SELECTED PAPERS OF THE TWENTIETH TRUMPETER SWAN SOCIETY CONFERENCE

Trumpeter Swan Restoration: Exploration and Challenges

20-22 October 2005
Council Bluffs, Iowa

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PREFACE

Members of The Trumpeter Swan Society share a common mission to assure the vitality and welfare of wild Trumpeter Swan populations. The Society advocates on behalf of the Trumpeter Swan in the areas of population security, range expansion, habitat conservation and management, research, and public education. Trumpeter Swan restoration in the Midwest was begun more than 40 years ago. Initially, emphasis was on restoring breeding pairs to northern historical nesting lakes and marshes. While once believed to be only a bird of pristine wilderness, we have seen that the Trumpeter Swan has been able to adapt and thrive in the Midwest, exceeding population goals in each of its various flocks. However, challenges to their security remain, especially related to the availability of healthy and secure winter habitat and developing techniques to encourage a larger portion of the Interior Population to migrate to more southern habitats.

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

The 20th Society Conference was held in Council Bluffs, Iowa, a historic Missouri River town. While presentations and discussions focused on the successes and challenges of the restoration of the Interior Population, we also heard talks ranging from Tundra Swan studies in Alaska to Trumpeter Swan surveys in western Canada and Mute Swan impacts on Chesapeake Bay. Liz Christiansen, Deputy Director of the Iowa Department of Natural Resources (DNR), welcomed conference participants to the 2 days of presentations. We give our sincere thanks to the Iowa DNR Trumpeter Swan Restoration Program for their help in arranging the many conference details and logistics. Thank you also to TTSS member Linda Scheurmann for researching the natural and historic highlights in and around Council Bluffs. The all-day field trip was hosted by Ron Andrews and Dave Hoffman who were our tour guides through the beautiful Loess Hills National Scenic Byway and DeSoto National Wildlife Refuge. Conference participants and local school children were able to witness a swan release at DeSoto Lake, an oxbow lake once part of the Missouri River, and now protected by the Refuge for waterfowl habitat. Many thanks to the staff at Hitchcock Nature Center for leading an interpretive hike overlooking the prairie and woodlands of the Loess Hills in fall color. At the Saturday evening banquet, TTSS member Arnie Fredrickson shared his excellent aerial and close-up slides of Trumpeter and Tundra Swans wintering and staging on the Mississippi River as well as trumpeters nesting in the marshes of east central Minnesota.

We gratefully acknowledge both Xcel Energy Foundation and The Summerlee Foundation for their generous funding that substantially defrayed conference costs and the printing of this special issue of *North American Swans*. Finally, we thank the authors who submitted their papers so that others might learn more about the needs of this majestic bird that we all cherish.

Madeleine Linck and Ruth Shea
The Trumpeter Swan Society

OPENING REMARKS

OCTOBER 20, 2005

On behalf of our Governor, Tom Vilsack, and the people of Iowa, I welcome you to our beautiful state and to Council Bluffs. I am glad you chose Iowa and Council Bluffs for your meeting this week. As we recognize and continue to celebrate the Bicentennial of the Lewis & Clark expedition that passed through here, it is appropriate to remind ourselves that this area did not always look as it does. We know the river looked different, but we cannot possibly comprehend the untouched beauty and natural abundance that once characterized this land. The French and Spanish explorers and traders who were in Council Bluffs almost a century before the Lewis and Clark expedition must have been amazed at these hills and the river so well known and cherished by Native Americans. When the expedition came through, the explorers stayed 5 days at White Catfish Camp, known today as Long's Landing. Lewis and Clark later met with Missouri and Otoe Indians 10 miles north of Omaha. This historic council in the bluffs provided the model for future meetings with the Native Americans and gave us the name of this city.

In studying Meriwether Lewis and William Clark's journals, it appears they may have been the first to describe our largest waterfowl, the Trumpeter Swan, and, just as importantly, differentiate it from the Tundra Swan (formerly known as the whistling swan). Lewis continually heard the swans bugling overhead throughout their travel west and in a note written in the course of the expedition in the Rocky Mountains, he recorded that "the Swans are of two kinds, the large and small. The small differs from the large only in size and note; it is about one fourth less, and its note is entirely different." Little did he know that those birds, so numerous as to darken the sky, would be persecuted to the point of near oblivion. It would take tremendous skill, effort, and ingenuity to reverse that trend and to hear and see the swans, the birds that Yeats called "those brilliant creatures" (Wild Swans at Coole), once again.

I would like to note a couple of interesting items about this area. Council Bluffs is often affectionately referred to as Iowa's "leading edge" or our "gateway to the west." It was none other than Abraham Lincoln who traveled to Council Bluffs in 1859 and spent 3 days discussing with locals the possibility of a coast-to-coast railroad. After he was elected to the presidency, Mr. Lincoln designated Council Bluffs the eastern terminus of the transcontinental railroad. You will tour through the unique Loess Hills, consisting of wind-blown silt that forms some of the most agriculturally productive soils in the world. The amazing thing about the Loess Hills is that, aside from the fact that this landform is found in only one other place in the world, China, because the silt was deposited by wind, it is a direct record of atmospheric circulation and as such can be used to test computer models of ice-age climates.

Returning to our swans, I applaud your work to restore this noble bird to its proper stature in our natural world. As you deliberate and discuss various issues, I encourage you to promote supporting environmental issues, especially water quality. Improving Iowa's water quality is one of Governor Vilsack's top priorities and, among those working in natural resources and environmental protection, it is one of the most critical issues facing us. Iowa has lost over 95 percent of its former 2 ½ million acres of glaciated wetlands and it shows. Rebuilding these important natural cleansing systems is a critical component of our work across the Department of Natural Resources. We are also working closely with private property owners to promote wetland restoration. Swans may be the key; since it turns out that citizens are really interested in Iowa's Trumpeter Swan restoration project and are encouraged by its success and want to be part of it. Ron Andrews calls it "trumpeting the cause for wetlands," knowing that improving water quality through wetland restoration will benefit our swans.

2005 marks the 10th year of Iowa's Trumpeter Swan restoration effort and we have reached our first goal of establishing 15 free-flying nesting Trumpeter Swans. Even better, we have nearly reached our second goal of establishing 25 nesting pairs. To date, 572 Trumpeter Swans have been released in Iowa and over 100 trumpeters wintered in Iowa during the 2004-05 winter. People were responsible for the demise of Trumpeter Swans, and it seems only appropriate that we bear the responsibility for their return. You professionals and organizations like The Trumpeter Swan Society are to be commended for your passion and tireless efforts to bring back this beautiful bird to the skies and wetland landscapes across America.

Once again, welcome to western Iowa and enjoy your conference!

Liz Christiansen, Iowa Department of Natural Resources

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INTERIOR POPULATION

IOWA'S TRUMPETER SWAN RESTORATION PROGRAM – A 2005 UPDATE

Ron Andrews and Dave Hoffman, Iowa Department of Natural Resources, 1203 North Shore Drive, Clear Lake, IA 50428

The following is a summary in time-line form that presents a brief overview of the history and development of the Trumpeter Swan restoration program in the State of Iowa. The last historical nesting of Trumpeter Swans in Iowa was recorded in 1883 at Twin Lakes in Hancock County.

- 1994: The Mississippi Flyway sanctioned and approved Iowa's Trumpeter Swan restoration plan.
- Goals were: (1) 15 wild nesting pairs by 2003. Goal later revised to 25 pair by 2006.
  (2) Promote the many values of wetlands.
- 1995: Field work was initiated.
- 1998 and 1999: First Modern Day nesting pair on a private farm pond in Dubuque County.
- 2000: Second nesting pair at Thorpe Park Wetlands, Winnebago County.
- 2001: Nine wild nesting attempts with 26 cygnets hatched; ~ 19 to flight stage.
- 2002: 10 wild nesting attempts with 37 cygnets hatched; ~ 27 to flight stage.
- 2003: 13 wild nesting attempts with 53 cygnets hatched; ~ 36 to flight stage.
- 2004: 15 wild nesting attempts with 44 cygnets hatched; ~ 36 to flight stage.
- 2005: 26 wild nesting attempts with 87 cygnets hatched; ~ 67 to flight stage (Figure 1).

In addition, listed below is other significant information.

- Iowa Trumpeter Swans were initially collared with green, then red collars, both having two white numbers and one white letter and a corresponding plastic tarsus band and a U.S. Fish and Wildlife Service lock-on tarsus band.
- Several of the Iowa released Trumpeter Swans have nested in Southern Minnesota and Wisconsin and one successful nest occurred in Missouri in 2005.
- To date, 685 Trumpeter Swans have been released; 113 trumpeters were released in 2005. The program will have approximately 80 swans to release in 2006.
- We have 55 flightless Partnership pairs that produce the greatest share of our 1-year old cygnets for release. The program is also obtaining cygnets from U.S. zoos as the opportunities arise.
- Iowa-banded Trumpeter Swans have been reported in 15 states and two provinces of Canada (Figure 2).
- Traditional migration/wintering sites in Iowa are developing. These sites include 74 swans near Webster City, 24 birds at Atlantic, 13 near Wheatland, and 15 swans near Mason City, Iowa. There are other scattered groups of smaller numbers at other sites within the State.
- 197 known mortalities have occurred to date: 39 from power line collisions; 41 poached by violators; 22 from diseases; seven from lead poisoning; seven from predators, and 81 from unknown causes.
- Shooting Trumpeter Swans in Iowa results in a $1,500 fine and court costs and possible hunting license revocation.
- The Iowa Trumpeter Swan database currently exceeds 3,500 observations.
- For additional Trumpeter Swan information, we recommend the following web sites: Iowa Department of Natural Resources at www.iowadnr.com, the Iowa State University Trumpeter Swan Committee at www.stuorg.iastate.edu/swan, and The Trumpeter Swan Society at www.trumpeterswansociety.org. During the nesting season, an Iowa nesting pair of swans can be observed on a web cam at www.osage.net/~mccb.
- For more information or questions concerning Iowa's Trumpeter Swans, please contact Ron Andrews or Dave Hoffman, Iowa Trumpeter Swan Restoration Coordinators, Iowa Department of Natural Resources, 1203 North Shore Drive, Clear Lake, IA 50428. Office Phone: (641)357-3517. E-mail address: Ron.Andrews@dnr.state.ia.us or David.Hoffman@dnr.state.ia.us

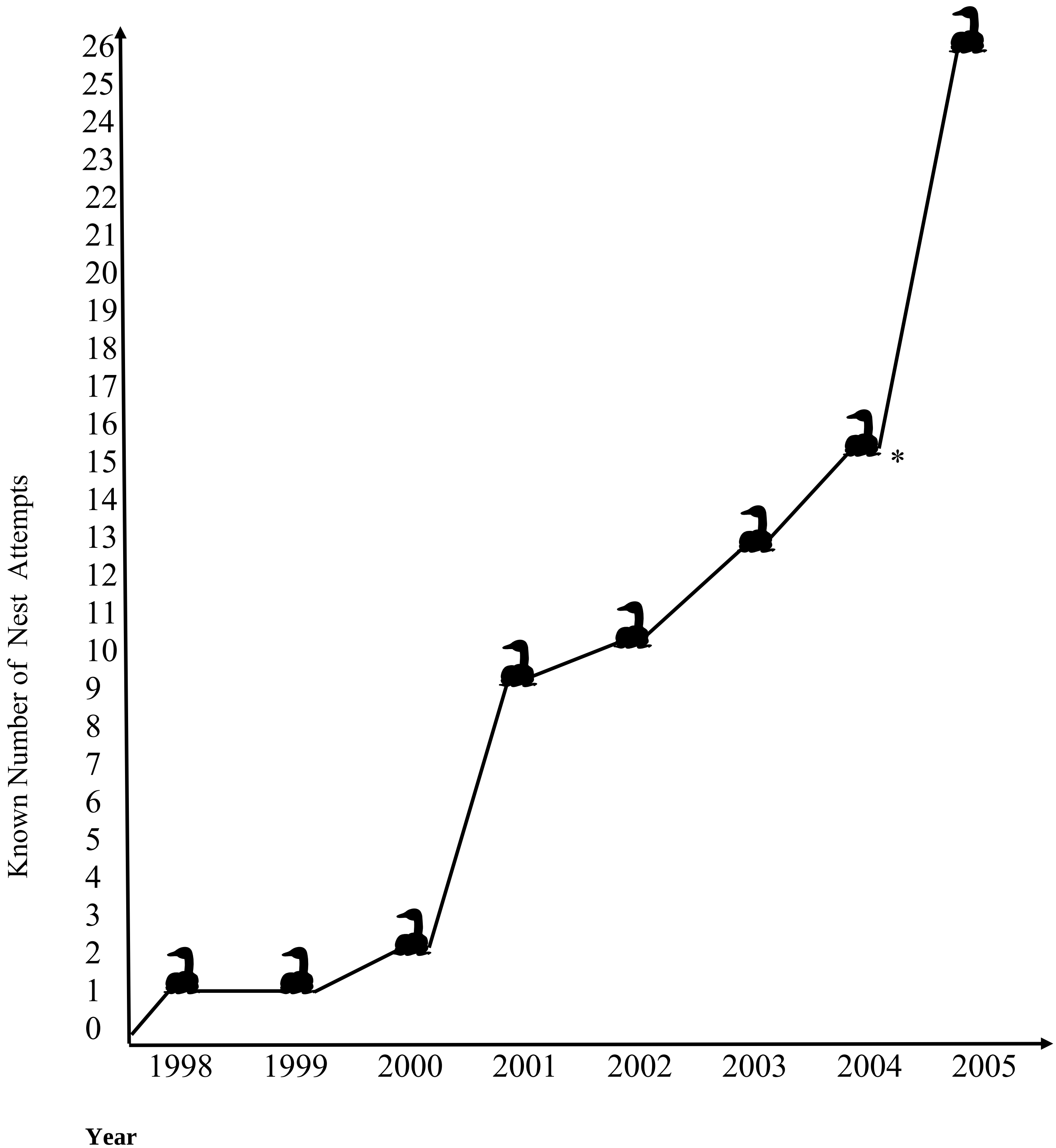

Figure 1. Number of known Trumpeter Swan nest attempts 1998 to present. * Flooding conditions in 2004 caused Iowa DNR staff to guesstimate nesting attempts.

Observations of Trumpeter Swans Released in Iowa
1995-2005

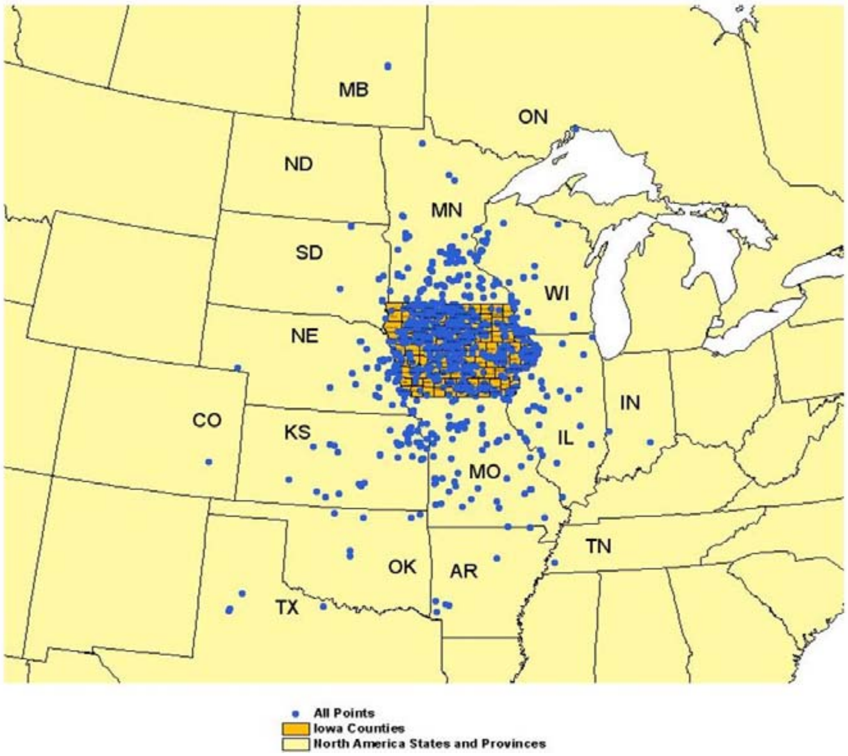

Figure 2. Observations of Iowa's released Trumpeter Swans.

OHIO TRUMPETER SWAN REINTRODUCTION

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ABSTRACT

In 1996, the Ohio Department of Natural Resources, Division of Wildlife, initiated a Trumpeter Swan reintroduction plan which had a goal of 15 breeding pairs by 2006. The intent of the program was to restore the native wildlife diversity found in Ohio prior to European settlement. The reintroduction plan consisted of 4 phases: (1) release of 3 and 4-year-old captive-reared swans (1996-97), (2) release of swans hatched from Alaskan Trumpeter Swan eggs (1998-2000), (3) release of swans obtained from private propagators (2002-2003), and (4) release of swans obtained through the W. K. Kellogg Bird Sanctuary (2003). The reintroduction program received a boost in 2002 when production increased from 18 fledged cygnets in 2001 to 40 in 2002. Since then, swan production has remained at or above 35 fledged cygnets/year. The number of breeding pairs remained at 12-14 pairs/year from 2001 until 2005 when 18 breeding pairs were counted.

INTRODUCTION

Archaeological evidence (Rogers and Hammer 1998) indicates that Trumpeter Swans were found in Ohio before European settlement; however, unregulated harvest of swans for meat and feathers extirpated the birds from Ohio in the early 1700s. No records indicate that swans nested in Ohio; however, French missionaries in the 1600s did report breeding swans at the mouth of the Detroit River (Hennepin 1697 in Thwaites 1903). At that time the Lake Erie marshes were continuous from Detroit to Sandusky; hence, it was likely that Trumpeter Swans nested in Ohio (Lumsden 1984).

A restoration effort was undertaken in 1996 as part of the Mississippi and Central Flyway Management Plan for the Interior Population of Trumpeter Swans. The Ohio Division of Wildlife (Division) has worked cooperatively with the Mississippi Flyway Council, the Cleveland Metropark Zoo, The Wilds, and Ducks Unlimited to implement this project. The reintroduction plan called for the release of about 150 Trumpeter Swans in selected Ohio wetlands with a goal of at least 15 breeding pairs by 2006. This unique reintroduction project was initiated to restore diversity to Ohio's fauna and to promote wildlife enjoyment opportunities on Division-managed wetland areas.

STUDY AREA AND METHODS

The reintroduction project consisted of four phases: (1) release of 2-3-year-old captive-reared Trumpeter Swans (1996-1997), (2) release of swans hatched from Alaskan Trumpeter Swan eggs (1998-2000), (3) release of swans obtained from private propagators (2002-2003), and (4) release of swans obtained from the Mississippi Flyway Council in an attempt to induce southern migration (2003).

For the Alaskan bird releases, Division personnel collected 50 eggs from Trumpeter Swan nests in Alaska in June 1996-1998. The eggs were hatched at the Cleveland Metroparks Zoo, and the cygnets taken to The Wilds, Muskingum County. After 2 years in captivity at The Wilds, the swans were released each spring at selected high quality marshes (Table 1).

Swan releases conducted in 2002-2003 consisted of parent-reared swans from Ohio, Wisconsin, or New York. The birds were purchased from private propagators in the spring of 2001 and 2002 as 9-month-old birds. They were kept at The Wilds over winter and released in 2002 and 2003 (Table 1).

Swans obtained for phase four were picked up at Kellogg Bird Sanctuary in Augusta, Michigan, as 4-month-old birds that had their primary wing feathers clipped. They were kept at The Wilds over winter and flew from the site as they completed their summer molt. Commercial feed for the swans was gradually reduced to encourage the birds to leave the immediate area.

RESULTS

The Division of Wildlife has released 154 swans since 1996. In addition, 199 cygnets have fledged in that time period (Figure 1). Swan production increased to 40 in 2002, and, since that time, swan production has remained at or above 35 fledged cygnets/year. Of the 353 swans that have been released or hatched in Ohio, 96 (27%) are known to be alive in the wild (seen within the last 12 months), 88 (25%) are verified dead, and the status of the remaining 169 (48%) is unknown. In 2005, 25 pairs of swans were observed in Ohio and 18 pairs nested (Figure 2). Eighteen of these nests successfully hatched a total of 60 cygnets of which 45 fledged.

Ten swans from Kellogg Bird Sanctuary were released in Muskingum County in summer of 2003 as a method to foster southward migration of Trumpeter Swans. Only one bird was seen more than 10 miles from the release site, so our hope of the birds migrating north to breed did not occur, but the Ohio flock was bolstered by 10 birds.

DISCUSSION

Ohio's reintroduction program received a large boost with the successful breeding year in 2002 and 2003. Ohio swans have experienced a cygnet survival rate of 74% which is on the upper end of reported values (Bellrose 1980). The increased production and cygnet survival indicate that the Ohio flock is progressing toward a viable breeding population. Thus, 2003 was the last year we released swans solely to increase the population. Significant additions to the population through natural reproduction should occur within the next couple of years.

The number of swans known to be alive is a conservative estimate, since it is primarily based on known breeding pairs of swans and observations from the public. As swans become more common, the public is less likely to report sightings, so the number of sightings is likely to decrease even as actual numbers of swans remain stable or increase.

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Table 1. Location of Trumpeter Swan release sites in Ohio, 1996-2003.

