swans sighted in Illinois, 1985-2001.

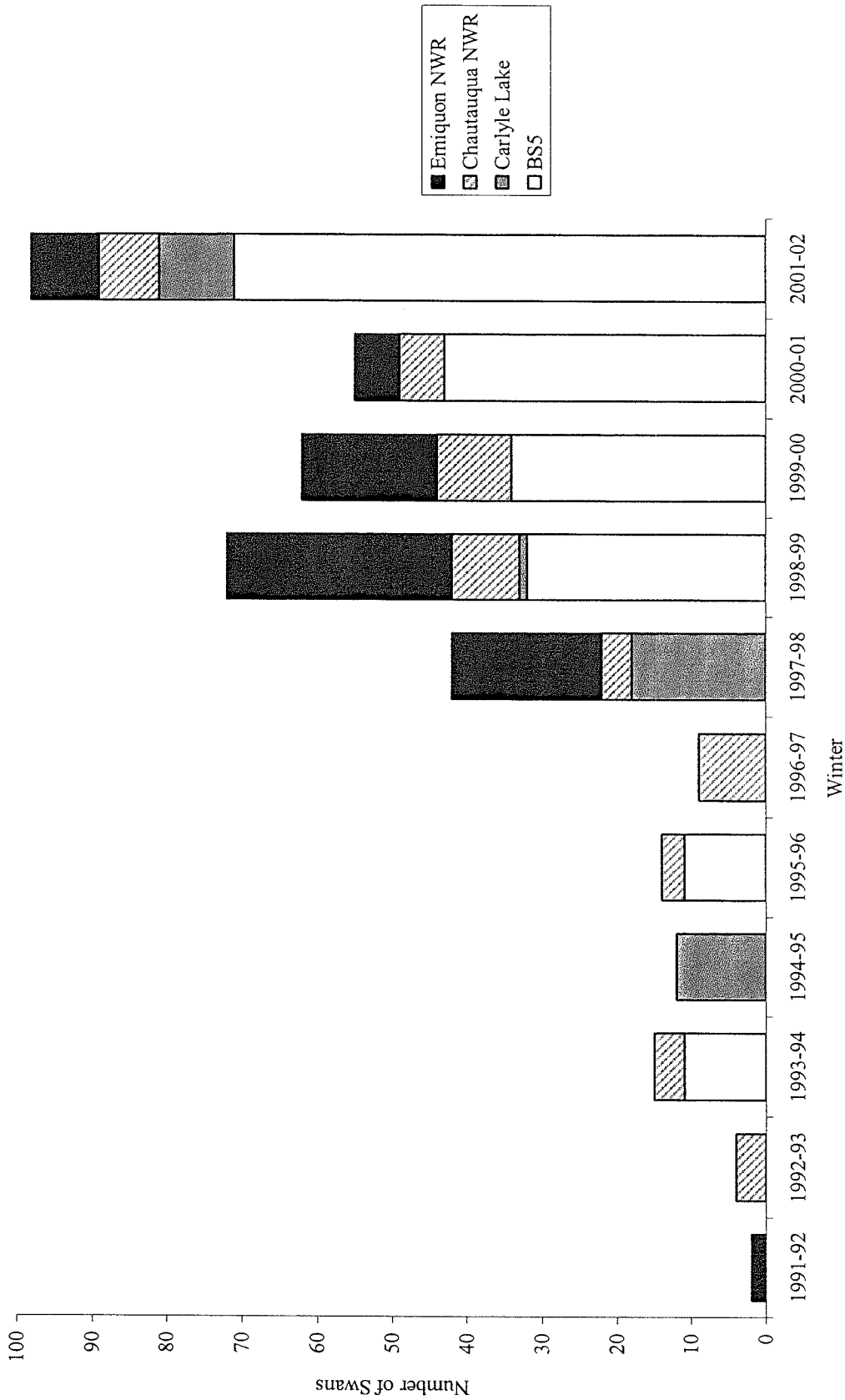


Figure 4. Population trends of Trumpeter Swans at four sites in Illinois: Emiquon National Wildlife Refuge (NWR), Chautaqua NWR, Carlyle Lake and Burning Star 5 coal mine.

THE ENDANGERED SPECIES PROJECT

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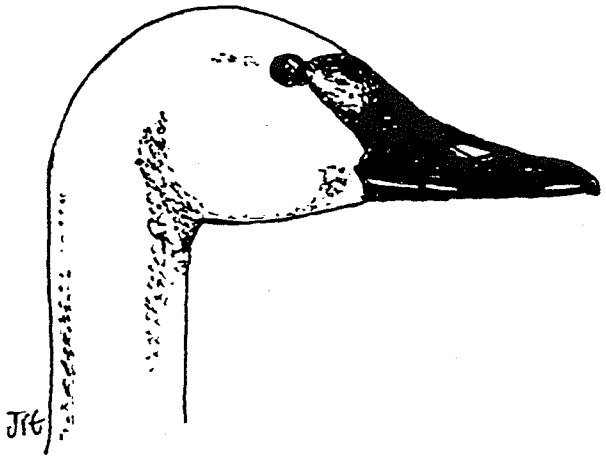
Since 1993, over 700 fourth grade students have been involved with their two communities, the Iowa Department of Natural Resources (DNR), the Izaak Walton League, the Iowa Wildlife Federation, Iowa State University, the Story County Conservation Board, the Governor's Conferences on Service Learning, the Heartland Area Education Association, Iowa Public Television, the local high school students, and hundreds of parents and other community members. In 1993, after researching about endangered animals, my students became very concerned when they discovered that recently there were less than 50 Whooping Cranes left in the world. They wanted to take action and asked all the students in the building to bring in their pennies. This was the beginning of an unbelievable saga covering 10 years of time. It all started with $172 in pennies and the belief of a group of children who felt they could make a difference about the plight of endangered animals in their world. The $172 was invested in some items the students wanted to raffle off by selling raffle tickets door-to-door in their community. One teacher helped by getting three wildlife prints to include in the raffle. In 2 months time, the students raised $2,000! Then, as a group, they had to decide how to spend their money. They decided to spend it internationally, nationally, statewide, and locally. Thus, $500 was donated to the Children's Rain Forest in Belize, $500 was donated to The Nature Conservancy (after a great deal of research), $500 was given to the Wildlife Care Clinic at Iowa State University, and $500 was willed to the next year's group of fourth grade students so they could continue to help endangered animals. The next year's students decided to hold an auction with items donated from their communities. This auction was held every spring for the next 6 years and earned over $37,000 to help organizations like Save the Manatee, World Wildlife Fund, The Marine Mammal Center, African Wildlife Foundation, International Crane Foundation, and many, many more. The most meaningful hands-on learning occurred when Ron Andrews of the DNR invited the children to help with the reintroduction of Trumpeter Swans to Iowa. The students helped with building floating nest platforms, putting up fencing, and wing clipping. This led to our adoption of a 100-acre wetland. A high school class helped the children make 25 Wood Duck houses and Iowa State University students helped put up some of the boxes in the wetland. Several students made presentations at the Governor's Conference on Volunteerism, while others appeared on Iowa Public Television to talk about their involvement with the Trumpeter Swans. An important date for the students was 4 November 1996, when the DNR helped us obtain our own nesting pair of Trumpeters. Nearly 200 people came to see the release. When some Trumpeters were harmed by thoughtless individuals in Iowa, the students wrote a letter to the editor about needing stronger laws to protect these birds. A State Representative read the students' letter and took it to the Iowa Legislature where a bill was drafted to protect swans and cranes and increase the fine for killing them from $500 to $1,500. The bill passed and the Governor invited us to attend when he signed the bill into law. This was a very rewarding experience for the children. My students have received many awards over the years for their hard work and willing participation including the Youth Conservationist Award from the Izaak Walton League and the Iowa Wildlife Federation, two Youth Volunteerism Awards from the Governor of Iowa, the Environmental Protection Agency Region 7 Award, and the Presidential Environmental Youth Award given by President George W. Bush in a special White House ceremony in April 2001. Behold the power of children! They are the messengers we send into a future we shall never see.

TUNDRA SWANS



MIGRATION CHRONOLOGY OF EASTERN POPULATION TUNDRA SWANS [1]

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ABSTRACT

Satellite transmitters (PTTs) were used to track spring and fall migratory movements of Tundra Swans (*Cygnus columbianus columbianus*) (1998-2000) captured at Long Point, Ontario. Migration corridors reported here corroborated those identified in previous studies using alphanumerically coded collars. However, PTTs provided additional information on duration of spring and fall migration, duration of stay in different staging regions, time spent on breeding and wintering areas, and migration speed. Birds migrated between the Atlantic Coast and northern prairies along a narrow geographic corridor through portions of the southern Great Lakes. From the northern prairies, swans followed three corridors to breeding areas on the west coast of Hudson Bay, central high Arctic, and Mackenzie River Delta. Whereas swans spent considerable time on Great Lakes (27% of spring migration) and northern prairie (40%) staging areas in spring, the northern boreal forest was an important fall staging area (48% of fall migration). Tundra Swans spent 20% of the annual cycle on wintering, 28% on spring staging, 29% on breeding, and 23% on fall staging areas. Length of migration and the fact that birds spend half their lives on staging areas, underscores the importance of conserving Tundra Swan migratory habitats. Thirty-gram collar-attached PTTs were more suitable than 95-gram teflon-harness-attached backpack PTTs for tracking Tundra Swans.

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TUNDRA SWAN RESEARCH NEEDS ON THE UPPER MISSISSIPPI RIVER

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ABSTRACT

The Upper Mississippi River (UMR) has become an important stopover area for the Eastern Population of Tundra Swans (*Cygnus columbianus columbianus*) during fall migration in recent years. During 1997 through 2002, annual fall swan use averaged more than 760,000 use-days. This represents a 700% increase in riverwide swan use from the early 1980s based on use-day estimates. Swan numbers on the UMR peaked in excess of 31,000 during late November 2002 and represented a substantial portion of the Eastern Population (2001-02 Midwinter Index was 104,100). Because of the increased public interest in swans and the responsibility for management of the UMR for this trust species, river managers and biologists have identified and prioritized research needs that would provide important information to support the wise management of Tundra Swans. Among the research needs identified were: (1) determine the importance of the UMR to the Eastern Population of Tundra Swans, (2) assess the availability of food resources and the impacts of Tundra Swans on those resources on the UMR, (3) determine local movements and the distribution of Tundra Swans on the UMR, (4) determine the impact of waterfowl hunting and the Closed Area program on swan movements and distribution, (5) evaluate public interest in swans, and (6) determine the amount and distribution of Trumpeter Swan (*C. buccinator*) use of the UMR. Federal and state partners are working to expand efforts to address these research areas. The accrued information should guide river resource managers in development and implementation of management strategies for enhancement of the UMR as an important resource for swans.