Year	Location	County	Number of swans
1996	Magee Marsh	Ottawa	15
1997	Killbuck Marsh Wildlife Area	Wayne/Holmes	15
	The Wilds	Muskingum	7
1998	Winous Point Marsh	Ottawa	7
	Pickerel Creek Wildlife Area	Sandusky	7
	Killbuck Marsh Wildlife Area	Wayne/Holmes	3
1999	Mosquito Creek Wildlife Area	Trumbull	15
	Mallard Club Wildlife Area	Lucas	14
2000	Killdeer Plains Wildlife Area	Wyandot	15
	Toussaint Shooting Club	Ottawa	9
	Winous Point Marsh	Ottawa	11
2001	Grand River Wildlife Area	Trumbull	7
2002	Grand River Wildlife Area	Trumbull	8
2003	The Wilds	Muskingum	16
	Cedar Point National Wildlife Refuge	Lucas	5

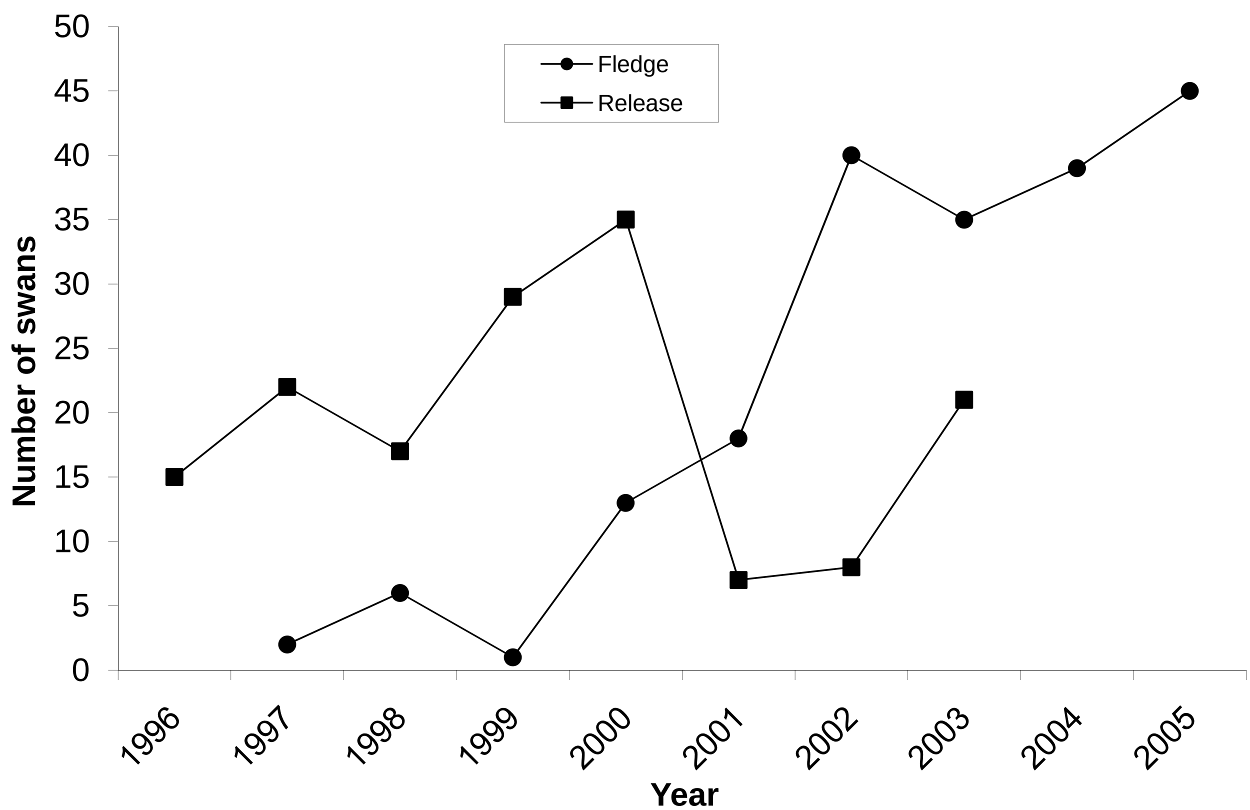

Figure 1. Number of Trumpeter Swans released and hatched in Ohio, 1996-2005.

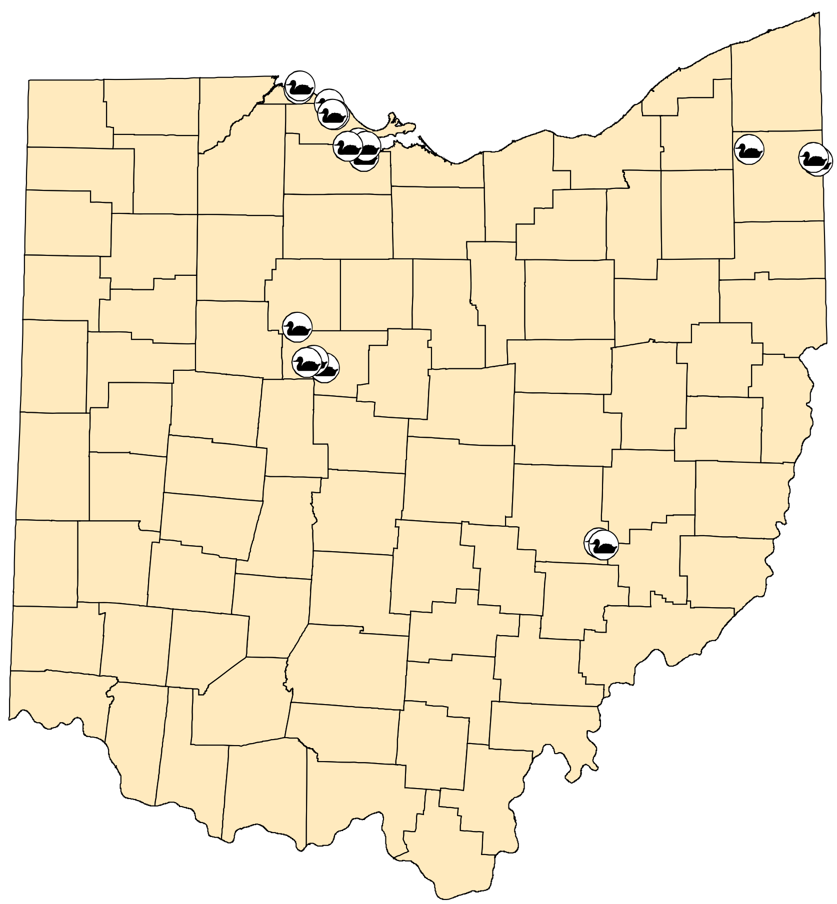

Figure 2. Location of Trumpeter Swan nest sites in Ohio, 2005.

THE INVENTORY OF TRUMPETER SWANS IN ONTARIO IN 2005

Harry G. Lumsden, 144 Hillview Road, Aurora, ON L4G 2M5

The Trumpeter Swan inventory for 2005 in southern Ontario, estimated from wing tag reports, adjusted for missed birds, and for the ratios of tagged to untagged swans recorded in the winter of 2004-05 was 359 swans. To this total were added 29 birds released before 1st September. To complete the 1 September population estimate, the wild production for the summer of 2005 must be added. There were 48 known pairs that attempted to breed. Thirty-eight of these pairs were successful in raising 135 cygnets. The mean per breeding pair was 2.8 cygnets and the mean per successful pair was 3.6 cygnets. There were eight breeding pairs that failed and an additional two pairs where the brood outcome is uncertain. Thus, our 2005 estimate of number of swans in southern Ontario totals 523.

This estimate of 523 swans may be too low, however. By examining the wing tag numbers tallied on the wintering grounds, we find many pairs that disappear from the record in late March or April, the beginning of the breeding season. They are not seen again until November through January when they reappear, often with a brood. We have no idea where these pairs nested. Furthermore, there are wintering sites for which we receive only sporadic or no reports or counts. These winter reports are typically from shallow, slow flowing rivers and occasional open areas on lakes and ponds where creeks enter and maintain open water.

The advice of geneticists is that, in order to achieve a self-sustaining population of Trumpeter Swans, we should have a population of 500 birds containing 100 breeding-age pairs. In 2004, we achieved the first objective with over 500 birds. Although some swans breed at 3 years old, and a very few even at 2 years of age, most swans do not start to nest until they are 4 years of age. Using the wing tag numbers, we are able to determine which are 4 years of age or older. There were 15 pairs in which neither partner was marked, which fledged broods in 2005. Among the unmarked pairs, there were eight more which are not known to have nested. Including the breeding pairs and pairs in which one bird was of known age over 4, we have a total of at least 82 pairs. This compares with the count of 64 pairs in 2004. The goal of 100 breeding-age pairs may be reached in 2006.

This year, there is evidence of further movement into Ontario of breeding-age trumpeters from Minnesota and Michigan. The Kenora District-Fort Frances area in western Ontario is just north of International Falls, Minnesota. This population of swans very likely originated from Minnesota and surprised all when a brood was found by a Breeding Bird Atlas team on Little Sachigo Lake in the Hudson Bay Lowlands. This brood was approximately 900 km (559 miles) north of their probable wintering ground on the Otter Tail River, Otter Tail County, Minnesota. There also was a brood reported on a lake northeast of Dryden, Ontario, which is east of Kenora and north of the Fort Frances area.

The restored Michigan Trumpeter Swan population is also moving into the Sault Ste. Marie area of Ontario. In 2005, two broods of trumpeters were recorded on the southwestern shore of St. Joseph Island, Ontario, just north of the eastern end of Michigan's Upper Peninsula.

WISCONSIN TRUMPETER SWAN RECOVERY PROGRAM: PROGRESS TOWARD RESTORATION, 1987-2005.

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INTRODUCTION

The Wisconsin Department of Natural Resources (WDNR) began its Trumpeter Swan (*Cygnus buccinator*) Recovery Program in 1987, hoping to achieve a recovery goal of 20 breeding and migratory pairs by the year 2000 (Matteson *et al.* 1986, 1988). In 1987 and 1988, while waiting in line behind Minnesota to go to Alaska to collect Trumpeter Swan eggs, we utilized cross-fostering as a reintroduction technique, using Mute Swans (*Cygnus olor*) as foster parents at a marsh site in southeastern Wisconsin. We used 35 Trumpeter Swan eggs from avicultural sources and experienced poor hatching success and survival, with only two cygnets reaching fledging age. This technique was discontinued after the 1988 season and replaced by an innovative technique called decoy-rearing, developed by the University of Wisconsin's Department of Wildlife Ecology in partnership with the WDNR. Decoy-rearing involved imprinting cygnets on life-size Trumpeter Swan decoys immediately after hatching, and transporting cygnets at age 3-5 days to sites in northern Wisconsin, where they followed floating decoys manipulated by University of Wisconsin interns in camouflaged float-tube blinds (Matteson *et al.* 1996).

Decoy-rearing and a second technique, captive-rearing (cygnets raised in captivity until 2 years, flight feathers trimmed, and the birds released at selected wetland sites) formed the basis for our restoration efforts, which began in full in 1989, when we flew to Alaska to collect Trumpeter Swan eggs for transport back to the Milwaukee County Zoo, where all of the collected Alaskan eggs were incubated during 1989-1997. During this period, through the cooperation of the U.S. Fish and Wildlife Service (USFWS) and direct assistance of pilot/biologist Rodney King, we collected a total of 385 eggs in the Nelchina Basin of southeastern Alaska and in the Minto Flats region of central Alaska. Terry and Mary Kohler of Sheboygan, Wisconsin, personally flew the WDNR team to Alaska, or arranged for private transportation to do the same. The Milwaukee County Zoo staff, under the direction of curators Ed Diebold and Kim Smith, placed the eggs in artificial incubators and hatched 356 (93%) during 1989-1997. Mean weights of the eggs collected (all years) ranged from 221.2 g to 242.8 g, with a weighted mean of 231.8 g.

NUMBERS RELEASED AND ANNUAL MONITORING

During 1989-2005, we released a total of 394 Trumpeter Swans to the wild. This number included 196 cygnets via the decoy-rearing technique, 159 subadults from the captive-rearing technique, 32 from captive-parent rearing (a complementary technique involving cooperators with private pairs, whose young produced were released as yearlings), six released as captive-reared yearlings, and one bird of miscellaneous origin released independently.

Annual monitoring of released birds and subsequent breeding activity occurred regularly during 1989-2005. Each spring, aerial surveys of potential wetland breeding habitat to locate nests took place; some of these surveys were part of Bald Eagle and Osprey survey flights. We also followed up on incidental/additional nesting reports from the public. Ground-truthing to determine clutch size at nests also occurred where and when possible.

The number of wild Trumpeter Swan active nests began slowly, with 1 in 1989 and 11 by 1995. After 1998, when we documented 18 nesting pairs, the number grew markedly. Between 1999 and 2005, the number of nesting pairs increased nearly 200% to a high of 92 nesting pairs in 2005. In 2005, breeding pairs occurred in 16 counties, with 55 (59.8%) clustered in northwestern Wisconsin, 18 (19.6%)

occupying wetland sites in northern Wisconsin, 16 (17.4%) in central Wisconsin, 2 (2.2%) in southwestern Wisconsin, and 1 (1.1%) in southeastern Wisconsin.

Observations of family groups occurred throughout the summer months, and these included an August pre-banding aerial survey to locate families and count cygnets.

During August and September from the mid-1990s through 2005, round-ups of cygnets and occasional molting subadults/adults occurred following a standard procedure: 1) a pilot in a small plane located a swan family, 2) pilot, with the swan family in sight, circled overhead and directed a flotilla of kayaks/canoes to the family group, where cygnets were captured by hand or with long-handled nets; 3) each captured bird was marked with a USFWS leg band and a yellow (formerly green, in earlier years) plastic collar with an alpha-numeric code; 4) health sampling followed: 5-6 cc of blood removed to test for lead poisoning, avian influenza, Newcastle's Disease, West Nile virus, and to determine sex via DNA analysis; 5) each bird was weighed and then carefully released back into its wetland.

Finally, fall (late September/early October) flights occurred to determine production.

During 1989-2005, we documented a total of 504 active nests, with 360 (71.4%) producing (fledging) 1,160 young (2.3 young/active nest; 3.2 young/successful nest—successful defined as producing at least 1 young). In examining nesting success by period, 1989-1994 (when we last reported on program progress), and during 1995-2005, it is evident how productive the growing population has been over the past decade. During 1989-1994, 30 nesting attempts produced 62 fledglings (2.07 young/active nest; 2.7 young/successful nest). For the period 1995-2005, 474 nesting attempts produced 1,098 fledglings (2.3 young/active nest; 3.3 young/successful nest).

In 2004, we examined the known origin of Wisconsin's breeding pairs and found that 62% were wild-produced birds, 14% were comprised of captive-reared and released birds, 11% were decoy-reared birds, 8% came from out-of-state, and 5% were captive parent-reared birds.

HABITAT CHARACTERISTICS

We identified the following Trumpeter Swan breeding habitat characteristics for the period 1989-2005: 1) shallow (1-2 m deep or less) waterfowl production areas and cranberry impoundments/flowages, with sedge and cattail marshes; 2) shallow State Wildlife Area (WLA) flowages, marshes, small farm ponds (<2 ac, 1 ha), and glacial potholes, with abundant submergent and emergent aquatic plant species (represented by *Elodea, Sagittaria, Najas, Nitella, Potamogeton, Sparganium,* and *Zizania*); 3) several Waterfowl Production Areas and WLAs dominated by wild rice or cattails/sedges; 4) backwater sloughs, beaver ponds, bogs, and hardwood swamps with small marshy islands/islets and abundant submergent foods (e.g. *Elodea, Potamogeton* spp.); 5) lake bay marshes and lake edge marshes; and 6) nests often constructed on small islands/islets or built-up mounds of detritus and *Typha, Zizania*, or *Scirpus*.

Marking nearly 1,500 trumpeters, including most cygnets produced, and all birds released during the program, has allowed us to track the migration and wintering of hundreds of birds. From fall 1999 through spring 2001, we equipped and tracked 16 trumpeters with satellite transmitters to learn more about migration distances and habitats used during winter. We learned that the shortest migration distance between breeding site (Shiloh Lake, Polk County) and wintering site (Lake Mallalieu, Hudson area, St. Croix County) was 41 miles (66 km), and the longest migration from breeding site (Little Turtle Flowage, Iron County) to wintering site (Union County WLA in southwestern Illinois) was 607 miles (971 km). We found that wintering habitats were generally similar to breeding habitats. For example, the breeding sites of central Wisconsin swans were shallow, diked pools/impoundments on State WLAs and cranberry lands. Wintering sites for central Wisconsin breeding swans were reclaimed strip mines managed for waterfowl in southwestern Illinois: habitats that looked like home.

CAUSES OF MORTALITY

We studied the causes of 226 known Trumpeter Swan mortalities during 1987-2005 and found that lead poisoning (n = 48), shooting (n = 46), and powerline collisions (n = 35) accounted for 57.1% of all mortalities. Seven additional factors ("undetermined"—13.3%, "other"—9.7%, "trauma/blood loss"—8.0%, "morbidity"—4.9%, "fish line/drowning"—2.7%, "human defense"—2.2%, "vandalism"—2.2%) comprised the remaining 42.9% of known deaths. In examining known mortalities by period, 1987-1994 and 1995-2005, the order of the three leading causes changed slightly: shooting (32.8%), lead poisoning (27.6%), and powerline collision (15.5%) during 1987-1994, and lead poisoning (19.0%), shooting (16.1%) and undetermined (17.9%), followed by powerline collision (15.5%), during 1995-2005. There were nearly three times as many mortalities during 1995-2005 (n = 168) than during 1989-1994 (n = 58), but the comparison is skewed because of the unequal number of years involved. Nevertheless, although shooting and lead poisoning remain important, they have declined proportionately when comparing the percentages of each for each time period. The same is not the case for powerline collisions, whose percentage of swan mortalities did not change between the two periods.

In 2004, after two different breeding adults (from adjacent wetland territories) died from colliding with the same powerline in central Wisconsin, the WDNR worked with Alliant Enegy to install 200 "firefly" bird flapper diverters along a 1-2 km north-south stretch of the powerline. These diverters (3.5 inches by 6 inches, acrylic plastic, UV-stabilized, with fluorescent reflective yellow-green patches on the front and fluorescent orange on the back), designed by Timothy Chervick of Swift Creek Consulting and produced by PR Technologies, Inc., were recommended by The Trumpeter Swan Society (Madeleine Linck, pers. comm.). We will be monitoring their effectiveness in the coming years. (Other bird diverters were installed in the 1990s in St. Croix County to address similar powerline collision issues.)

POPULATION VIABILITY ANALYSIS

Finally, we undertook a population viability analysis (PVA) to determine if the Wisconsin Trumpeter Swan population had achieved a stable, self-sustaining state. With the assistance of Paul Rasmussen of the WDNR's Bureau of Integrated Science Services, a quantitative evaluation of extinction risks and management options was achieved. Utilizing a VORTEX (Miller and Lacy 2005) software package, which simulates the fate of individuals using discreet events with probabilistic outcomes and incorporates both deterministic and random (stochastic) factors, we determined the rate of population change and probability of extinction under varying conditions. VORTEX is an individual-based population simulation model. Using input information that specifies the distribution of demographic parameters, it follows the fate of simulated individuals in the population and keeps track of these individuals as they are born, give birth, and die for generations (Miller and Lacy 2005, Lacy 2000). Because the life history events of the simulated individuals are determined by random processes with specified parameters (e.g., mean and variance), their fate is the result of both deterministic and stochastic factors. The simulation results thus portray the consequences of deterministic and stochastic factors on the population.

Values for model parameters were based on analyses of data from Trumpeter Swans in Wisconsin, published information for Trumpeter Swans in other areas of North America, and published information on other large birds such as Whooping Cranes. The parameters listed in Table 1 follow the format required for VORTEX; other models may use the same information in a different form. Because results of population modeling depend critically on parameter values, the parameters will be discussed following the order of Table 1.

Effects of inbreeding depression in the model were not included because Wisconsin's restored population originated primarily from Alaskan Trumpeter Swans, and probably incorporated considerable genetic diversity. It was assumed that the environmental factors affecting adult survival were primarily different from those affecting reproduction, so a good year for survival would not necessarily mean a good year for reproduction (in VORTEX language, environmental variation (EV) in reproduction and survival would not be concordant). Two catastrophe types, poor weather and disease, were included and will be discussed further below.

Most of the parameter estimates related to reproduction came directly from observations on Wisconsin Trumpeter Swans. Considerable effort has been allocated to observing Trumpeter Swan pairs in the spring, finding nests, and following their fate. This information is summarized in Table 1. The median age of first reproduction is used in simulating breeding behavior by VORTEX.

In Wisconsin, Trumpeter Swans may first breed at the age of 2, 3, and 4 years based on our field observations. Data from established western U.S. populations suggest breeding begins at 4 years or later (Mitchell 1994). Explorations with deterministic models showed it was difficult to match observed rates of Wisconsin Trumpeter Swan population increase unless breeding first occurred at least by age 3. Simulations were run with first breeding at each of the ages 2, 3, and 4 years. We have no information on density dependence in breeding. The percentage of females successfully breeding was calculated as the proportion of adult females attempting to breed (estimated during 1998-2000 as 64%) multiplied by the percentage of attempted nests that successfully fledged at least one swan (72% during 1996-2004). The estimated value of 46% seemed to be relatively high, so some simulations were run with the value of 36%. The percent of successful nests producing fledglings was estimated directly from observed Wisconsin nests during 1996-2004 (Paul Rasmussen, pers. comm.).

Although we have many observations of neck-banded Wisconsin Trumpeter Swans, we were not able to account for re-sighting probabilities and collar loss to obtain estimates of mortality directly for Wisconsin swans. The most careful study of Trumpeter Swan survival described in the literature provided an estimate of annual adult survival of 88%, or mortality of 12% per year (Anderson *et al*. 1986). This is consistent with estimates of adult survival for other species of swans (Bart *et al.* 1991). Even though the literature suggests low annual adult mortality in swans, model simulations were also run with higher values of 15% and 20% mortality per year. Estimates of survival for younger swans were less precisely estimated, but were somewhat lower than adult rates (Mitchell 1994). Estimates of standard deviation in mortality rates were not available. We used a slightly larger value (5%) than that used for simulations of Whooping Crane populations (3%; Mirande *et al*. 1997). Additional simulations used a standard deviation of 10% (Paul Rasmussen, pers. comm.).