INTRODUCTION

The Upper Mississippi River (UMR) serves as a major staging area for the Eastern Population of Tundra Swans (*Cygnus columbianus columbianus*) during fall migration. The UMR includes the 1,462-km portion of the Mississippi River between St. Anthony Falls in Minneapolis, Minnesota, to the mouth of the Ohio River at Cairo, Illinois (Figure 1). The majority of Tundra Swan use occurs along the UMR from Wabasha, Minnesota, downstream to Clinton, Iowa. A series of navigation dams with locks was constructed in the 1930s to provide a 2.7-m deep channel to facilitate commercial navigation (Fremling *et al.* 1989). This stretch of the Mississippi River contains a rich variety of open-water pools, backwater riverine wetlands, and floodplain habitats that support millions of migratory birds each year during autumn and spring migrations (Wiener *et al.* 1998). The Upper Mississippi River National Wildlife and Fish Refuge (UMRNWFR) comprises 785 km^2 within the floodplain of the UMR from the confluence of the Chippewa River to Lock and Dam 14. In 1997, the UMRNWFR was designated a Globally Important Bird Area in the *American Bird Conservancy's United States Important Bird Areas* program (U.S. Dept. of the Interior 1998). This designation cited the critical importance of the UMRNWFR in supporting global populations of Bald Eagles (*Haliaeetus leucocephalus*), Tundra Swans, and Canvasbacks (*Aythya valisineria*).

Interest in Tundra Swans has increased among the public and resource managers as the distribution and number of swans using the UMR has expanded. River managers and biologists met during the winter of 1997-98 and again in November 2002 to identify and prioritize research needs that would provide important information for managing Tundra Swans

on the UMR. This paper briefly summarizes historic and current Tundra Swan use of the UMR, concerns and observations of river managers, and outlines research needs.

Tundra Swan Use of the Upper Mississippi River

The Eastern Population of Tundra Swans (Limpert *et al.* 1991) nests from the Aleutian Islands across northern coastal tundra regions to the northeast shore of Hudson Bay and Baffin Island (Bellrose 1976; Limpert and Earnst 1994). These birds migrate through the prairie provinces, eastern Canada, the Dakotas, Minnesota, and Wisconsin to wintering areas along the Atlantic Coast primarily from New Jersey to South Carolina (Limpert *et al.* 1991). Historically, "small numbers" of Tundra Swans consistently stopped "along the Mississippi River as far south of the Twin Cities as La Crosse" prior to the mid-1970s (Bellrose 1976). Surveys in recent years indicate peak swan numbers greater than 31,000 along the UMR during late November. This count represents a substantial portion of the Eastern Population (2001-02 Midwinter Index was 104,100; U.S. Fish and Wildlife Service, 2002). Thorson *et al.* (2002) estimated that about 25% of the Eastern Population of Tundra Swans, including 52% of Eastern Population cygnets, used the UMR during autumn migration in 1998 and 1999.

Biologists with the UMRNWFR, the USGS Upper Midwest Environmental Sciences Center, and the Wisconsin Department of Natural Resources have conducted aerial waterfowl surveys along the UMR during the fall waterfowl migration period since 1978 (C. E. Korschgen *et al.*, U.S. Geological Survey, unpub. data; E. C. Nelson, U.S. Fish and Wildlife Service, unpub. data; L. B. Wlosinski, U.S. Fish and Wildlife Service, unpub. data; and J. F. Wetzel, Wisconsin Department of Natural Resources, unpub. data). The frequency, duration, and extent of surveys varied among years. Despite this variability, the survey data illustrate patterns of use and distribution of Tundra Swans on the UMR. Recent counts covered Navigation Pools (Pools) 4 through 13, the stretch of river between Wabasha, Minnesota, and Clinton, Iowa. Fall use-days determined from aerial surveys for the Winona (Pools 4, 5, and 5a plus Trempealeau NWR in Pool 6), La Crosse (Pools 7 and 8), McGregor (Pools 9, 10, and 11), and Savanna (Pools 12, 13, and 14) Districts of the UMRNWFR are summarized in Figure 2.

During the early 1980s, swans concentrated on the UMR Pools 4, 5, and 5A. During 1981 through 1984, approximately 60 to 80% of riverwide swan use occurred on these three pools while 20 to 40% occurred on Pools 7, 8, and 9. Total swan use during the fall averaged about 108,700 use-days during these years. Aerial surveys were incomplete for 1985 through 1988 and patterns of swan use were not documented. Swan numbers during 1989 through 1991 were comparable or less than those observed in the early 1980s. This reduction in swan numbers corresponded to a general drop in waterfowl numbers and is believed to have been related to a riverwide reduction in aquatic vegetation associated with the severe Midwestern drought of 1988-89 (Wiener *et al.* 1998).

Tundra Swan use on the UMR has increased dramatically during the past decade. Annual fall swan use has ranged between 260,000 to 1.2 million use-days and averaged more than 760,000 during 1997 through 2002. This represents a 700% increase in riverwide swan use from the early 1980s. Fall peak swan numbers have also increased significantly (slope = 502$\forall$109[SE], R^2 = 0.70, P = 0.001) since the early 1980s, and have kept pace with the Eastern Population midwinter index (U.S. Fish and Wildlife Service 2002; Serie *et al.* 2002) (Figure 3). Swan use of Pools 4 through 6 fluctuated during 1992 through 2002 but was generally comparable to that observed during the early 1980s (Figure 2). The major increase in swan use from 1992-2002 has occurred on Pools 7 through 9. By 2002, about 52% of riverwide swan use occurred on Pools 7 and 8, 27% occurred on Pool 9, and use of Pools 4 through 6 was 14%.

Aerial counts conducted in 1984, 1997, and 2002 (Figure 4) provide an indication of the chronology of Tundra Swan use of the UMR during the fall. Tundra Swans typically arrive in appreciable numbers on the UMR in the latter half of October. Numbers of swans generally build up on the northernmost pools (i.e., Pools 4 though 8) in late October and peak during the first half of November. Figure 4 also illustrates the increasing magnitude of swan use of the UMR and the shift in the importance of the southern pools relative to Pools 4 through 6 over the years. In 2002, large numbers of swans did not occur on southern pools (i.e., Pools 9 through 13) until the first part of November and peaked near the end of the month. It should be noted that weather and ice conditions, both on staging areas to the north and on the UMR, contribute to the variability observed in the chronology of swan numbers on the UMR.

Tundra Swans also use the UMR during their spring migration. The length of stay is brief and the birds appear to be continually moving north. Few aerial

waterfowl surveys have been conducted on the UMR in the spring, so swan use has not been well documented. During a survey of Pools 4 through 11 conducted on 22 March 2000, 22,875 swans were counted. Eighty-two percent of the birds were located in areas that were open to waterfowl hunting in the fall. Spring provides the opportunity for swans to exploit ephemerally flooded habitats and areas that are not readily available in the fall because of disturbance.

CONCERNS AND OBSERVATIONS OF RIVER MANAGERS

Public interest in swans

Tundra Swan viewing has become an increasingly popular fall recreational activity on the UMRNWFR. Surrounding communities have recognized and capitalized on the economic potential associated with having thousands of people visit the area each fall to view the spectacular sight of large concentrations of migrating Tundra Swans. Winona, Minnesota, and Alma, Wisconsin, have taken advantage of this influx of visitors. Each fall, Winona sponsors a Swan Watch Day and organizes bus tours and presentations for visitors to learn about Tundra Swans. Alma is fortunate in that a considerable concentration of Tundra Swans is attracted to the Rieck's Lake Closed Area that is located within the city limits. "Closed Area" refers to an area in which waterfowl hunting is prohibited. The U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, and the City of Alma cooperated to construct an observation platform at Rieck's Lake and it has become the focal point of the Alma Swan Watch. A dedicated group of about 35 volunteers staff the platform daily from mid-October until freeze-up and provide visitors with information about Tundra Swans, other wildlife, and the refuge. During 1992, volunteers recorded 700 visitors to the platform, but that number has increased dramatically, peaking at 19,680 in 1998. Visitors came from 42 states and 25 foreign countries. The reduction in visitation in recent years has been coincidental with a decline in swan use of Rieck's Lake.

In the La Crosse area, Pools 7 and 8 are used by large numbers of swans. However, viewing tends to be more long distance from overlooks along the river. Overall, an estimated 450,000 visits were made to the UMRNWFR from 1 October 2001 through 30 September 2002 for interpretation and wildlife viewing. In response to growing interest, the U.S. Fish and Wildlife Service and partners constructed an observation deck along Pool 8 for river viewing, including swan watching. While there is no estimate of the number of visits made specifically to observe swans, the number of visits to the river to watch swans appears to be on the increase. It is evident that there is growing interest in Tundra Swans on the UMR and it is likely that the public will strongly encourage and support research on this species.

There is also an indication that area waterfowl hunters are interested in an opportunity to harvest Tundra Swans on a limited basis. An opinion poll conducted by the La Crosse County (Wisconsin) Conservation Alliance at the 1995 Waterfowl Hunters Information Meeting indicated that the majority of those in attendance were concerned that concentrations of Tundra Swans were degrading traditional feeding and resting areas of ducks and geese. Ninety-four percent of the hunters surveyed (n = 53) at the 1995 meeting favored a limited swan season on the Mississippi River if it was "beneficial to the resource." At the 2002 Waterfowl Meeting, 81% of those participating in the opinion poll (n = 55) favored using Wisconsin's potential Eastern Population Tundra Swan quota (currently 300 swans) to institute a permit hunt in the state. Currently, no swan season is held in the Mississippi Flyway. Instead, the Mississippi Flyway's allotted swan quota is divided between the Central and Atlantic Flyways.

Relationship of swans to food resources available to waterfowl on UMR

Tundra Swans feed primarily on the leaves, stems, and tubers of aquatic plants and waste grains (see review by Limpert and Earnst 1994). There are only a few recorded observations of Tundra Swans feeding in fields adjacent to the UMR (Eric C. Nelson, pers. obser.). We suspect that the tubers of plants, such as arrowhead (*Sagittaria latifolia* and *S. rigida*) (Limpert 1974), sago pondweed (*Potamogeton pectinatus*), and wildcelery (*Vallisneria americana*) are important foods of Tundra Swans on the UMR but this has not been well documented. It is believed that the observed distribution of Tundra Swans closely approximates areas where these food resources are concentrated.

Rieck's Lake Closed Area on Pool 4 and Weaver Bottoms Closed Area, particularly near the mouth of the Whitewater River on Pool 5, were traditionally important staging areas for Tundra Swans on the Winona District of the UMRNWFR. No waterfowl hunting is permitted within these closed areas, which were established in 1957-58. During the last 15 years, submersed aquatic and emergent vegetation (e.g., arrowhead) suffered a severe decline in these areas (Nelson 1998). The reasons for these declines

are not completely understood. It is speculated that these closed areas no longer provide the nutritional requirements for large numbers of migrating Tundra Swans and other waterfowl.

The availability of food resources on Pools 7 through 9 appears to be the reason for increased swan use on these pools in recent years. It is important to understand food resource distribution and abundance in relation to exploitation patterns and food preferences of the swans and other waterfowl.

Impact of waterfowl hunting on distribution and movement of swans

During the waterfowl season, the closed areas in the Winona District still attract Tundra Swans. However, due to the apparent lack of food resources, these areas seem to function only as resting areas free from disturbance by hunters and trappers in the fall. During the last several years, Tundra Swans have abandoned the closed areas in favor of areas open to waterfowl hunting. Data are needed to help river managers evaluate the extent to which closed areas meet the needs of Tundra Swans and other waterfowl. Managers have few easy options on the Mississippi River to make changes that could significantly influence swan use of refuge wetlands. Alteration of closed area boundaries, poolwide drawdowns, and habitat restoration are among the options available, but are either very expensive or controversial.

A similar pattern of use was observed on Pool 8 during the late 1990s where the majority of swans concentrated in areas closed to waterfowl hunting during the day, then at night moved to the open hunting areas on the river to feed. Exceptions occur and swans will use open hunting areas during days and in areas with minimal disturbance from boaters, including waterfowl hunters. Because of better habitat conditions within the Lake Onalaska Closed Area on Pool 7, swans have more opportunities to feed during the day. Movement of swans from the closed area at sunset has been observed. Most radio-marked swans moved from closed areas to open areas at night in November 1998 and 1999, especially in Pools 4, 5a, 8, and 9 (Erik M. Thorson, pers. comm.).

Swans traditionally move from the closed areas into backwater areas to feed after the close of the duck season. Following years of exceptional tuber production on Pool 8 in 2001 and 2002, the majority of swans remained in the closed areas rather than moving to areas traditionally used during the late season. The birds appeared content with the food resources still available, even though the closed areas had accommodated >200,000 swan use-days during each year (J. M. Nissen, pers. obser.).

A relatively small number of Tundra Swans are shot each year on the UMR during the waterfowl hunting season. One documented reason why the shootings occur is misidentification (failure to properly identify before shooting, blinded by the sun with swans and geese in the air at the same time, and mistaken for geese). Causes of mortality were diagnosed for 24 of 38 Tundra Swan carcasses submitted to the U.S. Geological Survey National Wildlife Health Center, which were collected from counties adjacent to the Upper Mississippi River. Of the 24 diagnoses, 11 (46%) were attributed to lead poisoning, 5 (21%) to aspergillosis, and 3 (13%) were related to firearms.

RESEARCH NEEDS

River managers and biologists representing the U.S. Fish and Wildlife Service, the Wisconsin and Minnesota Departments of Natural Resources, the U.S. Geological Survey, and the University of Minnesota met in the winter of 1997-98 to discuss Tundra Swan management concerns and to formulate a prioritized list of Tundra Swan research needs. An issue paper describing the findings of the group served as the impetus for graduate research work on the population dynamics, movements, and habitat use of Tundra Swans (Thorson 2003), and addressed some of the identified needs.

The following points were identified as important for providing information needed to develop management strategies for Tundra Swans on the UMR:

1. *Determine the importance of the UMR to the Eastern Population of Tundra Swans.*

Three areas of concern were discussed. First, the proportion of the Eastern Population that uses the UMR must be estimated from information on abundance, timing of use, and turnover rates. Second, the relative importance and proximity of the UMR to other staging areas needs to be clarified. Third, the group felt it is important to describe the energetics of swans on the UMR during migration, based on condition of the birds on arrival and departure, and food consumption rates. The first component of this research need has been addressed by Thorson *et al.* (2002).

2. *Assess the availability of food resources and the impacts of Tundra Swans on those resources on the UMR.*

Biologists need to assess the availability and distribution of food resources on the UMR (primarily Pools 4 through 13), describe food preferences of Tundra Swans, and evaluate the magnitude of food resource depletion by swans. Identification of threshold values of tuber availability below which swans abandon foraging within an area (e.g., Beekman *et al.* 1991) and tuber exploitation patterns by Tundra Swans on the UMR could be useful in explaining local movements of birds in association with distribution of food resources and closed areas. In November 2002, river managers and biologists identified this as the priority research need at the present time.

3. *Determine local (inter- and intra-pool) movements and distribution of Tundra Swans on the UMR.*

Determine the dynamics of swan movements within the UMR. In general, Tundra Swans on the UMR used areas larger than average summer home ranges and breeding territories, moved extensively within pools, and used several pools over the course of the fall (Erik M. Thorson, pers. comm.). These insights are useful when managers consider changes to the spatial configuration of areas closed to waterfowl hunting or the development of habitat management projects on the UMR.

4. *Determine the impact of waterfowl hunting and closed areas on swan movements and distribution.*

Configuration and the location of areas closed to waterfowl hunting on the UMR may provide one of the most influential management actions that can affect Tundra Swan management on the UMR. Closed areas function as core resting and feeding areas early in the fall, but are used less for feeding later in the fall. Human disturbance, including waterfowl hunting, seems to have a strong influence on Tundra Swan use and movements within the UMR (Erik M. Thorson, pers. comm.).

5. *Evaluate public interest in Tundra Swans.*

Conduct a survey to determine public interest in swans from the standpoint of viewing, biology, and harvest, among other things. These interests have grown with the increasing swan population on the UMR.

6. *Determine the amount, timing, and distribution of Trumpeter Swan (C. buccinator) use on the UMR.*

Summarize historic data on Trumpeter Swan use of the UMR and initiate surveys to document current use patterns. Trumpeter Swans are occasionally observed on the UMR (Thorson 2003), but information on their use of the area is limited. Biologists need to determine the interrelationships between Tundra and Trumpeter Swans in terms of their spatial distribution and resource competition because increased Trumpeter Swan use of the UMR may have implications concerning future opportunities to harvest Tundra Swans.

7. *Future needs assessment.*

Identify conditions required to produce food resources and identify habitat management options (e.g., water level manipulation) to sustain current swan use of the UMR. To enhance the production of aquatic vegetation and improve fish and wildlife habitat, the U.S. Army Corp of Engineers conducted experimental water level reductions of Pool 8 during the summers of 2001 and 2002. This pilot effort provided an opportunity to assess the use of drawdown to enhance tuber production of important waterfowl food plants (K. P. Kenow *et al.*, unpub. data).

The Upper Mississippi River is a critical staging area for the Eastern Population of Tundra Swans during their fall migration. River resource managers face a challenge as they attempt to balance meeting the habitat needs of migrating waterfowl with competing user interests and changes in river productivity. Information is needed to address the issues raised in this paper to ensure the wise management of the UMR for swans. Accordingly, federal and state partners are developing a research scope of work to determine the availability of Tundra Swan food resources on the UMR and describe exploitation of this resource. This research will supplement the recent efforts of others (e.g., Thorson 2003) to develop a comprehensive understanding of Tundra Swan ecology on the UMR.

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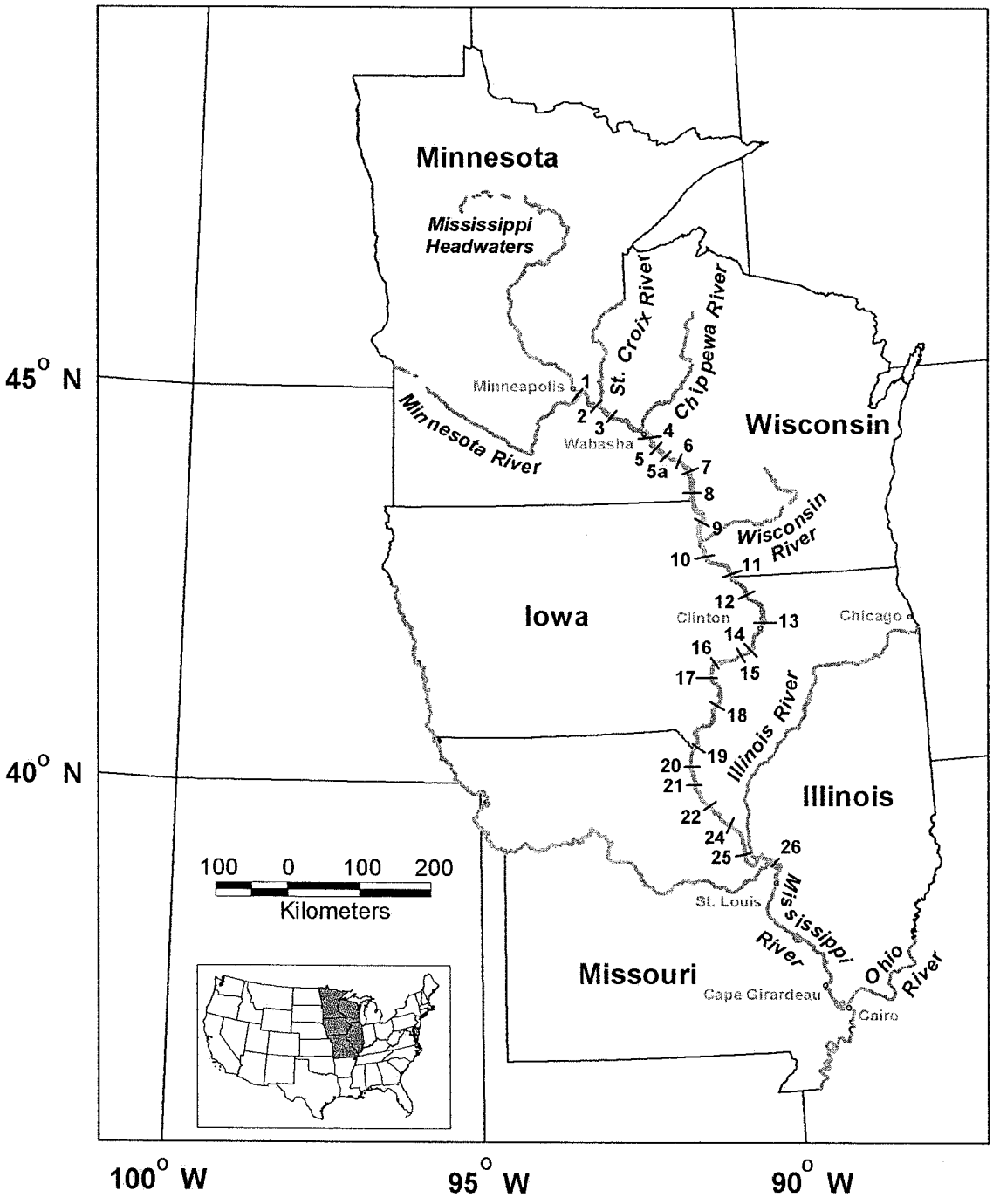