Catastrophes are extreme and infrequent events that may cause large reductions in survival, reproduction, or both. It is obviously difficult to estimate the frequency and effect of catastrophes because they are unusual and infrequently observed. Computer simulations of Whooping Crane populations assumed the frequency of disease was 5% (1 in 20 years) and that the impact was primarily in reduced survival for adults (Mirande *et al.* 1997). We followed these guidelines, except we increased the severity (70% of normal survival instead of 90%). We assumed that the primary effect of catastrophic weather would be during nesting, so that reproduction would be reduced substantially, and adult survival reduced by a small amount. Two values were used for the frequency of weather catastrophes: 2% (1 in 50 years) or 10% (1 in 10 years) (Paul Rasmussen, pers. comm.).

Because the current Wisconsin trumpeter population is increasing, there are more young birds than in a stable age distribution. For simulations, we made the more conservative assumption that the population had a stable age distribution. We started most simulations with an initial population of 300 and assumed the carrying capacity in the state was 700 swans, which may likely be an underestimate, but provided a reasonable approach for the purposes of our modeling.

Stochastic factors become especially important in determining the fate of small populations. In larger populations deterministic factors dominate (Lacy 1994). Deterministic projection matrix models were used to determine if the population parameters specified for Trumpeter Swans resulted in plausible behavior of the modeled population, in the absence of stochastic variation. We were primarily interested in determining what combinations of parameter values could result in population growth as large as that observed in Wisconsin. During the period 1998-2004, the number of active Trumpeter Swan nests in Wisconsin increased by approximately 25% per year. Although no true population estimates are available, approximate estimates of the number of swans of all ages in Wisconsin during 1998-2000 indicated that the total population was increasing even faster than the number of active nests during that time.

Although in western U.S. populations, Trumpeter Swans do not begin reproducing until age 4 or greater (Mitchell 1994), the earlier (age 2-3) reproduction observed in Wisconsin's swans may have resulted from different environmental conditions, or may be a characteristic of a restored population in an environment with abundant nesting opportunities. The best estimates of input parameters (based on the literature for survival and Wisconsin data for reproduction) resulted in lower projected growth rates than that observed in Wisconsin under the deterministic model. This suggests that these estimates are conservative. The age distribution of Wisconsin Trumpeter Swans may also contribute to their larger growth rate (there are a large number of young swans).

Stochastic models were implemented using VORTEX (Lacy *et al.* 2005). The final results of any PVA are critically dependent on the form of the model and the values of the input parameters. Trumpeter Swans have a relatively simple life history, with adults forming long-term, monogamous relationships and breeding once a year. This type of life history is well modeled by VORTEX. Values of demographic parameters can never be known with certainty and, in some cases, small changes in parameters can have large effects on extinction risk and population growth rate. Sensitivity testing of a quantitative PVA involves examining results of simulations for a range of plausible values for the uncertain parameters. This can lead to an arbitrarily large number of simulations, if additional permutations of possible values are considered. Simulations under 23 distinct combinations of parameter values (Table 2) were run, and for each combination 100 simulations for 100 years each were run as well. The probability of extinction calculated is thus the probability of extinction during this 100 year period. Also computed was the probability of the population falling below a population size of 100 swans during 100 years (Paul Rasmussen, pers. comm.).

Simulated populations based on the best estimates of input parameter values for Wisconsin's Trumpeter Swans increased 6% per year and had essentially no chance of extinction within 100 years (Table 2; parameters in bold). All simulated populations increased steadily until they reached carrying capacity and then leveled off. As already mentioned, this simulated rate of population increase is lower than that observed in Wisconsin over the last decade, so these parameter estimates are probably conservative. Because some of the input parameters were estimated directly from the increasing

Wisconsin population (reproductive parameters, especially), we should expect that they would result in simulations of increasing populations. Despite this potential circularity in reasoning, this initial model represents the current Wisconsin population of Trumpeter Swans and suggests that the population is likely to grow to carrying capacity and fluctuate at that level, with little chance of extinction (Paul Rasmussen, pers. comm.).

The effect on extinction risk of varying the input parameters from the best estimates can be evaluated from other simulation results in Table 2. Simulations suggest that unless adult mortality is considerably larger than the best estimate (20% instead of 12%), factors affecting adult mortality alone are not likely to result in a declining population or substantially increased extinction risk. Other input parameter combinations that resulted in a decreasing population growth rate included either an increased median age at first breeding (age 4) or a decreased percentage of successful nesting (36% instead of 46%). These may represent conditions that are more likely as the Wisconsin population occupies available nesting habitat. Increased variability in juvenile and 1-2 year mortality and increased frequency of weather-related catastrophe increased the extinction risk somewhat, although these populations increased on average. Decreased initial population size resulted in a small increase in extinction risk, unless coupled with decreased nest success, which increased extinction risk more substantially (Paul Rasmussen pers. comm.).

What the models show is that the restored Wisconsin population of Trumpeter Swans has increased rapidly in the last decade even as releases of birds hatched from Alaskan eggs have stopped. Simulations reported here using the best estimates of demographic parameters for Wisconsin imply that the population should continue to increase with little likelihood of extinction or even significant decline. Even with moderately increased environmental variation and increased likelihood of weather-related catastrophes, simulations indicated little chance of extinction or decline. There is uncertainty involved in the estimation of all input parameters for the simulations, but parameters would have to be substantially different from the best estimates before extinction risk would increase significantly. Because mortality rates were based on estimates from western U.S. populations, it would be useful to obtain mortality estimates from Wisconsin birds for a future PVA (Paul Rasmussen pers. comm.).

Comparison of the Wisconsin Trumpeter Swan population to western U.S. populations suggests that all the populations probably have low adult mortality, but that the Wisconsin population differs from the western U.S. populations in having a lower age of first reproduction and greater nest success. The restored Wisconsin population may be in the process of filling up available breeding habitat; as the population increases, it may eventually be limited by breeding habitat. As that happens, the age of first breeding and nest success may change to levels closer to those seen in established western U.S. populations, leading to a decline in the population growth rate. Continued monitoring of age at first breeding and nest success are recommended (Paul Rasmussen, pers. comm.).

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Table 1. Values of parameters used in population modeling. Parameters and parameter names follow the usage of the software package VORTEX (Lacy *et al.* 2005).

Parameter	Input value	Comments
Species Description		
Inbreeding depression	N	Eggs originate from diverse Alaskan population
EV concordance in survival and repro	N	Factors affecting young and adults differ
Number of catastrophe types	2	Disease, weather
Reproductive System		
Breeding system	L-t M	Long-term monogamous
Female breeding age	3 – WI 4 – West	Median age of first breeding
Male breeding age	3 – WI 4 – West	
Maximum age	15	Maximum age of reproduction; lifespan up to 25+ Known to breed at age 12 from WI;
Sex ratio	0.5	?
Maximum brood size	8	WI data
Density dependent Breeding	N	
% females breeding	46%	WI data – probability that a given adult female will successfully produce offspring: .64 x .72 = .46
EV in % breeding	10	10 used for Whooping Cranes
Brood size	1 – 26 2 – 18 3 – 14 4 – 14 5 – 12 6 – 11 7 – 4 8 – 1	WI data, 1996-2004
Mortality rates		
Females and males (same)		
Age 0 – 1	rate 45 SD 5	From literature and WI analyses
Age 1 – 2	rate 30 SD 5	
Age 2 +	rate 12 SD 5	
Catastrophes		
Disease		
Frequency	5%	Whooping crane model
Severity – Reproduction	1	No effect; assume disease is not occurring during breeding
Survival	.7	
Weather		
Frequency	2%	10% used in some simulations
Severity – Reproduction	.5	"
Survival	.9	"
Mate monopolization		
% male breeders	90	Not known
Initial population		
Stable age distribution	Y	

Initial population size 300
Carrying capacity 700
Harvest N
Supplement N?

Notes on Breeding: The percentage of adult females breeding is the probability that a given adult female will successfully produce fledglings in a given year. The percentage was calculated from the product of the proportion of females attempting to breed (.64) and the proportion of those females that produced at least 1 fledgling (.72). Annual survival rates were for: 1) fledging to 1 year later, 2) 1+ to 2 years old, and 3) 2+ to 3 years old.

Table 2. Extinction risk and population growth rate under specified combinations of input parameters using VORTEX. All simulations began with an initial population of 300 swans with a stable age distribution. In each case 100 populations were simulated for 100 years. Conditions in **bold** are the best estimates based on Wisconsin data and literature values.

Breeding Age	Adult Mortality	Juvenile Mortality	Juvenile Var	Age 1 – 2 Mortality	Age 1 – 2 Var	Successful Breeding	Frequency of bad Weather	Probability of Extinction	Probability of N < 100	% annual deterministic change
2	12%	45%	5%	30%	5%	46%	2%	0.00	0.00	10.4
2	15%	45%	5%	30%	5%	46%	2%	0.00	0.00	8.1
2	20%	45%	5%	30%	5%	46%	2%	0.00	0.01	4.3
3	12%	45%	5%	30%	5%	36%	2%	0.00	0.01	2.2
3	**12%**	**45%**	**5%**	**30%**	**5%**	**46%**	**2%**	**0.00**	**0.00**	**6.0**
3	12%	45%	10%	30%	10%	36%	10%	0.06	0.25	0.7
3	12%	45%	10%	30%	10%	46%	10%	0.00	0.01	4.5
3	12%	55%	5%	30%	5%	36%	2%	0.14	0.54	-0.7
3	12%	55%	5%	40%	5%	36%	2%	0.66	0.99	-2.8
3	12%	55%	5%	30%	5%	46%	2%	0.01	0.02	2.8
3	12%	55%	5%	40%	5%	46%	2%	0.03	0.24	0.6
3	15%	45%	5%	30%	5%	46%	2%	0.00	0.00	3.5
3	15%	45%	10%	30%	10%	46%	10%	0.01	0.10	2.0
3	20%	45%	5%	30%	5%	46%	2%	0.21	0.55	-0.7
3	20%	45%	10%	30%	10%	46%	10%	0.58	0.90	-2.1
4	12%	45%	5%	30%	5%	36%	2%	0.06	0.53	-0.3
4	12%	45%	5%	30%	5%	46%	2%	0.00	0.01	2.9
4	15%	45%	5%	30%	5%	46%	2%	0.04	0.32	0.3
4	20%	45%	5%	30%	5%	46%	2%	0.93	1.00	-4.0

Additional simulations with conditions same as best estimates for Wisconsin except for parameters listed below.

Initial Population	Successful Breeding	Probability of Extinction	N < 100	% annual change
100	36%	0.07	0.17	2.2%
100	46%	0.00	0.00	6.0%
200	36%	0.01	0.05	2.2%
200	46%	0.00	0.00	6.0%

STATUS OF THE MICHIGAN POPULATION OF TRUMPETER SWANS, 2005

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ABSTRACT

The Michigan Trumpeter Swan restoration plan was approved by the Mississippi Flyway Council in 1986. For 3 years, we attempted to cross-foster Trumpeter Swans under Mute Swans. Eggs were solicited from several cooperative zoos and private aviculturists. From 1986 through 1988, a total of 44 Trumpeter Swan eggs were placed under Mute Swans, 35 hatched, however, only six cygnets survived to flight. Beginning in 1989, an alternate method of the rearing and release of 2-year-old sibling groups on suitable wetlands was initiated. Between 1989 and 1990, 91 eggs were collected on Minto Flats, near Fairbanks, Alaska. Eighty-eight eggs hatched, of which 80 young survived to flight. Cygnets were also obtained from zoo pairs and private aviculturists. Between 1989 and 2005, we released a total of 346 swans, of which approximately half were of Alaskan origin. Five captive pairs of Alaskan swans were developed from eggs collected in 1990 and 1991. The restoration was a cooperative effort between Michigan State University and the Michigan Department of Natural Resources Nongame Program, many zoos, private citizens, corporate partners, Native Americans, and federal agencies within the state. In 2005, the release of 14 swans, the production of 188 cygnets by 61 successful pairs, and the addition of the surviving birds from previous years yielded an estimated fall flight of 728 Trumpeter Swans (Figure 1). While still considered a Threatened Species, trumpeters now nest in 23 of 83 counties in Michigan (Figure 2). We had a goal of 200 birds in two flocks by 2000, and we reached that goal in 1997 (Figure 1).

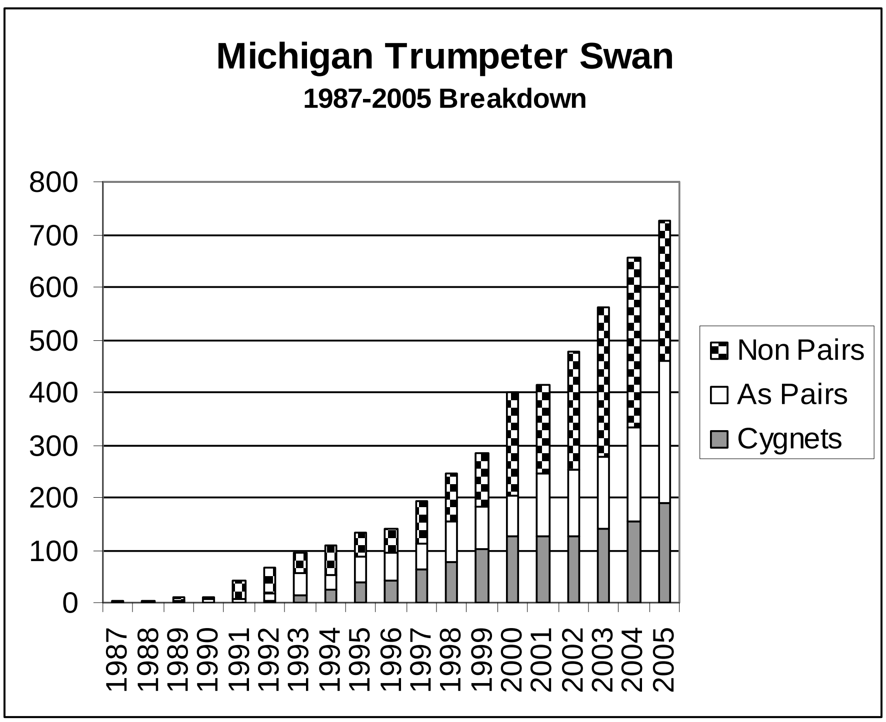
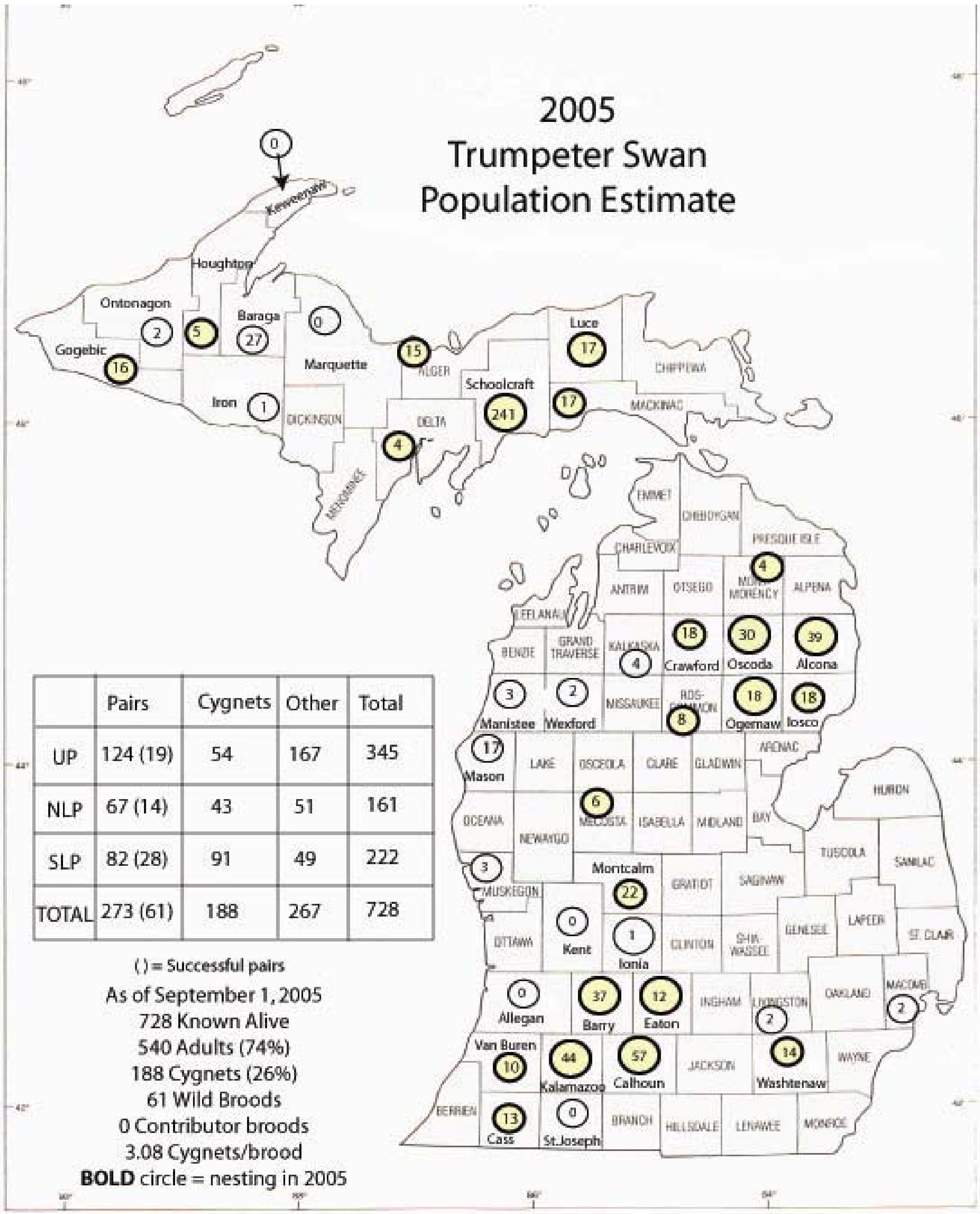


Figure 1. Michigan Trumpeter Swan nonpairs, pairs, and cygnets 1987-2005.



	Pairs	Cygnets	Other	Total
UP	124 (19)	54	167	345
NLP	67 (14)	43	51	161
SLP	82 (28)	91	49	222
TOTAL	273 (61)	188	267	728

Figure 2. 2005 Michigan Trumpeter Swan estimate.

STATUS OF TRUMPETER SWANS (*Cygnus buccinator*) AT SENEY NATIONAL WILDLIFE REFUGE (1991-2005)

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ABSTRACT

Because of its enabling legislation, remoteness, and habitat quality, Seney National Wildlife Refuge in Upper Peninsula, Michigan, was identified as a site for Trumpeter Swan reintroduction in the late 1980s. Subsequently, 44 swans were released in the Refuge over a period of 3 years (1991 – 1993) in a multi-agency attempt to bring back a breeding population of Trumpeter Swans to the Upper Great Lakes region. The past 14 years has shown a steady increase in the total number of white birds (adult/juvenile swans) on the Refuge (231 in 2005), the number of swan nests on the refuge (26 in 2005), and the total number of cygnets hatched (110 in 2005). However, cygnet survival (20%) was the lowest this year since the swans started nesting on the Refuge in 1992. Although the swan reintroduction program is an ongoing success for the Great Lakes region, information gaps still exist. These gaps include, but are not limited to, determining adult survival rates, identifying wintering and pre-breeding areas, identifying predators and predation rates on cygnets, and determining how swans are affecting the overall ecology of the pools on the Refuge.

STATUS OF THE HIGH PLAINS FLOCK OF TRUMPETER SWANS IN 2005

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ABSTRACT

Lacreek National Wildlife Refuge was the focal point for reintroduction of Trumpeter Swans (*Cygnus buccinator*) into the High Plains in the 1960s, but soon the swans pioneered into other parts of South Dakota and Nebraska. This High Plains Flock (HPF) eventually established nesting territories in northeastern Wyoming, western South Dakota, and throughout the Sandhills of Nebraska and South Dakota. The HPF has continued to grow, and the average annual growth rate was 4.2 percent during 1990-2004. The estimated total that presently comprises the HPF was just under 400 birds. Additionally, 40 broods were produced in 2004, the highest thus far. The majority of these swans (90%) were located in the Sandhills and mostly in western Nebraska. In 2005, 106 of the Trumpeter Swans counted during the midwinter survey were in the Lacreek area, and the remaining 423 were observed in Nebraska (Refuge files). Refuge staff believes that Lacreek NWR will continue to support swans in the winter, but may also function as a migratory and staging location with continued population growth.

INTRODUCTION

Trumpeter Swans historically nested in South Dakota and Nebraska, however by the early 1900s few swans remained. Only three records of nests were noted between 1912 and 1960 in this region, and all were in the Sandhills (Lacreek NWR, 1982). Because these birds historically occurred in the Sandhills and much of the wetland habitat was still relatively intact, biologists believed this area was well suited for reintroduction of swans. The U.S. Fish and Wildlife Service (Service) began to reintroduce swans into the interior United States at Lacreek National Wildlife Refuge (NWR) when 57 cygnets were transported from Red Rock Lakes NWR between 1960 and 1962 (Monnie 1966). The Refuge kept these cygnets in holding facilities for 3 years before releasing them on the Refuge, and ultimately released seventeen 3-year-old birds on Lacreek NWR from 1963 to 1966.

Lacreek NWR was the focal area for nesting and wintering swans, but soon the swans pioneered into other parts of South Dakota and eventually into Nebraska, where they began nesting at Valentine NWR in 1969. By 1977, the Lacreek flock increased to 200 birds, and, by 1978, banded birds began moving southward into Missouri. This flock established nesting territories in northeastern Wyoming, western South Dakota, and throughout the Sandhills of Nebraska and South Dakota. In 1991, Trumpeter Swans collared on their breeding territories in Greenwater Lake Provincial Park in northeastern Saskatchewan wintered at Lacreek NWR. This portion of the flock has continued to grow. It is believed that these nesting birds originated from the Lacreek Flock and now have a well established migratory route from breeding territories in Canada to Lacreek NWR and vicinity. This flock is now referred to as the High Plains Flock (HPF) which more accurately describes its range.