Figure 1. Location of the Upper Mississippi River, including approximate locations of locks and dams that create associated navigation pools, selected cities, and other features. The numbers 1-26 represent the navigation pools in this section of the river.

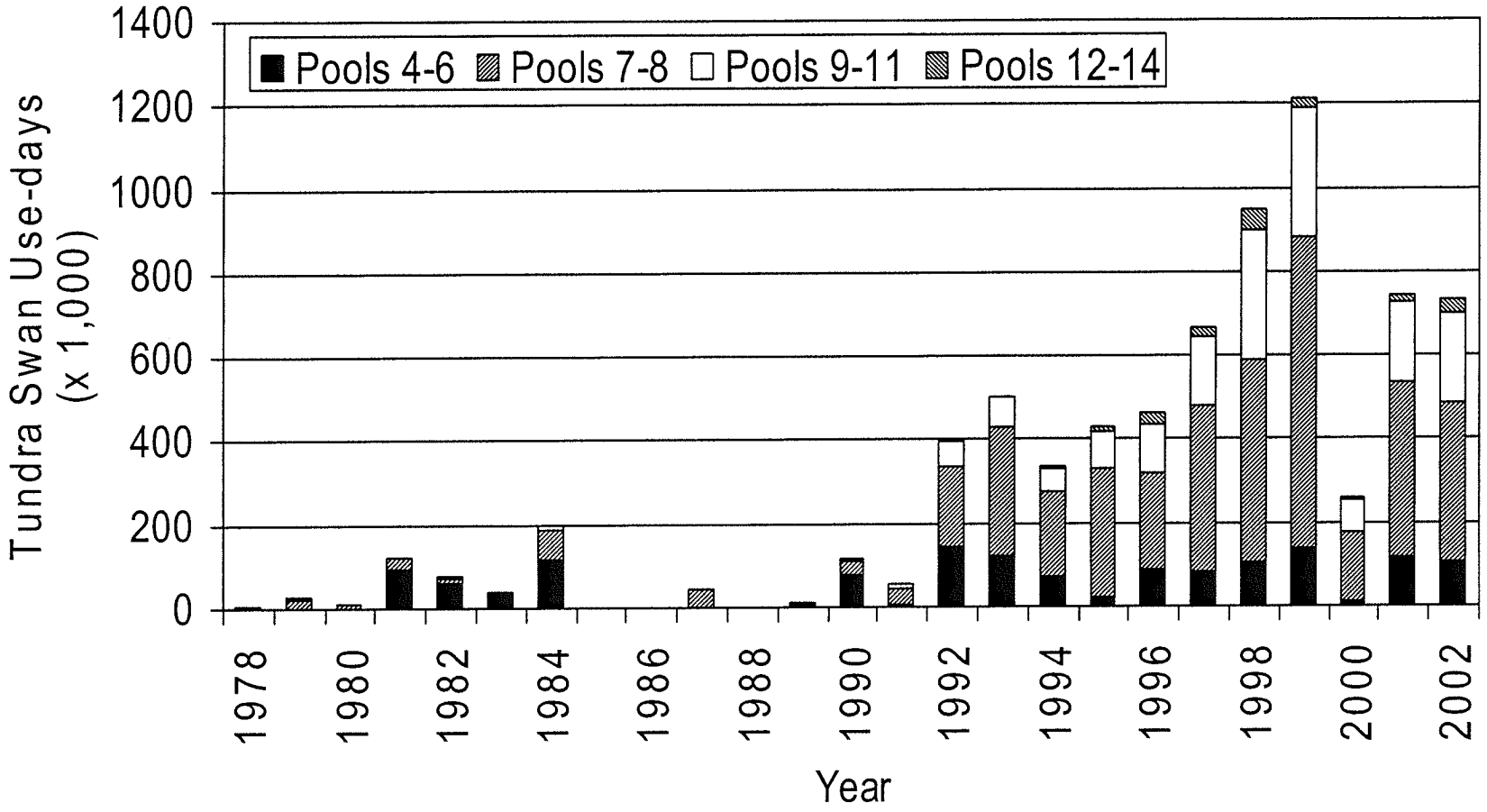

Figure 2. Tundra Swan use-days on the Upper Mississippi River during fall 1978 through 2002. Use-days for 1978 through 1989 calculated according to C. E. Korschgen et al., U.S. Geological Survey, Unpublished data; 1990 through 2002 from L. B. Wlosinski, U.S. Fish and Wildlife Service, Unpublished data. Aerial surveys were incomplete for 1985 through 1988 and patterns of swan use were not well documented.

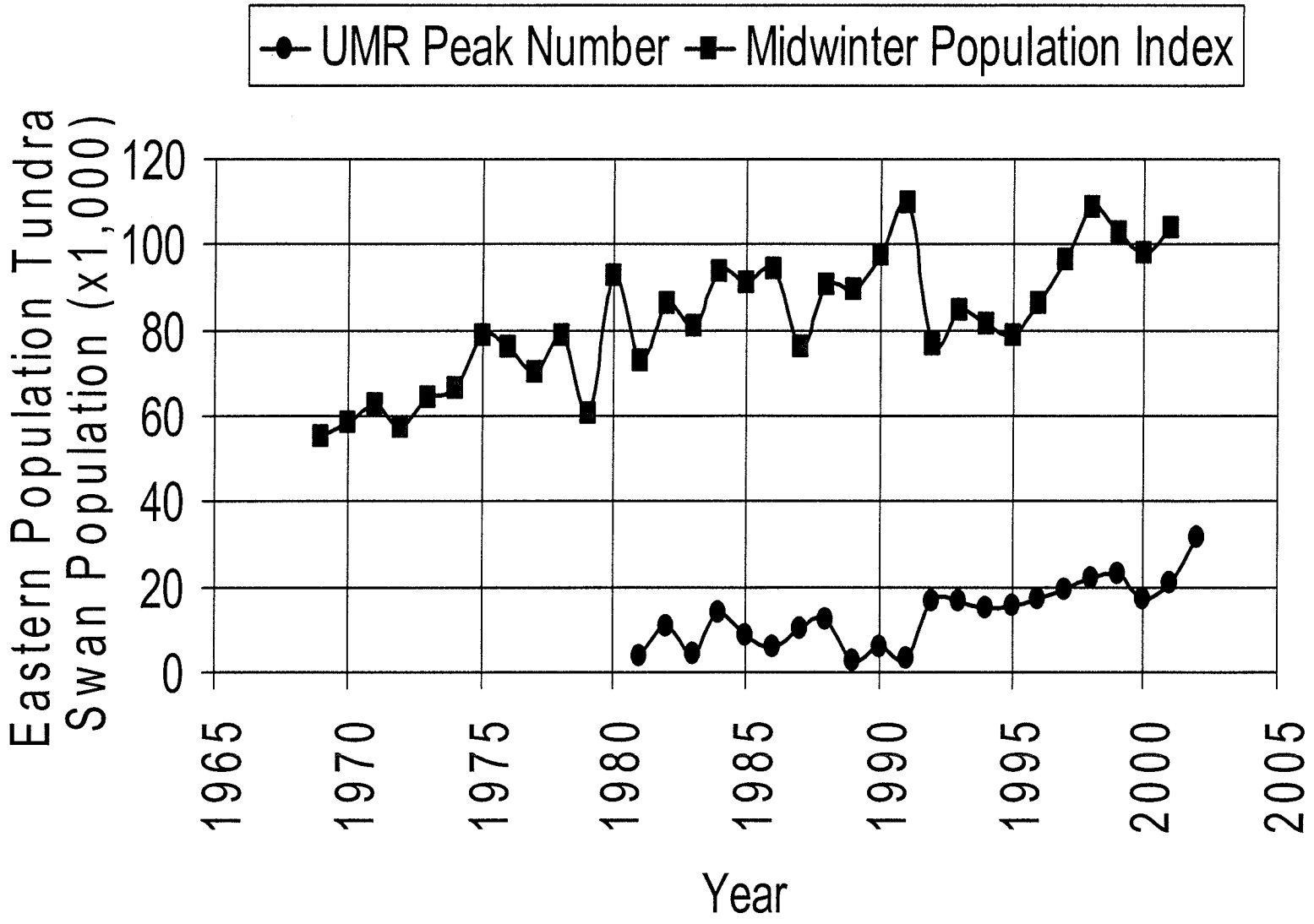

Figure 3. Tundra Swan midwinter population indices for 1969-70 to 2001-02 (source: U.S. Fish and Wildlife Service 2002) and peak swan population on the UMR for selected years.

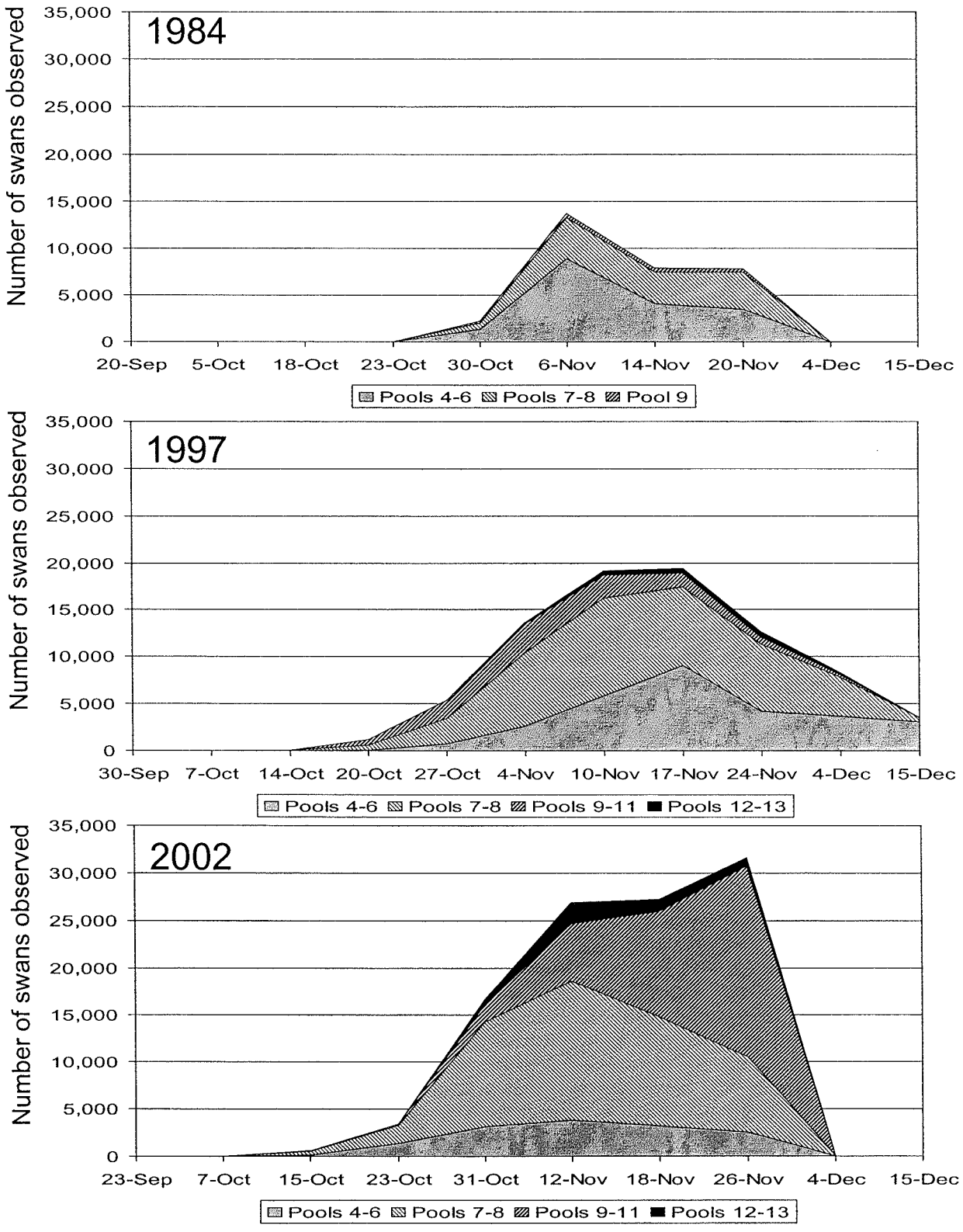

Figure 4. Chronology of Tundra Swan use on Pools 4 through 13 of the Upper Mississippi River during fall 1984, 1997, and 2002 based on aerial surveys.

LOCAL OBSERVATIONS OF TUNDRA SWANS (*CYGNUS COLUMBIANUS COLUMBIANUS*) IN THE MACKENZIE DELTA REGION, NORTHWEST TERRITORIES, CANADA

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ABSTRACT

The Mackenzie Delta region is home to Gwich'in and Inuvialuit, two aboriginal groups with settled land claims. Tundra Swans (*Cygnus columbianus columbianus*) are an important subsistence food source for these people and vital to their cultures. Trapping and fishing camps are found throughout the delta region. Individuals at these camps hunt Tundra Swans and observe their behaviour throughout the breeding season. In 2001-02, 31 individuals, recommended by local resource management committees in five communities surrounding the delta, were interviewed. Interviews documented the cultural significance and ecological understanding of Tundra Swans in the region. Local residents assisted with mapping and translation during interviews. As local knowledge is specific to geographic regions, interviews began with a geographic life history of the resource user to determine with what aspects of Tundra Swan life history or cultural use an individual was most familiar. A checklist approach was used with the questionnaire. Twelve general topics ranging from the chronology of breeding biology for Tundra Swans to their cultural use were addressed by each resource user. Depending on the geographic area being discussed, more focused questions would attempt to capture the resource users' specific areas of expertise. The checklist approach allowed for flexibility in the order of questioning as one response sometimes answered three questions. This method allowed the interview to become more of a conversation, causing less frustration for indigenous people. Interviews were digitally recorded and returned to the resource users in the form of an audio compact disk for review and personal archiving. Involving local residents as research assistants facilitated dissemination of information discussed during interviews to the community at large. All interviews were transcribed and summarized as a story. Stories were then returned to each resource user for verification. A final meta-narrative or summary story was used to describe the results of the study. Resource users had a rich understanding of the general biology of Tundra Swans. Timing of migration in spring and fall correlates with data recorded in the literature. Nesting sites were observed in a variety of habitats with the outer delta, islands in large lakes, and tops of hills most commonly mentioned. Obscure nesting sites in dense willows were also described. These nest site descriptions parallel those seen during the field component of this study. The number of young was observed to range from one to five cygnets. Resource users described nesting distributions and areas used for staging, moulting, and roosting by Tundra Swans. Most observations were timed with the spring and fall hunt, and general hunting practices were described. Some interviewees gave detailed descriptions of how adult swans train young swans to fly. Others referred to important foods consumed by Tundra Swans. A potentially critical food source was identified along point bars of the main channel of the Mackenzie River where swans feed from break-up until mid-July. Horsetail or "Goose Grass" (*Equisetum arvense* and *E. fluviatile)* was considered the preferred foods in this habitat. Specifically, resource users described, "Black berries on a string that muskrats eat, too, they taste sweet," which were verified with resource users as tubers found on rhizomes of *E. arvense* that are known by biologists to be high in glucose in the spring. These tubers were found in the esophagus of swans that were hunted by aboriginals during spring break-up – a time when lakes are still frozen and food for aquatic feeding birds is limited. The rhizomes became available due to softening of the mud during high water and through erosion of the riverbanks. After

a long migration, this food source could prove critical to migrating waterfowl with high-energy needs. Local knowledge collected through interviews demonstrates a rich understanding of Tundra Swan ecology by indigenous people that has evolved through generations of oral tradition and time on the land. Results from this study provide a typology of local knowledge that is useful when linking it with science-based research on Tundra Swans.

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FACTORS INFLUENCING REPRODUCTIVE SUCCESS OF TUNDRA SWANS (*CYGNUS COLUMBIANUS COLUMBIANUS*)

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ABSTRACT

The Mackenzie Delta of the Northwest Territories is one of the most important breeding areas for Tundra Swans (*Cygnus columbianus columbianus*) in North America and is currently at a regulatory application and review phase by industry for the development of its petroleum resources. In 2001, 40 monitoring plots (25 km^2) were established in the Mackenzie Delta, with 20 in areas of known or expected oil and gas development and 20 as control plots. Plots were surveyed by helicopter to count all swans and nests in June, and surveys were repeated in August to count adult swans and young produced. A subsample of nests was visited before hatch to determine nest initiation date, clutch size, and egg size. Nests were revisited after hatch to estimate reproductive success and habitat use. Information on habitat use, nest initiation dates in relation to spring climatic conditions, nest site reuse, and factors affecting reproductive success were discussed. Most of the data collected in this study were considered pretreatment information for monitoring impacts of oil and gas development on breeding success and population size of Tundra Swans. A 3rd year of data collection is planned for 2003 and final project results will be published in 2003-04.

PRELIMINARY STABLE ISOTOPE ANALYSIS OF TUNDRA SWAN FEATHERS: A NEW TECHNIQUE FOR DELINEATING BREEDING ORIGINS OF WINTERING BIRDS

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ABSTRACT

Stable isotope analysis of feathers can provide information on the region where they were grown. This technique can be applied to Tundra Swans (*Cygnus columbianus columbianus*) breeding across a latitudinal gradient in growing-season average rainfall deuterium (δD). Here, a sample of flight feathers from wintering swans in the eastern United States were examined for δD values. These values were then compared to a continental pattern of feather δD overlaid on the known breeding distribution in order to evaluate possible origins of individuals. This exercise suggested that approximately 38% of the birds originated from more southern components of the breeding range. However, the assumption that birds grew their feathers on natal or previous breeding sites may not be applicable to the whole sample and so the more southern origins inferred from the data may be the result of molt migration of previous nonbreeders. Nonetheless, the technique will be useful in developing population structure in this species when more individuals can be examined and stratified according to age and previous breeding status.

INTRODUCTION

The successful management of any species requires a good understanding of subpopulation structure and the linkage between breeding and wintering populations. Tundra Swans (*Cygnus columbianus columbianus*) occur as two management populations, an Eastern Population (EP), which winters within the Atlantic Flyway, and a Western Population (WP), which winters in the Pacific Flyway. Among the several management concerns associated with this species is the need to understand how each of these populations may be distributed on the wintering grounds relative to their breeding origins and their degree of site fidelity. However, movements of Tundra Swans are poorly understood. These include movements between breeding and wintering areas, migration stopover locations, and movements within the flyways during the winter period. No information is available on possible subpopulations or flock affiliations, nor is there information on interchange between various winter aggregations. Radio tracking projects in Ontario (S. Petrie, pers. comm.) and Minnesota (E. Thorson, pers. comm.) have gathered some information about the timing of migration flights and the relative importance of various migration stopover locations. Other methods include the marking of large numbers of individuals using leg bands or collars. Unfortunately, such conventional approaches to tracking movements of individuals require considerable effort and expense, particularly when breeding origins are included in the methodology.