ABUNDANCE AND DISTRIBUTION

Summer

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

The HPF has continued to grow, and the average annual growth rate was 4.2 percent during 1990-2004 (Figure 1). The estimated total that presently comprises the HPF was just under 400 birds. Additionally, 40 broods were produced in 2004, the highest thus far (Table 1). The majority of these swans (90%) were located in the Sandhills and mostly in western Nebraska. Areas in Wyoming and South Dakota combined contained less than 40 swans.

Winter

Waterfowl surveys are conducted each January by federal and state agencies in South Dakota and Nebraska, and these surveys enumerate Trumpeter Swans. During the 2004 midwinter waterfowl surveys, 529 swans were counted in the High Plains (Figure 3). The difference between the summer and winter counts varies from year to year, but on average the difference seems minimal, with winter counts being slightly higher than summer counts (Õ = 36 ± 14 birds; 1980-2004). This difference may be due to HPF birds expanding to areas outside the survey route in the summer, but inhabiting areas within the boundaries of the winter survey, movement of birds from Canada or other restoration areas into the winter survey area, or both.

As many as 268 swans have been observed at Lacreek NWR in early winter months, but that number can drop to as little as 24 birds when prolonged subzero temperatures leave little open water on the Refuge. During that time, most move to more southerly locations such as the Snake and North Loup Rivers (Nebraska Game and Parks Commission, unpublished memo). In 2005, 106 of the Trumpeter Swans counted during the midwinter survey were in the Lacreek area, and the remaining 423 were observed in Nebraska (Refuge files). Refuge staff believes that Lacreek NWR will continue to support swans in the winter, but may also function as a migratory and staging location with continued population growth.

Management of this flock will promote the natural migration of swans to adequate wintering locations beyond those currently utilized. Small numbers of birds have migrated as far south as Missouri and Oklahoma, (Ad hoc Drafting Committee for the Interior Population of Trumpeter Swans 1998) and managers hope this trend will continue as to expand the extent of the winter range.

Current HPF survey data

Biologists counted a total of 358 swans in 2005, which is a decrease of 8 percent from 2004. The decrease was solely the result of a decrease in cygnet production (31%; 107 to 74 birds); the number of white birds remained the same at 284 (Figure 2). These results are above the 16-year average for white birds (185 ± 14) and total birds (266 ± 17), but not cygnets (81 ± 6). Although the number of cygnets decreased this year, the count is not significantly different from the 15 year average ($P<0.001$). Specific results for each category are listed in Table 2.

Flock status in 2005

Although the number of white birds remained steady this year, a large percentage (72%) of the pairs observed had no cygnets. This may be because many of the white birds counted have not reached breeding age and did not produce young, or due to a loss of broods as a result of several hail-producing thunder storms that occurred early in the summer. Also, some breeding pairs that were present in South Dakota may not have been counted because heavy cloud cover prevented aerial observers from surveying the area. The percentage counted in that area is generally small, however, and likely would not significantly change the final survey results. A drop in cygnet numbers like the one experienced this year has happened before, but the flock increased to pre-decline levels in 1 to 2 years. In 2001, the number of cygnets dropped to 45, but rebounded to 121 the following year. This slight decrease in production is likely part of population dynamics for this long-lived bird and currently warrants little concern.

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Table 1. Breeding performance of High Plains Flock from 1980 to 2004.

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

Table 2. Results of the 2005 fall production survey of High Plains Flock of Trumpeter Swans.

Population parameter	Count or Mean Estimate
Adults and subadults	284
Cygnets	74
Total swans	358
Adults and subadults in flocks	70
Total flocks	15
Pairs with cygnets	27
Pairs without cygnets	69
Singles with cygnets	2
Singles without cygnets	14
Total broods	29
Mean brood size	2.53

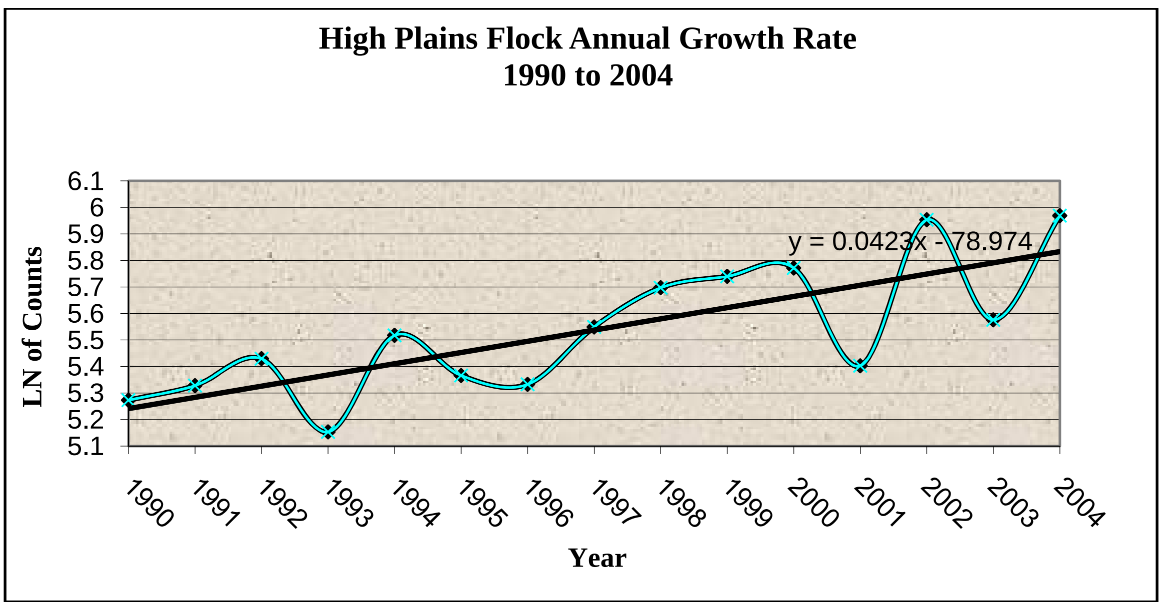
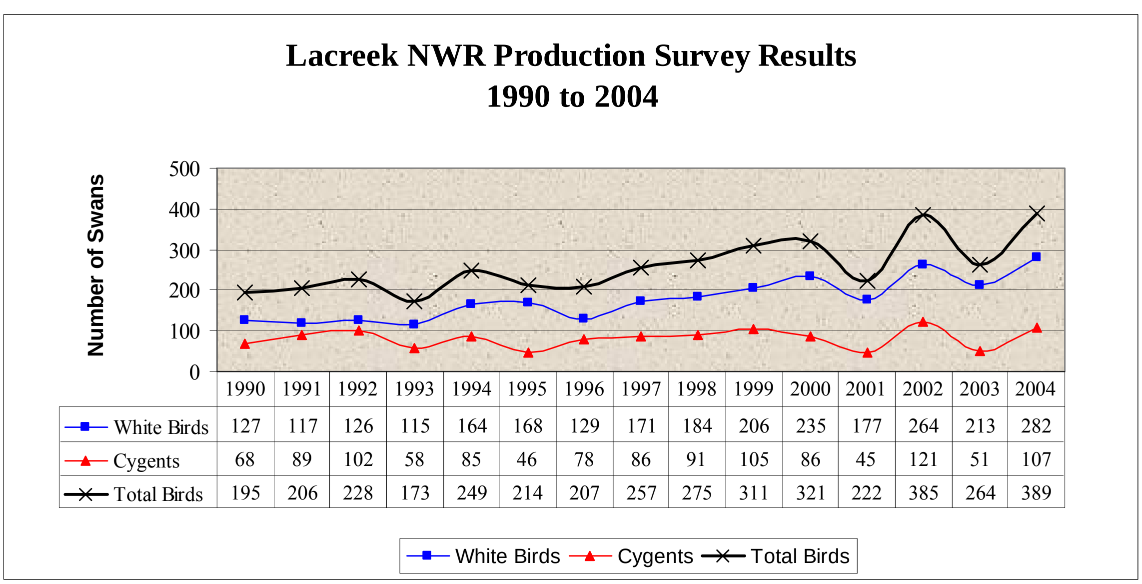
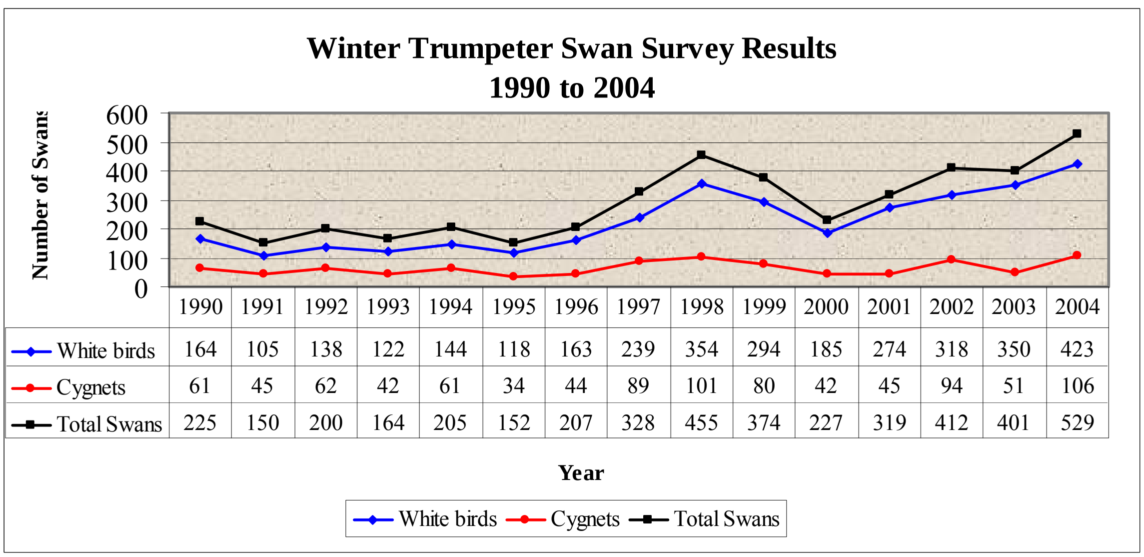


Figure 1. High Plains Flock annual growth rate 1990 to 2004.



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
White Birds	127	117	126	115	164	168	129	171	184	206	235	177	264	213	282
Cygents	68	89	102	58	85	46	78	86	91	105	86	45	121	51	107
Total Birds	195	206	228	173	249	214	207	257	275	311	321	222	385	264	389

Figure 2. The High Plains Flock fall production survey results from 1990-2004.



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
White birds	164	105	138	122	144	118	163	239	354	294	185	274	318	350	423
Cygnets	61	45	62	42	61	34	44	89	101	80	42	45	94	51	106
Total Swans	225	150	200	164	205	152	207	328	455	374	227	319	412	401	529

Figure 3. Midwinter Trumpeter Swan survey results for the High Plain Flock, 1990 to 2003. The year reflects the results that correspond to the most recent fall survey (i.e., the winter 1990 count was actually derived from the January 1991 survey).

INTERIOR POPULATION OF TRUMPETER SWANS: STATUS AND TRENDS

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ABSTRACT

Trumpeter Swans (*Cygnus buccinator*) of the Interior Population (IP) were extirpated by 1900. The population now consists of 19 restored subpopulations located in eight states and three Canadian provinces. Initial restoration efforts began in the Central Flyway in the 1960s, followed by six projects in the Mississippi Flyway in the 1980s and 1990s. Approximately 2,424 swans have been released and wild pairs have produced over 9,600 cygnets (1962-2005). In 2005, 165 swans were released, and 422 successful pairs produced 1,419 cygnets. When added to survivors from previous years, the 2005 fall flight was estimated to be 4,750. All programs have exceeded "goals" stated in their Flyway approved plans. We are at 245% of successful pair goal and 237% of population goal as stated in Management Plan for the Interior Population of Trumpeter Swans. The population increased 91% from 2,426 in 2000 to 4,750 in 2005, preliminary results (Table 1, Figure 1). The population has been doubling every 5 years since 1985.

Table 1. Interior Population estimates from Quinquennial Surveys, 1968-2005

Year	Number	% Cygnets
1968	65	33%
1975	116	30%
1980	176	28%
1985	209	33%
1990	422	30%
1995	927	25%
2000	2,426	28%
2005*	4,750	30%

* 2005 data preliminary

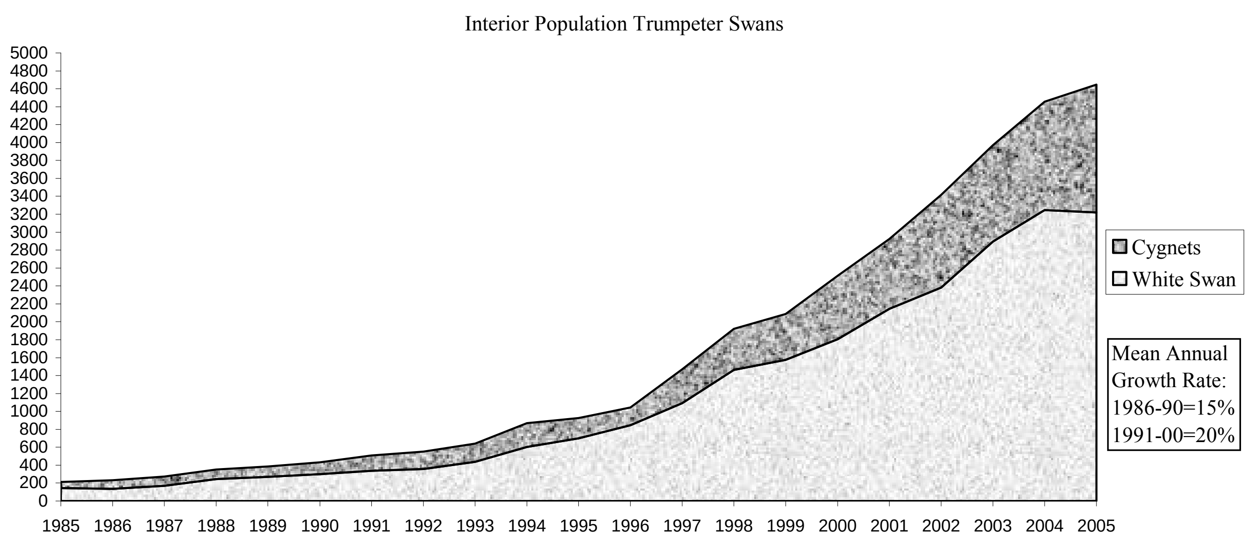

Figure 1. Growth rate of the Interior Population of Trumpeter Swans based on late summer and fall census.

CENTRAL FLYWAY PERSPECTIVES ON TRUMPETER SWANS

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ABSTRACT
The Central Flyway is responsible for migratory waterfowl and other birds, including Tundra (*Cygnus columbianus*) and Trumpeter Swans (*C. buccinator*). One restoration and one pioneering flock of Trumpeter Swans exist within the Central Flyway and other restoration efforts occur to the east and west. Tundra Swan hunting seasons occur in three Central Flyway states. Approximately 1,000 swans are harvested annually, with North Dakota harvesting the most swans. While restoration flocks of Trumpeter Swans are nearing or exceeding population objectives, continued success will likely depend on the availability of suitable migration and wintering areas and their ability to adequately support Trumpeter Swans without impacting other waterfowl populations and associated hunting programs.

INTRODUCTION

The Central Flyway is a coalition of 10 states, two Canadian provinces and two Canadian territories that works in conjunction with the respective federal governments to manage migratory waterfowl and other birds and their habitats throughout a large sector of North America. Most of the conservation programs for migratory birds in a significant portion of mid-America, particularly for waterfowl, are delivered by Central Flyway states in cooperation with federal agencies and non-governmental partners.

Included under the responsibilities of the Central Flyway and associated federal agencies is the management and conservation of Tundra (*Cygnus columbianus*) and Trumpeter Swan (*C. buccinator*) populations. The two species have differing management considerations in the Central Flyway that may at times directly conflict with each other (Vaa *et al*. 1999). To deal with issues concerning swans, a special subcommittee of the Central Flyway Waterfowl Technical Committee has been established to review and initiate actions or recommendations to deal with those issues. However, collaboration and communication with agencies or organizations outside the borders of the Central Flyway is necessary to foster understanding and identify those programs that are important to agencies within and outside of the Central Flyway. Thus, the objectives of this paper are to review the status and background of swans in the Central Flyway, review Tundra Swan hunting seasons in the Central Flyway, discuss possible migration and wintering areas and habitats for Trumpeter Swans in Central Flyway states, and offer Central Flyway perspectives on these issues.

SWANS IN THE CENTRAL FLYWAY

There are two populations of Trumpeter Swans in the Central Flyway. The larger of the two is the High Plains Flock which is located at Lacreek National Wildlife Refuge (NWR) in South Dakota and the Sandhills region of Nebraska as part of a restoration effort begun in the 1960s (Figure 1). The other flock is located in eastern Saskatchewan and western Manitoba (Figure 1). This Canadian flock is likely the result of Lacreek NWR swans pioneering into the region, but only discovered in the early 1990s. Currently, both populations are doing well, with the High Plains Flock numbering approximately 360 birds in fall 2005 (Kingfisher and Vrtiska 2005) and the Canadian flock numbering approximately 113 birds (Gerard Beyersbergen, pers. comm.).

Just east of the Central Flyway, restoration flocks have been established in Minnesota and Iowa (Figure 1). Both of these efforts also appear successful and swans from these efforts have been observed in the Central Flyway. These trumpeters are a part of the Interior Population of Trumpeter Swans that includes several other states and Ontario. Finally, there are restoration efforts for Trumpeter Swans to the west of the Central Flyway states in the Pacific Flyway portions of Wyoming and Montana (Figure 1).

A large portion of the Eastern Population of Tundra Swans migrates through the Central Flyway in fall and spring, primarily through the province of Saskatchewan and the states of Montana, North Dakota, and South Dakota (Figure 1). Staging areas are confined to southern Saskatchewan, northeastern

Montana, large portions of North Dakota and northeastern South Dakota (Figure 1). The swans are attracted to large open wetlands for roosting and those containing adequate amounts of sago pondweed (*Potomogeton pectinatus*) for foraging (Earnst 1994).

Although relatively few in number, Mute Swans (*C. olor*) do occur in the Central Flyway in limited numbers. However, they do not appear to be causing damage to aquatic habitats as they have in the Atlantic Flyway (Maryland Department of Natural Resources 2003) or causing other management dilemmas.

SWAN HUNTING SEASONS

Currently, three states in the Central Flyway (Montana, North Dakota, and South Dakota) hold Tundra Swan hunting seasons in compliance with the *Eastern Population Tundra Management Plan* (Ad Hoc Tundra Swan Committee 1997). Harvest of Tundra Swans is managed by a permit system, with Montana, North Dakota, and South Dakota currently receiving 500, 2,200, and 1,300 permits, respectively. North Dakota typically issues all of their allotted permits, while Montana and South Dakota are issuing just under their allotment.

Harvest of Tundra Swans has ranged from just under 1,700 to less than 400 (Kruse 2005) (Figure 2). Annual mean harvest of swans is approximately 1,000 birds in the Central Flyway (Kruse 2005) (Figure 2). North Dakota annually harvests more Tundra Swans than Montana and South Dakota, and Montana harvests the least number of Tundra Swans. Total harvest also appears to be decreasing over time (Figure 2). However, even with Tundra Swan hunting seasons, population indices and 3-year averages derived from winter counts indicate the population has remained relatively stable since 1990 (Kruse 2005) (Figure 3).

Swan hunting in these states is popular among hunters (Vaa *et al*. 1999). There also appears to be little conflict between Tundra Swan hunting seasons and restoration flocks of Trumpeter Swans (Vaa *et al*. 1999). Montana and South Dakota obtain bill measurements on harvested swans to ascertain if any trumpeters are harvested during their Tundra Swan seasons (Jim Hansen, Montana Fish, Wildlife and Parks, and Spencer Vaa, South Dakota Dept. of Game, Fish and Parks, pers. comm.). Despite few anticipated conflicts and effects to Trumpeter Swan restoration flocks, the Central Flyway is currently not interested in pursuing a general swan season similar to that in the Pacific Flyway. Recent controversies and subsequent lawsuits over swan seasons in the Pacific Flyway have made us cautious about such an approach. Despite differences in affected swan populations and circumstances between Pacific and Central Flyway hunting seasons, we believe a general swan season could potentially jeopardize current Tundra Swan seasons. Further, we also question the true motives behind lawsuits in whether they were initiated to protect Trumpeter Swan populations or ultimately abolish swan hunting.

TRUMPETER SWAN RESTORATION

The Central Flyway has observed the success of Trumpeter Swan restorations within and outside the Flyway. Undoubtedly, propagation and restoration of Trumpeter Swans flocks can be accomplished. However, despite successes with breeding populations, we are concerned about the viability of these populations in relation to their use of new migration and wintering areas. We believe the continued success of Trumpeter Swan restoration and support of restoration efforts by Central Flyway states will involve making restoration flocks independent of supplemental feeding and encouraging trumpeters to naturally pioneer to suitable migration and wintering areas. We are concerned about artificial feeding of Trumpeter Swans in both in terms of creating and perpetuating unnatural swan behavior as well as creating illegal baiting situations during waterfowl hunting seasons.

Inquiries about the availability or location of possible migration or wintering sites in the Central Flyway have been met with caution. First, we are not sure of any specific criteria or habitat requirements needed by Trumpeter Swans. Without knowledge of specific criteria, determining appropriate areas is difficult. If such criteria were known, use of analytic tools such as Geographic Information Systems (GIS) could more accurately depict and quantify possible migration and wintering areas.

Additionally, some work is needed in identifying the current quantity and quality of wintering habitat available to the High Plains and Canadian flocks. While these populations have been increasing steadily, they may be limited in the near future by the amount of available wintering habitat. That information also needs to be reconciled with the amount of possible breeding habitat available to Trumpeter Swans in the Sandhills of Nebraska.

Finally, we remain concerned about Trumpeter Swan restoration and possible impacts to hunting programs (Vaa *et al*. 1999). Within the management plan for the Interior Population of Trumpeter Swans, management strategies are detailed to deal with conflicts between hunting programs and Trumpeter Swan restoration programs (Subcommittee on the Interior Population of Trumpeter Swans 1997). Those strategies need to be included in future updates of the Interior management plan. Increased incidental take is likely, given increases in Trumpeter Swan flocks. However, we still believe that incidental take shall not be grounds for any changes in existing hunting programs and that incidental take will not harm Trumpeter Swan restoration efforts (Vaa *et al*. 1999).