Recent advances in the use of stable isotope methods to determine origins of migratory wildlife have provided managers with a new tool to link breeding and wintering grounds of migratory bird populations in North America (Hobson 1999; Hobson and Wassenaar 2001; Wassenaar and Hobson 2001; Rubenstein *et al.* 2002). This approach is based on the fact that deuterium abundance in rainfall shows a predictable pattern across North America with enriched values occurring in the southwest region of the continent and more depleted values in the northwest. These patterns of growing-season average deuterium in rainfall are transferred through the food web to plants and ultimately to birds and other higher order consumers (Hobson and Wassenaar 1997). This provides a convenient means of determining approximate provenance (especially latitude) of the locations where feathers are grown. Wassenaar and Hobson (2001) have since modified the continental average growing season deuterium map to include fractionation expected during the fixation of deuterium in the food web and the formation of feathers. As such, we now have a convenient tool to apply to management issues of migratory birds in North America.

In this study, a sample of secondary feathers from EP Tundra Swans at various locations on their wintering grounds in the eastern United States was obtained. Using the isotopic base map of Wassenaar and Hobson (2001), these individuals were then associated to their breeding grounds in the western Arctic. For all birds, we made the assumption that feathers were grown on the breeding or natal grounds.

METHODS

Secondary flight feathers were taken from swans captured on the wintering grounds (see locations listed in Table 1). The feathers were then cleaned with a chloroform:methanol solvent to remove surface contaminants. Cleaned feather vanes were then subsampled for deuterium isotope analysis. Stable-hydrogen isotope analyses of feathers are complicated over conventional measurements of $\delta^{13}C$ and $\delta^{15}N$ due to the problem of uncontrolled isotopic exchange between samples and ambient water vapor (Wassenaar and Hobson 2000). Elsewhere, the routine use of keratin standards as a means of correcting for this effect is described so that the values reported here are equivalent to nonexchangeable feather hydrogen (Wassenaar and Hobson 2003). Briefly, this process involves the simultaneous measurement of unknowns with several replicates of three different keratin standards the nonexchangeable δD values of which are known and which span the range of expected feather values. Algorithms generated from each run that relate δD values of unknowns to their expected nonexchangeable values are then used on a run-by-run basis.

Stable hydrogen isotope measurements on feathers and keratin standards were performed on H_2 derived from high-temperature flash pyrolysis of feathers and CF-IRMS. Pure H_2 was used as the sample analysis gas and the isotopic reference gas. A Eurovector 3000™ high-temperature elemental analyzer (EA) with autosampler was used to automatically pyrolyse feather samples to a single pulse of H_2 gas. The resolved H_2 sample pulse was then introduced to the isotope ratio mass spectrometer (Micromass Isoprime™ with electrostatic analyser) via an open split capillary. All δD results are expressed in the typical delta notation, in units of per mil (‰), and normalised on the VSMOW-SLAP standard scale. Repeated analyses of hydrogen isotope intercomparison material IAEA-CH-7 (-100 ‰), routinely included as a check, yielded an external repeatability of better than ±1.5 ‰.

RESULTS

Our sample of EP Tundra Swans showed a considerable range in deuterium feather isotope values indicating a diverse source population (Table 1; Figure 1). No significant differences were found among age groups although the small sample of hatching year (HY) birds formed a tight cluster and were generally of lower mean deuterium value than the other age classes (Figure 2). Applying our results to the feather isotope base map of Wassenaar and Hobson (2001) to the known breeding distribution of this species allowed the depiction of the approximate origins of the sample of swans if they grew their feathers on breeding or natal sites (Figure 3). Arbitrarily, birds breeding on the North Slope of Alaska were assumed to be part of the EP and birds breeding further west were assumed part of the Pacific Flyway (WP). This shows that a disproportionate component of the winter sample originated from the southern Hudson Bay region. Older birds (AHY - after hatching year) may have included nonbreeders and, so, the southern Hudson Bay region may have involved individuals traveling there as a result of molt migration.

DISCUSSION

This preliminary investigation has demonstrated how breeding or molting ground location information can be gleaned from the stable isotope analysis of swan feathers sampled on the wintering grounds. The broad latitudinal breeding distribution of Tundra Swans across the western Arctic makes them a very useful candidate for this isotopic approach, since such a distribution covers about a 50°/oo range in expected mean growing season deuterium abundance in precipitation.

Clearly, more information on the robustness of the isotopic contours throughout the Arctic region would be desirable. The current isotopic base map represents about a 40-year average, but the region has relatively few sampling stations. Nonetheless, based on the analysis of long-term datasets, such patterns are expected to hold and at least provide relative measures for population delineation. Such information can be used to test hypotheses of origins and movements of this species.

These results need to be interpreted with caution. If individuals did not grow their flight feathers on the known breeding grounds, then instead of being restricted to the coastal margin as shown in Figure 3, they could have instead grown those feathers inland along the same isotopic contour. Future studies will need to stratify a suitable sample of birds by age and likely previous breeding status in order to better clarify origins based on known molt movements or patterns. Nonetheless, with HY birds, the technique can be readily applied to obtain a quantitative estimate of where birds are being produced. Figure 2 indicates that HY birds tended to originate in more northern locations compared to the other two age categories (i.e., they had more negative deuterium feather values).

This was a preliminary investigation and the broad survey of wintering birds is now encouraged. Such an investigation, although involving considerable cost of analysis (about $20US per sample) would presumably need to be conducted rarely: once to describe the basic population structure and perhaps at a more limited scale to evaluate site fidelity among individuals. Future sampling should be directed at HY birds to investigate where the key production areas are located.

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Editors' Note: The presenter was unable to attend the Conference. His paper is presented here.

Table 1. Sample of feathers and results of deuterium isotope analysis for each individual Tundra Swan used in this study.

Location	Age/sex	Corrected δD (°/oo)
Ahoskie Treatment Plant	ASY/ F	-185
Alligator River NWR	AHY/ F	-173
Alligator River NWR	AHY/ F	-142
Caledonia Prison Pond	ASY/ F	-167
Caledonia Prison Pond	ASY/ F	-150
Caledonia Prison Pond	ASY/ F	-149
Caledonia Prison Pond	ASY/ F	-146
Caledonia Prison Pond	ASY/ F	-142
Chesapeake County	HY/ F	-157
Essex County	AHY/ F	-203
Essex County	AHY/ F	-184
Essex County	AHY/ F	-176
Essex County	AHY/ F	-162
Essex County	AHY/ F	-146
Essex County	AHY/ F	-145
Little Alligator Gameland	ASY/ F	-121
Middle Creek WMA	AHY/ F	-189
Middle Creek WMA	AHY/ F	-175
Middle Creek WMA	AHY/ F	-163
Middle Creek WMA	AHY/ F	-157
Middle Creek WMA	AHY/ F	-146
Near Schaefferstown	AHY/ F	-196
Near Schaefferstown	AHY/ F	-178
Near Schaefferstown	AHY/ F	-178
Near Schaefferstown	AHY/ F	-152
Near Schaefferstown	AHY/ F	-150
Near Schaefferstown	HY/ F	-195
Near Schaefferstown	HY/ F	-192
Near Schaefferstown	HY/ M	-214
Near Schaefferstown	HY/ M	-191
Pocosin Lakes NWR	AHY/ F	-185
Pocosin Lakes NWR	AHY/ F	-169
Pocosin Lakes NWR	AHY/ F	-161
Pocosin Lakes NWR	ASY/ F	-137
Purgatory- Currituck	ASY/ F	-179
Purgatory- Currituck	ASY/ F	-165
Purgatory- Currituck	ASY/ F	-162
Purgatory- Currituck	ASY/ F	-149
Surry County	AHY/ F	-197
Surry County	AHY/ F	-191

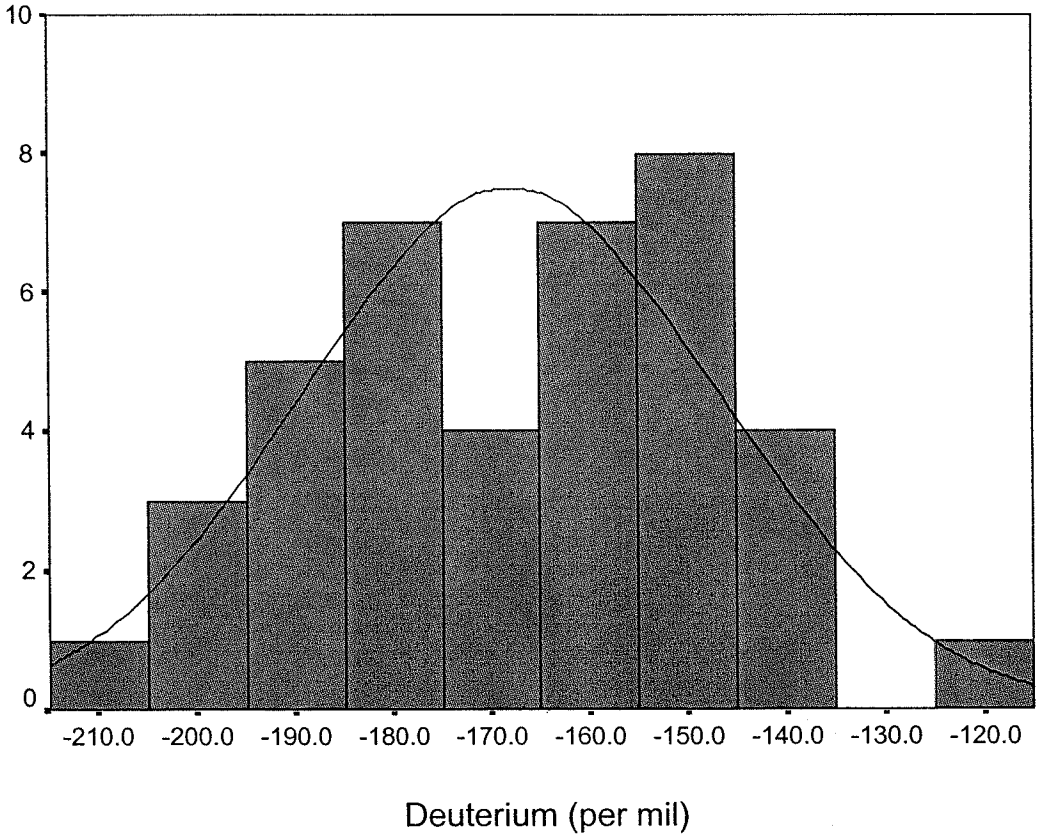


Figure 1. Distribution of deuterium isotope values for the Tundra Swan sample.

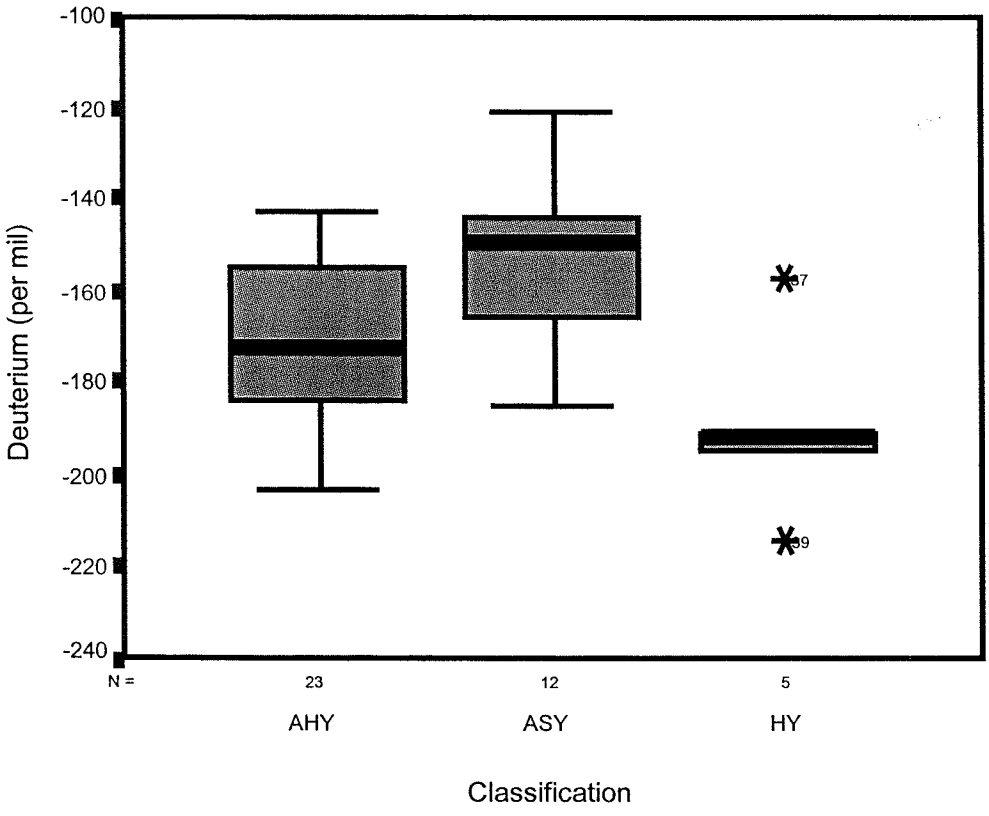


Figure 2. Box and whisker plot of deuterium values for each age group of Tundra Swans.

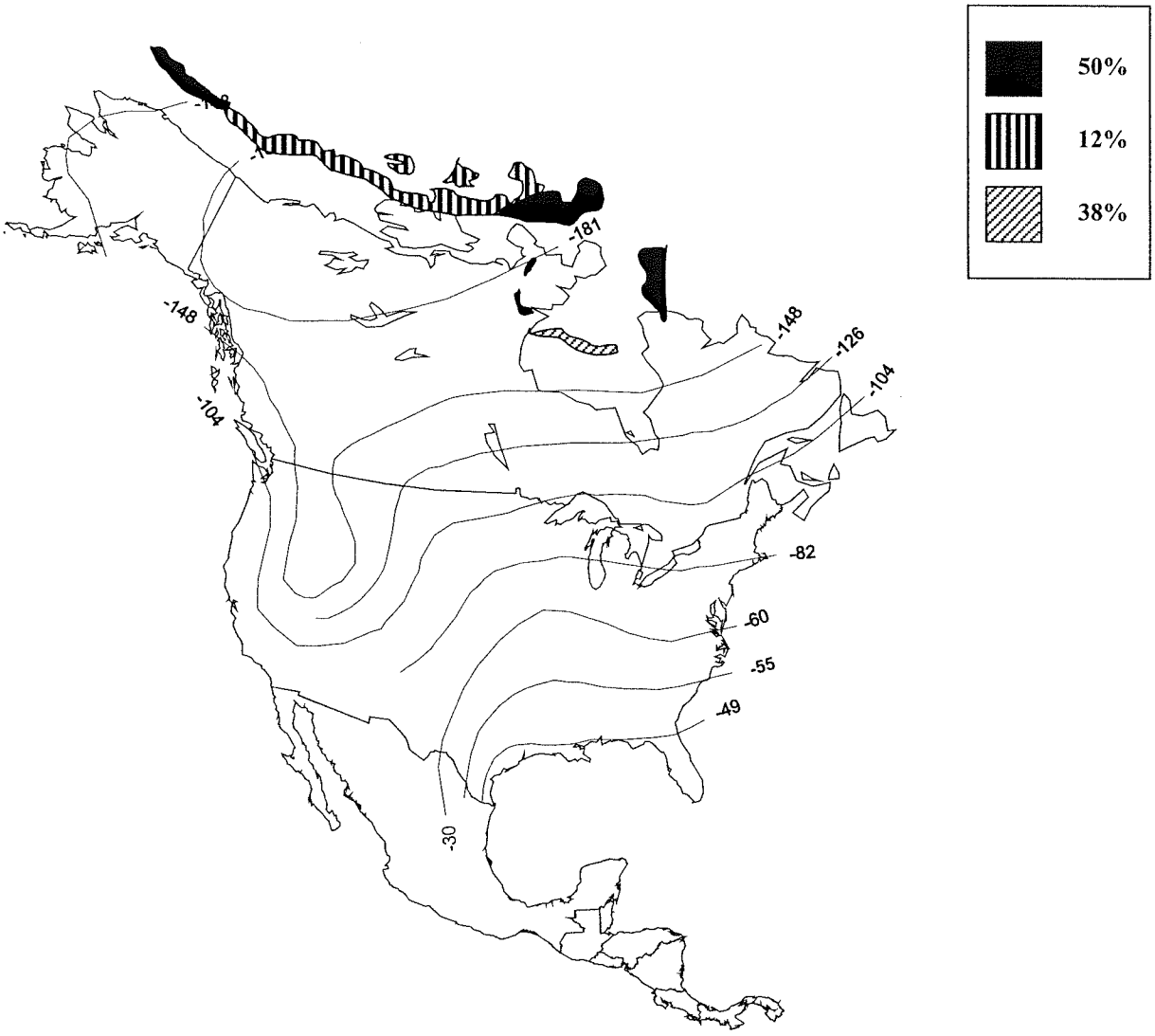
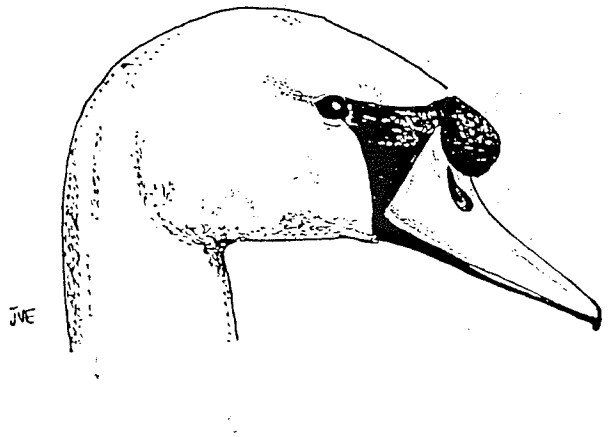


Figure 3. Origins of winter-sampled birds based on deuterium values of feathers. The percentage subdivision represents the proportion of the population growing flight feathers in the indicated region. Map delineation based on known breeding/molting distribution.

MUTE SWANS



REVIEW OF THE STATUS OF MUTE SWANS ON THE CANADIAN SIDE OF THE LOWER GREAT LAKES [1]

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ABSTRACT

Lower Great Lakes coastal wetlands provide important staging habitat for numerous native species of ducks, geese, and swans. Unfortunately, these coastal wetlands have been affected severely by drainage and development. Only 20-25% of western Lake Ontario's and less than 5% of western Lake Erie's original wetlands remain. This wetland loss has concentrated birds on a reduced habitat base, which probably has increased the importance of remaining lower Great Lakes wetlands for staging waterfowl. Although rates of wetland loss have declined over the last half century, introduction of exotic plants and animals to the lower Great Lakes system is now the main threat to the ecological integrity of remaining wetlands.

Mute Swans (*Cygnus olor*), which are endemic to Eurasia, were transported to North America for captive and semi-captive collections during the late 1800s and early 1900s. The intentional release and accidental escape of these birds resulted in the establishment of wild populations along the northeastern Atlantic Coast of the United States, portions of the Pacific Coast, and the lower Great Lakes basin. Since the mid to late 1900s, Mute Swan populations have been rapidly expanding, particularly along the Atlantic Coast. For example, the Chesapeake Bay (Maryland and Virginia) populations have grown from 5 birds in 1962 to over 4,000 at present. Despite control efforts, the Atlantic Flyway population is now approximately 15,000 birds. More recently, Mute Swan populations also have been increasing in the Great Lakes watershed. The current population is close to 10,000 birds.

Exotic waterfowl can have negative ecological impacts on native species, especially if the introduced species is aggressive, competes with other waterfowl for food or habitat, and/or hybridizes with native species. The Mute Swan's size, aggressive disposition, and appetite make it a strong potential competitor that can have substantial impacts on native waterfowl and their habitats. Mute Swans have also recently been reported to hybridize with native Trumpeter Swans (*C. buccinator*) in the wild.

The first noncaptive Mute Swan in Ontario was seen at Long Point in 1934. The first breeding pair in Ontario was recorded in 1958 at a golf course near Georgetown, and larger scale colonization began in the lower Great Lakes during the mid 1960s and 1970s. Since then, breeding and wintering populations have been established throughout coastal regions of Ontario's lower Great Lakes. Based on data from the Ontario Breeding Bird Atlas from 1981-85, plus anecdotal evidence since then, Mute Swans breeding in southern Ontario remain concentrated in coastal wetlands associated with the Great Lakes, especially Lakes St. Clair, Erie, and Ontario. During a 2002 midwinter waterfowl survey of the Canadian lakeshore, 1,369 Mute Swans were counted between the St. Lawrence River and Lake St. Clair. Because not all habitats were surveyed thoroughly and winter emigration rates to the U.S. are unknown, this can be considered a conservative estimate of Ontario's Mute Swan population.