The Central Flyway is willing to cooperate in updates of the Interior Population of Trumpeter Swans Management Plan and with other flyways, groups, and organizations concerning all swan management issues. Open and frank communication is necessary to continue or further programs that all groups promote or support, including Trumpeter Swan restoration.

ACKNOWLEDGMENTS

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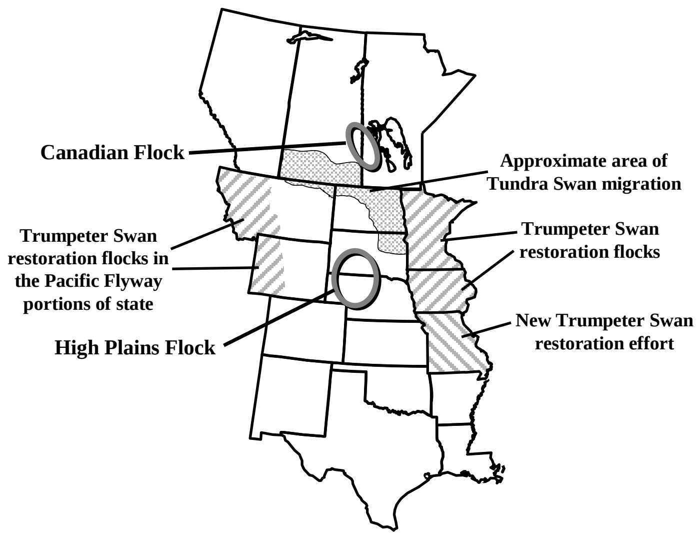

Figure 1. Location of Trumpeter Swan restoration populations adjacent to the Central Flyway.

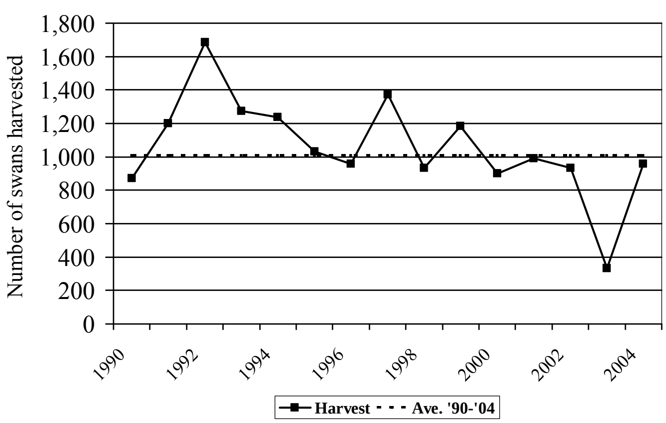

Figure 2. Harvest of Tundra Swans in the Central Flyway, 1990-2004.

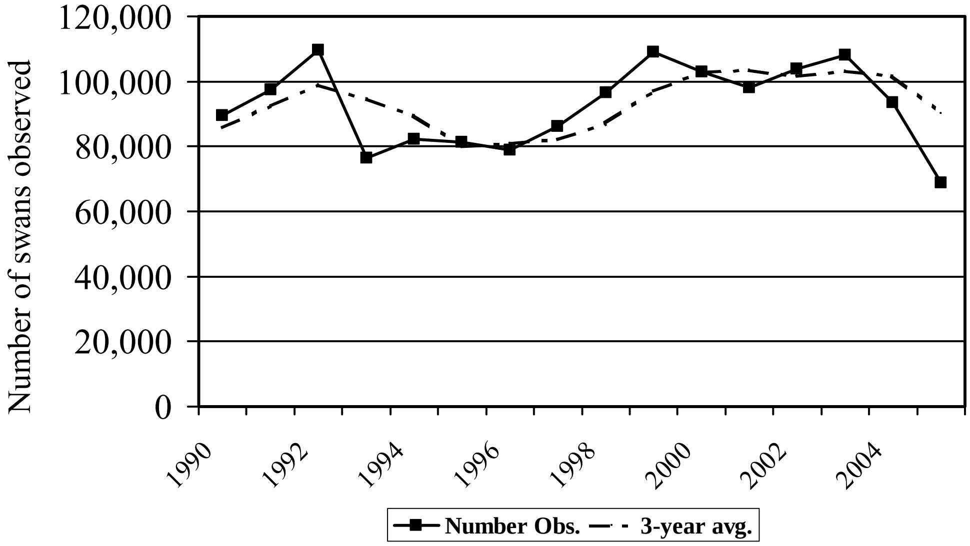

Figure 3. Counts (solid line) of the Eastern Population of Tundra Swans observed during the Mid-Winter Survey, 1990-2004. Mean count is dotted line.

MANAGING MONTICELLO TRUMPETER SWANS AND POWER LINE ISSUES – A COOPERATIVE EFFORT

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ABSTRACT

In the winter of 1986/1987, the first adult and cygnet Trumpeter Swans showed up at the home of Sheila Lawrence on the shore of the Mississippi River in Monticello, Wright County, Minnesota. These swans were banded by Hennepin Parks (now Three Rivers Park District). During the next winter, 15 trumpeters wintered at this location on the Mississippi River. The number of wintering swans continued to grow and by the winter of 1996/1997, Sheila Lawrence counted 200 swans wintering at Monticello. In the winter of 2004/2005, there were an estimated 1,100 swans wintering on the river between Monticello and Elk River, Minnesota (Sheila Lawrence, pers. comm.). The swans usually arrive at Monticello around late December, once the area lakes have frozen over. Xcel Energy facilities include the Sherburne County Generating Plant and the Monticello Nuclear Power Generating Plant which create a warm water discharge that provides ~10 miles of ice-free water between Monticello and Elk River, Minnesota.

There are multiple 69 kV and 345 kV electric transmission lines (Figure 1) in the vicinity of the Trumpeter Swan wintering area at Monticello. In 2002, Xcel Energy met with The Trumpeter Swan Society, the Minnesota Department of Natural Resources, Three Rivers Park District, and Monticello residents to address the issue of the swan collisions with the 69kV transmission lines that run across the Mississippi River in Monticello, a location where a number of swans have had fatal collisions or injuries. Other swan collisions with power lines have occurred in Rogers, Hennepin County, Minnesota, and in other growing suburbs of the western edge of the Twin Cities where Trumpeter Swans now regularly nest (Figure 2). Collisions have also been documented with lines that run along lakes and potato fields where the swans fly in to feed and do not see the wires. Bird flappers have been used by local cooperatives and Xcel Energy to prevent collisions with distribution lines (Figure 3). All collisions of swans with power lines will not be eliminated. We must balance the costs with any impact to the population success. Xcel Energy will continue to work with community, agencies, and interest groups such as The Trumpeter Swan Society, Minnesota DNR, U.S. Fish and Wildlife Service (USFWS), Three Rivers Park District, and Monticello residents. Xcel Energy will continue to monitor collision incidents, support restoration, and management efforts. Xcel Energy has a Memorandum of Understanding with the USFWS to report all known swan power line collisions and is currently working with a consultant to develop an Avian Protection Plan for both Northern States Power Company-Minnesota and Northern States Power Company-Wisconsin operating companies.

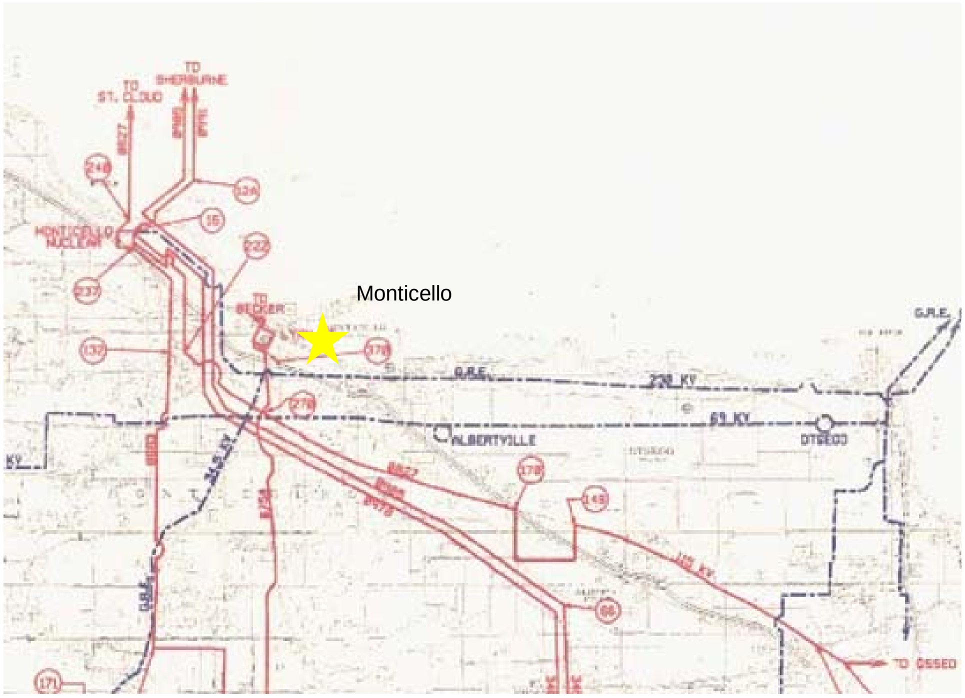

Figure 1. Multiple electric transmission lines in proximity to Monticello, Minnesota.

Figure 2. Swan power line collision at western edge of the Twin Cities, Minnesota.

Figure 3. Local energy cooperatives and Xcel Energy install bird flappers on power lines.

MIGRATION OF ONTARIO TRUMPETER SWANS

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ABSTRACT

Migration is defined as a traditional movement from a specific breeding ground to a specific wintering ground and annual return. Of 703 wing-tagged Trumpeter Swans released in Ontario, 586 survived at least to their first winter. Of these, 138 were 4+ years old, and therefore chosen for this analysis. Most birds do not leave their release site. Very few swans showed behaviour consistent with the definition above. Only four (7%) migrated from Wye Marsh, Midland, Ontario to Burlington, Ontario, as defined here. However, 43 (31%) moved inconsistently on this route. Between 1982 and 2005, 54 trumpeters moved to the United States. This is 9 percent of those surviving through their first winter. The longest movement was 978 km (608 miles) from Wye Marsh to Tennessee. In western Ontario, the Kenora population migrates to the Otter Tail River, Otter Tail County, in Minnesota. Winter feeding has a powerful influence on the movements of Trumpeter Swans in Ontario.

INTRODUCTION

A definition of migration for Trumpeter Swans might include a movement in fall from a specific nesting or summering area to a specific wintering ground and return to the same breeding area the next spring. This kind of movement should persist for the lifetime of the bird to be considered true migration. Grande Prairie Trumpeter Swans move to the Tristate area of Montana, Idaho, and Wyoming for the winter. The consistent Tristate winterers have a migration that conforms to the above definition. Many expect that introduced trumpeters should do the same. This paper examines what restored Ontario Trumpeter Swans actually do.

METHODS

Each wintering area is considered to cover a radius of 10 km from the main concentration point. For example, La Salle Park is the focus for the Burlington, Ontario, wintering area. Records are available of movements of 703 Trumpeter Swans that are marked with patagial tags. To encourage the public to report numbers, all phone calls and emails from naturalists and birders are recorded and the life history of the particular swan is given to the reporters when possible.

Media outlets are widely used to publicize the purpose of the program and to appeal for reports of wing tag numbers. A large number of talks have been given to naturalist and other groups and annual progress reports have been sent to many interested parties. Funds are raised by applying to corporations, foundations, clubs, and individuals. We released swans raised in captivity at 42 sites. We banded wild-hatched swans wherever we could catch them, the majority at Wye Marsh in Midland, Ontario, and at LaSalle Park, in Burlington, Ontario, on Lake Ontario.

To test the definition of migration, only swans 4 years or more at liberty have been analyzed. Out of 703 tagged swans, 586 survived over their first year and 138 birds satisfy this qualification. December to February is counted as a migratory opportunity for each swan. These swans have had 822 opportunities for migration, or, an average of six each. The public is encouraged to feed swans in winter at sites that are free of lead shot and sinkers. This certainly influences winter movements and reduces winter mortality.

RESULTS

Marked birds lose their tags and drop out of the record. We re-tag as many as we can catch. Only about half the population is marked. Observers make errors in reading or reporting numbers. Reports come from where interested observers operate. There are wide areas where we suspect marked swans are living, but no one is aware of the program and we do not get reports. This is particularly evident in records of marked swans reported in winter, which disappear into the north and for which there are no summer records. In some cases, pairs nest in beaver ponds in forests where they are only visible from the air. The number of reports of individual swans varies from a low of one, at the time of release, to 140 or more for some birds that are at liberty for 10 - 13 years.

One can recognize about five categories of movement among those swans that lived for 4 years or longer. Some swans do not move from their release site, either because there is always open water and natural food, and/or because they are fed. There were 73 swans in this category, which is 53 percent of the 138 birds in this study.

There is a strong connection between Wye Marsh and the Burlington, Ontario, area. There were 43 swans (31%) that follow the pattern of breeding in the Wye Marsh area and wintering at least some of the time at Burlington on Lake Ontario. Most were wild caught for tagging and only 10 were captive-bred and released at Wye Marsh. The birds are fed year-round at Wye Marsh where the water is kept open and in winter at Burlington.

There was no tradition of wintering at Burlington until 1992 when a movement was initiated on 29 January by three cygnets captive-raised at Wye Marsh. Without flying parents, they wandered south and wintered on Lake Ontario at Bronte, east of Burlington. Judging by their behaviour, I do not think they were fed artificial food that winter. Every time I saw them, they were very wary. Last seen there on 27 March, they were reported back at Wye on 8 April 1992. As yearlings, they did not return in the winter of 1992-93, but remained at Wye Marsh. In 1993, only one, tag number 100, bred at Wye Marsh, raised six cygnets and returned to Burlington with her mate on 12 December. Number 100 and her offspring were the first trumpeters to winter on that shore. They were fed regularly by volunteer Bev Kingdon. Number 100 returned to the Burlington area in 4 subsequent winters when she had raised broods. For 2 winters, she did not return, but stayed at Wye Marsh when she failed to raise young.

Only four (7%) are true migrants according to our definition. Always summering in the Wye Marsh area, they moved each winter to Burlington. There are some birds which spent 1-3 winters at Burlington, but most of their winters elsewhere. Fourteen (10%) were in this category; eight (6%) birds never visited the Burlington area, but wintered once or twice at Wye Marsh and the rest of the time at a variety of other sites.

Some trumpeters winter in the United States. These are in addition to the 138 swans 4+ years of age discussed above. Those that wintered in the U. S. number 54, but only nine were 4+ years at liberty. These include four adults trapped at Comox, British Columbia, and released as an experiment at Port Rowan, Ontario, on Lake Erie. All had undertaken at least one migration from Alaska prior to capture. All moved south from Ontario the winter following release. This group visited nine states. New York State received 24 visits. Four birds also went on to Pennsylvania. One bird spent 4 winters, but not always in the same place; two birds stayed for three winters and one bird went twice. Twenty-one swans visited Pennsylvania, three swans also moved on to Ohio and four came from New York. One bird visited twice. Ohio wintered three swans, which moved through Pennsylvania. Tennessee hosted one; Virginia was visited twice by one swan; Maryland wintered three swans; a single bird went to New Jersey before continuing on to Connecticut.

Only one brood seems to have been involved in movement to the United States. A pair, Number 239 and Number 259, nested at Warminster in 1995 and hatched four cygnets. They raised two and moved south to Burlington where the male was caught, suffering from lead poisoning. Despite treatment, he died. The female and two cygnets moved to Leetown, West Virginia, 721km (436 miles) from Warminster where they stayed from 11 to 13 March. The female had only one cygnet when they returned to Richmond Hill, Ontario, on 23 April 1996. This female lived for at least another 4 years before she lost her tags. We have no record of her return to the U. S. and have a record of her presence in Ontario in almost every month to 30 September 2000.

Of these swans that visited the U.S., four are known to be dead and 21 have not been seen back in Ontario. We consider those that are not reported for over a year to be dead. Seven may still be alive, but have not been noted back in Ontario since their last U. S. report. They have not been missing for over a year and we consider them possibly to be still alive. Thus, 18 are known to be dead or missing, constituting 35 percent of those that crossed the border. If the missing birds do not turn up, the loss would be 46 percent.

Ten of those birds that moved to the U.S. were 4 to 7 years at liberty; only one spent each of its 4 winters in New York State, but at three different localities and cannot be defined as a migrant according to our definition One swan came down with lead poisoning (3.6 ppm) at Bear Creek, New York. We are grateful to Wendy Pencilla who treated and released him. He subsequently returned to Ontario. Another bird died at Valencia, Pennsylvania. We thank Beth McMaster who carried out a necropsy and found that a congenital defect in the aorta contained a blood clot, part of which broke off and lodged at the base of the brain.

The distance that Ontario swans move is of some interest. The flight from Wye Marsh to Burlington is 165 km (102 miles), but many make much longer journeys. Two untagged trumpeters were videotaped by Ken Abraham in summer on the Swan River in the Hudson Bay lowlands. We do not know from where they originated, but Wye Marsh is the nearest concentration area and is 701 km (436 miles) to the south. Two tagged swans were seen on a summer survey from the air by a Canadian Wildlife Service (CWS) field crew in 2004 at Val Coté. This locality is 570 km (354 miles) northwest of Wye Marsh. Some of the longest distances covered in the U.S. were two from the release site at Whitby to Saint Michaels, Maryland, 683 km (424 miles). Released at Callander Bay, one flew to Mechanicburg, Pennsylvania, 702 km (436 miles) to the southeast. Another moved from Port Rowan, Ontario, to Fort Belvoir, Virginia, 522 km (324 miles). The longest move was from Wye Marsh to Jonesborough, Tennessee, 978 km (608 miles).

The map in Figure 1 shows some selected records flown by Trumpeter Swans from their release site to the United States. There were other records that were not marked on road maps and could not be found. The clearest example of true migration we have in Ontario is the movement of swans from their breeding ground in the western part of the province in the Ministry of Natural Resource's districts of Kenora and Fort Francis. The birds came from Minnesota originally and return in winter to the Otter Tail River, Otter Tail County, in western Minnesota (Steve Kittelson, pers. comm... The distance for the Kenora birds is about 430 km (267miles).

DISCUSSION

If we use the definition of migration strictly, we find that of the Wye-Burlington group, there are only four (7%) that conform. If we loosen the definition slightly by allowing 1 winter away from the traditional site, there are 12 (22%).

There were six birds that passed their first winter at Wye Marsh before moving to Burlington as their regular wintering quarters. One bird, released at Wye Marsh, lived at Burlington for its first winter and then moved to Frenchmans Bay, 79 km (49 miles) to the east for 9 consecutive winters, wandering widely during 3 summers before it started to breed in the Pickering area. Another swan, released on Lake Simcoe, spent its first winter on Leslie Street Spit, Toronto, 67 km (42 miles) south, before moving to Wye Marsh 101 km (82 miles) to the northwest for its next 4 winters. A bird released at Cooks Bay, Lake Simcoe, wintered there before moving to Newcastle 83 km (51 miles) southeast for the next 4 winters. It seems that most Ontario trumpeters move erratically with very little traditional migration taking place. Winter or year-round artificial feeding must have a profound effect on their behaviour.

LaSalle Park in the Burlington area could be a natural wintering area for trumpeters. It is shallow enough that one can see both migrant Tundra and Trumpeter Swans tipping for food several hundred meters from shore. Normally, Burlington Bay does not freeze completely and a few Tundra Swans may winter there occasionally. However, in 2003 and 2004, the bay froze and both Mute and Trumpeter Swans spent the night on open water near the Canadian Center for Inland Waters or on Lake Ontario. Each day they flew at least 3.5 km across the frozen bay to land on the ice at LaSalle Park where they were fed. In the absence of artificial food, these birds would have moved further south, probably to the United States. As it was in these two hard winters, there was an increase in the number of swans moving to the U.S. There were nine (17%) of all the birds that had moved since 1983. With a few birds from other areas, the peak numbers at LaSalle Park in 2002 were 92-93, in 2003 110, and in 2004 132 (Beverly Kingdon, pers. comm.).

Members of the public enjoy feeding birds, particularly geese and swans. It is not easy to prevent people from feeding geese when they become a nuisance. Enforced municipal laws seem to have been partially effective in Ontario for geese.

Our first experiences of frequent lead poisoning and disappearances, many of which we suspect were lead caused, persuaded us to try to winter swans in a lead-free environment. While lead poisoning was frequent at Wye Marsh at the beginning of the program, the situation improved when Don Foxall and his colleagues developed a pontoon mounted vibrator which caused the lead to sink below the reach of swans in the soupy marsh. Burlington Bay was un-hunted and when Trumpeter Swans chose to winter there, it was a simple matter to feed them and hold them there. At most wintering sites, we have no objection to feeding and a host of volunteers led by Bev Kingdon at LaSalle Park do a very efficient job.

Swans are easy to catch for banding when they are hand fed and they become extremely tame. It is of interest that when most of these birds reach their breeding territories, they become wary and secretive. The argument that hand feeding destroys wildness is not necessarily true. If cottagers offer food, subadults will sometimes accept it in summer.

Trumpeter Swans will winter as far north as they can find open water and food. In Ontario, trumpeters are the latest waterfowl to move south and about the earliest to move north in spring. The northernmost wintering site in Ontario is a small flock released at Sudbury, 47 ^{o} 10′ N 82 ^{o} 00′ W, that does not migrate, but breeds and winters north of Lake Huron. Trumpeters winter in some locations in Alaska. In eastern North America, we can expect them to be able to winter at any site where Canada Geese and Black Ducks choose to remain. Both these species winter at Parson's Pond (50^{o} 00′ N 57 ^{o} 55′ W) in Newfoundland (Gillespie and Roberts, CWS unpublished report). Trumpeters Swan bones were recovered from a burial site at Port-au Choix just north of Parsons Pond. There used to be large numbers of Canada Geese and ducks wintering on the bay at Port Joli in southeastern Nova Scotia, feeding on extensive beds of eelgrass (personal observation). Many other locations along the east coast would provide the conditions suitable for the winter survival of Trumpeter Swans. The Maritime Provinces and northern states in the Atlantic Flyway might establish local populations of trumpeters, which, with management, would have no need to move south where they are apparently not wanted. If the Atlantic Flyway insists on having a migratory population of Trumpeter Swans, they should state where they are supposed to breed and in what area they are required to winter.

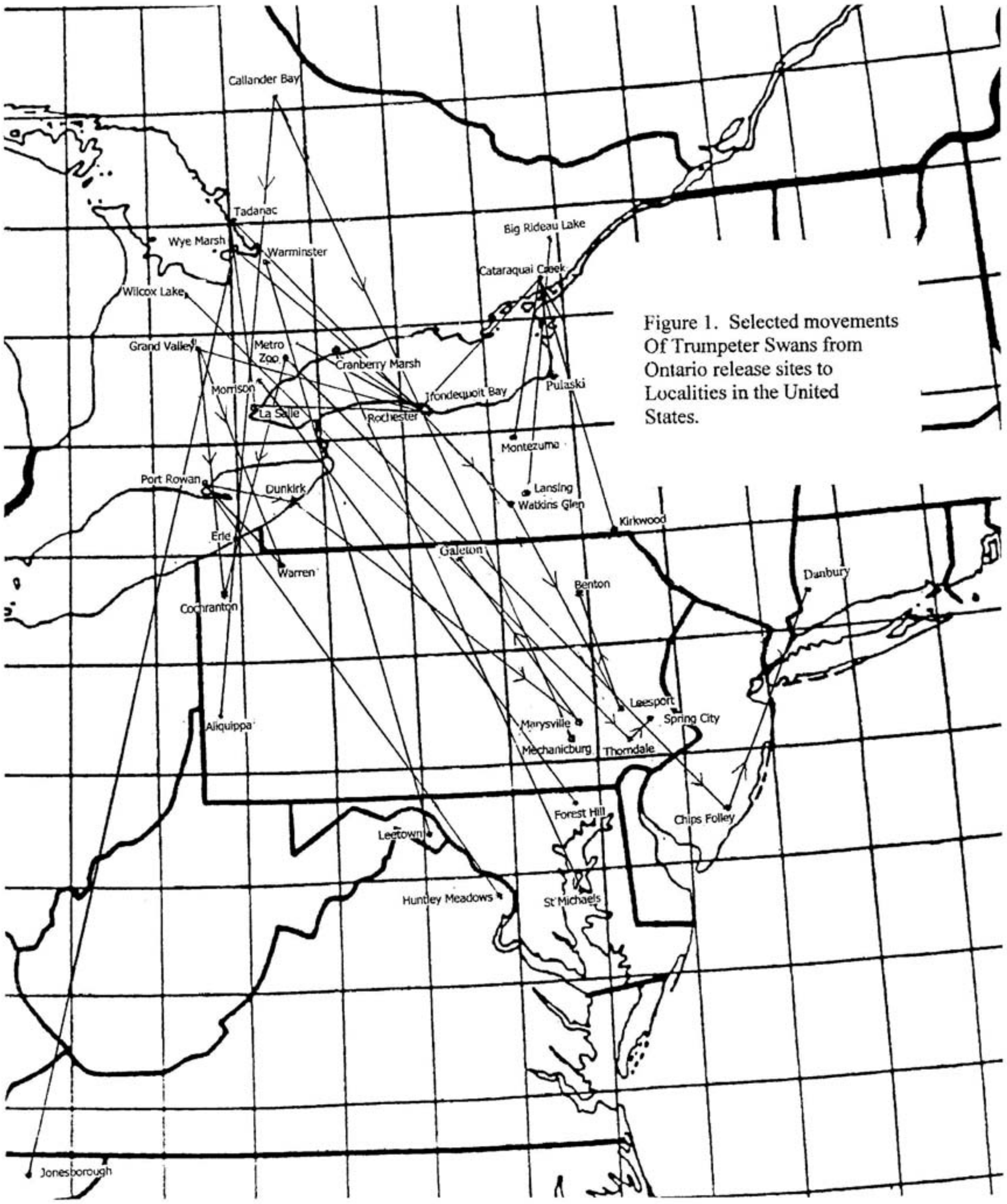

Figure 1. Selected movements of Trumpeter Swans from Ontario release sites.

THE TRUMPETER SWANS OF HEBER SPRINGS, CLEBURNE COUNTY, ARKANSAS

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INTRODUCTION

Three unmarked Trumpeter Swans were first observed in the Heber Springs, Arkansas, area 30 December 1990 – 12th January 1991. Heber Springs is approximately 50 miles north of the City of Little Rock in Cleburne County. The birds were sighted on an oxbow of the Little Red River by very reliable birders of the Arkansas Audubon Society through January 1991. In Winter 1991/1992, three juvenile Trumpeter Swans landed on Magness Lake, a 30-acre private lake about 5 miles east of the City of Heber Springs, on the property of Perry Linder. Mr. Linder believed that the three juveniles were thrown off course by a sudden snowstorm. Mr. Linder, a farmer and real estate agent, lived in town, but came out daily to Magness Lake to feed corn to his flock of about 30 domestic geese. He maintained a herd of cattle on pasture land adjacent to the lake. It is likely that the swans were decoyed into the lake by the domestic geese, the presence of other wild ducks and geese, and the corn feed.

The following winter, Minnesota Department of Natural Resources (DNR)-banded female Number 207 Trumpeter Swan wintered with its mate on Magness Lake. The Minnesota swan pair returned the next winter with three cygnets. An adult and a cygnet were shot in November 1993, presumably by waterfowl hunters hunting geese. Minnesota female Number 207 continued to return with a mate and cygnets from the current year. Number 207 eventually lost its orange wing tag, but retained its U.S. Fish and Wildlife Service tarsus band that allowed for identification. No matter when freeze-up occurred in Minnesota and the Upper Midwest, swans typically began arriving at Magness Lake in November, occasionally as early as the 2nd week of November. Mr. Linder fed corn daily to the swans along a flat area, at the edge of the lake. He believed that the birds recognized his truck and trusted him, coming up on shore to take the corn as soon as he arrived. The swans generally leave Heber Springs by 1 March, but in milder winters have left as early as mid to late February. Mr. Linder and visiting birders frequently sent swan reports and updates to The Trumpeter Swan Society (TTSS).

HABITAT

Our slides show that there are shrubs and trees around a good part of the shoreline of the lake (Figure 1). A paved county road runs on one side where Mr. Linder posted *No Hunting* signs, and signs alerting visitors that there are tame ducks, geese, and swans on the lake. A small gravel parking area along the road bordering the lake allows visitors to pull off to see and photograph the swans. Cattle graze in nearby pasture land. Recently, nearby pastures have been planted in fescue, a cool-season grass, and Bermuda grass, a warm-season grass grown for cattle forage. When Mr. Linder owned the land, he planted winter wheat or rye grass in a field adjacent to the lake and sent TTSS a photo of the swans grazing on winter wheat in the field. Mr. Linder observed that the swans typically flew out during the day with the wild geese to field feed and returned to the lake by late afternoon to roost. The swans would also fly about ¼ mile to the Little Red River, a cold water trout stream. Residents in surrounding towns occasionally reported the swans out feeding in other fields and impoundments.

PUBLICITY

Since the shooting of the swans in 1993, there has been considerable media publicity surrounding the winter presence of the swans. Mr. Linder believed that the growing publicity and viewing popularity helped protect the swans. TTSS helped with providing background information and brochures. The swans made the local television news numerous times. The *Arkansas Democrat Gazette* featured articles on the swans with photos of Magness Lake, the swans, and interviews with Mr. Linder discussing the growing numbers of wintering swans, and the history of Trumpeter Swan restoration in the Midwest. The swans are always listed on the Little Rock Audubon Society's Birders' Hotline, attracting birders from as far away as Tennessee, Mississippi, Texas, and Oklahoma. There have been organized visits by senior citizen and school groups. Mr. Linder stated that it was not unusual to have about 60 people on a Saturday viewing and photographing the swans and that he frequently would give interpretive tours. In sum, the wintering swans at Heber Springs have become a great public attraction and an excellent place for educating the public about the wintering needs of Trumpeter Swans.

MIDWEST NORTH-SOUTH CONNECTIONS

The numbers of swans coming to winter on Magness Lake has grown steadily from the first winter count of three trumpeters. One winter, the Minnesota DNR Number 207 arrived with five cygnets. Another Minnesota – Arkansas connection was made when a rare yellow-legged "leusicitic phase" trumpeter was photographed in Winter 2000/2001 at Heber Springs and what looked to be the same bird showed up in Monticello, Minnesota, on 11 March 2001 where it was also photographed. The bird was very used to eating shelled corn thrown on the shore. Two sibling cygnets, banded in Hubbard County, in northern Minnesota, wintered 2 years in a row at Magness Lake. While most of the swans are unmarked, there have been banded swans from restoration programs in Iowa, Michigan, Wisconsin, Three Rivers Park District (formerly Hennepin Parks), Minnesota, and the Minnesota DNR. In Winter 2004/2005, there were at least 88 swans (Figure 2), as well as one Mute Swan and one Tundra Swan. There were three other Trumpeter Swans reported to be on another nearby impoundment.

MANAGEMENT CONSIDERATIONS

Although Perry Linder took a great deal of interest in the wintering Trumpeter Swans, promoted their presence in the community, provided feed, and in general, looked out for their protection, there was no long-term plan for the protection of Magness Lake and its surrounding fields. Over several years, Arkansas Game and Fish Commission (AGFC) attempted unsuccessfully to negotiate conservation easements on 60 acres, including Magness Lake. In conversations with Larry Gillette of TTSS, the AGFC was very aware of the significance of Magness Lake for the Interior Population of Trumpeter swans, and wanted very much to protect the swan wintering habitat, but was limited by State budget restrictions.

Trumpeter Swans are extremely faithful to their breeding and wintering locations, and once they have found a successful route, are not apt to deviate from it. Young Trumpeter Swans learn about stopover sites and suitable wintering locations from their parents and will bring their own offspring in the future, assuming the experienced birds survive to carry on the tradition.

Mr. Linder sold his Magness Lake property in 2005 and the new landowners, Larry and Pat Eason, have taken a real interest in preserving and improving the habitat for the wintering swans and other wildlife. The Eason family is very aware of the significance of their property and joined The Trumpeter Swan Society in 2005 to learn more about and support the Trumpeter Swans.

Karen Rowe, AGFC's Nongame Migratory Bird Program Coordinator, has expressed the following concerns about the Trumpeter Swans at Magness Lake:

- The wintering swan flock might be too dependent on the one wintering lake.
- Heber Springs is a growing resort town with significant threat from recreation and second home development.
- The habitat within 5 miles of Magness Lake is currently not typical swan habitat: It is the flood plain of the Little Red River which is important recreational trout stream; there is pasture, but no row crop agriculture.
- Grass Carp in Magness Lake may be depleting aquatic vegetation that could provide more natural food for the wintering swans.

To fulfill its goal of protecting the wintering Trumpeter Swans, AGFC has developed the following objectives:

- Identify other potential ponds and impoundments near Magness Lake.
- Identify willing landowners and work with them to encourage the planting of winter swan forage such as rye grass and winter wheat.
- Work with the new owner of Magness Lake to remove Grass Carp and to plant forage crops, so that the swans will have alternative food resources.

Overall, Trumpeter Swans are doing very well on their summer breeding grounds in the Midwest. However, only a small percent of these northerly breeding birds migrate to spend the winter in southern locations below the 40° N parallel. One of the management objectives of the Mississippi and Central Flyway Management Plan for the Interior Population is to encourage migration to suitable winter habitat. Heber Springs is the largest most southerly traditional wintering location for the Interior Population of Trumpeter Swans. The local public seems to be very enthusiastic about the swans and the private landowners are very welcoming to their presence for several months each year. Initially being drawn by artificial feed, the swans appear to be gradually exploring the area and making use of other food resources, including field feeding. Heber Springs looks to be a promising Trumpeter Swan wintering location for years to come, an example for the development of other potential southern wintering locations. TTSS views Magness Lake and its surrounding uplands as critical components in the restoration of Trumpeter Swans to the Interior Population and is excited about working with AGFC and private citizens to further benefit the swans.

Figure 1. Trumpeter Swans feeding at Magness Lake, Heber Springs, Arkansas.

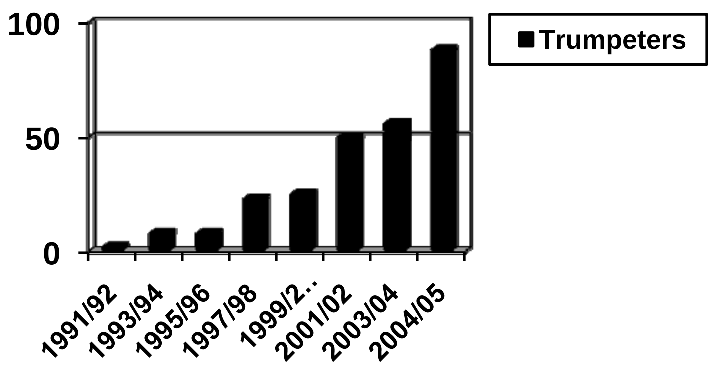

Figure 2. Growth of wintering Trumpeter Swan numbers at Heber Springs, Arkansas 1991 - 2005.

SURVIVAL OF WISCONSIN INTERIOR POPULATION OF TRUMPETER SWANS

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ABSTRACT

Trumpeter Swan reintroduction efforts have concentrated on creating breeding populations, while work to encourage winter migration has been more limited. As a result, most populations cannot be considered self-sustaining. Migratory populations of Trumpeter Swans in the Midwest have not been well studied. In general, little is known about the importance of diet and nutrition in swan survival. To determine how migratory behavior and nutrient availability impact Trumpeter Swan mortality, we will compare survival estimates between migratory and non-migratory swans and among swans using different wintering areas. We will calculate annual and seasonal survival rates on the wintering and breeding grounds based on mark-resight data gathered since 1994. We will use activity-time budgets and habitat use surveys to determine the diets of at least two different wintering populations of trumpeters. We hope to determine what type of wintering habitat supports the highest survival rates for migratory swans and whether migratory swans survive at a different rate than nonmigratory swans.

INTRODUCTION

The historic breeding and wintering range of Trumpeter Swans (*Cygnus buccinator*) once covered much of North America (Banko 1960). By the early 1900s however, the species had been severely over-hunted and was considered to be doomed by many ornithologists (Banko 1960). In 1929, the National Park Service began a survey to determine the population status of Trumpeter Swans. By 1932, they had found that there were 31 individuals in Yellowstone Park in Wyoming, 26 on the Red Rock Lakes in the Centennial Valley of Montana, and 12 others in the surrounding region (Banko 1960). At the time, these were thought to be the only birds remaining for the entire species. In 1954, however, a large breeding population was discovered in Alaska (Banko 1960). By that time, the population of Trumpeter Swans in the lower 48 states was increasing, mainly due to supplemental feeding during the winter, protection of breeding habitat, and protection from hunting (Banko 1960). In the last continent-wide Trumpeter Swan survey in 2005, 34,803 swans were counted (Moser, in press).

RESTORATION BACKGROUND

There are three distinct populations of Trumpeter Swans in North America: the Pacific Coast Population, the Rocky Mountain Population, and the Interior Population (IP). Historically the IP bred throughout the upper Midwest and wintered along the Lower Mississippi River south to the Gulf Coast and along parts of the Atlantic Coast (Banko 1960). The IP, which once may have numbered more than 100,000 individuals, was extirpated by market hunting by the early 1900s (Banko 1960). In 1960, the first reintroduction of Trumpeter Swans to the IP was made on the Lacreek National Wildlife Refuge in South Dakota (Hansen 1973). The second transplant took place in 1966 in Carver County, Minnesota (Hansen 1973). Since that time, other states and the Province of Ontario have initiated reintroduction programs to restore Trumpeter Swans. In 1987 and 1988, the Wisconsin Department of Natural Resources (WDNR) used cross-fostering (using Mute Swans to incubate and raise trumpeter young), decoy rearing (a surrogate parent in the form of a decoy raised the decoy-reared birds), and captive-parent rearing (captive trumpeters were used to rear young) to re-introduce a wild population (Abel 1993). The original goal of the program was to have a minimum population of 20 breeding migratory pairs (Ad hoc Swan Committee 1998). The reintroduction was successful, and today the estimated population of Trumpeter Swans in Wisconsin is more than 500 individuals (Sumner Matteson, WDNR, pers. comm.). As early as 1993, a few trumpeters from Wisconsin began migrating to wintering areas in southern Illinois (Babineau 2004).

The lack of migratory behaviors and suitable wintering areas are considered the greatest obstacles to the complete recovery of the IP to a healthy, self-sustaining population (Mitchell 1994). Currently, only a fraction of the birds migrate to wintering sites below 40° N latitude (Gillette 1999). Some states with reintroduction programs have intentionally discouraged migration by failing to discourage supplemental feeding by private citizens during the winter to preclude high winter mortality rates. Swans that remain north during the winter often cannot survive without direct human intervention such as supplemental feeding or aerators to keep the water open. In some areas, people indirectly assist the swans in the form of power plants that release warm water and keep large stretches of river open throughout the winter. During exceptionally harsh winters, these areas may freeze over causing large die-offs in these nonmigratory groups of birds (Linck 1999, Drewien *et al.* 2002). If these swans migrated to more appropriate southern areas, they would not be exposed to this risk during the winter. There also are many dangers associated with long migrations, however, and anecdotal evidence suggests migratory Trumpeter Swans have lower survival than swans that do not migrate, but this premise has not been supported with empirical evidence. Additionally, there is some question whether good wintering areas are still available in the south (Mitchell 1994). Most wetlands in southern states have been drained and converted to agricultural fields (Dahl and Johnson 1991). Some populations of Trumpeter Swans field-feed, but some do not (McKelvey and Verbeek 1988, Hamer 1990, Beekman 1991, Squires 1991, Anderson 1993, Squires and Anderson 1995, Lamontagne *et al.* 2003, Babineau 2004). It is currently unknown if agricultural foods meet the energetic and nutritional requirements of Trumpeter Swans to allow for maximum population growth.

Swans are often the last species of waterfowl to leave the breeding grounds in the fall and the first to return in the spring (Banko 1960). IP swans appear on the wintering grounds toward the end of November and leave for the breeding grounds before mid-March (Babineau 2004). Trumpeter Swans are philopatric to both the breeding and wintering grounds each year. Young swans remain with their parents until the next spring, enabling them to learn the migration routes from their parents. Once the extirpation of a migratory population breaks the migratory tradition, it can be very difficult to reestablish (Ogilvie 1972). There are very few wintering grounds north of 40° latitude with adequate food and open water to support trumpeters throughout the winter. As populations grow and these northern wintering grounds become crowded, some swans may have to migrate randomly at first to search for a suitable wintering area. Gillette (1997) believes that these individuals have higher mortality rates than the swans that are sedentary or those that migrate to a known area. He states that searching may increase the risk of lead poisoning, shooting, and accidents when swans have to visit multiple, unfamiliar wetlands to find a good location (Gillette 1997). Some studies have shown that postfledging survival has a direct negative relationship with the length of the fall migration (Pienkowski and Evans 1985, Owen and Black 1991).

FORAGING BEHAVIOR

Many waterfowl species have adapted to a lack of good aquatic habitat by foraging in agricultural fields, usually to their benefit (Bellrose 1980, Baldassarre and Bolen 1994). Availability of food during winter is probably not a limiting factor for populations that use agricultural resources (Gates *et al.* 2001). Trumpeter Swans on the West Coast shifted from foraging exclusively on fresh water plants to grain and produce fields in the late 1970s (McKelvey 1981). There are multiple hypotheses that may explain why this switch occurred. Trumpeter Swans in the Skagit Valley of Washington may have begun field-feeding after seeing Tundra Swans grazing on croplands (Hamer 1990). Researchers have suggested that once the density of aquatic tuber stocks drop below a certain level, swans switch to feeding in agricultural fields for the remainder of the season (Beekman 1991, Squires and Anderson 1995). Eastern population Tundra Swans began feeding on crops because of a long-term decline in the quality and quantity of natural aquatic foods (Crawley and Bolen 2002). Flooding of the traditional aquatic habitat caused swans in one area of Europe to begin field-feeding. In subsequent winters, the swans returned to those fields even though there was no flooding (Owen and Cadbury 1975). During one study, Trumpeter Swans were observed feeding in pasturelands, even though their traditional habitat was still intact. Standing water in the fields may have attracted those swans to begin with (McKelvey and Verbeek 1988). They may have then continued feeding on the pastures because the grass was not only easier to eat, but was also much higher in protein than the estuary plants (McKelvey and Verbeek 1988). In southern Illinois, some groups of wintering IP Trumpeter Swans have been observed foraging solely on agricultural fields, while other groups may still use predominantly aquatic vegetation (Babineau 2004).

Among swans that forage on aquatic vegetation, the tubers of sago pondweed (*Potamogeton pectinatus*) seem to be strongly preferred (Owen and Kear 1972, Beekman 1991, Squires 1991, Squires and Anderson 1995, Lamontagne *et al.* 2003). Sago pondweed tubers are high in carbohydrates and protein and have a high digestive efficiency compared to other aquatic vegetation (Mitchell 1994, Squires and Anderson 1995). Tubers take a lot of time and effort to extract, so the swans will not use them unless the density of the tuber stocks is high (Beekman 1991, Lamontagne *et al.* 2003). Trumpeter Swans also favor muskgrass (*Chara spp.*), waterweed (*Elodea spp.*), and arrowhead (*Sagittaria spp.*), (Owen and Kear 1972, Mitchell 1994, Squires and Anderson 1995). Aquatic plants have less digestible protein and more fiber than many of the crops Trumpeter Swans use (Anderson 1993). To meet their daily energy requirements, swans have to spend more time feeding on aquatic plants than if they are eating soybeans and wheat (Bortner 1985). When the time and energy costs of feeding on aquatic vegetation become too high, swans shift to foraging on agricultural fields such as pastures and grain and produce crops (McKelvey and Verbeek 1988, Hamer 1990, Anderson 1993, Babineau 2004). Trumpeter Swans have been observed eating corn, soybeans, potatoes, carrots, winter wheat and pasture grasses (McKelvey and Verbeek 1988, Hamer 1990, Anderson 1993, Babineau 2004). Trumpeters in the Pacific Coast Population fed on corn in early winter, potatoes in mid-winter, and potatoes and grass in late winter, with potato fields receiving the highest use overall (Anderson 1993). IP Trumpeter Swans in southern Illinois ate both corn and winter wheat, with preferences among years associated with ambient temperature (Babineau 2004).