Petrie and Francis[1] determined the rate of Mute Swan population growth on the lower Great Lakes and predicted how large the population could become in order to make recommendations for future management of swans in the region. Three independent historical data sets (Canada Christmas Bird Counts, 1970-2000; Midwinter Waterfowl Inventory of the Canadian side of Lake Ontario, 1980-2000; and Long Point, Lake Erie spring and fall aerial surveys, 1971-2000) were used to estimate rate of Mute Swan population change on the Canadian side of the lower Great Lakes. All three independent data sets they analyzed indicated rapid growth of the Mute Swans on the lower Great Lakes. Christmas Bird Counts on the Ontario side of the lower Great Lakes (Lakes Ontario, Erie and St. Clair) increased by about 14% from 1980-2000. The number of swans recorded on the Lake Ontario midwinter survey increased from 49 birds in 1980 to 327 in 2000. The average rate of annual increase during that period was 10%. The average annual rate of population increase

between 1971 and 2000 at Long Point was 16% based on spring data and 12% based on fall data. During the period 1980-92, the growth rate was about 30% per year.

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[1] Editors' Note: The citation for the published paper from which this abstract was written is: Petrie, S. A. and C. M. Francis. 2003. Rapid increase in the lower Great Lakes population of feral Mute Swans: a review and a recommendation. Wildlife Society Bulletin 31:407-416.

STATUS AND MANAGEMENT OF MUTE SWANS IN SOUTHWEST BRITISH COLUMBIA

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ABSTRACT

Mute Swans (*Cygnus olor*) were introduced to city parks in Victoria in 1889 and in the 1930s, and to Stanley Park, Vancouver, in 1974. Mute Swans have since spread from these release sites and they now breed in the wild on Vancouver Island and on the southwest mainland coast of British Columbia. Recent surveys suggest that there are roughly 300 Mute Swans in the province, of which approximately 200 are feral. Breeding range and numbers appear to be increasing. Mute Swans now breed in prime Trumpeter Swan (*C. buccinator*) wintering areas and a cross-species pair involving a resident Mute Swan and a migrant Trumpeter Swan has been observed on Vancouver Island with three hybrid offspring. The Canadian Wildlife Service considers the Mute Swan a nonindigenous species that could be harmful to the environment. The British Columbia Waterfowl Technical Committee (BCWT) oversees the management of feral Mute Swans and those kept under avicultural permits. The management of feral Mute Swans involves the following principles: 1) recognize that they are valued by the general public and aviculturists, and are useful for wildlife control programs; 2) over the long term, they should be removed from the wild; 3) they should be humanely treated in a publicly acceptable fashion; and 4) their management should preferably be done through nonlethal methods. The conditions associated with keeping Mute Swans in captivity under avicultural permits have also changed to prevent the release of birds from captive stocks. Under a new avicultural policy adopted by the British Columbia Wildlife directors, Mute Swans kept under avicultural permits must: 1) be rendered permanently flightless either by pinioning or tendonectomy to prevent escapees from dispersing; 2) be marked with numbered bands, with the band numbers recorded on the permittee's file; and 3) be confined to the property of the permittee. These proposals are the first steps toward a more active management of the species to remove all "wild" birds in a publicly acceptable, humane manner, while preventing the birds kept under avicultural permits from developing further feral populations.

MUTE SWANS IN MARYLAND: THEIR STATUS AND A PROPOSAL FOR MANAGEMENT

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ABSTRACT

The Mute Swan (*Cygnus olor*) was introduced to the Atlantic coastal region of North America from Europe during the late 1800s and early 1900s. The impetus for these early introductions was a desire to enhance the visual beauty of public parks and estate ponds. Subsequent escapes and deliberate releases of Mute Swans into the wild are responsible for the ~22,000 birds that now occupy coastal and freshwater habitats across the continent. In Maryland's portion of Chesapeake Bay, the first documentation of feral Mute Swans did not occur until 1962 when five birds escaped from an avicultural collection. Within 10 years, this "flock" increased to ~100 and by 1986, it numbered 264 birds. The population then underwent a dramatic growth and range expansion, rising in number to ~4,000 birds by 1999. Concomitant with this surge in population growth was the recognition of the Mute Swan as a public nuisance and detriment to the bay environment. Aggressive interactions occurred among Mute Swan pairs defending their nests and young during the breeding season and people wishing to use shoreline property and riparian waters. Conflicts between Mute Swans and native wildlife increased, including displacement of colonial waterbirds and native waterfowl from nesting and feeding areas. Further, Mute Swan grazing on submerged aquatic vegetation impacted the amount of this critical habitat available to waterfowl, fish, and other forms of wildlife. To address these concerns, the Maryland Department of Natural Resources appointed a Mute Swan Task Force in 1999 to develop management recommendations. A public outreach program has been implemented to make people aware of the problem, an active egg oiling program is in place to curtail short-term population growth, a statewide management plan is now under consideration for the Mute Swan, and a state-supported research program is underway to further address biological and ecological concerns.

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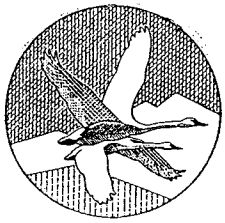
THE TRUMPETER SWAN SOCIETY

The Trumpeter Swan Society (TTSS) is a private, non-profit organization dedicated to assuring the vitality and welfare of wild Trumpeter Swan populations.

Since its founding in 1968, TTSS has provided the vision, knowledge and advocacy to move restoration efforts forward and improve management of Trumpeter Swans across North America. Our ~ 480 members in the U. S. and Canada include interested private citizens and waterfowl propagators, plus most of the professional waterfowl biologists and managers who have guided Trumpeter restoration and management in recent decades. Most of our accomplishments result from the work of our members and Board of Directors in their professional roles and through their countless hours of volunteer effort.

The Society is run by a President, Vice President, Board of Directors and a part time Executive Director and Administrative Assistant/Treasurer. The Society headquarters is located at Three Rivers Park District, Maple Plain, Minnesota. We publish *Trumpetings* four times per year and *North American Swans*, schedule determined by the Editorial Board. We are a nonprofit, tax exempt corporation under Section 501(c)(3) of the Internal Revenue Code. Contributions are tax deductible. The TTSS Web Page is located at www.trumpeterswansociety.org



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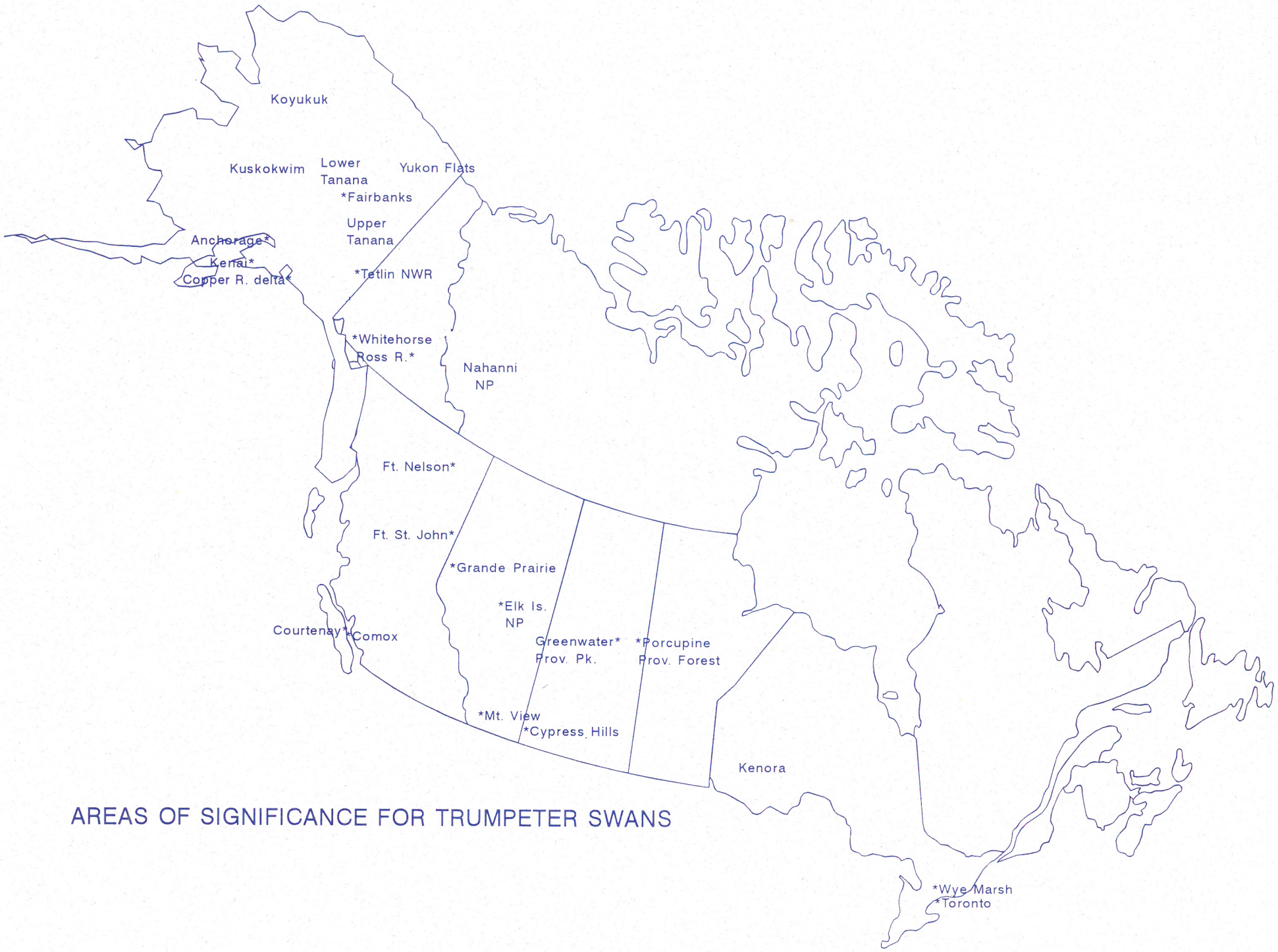

AREAS OF SIGNIFICANCE FOR TRUMPETER SWANS

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