The best way to study waterfowl diets is to collect the birds and examine their esophageal contents (Baldassarre and Bolen 1994). Because of the population status of the Trumpeter Swan, however, this method is not possible. Fecal analysis is another method, but the results can be biased (Grant *et al.* 1994). To study the diets of Trumpeter Swans, some researchers have used activity-time budgets (McKelvey and Verbeek 1988, Hamer 1990, Grant *et al.* 1994, Lamontagne *et al.* 2001, Babineau 2004). One study found that Trumpeter Swans foraged on pastures only during daylight hours, but while on the estuary, they foraged almost as much at night (47.2%) as during the day (57.6%, McKelvey and Verbeek 1988). In an area where wintering trumpeters foraged on agricultural fields, both crop and pasture, they spent 28 percent of their diurnal activity budget foraging (Hamer 1990). Another study showed that field-feeding swans in southern Illinois spent 45 percent of their time foraging during the winter (Babineau 2004). Swans that forage on aquatic vegetation increased the amount of time they spend foraging from 30 percent during the winter to 45 percent in the spring (Squires and Anderson 1997).

SURVIVAL FACTORS

The abundance of a population is a balance between factors that lead to population increase such as productivity and immigration and factors that lead to population decline such as post-fledging mortality and emigration. Interior Population Trumpeter Swans appear to be isolated from the Pacific and Rocky Mountain populations (Caithamer 2001), thus, are unaffected by emigration and immigration. Therefore, productivity and post-fledging mortality exclusively influence the population abundance of IP Trumpeter Swans. Either an increase in mortality without a balancing increase in productivity, or decrease in productivity without a countering decrease in mortality could cause the population to decline. Alternatively, the opposite changes in these vital rates could lead to an increase in the population. Changes in productivity and mortality influence population dynamics of species to various extents and variation with average body size of individuals within a species correlates strongly with the degree of response (Jennings *et al.* 1999, Reznick *at al.* 2002). Change in productivity has a greater influence on population dynamics of smaller bodied species of waterfowl, while change in post-fledging survival has a greater influence on population growth rate of larger bodied species (Schmutz *et al.* 1997, Jennings *et al.* 1999, Hoekman *et al.* 2002). This is because smaller bodied species typically evolved a strategy of high reproductive rates, but low annual survival rates relative to larger bodied species (Eberhardt 1985, Lebreton and Clobert 1991). For example, smaller bodied species such as a Mallard Ducks tend to nest their first breeding season, lay clutches of 8 – 10 eggs, and re-nest up to six times when previous nests are destroyed, but have a low annual survival rate of about 65 percent relative to larger bodied species. Alternatively, larger bodied species such as Trumpeter Swans often delay nesting until their 3rd or 4th breeding season, lay four - six eggs, do not re-nest, and typically have about a 90 percent annual survival rate. Thus, larger bodied species rely more on having numerous years to successfully reproduce, whereas, smaller individuals rely more on successfully reproducing in any given year.

Swans have the highest survival rates of all waterfowl species (Nichols 1989, Johnson *et al.* 1992). Several studies have shown that survival does not vary between the sexes for adult swans and geese, because males stay with the females throughout the breeding season and the risks posed by nesting and brood-rearing are similar for both sexes (Nichols 1989, Johnson *et al.* 1992, Nichols *et al.* 1992, Schmutz *et al.* 1994, Ward *et al.* 1997). Survival does, however, vary with age. In general, researchers have observed reduced survival relative to adults during the 1st year after hatching, especially during the first fall migration (Ogilvie 1967, Coleman and Minton 1980, Owen and Black 1989, Perrins 1991, Schmutz *et al.* 1994, Menu *et al.* 2005). Coleman and Minton (1980) also observed reduced survival of young during the first spring migration in Mute Swans. Among swan species, migratory populations appear to have higher adult survival rates than those that are sedentary (Bart *et al.* 1991). It is unknown if this pattern also applies to Trumpeter Swans though, since migratory populations of this species have not been well-studied (Bart *et al.* 1991). Overall, annual survival rates for adult swans have been very high (Owen and Cadbury 1975, Anderson *et al.* 1986, Nichols *et al.* 1992, McCleery *et al.* 2002).

Lead poisoning, predators, adverse weather conditions, disease, parasites, flying accidents, birth deformities, pollution, and illegal shooting all cause mortality in Trumpeter Swans (Banko 1960, Mitchell 1994, Lagerquist *et al.* 1994). Collisions with overhead wires seem to be a major cause of death for some swan species. From 22-38 percent of reported deaths has been attributed to power lines in some studies (Owen and Cadbury 1975, Perrins 1991, Collins 2002). Cygnets on their first fall migration may be more vulnerable to collisions than adults (Ogilvie 1967, Owen and Cadbury 1975). There may be a bias toward reporting swans that hit power lines since power lines are usually located near people, an outage may result from a collision, and a swan will likely be found (Perrins 1991, Collins 2002). Because their method of feeding, which involves digging up large amounts of sediments, makes Trumpeter Swans more likely to ingest lead shot than other bottom-feeding waterfowl, lead poisoning causes 20-50 percent of swan deaths (Irwin 1975, Owen and Cadbury 1975, Blus *et al.* 1989, Lagerquist *et al.* 1994, Gillette 1996). Trumpeter Swans may also be more susceptible to lead poisoning than other species since low levels of lead seem to cause severe pathological changes in some birds (Blus *et al.* 1989).

MIGRATORY BEHAVIOR SOUTH OF 40° N LATITUDE

Two populations, totaling approximately 250 individuals of the 500 trumpeters in Wisconsin, have naturally established migratory behavior to more traditional wintering areas south of 40° latitude. One of these is at Burning Star # 5 (BS5), a reclaimed coal mine owned by Consolidation Coal Company in Jackson County, approximately 6 miles east of DeSoto, Illinois. The other site is the U.S. Army Corps of Engineers (USACE) Riverlands Refuge (Riverlands), a backwater area of the Mississippi River on the west side of the Mississippi River, West Alton, Missouri. Neck collar observations indicate little movement between these two winter locations suggesting they are separate winter populations (Babineau 2004). To determine habitat needs of wintering swans and determine if IP Trumpeter Swans have adapted to take advantage of agricultural habitats similar to other swan populations, Babineau (2004) conducted a study on the wintering population at BS5. She concluded this population of swans, which is increasing in abundance, uses primarily agricultural habitat as a food source. Although these results suggest the IP trumpeters can adapt to exploit agricultural habitat, agricultural foods may not supply all the nutritional requirements of free ranging geese (e.g., Buckley 1989, Amat *et al.* 1991). Thus, although swans using agricultural habitat may be meeting their minimal nutritional needs, use of this habitat type may not be allowing for maximum growth of the population. If swans are able to meet their nutritional requirements through the exploitation of agricultural habitat, it appears adequate wintering habitat exists throughout the historic wintering range of the IP of Trumpeter Swans to maintain the desired population. In contrast to the swans wintering at BS5, observations of the Riverlands winter population indicates those swans primarily use naturally occurring aquatic vegetation similar to historic food sources (Ed Zwicker, Illinois Department of Natural Resources, pers. comm.).

STUDY OBJECTIVES

To address the concern that habitat currently available is inadequate to properly support the population and that mortality during the migratory period may limit the growth of the population, we are initiating a study of IP Trumpeter Swan mortality with four primary objectives:

1. Verify that swans at Riverlands are depending more on natural submersed aquatic vegetation (SUV) for food than swans at BS5.
2. Identify the period of the life cycle (i.e., breeding, fall migration, winter, spring migration) in which most mortality occurs.
3. Determine if swans migrating below the 40° latitude have a different survival and reproductive rate than those swans that do not migrate.
4. Assuming the anecdotal evidence is correct that swans at Riverlands rely more on SUV,

determine if swans feeding on a more diverse diet at Riverlands have a different survival rate than those feeding almost exclusively on agricultural food sources at BS5.

METHODS

To determine if habitat use and diet differ between the two migratory swan populations, BS5 and Riverlands, we will estimate percent of daylight hours spent in each of two primary habitat types, aquatic and terrestrial, and five secondary terrestrial habitat types, corn, soybeans, winter wheat, milo, and other. To determine if these habitat types are used for feeding or roosting, we will conduct 72 hours of 1-hour activity-time budgets on focal birds, including 24 hours at BS5 and 48 hours at Riverlands. Babineau (2004) collected 66 hours of activity-time budget data at BS5 in a previous study; therefore, less data is needed for that site. We will distribute the time budgets among habitat types in proportion to the amount of time swans are observed using each habitat type. To verify that swans are foraging on foods representative of the habitat type they are seen in, we will estimate percent of forage cover on 0.5 m^2 plots randomly located within areas where swans are observed feeding. This will allow us to describe all types of forage swans may be consuming in each habitat type.

Approximately 50 percent of the swans wintering at BS5 and Riverlands have been fitted with neckbands. We will attempt to read and record all neckbands at both study sites weekly. Because most neckbanded swans seen in southern Illinois were banded in Wisconsin, we will also record neckbands of swans on the Wisconsin breeding grounds. We will record band resightings made at the start of the breeding season and again at the end of the breeding season, before the fall migration. We will use an information-theoretic approach with the Cormack-Jolly-Seber model in Program Mark to determine if the data indicates daily survival rate varies seasonally in adult and juvenile swans.

Wisconsin WDNR personnel will provide us with all previous records of neckband attachments and observations from that state. We will also acquire previous records of neck-banded swans wintering in southern Illinois from the Illinois Department of Natural Resources and the Cooperative Wildlife Research Lab at Southern Illinois University Carbondale. These data, as well as data collected during this study, will be used to estimate age, sex, and site-specific survival as well as annual survival.

We will consider swans observed north of 40° N latitude during December and January as nonmigratory, while we will identify swans observed during December or January south of that latitude as migratory. We will again use an information-theoretic approach with the Cormack-Jolly-Seber model in Program Mark to determine if the data indicate a difference in survival between migratory and nonmigratory swans.

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TEACHING GEESE, SWANS AND CRANES PRE-SELECTED MIGRATION ROUTES USING ULTRALIGHT AIRCRAFT, 1990-2004 - LOOKING INTO THE FUTURE

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ABSTRACT

We are summarizing efforts made from 1990 to 2004 to restore migration routes to the once endangered Trumpeter Swan, *Cygnus buccinator*, and the endangered Whooping Crane, *Grus americana*; first using the Canada Goose, *Branta Canadensis*, and Sandhill Crane, *Grus canadensis*, as test birds.

INTRODUCTION

Geese, swans, and cranes are large, vocal, long-lived and flocking birds that remain in family groups during their migrations and in winter. Unlike the instinctive behavior of warblers and many other migratory birds, their young learn a migration route from their parents when they first fly south from their breeding areas. If parents are flightless, their offspring will form resident populations similar to the now nuisance resident Canada Geese. These geese, originating generations ago from pinioned or crippled birds, are now abundant from Alaska to Florida. But it has taken them more than 40 years with high initial mortality to form new migratory routes from breeding regions that freeze up in winter to warmer southern climes. In contrast, the resident Canada Geese in Virginia's more temperate climate do not migrate, remaining in the breeding area year round.

According to the U.S. Fish & Wildlife (USFWS) 2005 Survey there are now approximately 4,600 trumpeters in the Interior Population (IP), all from restoration programs (Moser, in press). However, restoration of lengthy traditional migratory flocks of, for example 1,000 miles, such as can be witnessed in the Pacific Population has yet to be established despite more than 30 years of release programs in the IP**.** Our aim was to establish a pre-selected migration route for Trumpeter Swans in the Atlantic Flyway, a flock we believe existed in pre-settlement days (Lumsden 1984, Rogers and Hammer 1998).

There was a different objective for the Whooping Crane Eastern Partnership program (www.bringbackthecranes.org). Because the only remaining traditional Whooping Crane migratory route from Wood Buffalo National Park, Alberta, to Aransas National Wildlife Refuge (NWR), Texas, was vulnerable, it was decided to create a new 1,200-mile pre-selected route between Necedah NWR, Necedah, Wisconsin, and Chassahowitzka NWR, Crystal River, Florida (Clegg and Lewis 2001, Whooping Crane Eastern Partnership 2003, 2005).

In the Canada Goose and Sandhill Crane experiments, the aim was to demonstrate that the birds would come back on their own if led one way south by the aircraft. The same applied to the Trumpeter Swan experiments since there was as yet no Management Plan for release of these birds in the Atlantic Flyway. However, with full support from USFWS and seven states along the proposed migration pathway, the Whooping Crane Eastern Partnership in 2001 was given approval to train 10 flocks of Whooping Cranes during seasons 2001 through 2010. In the four Whooping Crane experiments so far completed, a 2,400-mile (4,000 km) round-trip migration has been established by the ultralight technique. From a total of 51 cranes that landed safely in Florida, 41 (80%) are now migrating back and forth each year between Wisconsin and Florida (Whooping Crane Eastern Partnership 2001 – 2004).

GENERAL CONCLUSIONS

The general conclusions from a total of 29 experiments (7 goose, 6 trumpeter, 11 Sandhill Crane and 5 Whooping Crane) are:

1. To learn the route, the greater proportion of the birds had to follow the ultralight the entire way.
2. If the occasional bird fell out, but remained in the group during the journey and subsequent winter, it would usually join the trained birds in finding their way home.

3. If all the birds are trucked the entire route (as controls) or the majority are trucked part of the way, they will remain in the winter area and become residents.
4. To avoid aggressiveness and attachment to humans, crane handlers wore uniforms, following a strict routine (Ellis *et al.* 2000). With the geese and swans, uniforms were inconsistently used in earlier experiments, but later not found necessary; the important need was to regularly haze them from hatching or, in the third swan experiment, acquire young a few weeks after being hatched by their natural parents in Alaska (Sladen *et al.* 2002).
5. Following an ultralight takes the birds on an extremely unnatural "migration", yet they somehow learn the route.
6. The ultralight technique is very expensive, costing over 1.5 million dollars every year.
7. The migration between Wisconsin and Florida also takes a long and unnatural time of 8 to 10 weeks.
8. Using an ultralight that can only fly safely with birds in the morning and in almost calm weather is potentially dangerous for the pilots and birds.

THE FUTURE

Looking into the future, we believe "*Passive Migration*" should be tested, where the young learn a route by traveling in cages under an airship during the peak of the migration season, observing migratory birds and the land below without flapping a wing. A preliminary experiment was conducted in 2001 using a gas balloon (Sladen 2002). Airships are Federal Aviation Administration certified, can fly day and night, and could show experimental birds in cages a route during a typical migration. The experiment would be over in 1 or 2 days, costing a fraction of that spent on the ultralight technique. Moreover, in some instances, the birds would be flying and vocalizing with their kind.

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Editors' note: In 2006, a pair of the ultralight-led Whooping Cranes hatched and fledged a chick in Necedah NWR, Wisconsin.

IS MIGRATION NECESSARY FOR RESTORATION OF TRUMPETER SWANS IN THE MIDWEST?

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I have been working with Trumpeter Swans in the Midwest for the past 32 years. My involvement with the migration effort started in 1984, when 31 swans migrated for the first time from Hennepin Parks in east central Minnesota. Since then, I have attended Flyway Technical Committee meetings, toured southern states to assess winter habitat, co-hosted meetings for swan managers to try to develop a coordinated plan and presented papers on migration at four of the last five Trumpeter Swan Society Conferences.

Restoration of breeding flocks of Trumpeter Swans in the upper Midwest has been extremely successful. Population objectives for breeding birds have been met for almost every flock. However, efforts to restore flocks that are migratory have been marginal at best. I am frustrated, primarily because I believe we have the biological knowledge to be successful, but we lack the political will to do it. While everyone appears to agree on the merits of establishing a migratory population, few are willing to embrace aggressive measures to achieve that goal. The objective for migration in the Management Plan for the Interior Population (IP) of Trumpeter Swans states "Encourage the development of migratory behavior by IP swans in response to suitable habitat and climatic conditions." This objective leaves a lot of latitude on what to do, but overall the Management Plan is excellent. Unfortunately, it has not been implemented. In recent years, only Iowa and Arkansas have made significant efforts to promote migration, and I commend them for their efforts.

There have been numerous political obstacles to achieving the goal of a migratory population of Trumpeter Swans. No one group is completely responsible, but everyone can share some responsibility. Some examples appear below.

- The Trumpeter Swan Society's Board of Directors has been split on the merits of winter swan viewing areas and the use of supplemental feeding to create these areas and facilitate migration. In addition, the Society has not been able to reach a consensus on how to resolve the hunter liability issue, and the potential impact trumpeters could have on Tundra Swan hunting, which leaves state waterfowl managers concerned.

- Trumpeter Swan restoration managers have not addressed the migration effort aggressively beyond their own state lines, nor have they come to any consensus on what should be done.

- Flyway waterfowl managers are apprehensive about having Trumpeter Swans in their states, fearing that they will require additional management effort and could interfere with established waterfowl seasons, especially Tundra Swan hunting.

- The United States Fish and Wildlife Service, which has responsibility for migratory birds, has basically side-stepped the issue for the IP by stating it will provide assistance, but will not take the lead.

- Non-government conservation organizations have remained relatively silent, except for time spent debating the original range of Trumpeter Swans and whether the program should be called restoration or introduction.

- Private citizens are the strength of the program, but too few of them are even aware that they could have Trumpeter Swans wintering in their areas or know how they can help to achieve this goal.

- And, obviously, I have done a poor job in rallying all these groups to embrace procedures that are needed to develop a migratory population.

With all these divergent opinions, it is easy to see why very little has been accomplished.

Once trumpeters establish migratory routes and traditions, they adhere to them faithfully, bringing their offspring with them. It will be much more difficult to get the established flocks of swans to migrate to south today, since they are already familiar with other destinations.

In my opinion, the most significant missed opportunities in efforts to restore migratory flocks of Trumpeter Swans was the reluctance to use supplemental feeding to entice trumpeters to stay at southern locations when they made exploratory migrations during the early phases of most restorations. Almost all of the released swans had been raised in captivity, and had been fed on a diet of corn and pellets. Since they had no history of migration, they wandered south in a random fashion, searching for places to spend the winter that resembled what they had become familiar with in the past. It would have been so easy to feed these birds for several years until they had developed a tradition for migration, passed that tradition on to their offspring and learned how to live in the new landscapes they found. However, feeding was discouraged in most situations for a variety of reasons, such as the fear of the birds becoming more habituated to people. This concern has since proven to be unfounded, and it will be discussed further later in this paper. The pioneering swans wandered from place to place and many died. Those that survived finally settled on wintering locations where they were fed, which were generally in the north. Trumpeters were fed at a few locations like Heber Springs, Arkansas. The swans returned to this site in greater numbers each year, as was mentioned in a previous presentation (Linck *et al*. in press).

I am an unapologetic supporter of the use of supplemental feeding as a way to achieve a migratory population. Feeding has been used to attract and hold trumpeters at numerous locations in ways that do not alter the behavior of the birds towards people, especially during the non-winter months. Trumpeters do not behave as Canada Geese or Mute Swans do, even when they are fed in winter. However, I think a distinction has to be made between intentional wildlife habituation and attracting wildlife to a specific site. Swan feeding all year long through close contact with people could alter the behavior of the birds. Fortunately, there are ways swans can be attracted to a site without habituating them to people. This has been demonstrated almost everywhere that swans over-winter in the north, but it was not recognized during the earlier restoration efforts.

It would be tremendous if sufficient natural winter habitat could be restored to support IP trumpeters and other waterfowl. However, humanity seems incapable of controlling its own growth or achieving any lasting improvements for wildlife. Natural winter habitat for waterfowl in the southern Midwest today consists almost exclusively of agricultural fields, not wetlands. These fields consist of waste grain or green crops of winter wheat and rye. It takes time for trumpeters to adapt to new conditions, and I am not convinced that they are very well suited for the types of agricultural feeding that is available in the Midwest.

I also support the development of winter viewing areas for trumpeters and perhaps other waterfowl near urban centers, similar to the waterfowl sanctuaries in Europe. These sites can serve as migratory destinations, provide wonderful opportunities for the public to view these magnificent birds in a semi-natural setting, increase the survival of the swans, and reduce interference with waterfowl seasons. Jim King spoke about this opportunity at TTSS 15th Conference presentation in 1995. "We must find ways to allow crowds of people to enjoy swans. We need swan refuges with visitor centers near big cities for public viewing and education." (King 1996) Trumpeter Swans are not game birds, and their management should reflect their different status.

The American public is becoming more disconnected from the natural world every day despite increased efforts at environmental education. While some people think winter feeding sites increase this disconnect, I think they can provide a way to expose people to some of the wonders of the natural world that could generate support for waterfowl and wetland management and other environmental issues with people who would otherwise be lost.

My endorsement of the use of supplemental feeding and the creation of viewing areas for trumpeters poses an interesting question in light of the reluctance to use either of these techniques in the south. Is it important to get trumpeter swans to migrate? There are numerous places in the north with open water all winter, either of natural or manmade origin. Trumpeters are not bothered by extreme winter temperatures. The swans are already migrating to these sites, and the flocks are flourishing as a result of the birds' use of these sites. Even in the north, trumpeters use the sites for only 4 months each winter. The chances of concentrations of trumpeters contracting diseases are probably less on the frozen tundra than they would be in the south. Keeping trumpeters permanently in the north reduces logistical and political problems associated with migration tremendously. The Mississippi River at Monticello and the Toronto waterfront are examples of wintering sites in the north where trumpeters thrive and where the public has wonderful opportunities to view the swans.

Are there advantages to having a migratory population that are worth pursuing in light of all the obstacles? Of course, trumpeters migrated in the past. Migration gives trumpeters a chance to adapt to more "natural" agricultural foods, which could reduce the need for supplemental feeding, but may increase conflicts with farmers. Viewing swans would be more comfortable in the south. The swans could be viewed by a larger audience, which could generate more support for habitat preservation.

Are these advantages sufficient to justify the continued effort that would be necessary to get trumpeters to migrate? I am interested in your response.

Swan flocks are continuing to grow in almost all locations in the Midwest. If we accept the current winter distribution for trumpeters, it will probably be necessary to increase the number of wintering sites in the north. It may also be necessary to re-evaluate population objectives for flocks of trumpeters that rely exclusively on natural winter food supplies. The question shifts from how many breeding pairs a region can support to how many swans the winter habitat can support for the long term? For example, how many trumpeters can spend the winter on streams in Nebraska before the habitat is compromised? Where will the swans go if these streams are over-grazed? There are no similar sites to the south. And, what impact will over grazing have on other wildlife? Supplemental feeding at this location would only make the situation worse for the naturally occurring vegetation. Feeding sites would have to be set up far enough away that the swans would not make daily flights between sites.

The private sector can play and has played a very important role in the management of Trumpeter Swans. The restoration program in Iowa is a perfect example (Andrews and Hoffman, in press). These efforts can easily be extended to managing wintering sites, which would reduce requirements for state officials. I think the possibilities for public participation have been overlooked by most wildlife managers.

A working session for swan managers in the Midwest is scheduled for tonight to discuss what should be done about migration. Anyone is welcome to sit in. I have my personal opinions, but I am sure everyone else does also. There have been several similar sessions in the past, but to date there has not been a consensus on what should be done. I am hopeful that our increased experience with swan behavior may have changed some peoples' opinions on what can or should be done.

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PACIFIC COAST/ROCKY MOUNTAIN POPULATIONS

THE YUKON AND NORTHWESTERN BRITISH COLUMBIA TRUMPETER SWAN SURVEY, 2005

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ABSTRACT

The 5th quinquennial Yukon and northern British Columbia Trumpeter Swan survey was conducted from 11-26 August, 2005. Since 1995, the survey has used a stratified random sample design with optimal allocation to make the most efficient use of aircraft flying time. A total of 68 maps (50,749 km^2) from a total of 596 maps (442,121 km^2) was surveyed entirely for swans, using 70.9 hours of flying time on 11 separate days. A total of 1,472 swans was sighted, including 968 adults and 504 cygnets in 143 broods. The mean brood size was 3.52 and 34.2 percent of the birds were cygnets. The total population estimated was 3,034 (±183 SE) swans, including 1,798 (±173) from the Rocky Mountain Population (RMP), and 1,236(±62) from the Pacific Coast Population (PCP). An estimated 2,693 swans were in Yukon Territory and 342 in British Columbia. In this survey area, the RMP has been increasing at an annual rate of about 8.5% since 1995 and the PCP has been increasing about 10% annually. Currently, the most densely populated 1:50,000 maps are Koidern (95 swans) and Scottie Creek (69 swans) in the Klondike Plateau ecoregion of extreme western Yukon. Although it is relatively expensive and designed for a single species, this 5-year survey is worthwhile for the valuable information it provides on a high-profile species and the highly productive wetlands it needs for breeding.

INTRODUCTION

Trumpeter Swans in the Yukon Territory and northern British Columbia have been surveyed every 5 years beginning in 1985 as part of a continent-wide survey effort that relies on hundreds of cooperators from federal, state, and provincial agencies as well as other groups such as The Trumpeter Swan Society (Anonymous 1986, Anonymous 1994, Caithamer 1996, Caithamer 2001). The goal of the continental survey is to estimate the post-breeding size of the three wild populations of Trumpeter Swans in North America. The Yukon Territory and northwestern British Columbia have portions of both the PCP and the RMP, two of the three major populations of trumpeters in North America.

The first two widespread surveys in the Yukon Territory and northwestern British Columbia in 1985 and 1990 (McKelvey 1986, McKelvey and Hawkings 1990) either followed previously established flightlines or created new ones in areas that were known to have swans, but had not previously been included in the survey. This design did not really allow us to estimate the total swan population of the Yukon Territory, and created the continuing dilemma of how to incorporate new areas as trumpeters expand their range in the Yukon Territory. In 1995, a sampling survey was adopted, modeled to some extent after a design first implemented in Alaska in 1986 for Trumpeter Swans (Conant *et al*. 1991). It used a stratified random sampling procedure with optimal allocation (Cochran 1977) to attempt to minimize variance for a fixed "cost" (i.e. aircraft flight time). The results of 1995 and 2000 for Yukon Territory and northwestern British Columbia surveys using this method were discussed previously (Hawkings 2000, Hawkings *et al.* 2002). The protocol involved total counts within sample units chosen at random within different density strata. Sample units were assigned to density strata according to the number of swans likely to be present in each unit, based on previous knowledge of the area. Individual 1:50,000 maps were used as sample units. The total population and variance were estimated within each density stratum and the totals were added to obtain an overall estimate for the survey area (Cochran 1977). Post-stratification estimation procedures (Thompson 1992) were used to estimate swan numbers in different geographic units that separate populations (RMP vs. PCP) and provinces (Yukon Territory vs. British Columbia). The 2005 survey used this design, with slightly modified strata definitions.

METHODS

National Topographic Survey 1:50,000 maps were the sample units for the survey. Most of the Yukon Territory south of 65 ° North was included, as well as a large portion of northwestern British Columbia (Figure 1). All maps were stratified according to the following criteria, using former survey data (primarily the 2000 survey) as the basis:

0 apparently no possibility of suitable habitat (either no water or only fast-flowing streams and rivers with no floodplain wetlands and no lakes/ponds of suitable size with emergent vegetation.). Includes much of the high-elevation areas of Kluane National Park, Mackenzie Mountains, Ogilvie Mountains. This stratum was not sampled.

1 likely to have no swans because of very limited habitat on the map or because there was no past or recent evidence of swans in spite of suitable habitat being present. This stratum was sampled.

2 likely to have 1-10 swans per 1:50,000 map.

3 likely to have 11+ swans per 1:50,000 map.

As the cost and logistics of obtaining paper copies of all the 596 sheets were prohibitive, stratification was performed by examining each 1:50,000 map in digital form on a computer monitor.

All sampling and estimation were based on strata 1, 2, and 3 only. Following the stratification of all maps, optimal allocation calculations were performed, using the data total swans per map and total time to survey each map from the 2000 survey (Table 1). Data from the previous two surveys in 1995 and 2000 suggested that, overall, about 1 hour of flying was required to complete each survey unit. Approximately 65 hours of flying time were available for the 2005 survey, so a total sample size of 65 was used to perform the calculations. No swans were expected to occur in Stratum 1 based on all available knowledge (any maps known or strongly suspected to have swans were placed in Stratum 2), so it was impossible to include it in the optimal allocation procedures. After the sampling effort was allocated between strata 2 and 3, a sample size of ten was arbitrarily assigned to stratum 1 and sample sizes in the other two were reduced by a total of 10. The resulting numbers of samples in each stratum were then randomly chosen from the total available maps in each stratum.

The survey was conducted by a pilot (Denny Denison) and one observer (J. Hawkings) using a Maule M7 aircraft. We attempted to search all suitable habitat within each 1:50,000 map on the survey. The aircraft was flown at varying altitudes depending on wind, clouds, visibility, and terrain, but usually between 300-500 feet above the ground. A laptop computer loaded with moving map software and connected to two consumer-grade GPS units was used to navigate to and within each sampled map and record the locations of swans. The location of each group of swans (and often other wildlife) was marked as a waypoint in the moving map software, and the details of each sighting (number of adults, cygnets, etc.) were recorded on small handheld digital voice recorder. The entire flight track was recorded on the GPS units as well as in the computer. Much of the flying time in the survey was required to ferry the aircraft between sampled maps and to and from the various bases. During this ferry time, we continued to record incidental sightings of swans and we attempted to look at any promising habitat that was enroute.

Following the survey, all waypoints and tracks were exported from the moving map software to a Geographic Information System (GIS). Details of each swan group were transcribed from the voice recorder to a Microsoft Access database and these attributes were linked to the locations in the GIS files.

Population estimates were then generated for each stratum (1, 2, 3) within each population (PCP or RMP). Estimates of precision (standard error) were generated separately for each stratum/population. These estimates were then subdivided by province using the mean values (swans per map) in each stratum of each population and estimating the total for each population/province block. Due to small sample sizes, particularly in British Columbia, I used the same estimates of precision for the province/population blocks as for the larger population blocks.

RESULTS

Of 596 total maps in the survey area, 509 were assigned to strata 1, 2, or 3. A total of 68 of these were surveyed (Figure 2), with 10, 27, and 31 in strata 1, 2, and 3, respectively. These numbers differ slightly from those in Table 1 because, for various reasons, some maps that were chosen were not surveyed and a few that were not chosen were surveyed. The survey was conducted from 11-26 August 2005. It required 70.9 h of flying on 11 different days, an average of 6.4 h per day (Table 2).

Sightings

Including incidental sightings, a total of 1,472 swans was seen, including 968 adults and 504 cygnets in 143 broods (Table 3). The mean brood size was 3.52, and 34.2% of the birds counted were cygnets (52.1 cygnets per 100 adults). Swans were sighted on 52 of the 68 maps surveyed, as well as on another 71 maps which were not officially surveyed. The distribution of sightings is shown in Figure 2.

Population estimates

A total of 960 swans, including 635 adults and 325 cygnets in 92 broods, was sighted on the maps which were officially surveyed in 2005 (Table 4). The resulting population estimates for Yukon Territory and northwestern British Columbia totaled 3,034±183(SE) swans including 1,798±173 in the range of the RMP and 1,236±62(SE) in the range of the PCP (Table 5). Estimates of the proportion of cygnets range from 33.3% for RMP to 29.9% for the PCP.

When compared with estimates from earlier surveys, the 2005 estimates (Table 6, Figure 3a,b) indicated that there was continuing growth in both the PCP and the RMP in this region. Since the Yukon Territory survey was redesigned in 1995, the PCP has increased at an annual rate of about 10% and the RMP at about 8.5%. These are quite similar to corresponding recent (2000-2005) growth rates in the Alaska portion of the PCP (6.5%) and the Canadian-breeding portion of the RMP (7.9%). It is difficult to assess population changes in the part of northwestern British Columbia that is covered by this survey because of the small numbers of maps that are surveyed there, and the low density of swans. This is compounded by the fact that there is little overlap in maps surveyed in successive surveys because of the random sample design.

If we look at the number of swans counted on individual maps that were surveyed in both 2005 and 2000 (Table 7), there appears to be a fairly large and consistent increase in the PCP (together, six maps had a total increase of 121% in 5 years, and an annual increase of 17%). There was a much more modest and more inconsistent increase within the RMP range, where only 5 of 13 maps increased (the total increase was 7% in 5 years and the annual rate of increase was less than 1%) and some decreased substantially.

Distribution

The 2005 distribution of Trumpeter Swans shows two relatively distinct groups corresponding to the ranges of the RMP and PCP. Relative to Ecoregions which have been described for the Yukon Territory and northwestern British Columbia (Figure 2) the RMP birds are in the Liard Basin, Hyland Highland, Selwyn Mountains and Yukon Plateau North and PCP swans are in the Klondike Plateau, Ruby Ranges, Yukon Stikine Highlands, and Yukon Southern Lakes. Swans in the Yukon Plateau-Central are likely from the PCP, although those in the northern portion may be affiliated with the RMP. Swans in the Nisutlin River area in the eastern portion of the Yukon Southern Lakes are thought to be associated with the RMP. Swans are most abundant in the Ruby Ranges, Yukon Plateau-North, Liard Basin, Yukon Southern Lakes, and Klondike Plateau (Table 7). Pickhandle Lakes along the Koidern River had the most swans (95) of any map in 2005, followed by Scottie Creek and two maps along the Nisutlin River. Of the ten maps having the largest numbers of swans (Table 9), eight were in the PCP range, and two in the RMP range.

DISCUSSION

There appears to still be substantial unoccupied habitat in the Yukon Territory and northwestern British Columbia that is suitable for breeding. Swans seem to be moving into many of the major river floodplains that were formerly only sparsely occupied, for example the MacMillan, Stewart, and Donjek rivers. There has also been a major population increase in the wetland-rich areas of the Klondike Plateau, such as Scottie Creek. It is very difficult to predict how many Trumpeter Swans can coexist in any area. A case in point is the Pickhandle Lakes area, which in 2005 had double the number seen in any previous survey, even though it appeared well-occupied on those surveys.

The stratified random sample survey technique used since 1995 in this survey was intended to allow estimation of the total population in the area and track changes in distribution. It has done a good job of that, but the random sample design does limit the sample of individual maps which is repeatedly surveyed. This also makes it difficult to say in some cases exactly how populations have changed in various subareas, for example ecoregions or individual river floodplains. Fortunately, it will be possible to address this question for some areas by looking at incidental sightings and the archived aircraft flight tracks over the course of 10 or 15 years (two or three surveys).

Trumpeter Swans appear to be moving into the Old Crow Flats, Fort McPherson Plain, and Peel River Plateau Ecoregions of the northern Yukon Territory. There have been multiple observations of trumpeters, including confirmed breeding, in the Peel River Plateau since 1999 (Eckert *et al.* 2003). There have also been recent reports of likely trumpeters from the Old Crow Flats. These areas are all rich in wetlands, but have not been included in the 5-year survey to date. If the North American survey is to be continued in 2010 and beyond, these areas should be considered for formal coverage. However, likely overlap with breeding Tundra Swans in these areas is going to make future aerial survey efforts challenging.

This Yukon Territory and northern British Columbia Trumpeter Swan Survey is relatively expensive and designed to count a single species only. However, the trumpeter is a species that is very high-profile, especially in the Yukon Territory. It is a conservation success story – something all too rare in this day and age. It also requires breeding areas that are rich in emergent and submergent aquatic vegetation – generally healthy, highly productive wetlands that have diverse flora and fauna. Thus, the survey results can be used as one indicator of the most productive wetlands in Yukon and northern British Columbia. For these reasons, it is worthwhile to continue this survey every 5 years as part of the North American-wide survey.

ACKNOWLEDGMENTS

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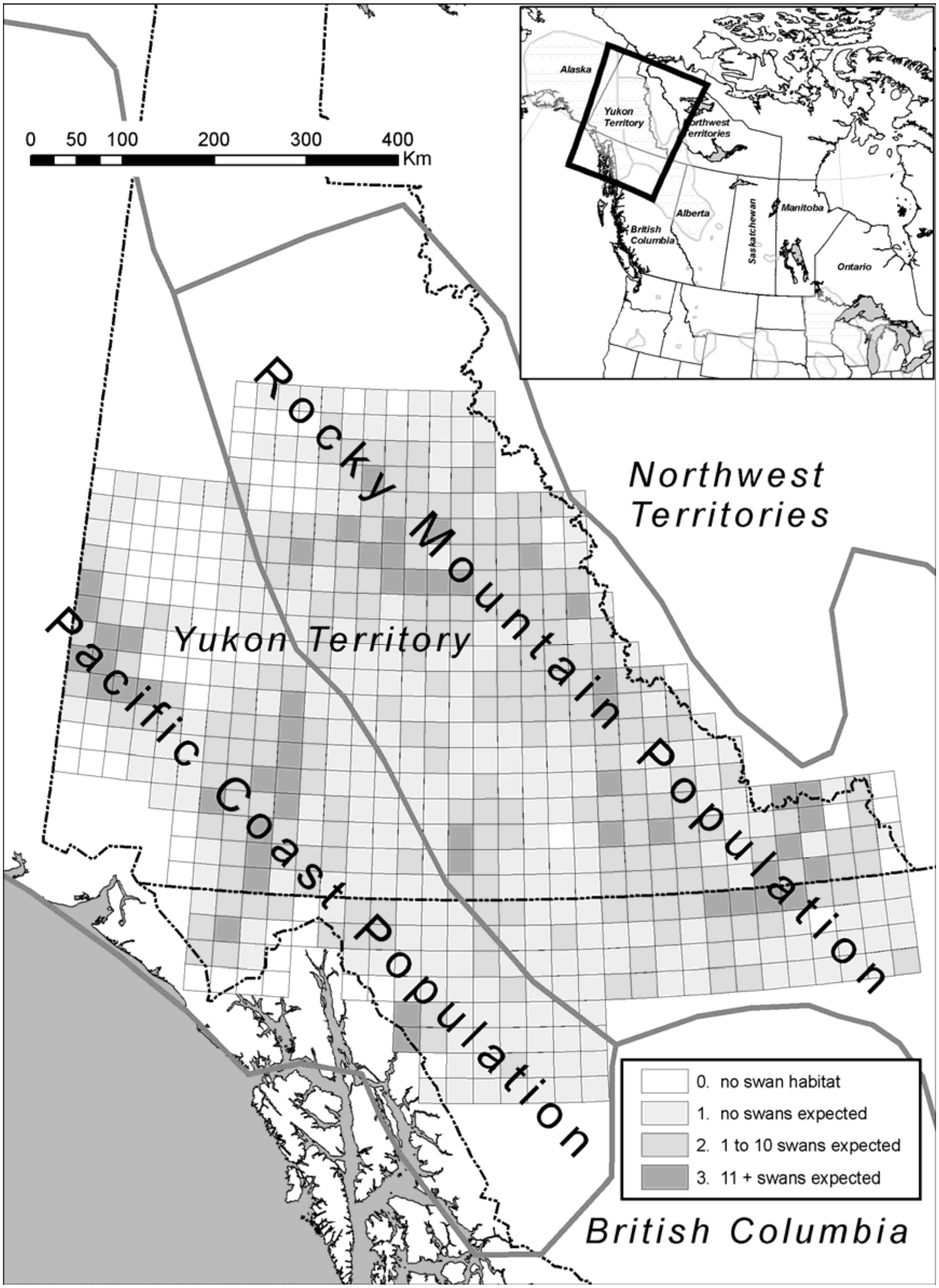

Figure 1. Location of the Yukon and northwestern British Columbia Trumpeter Swan Survey area and distribution of individual maps in four survey strata used for the 2005 survey. Heavy gray lines (and shaded areas of western Canada and Alaska in inset map) indicate the approximate range of the Pacific Coast Population and the Rocky Mountain Population of Trumpeter Swans.

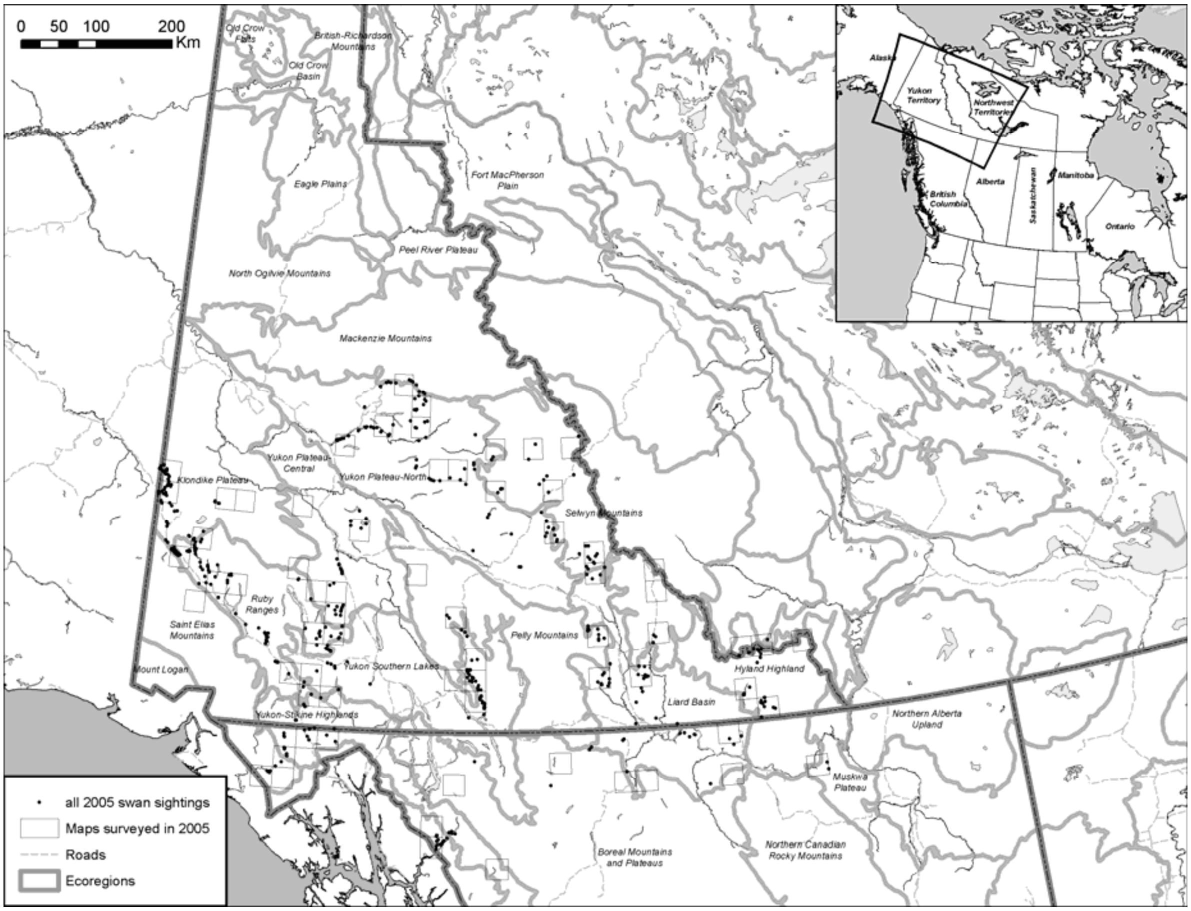

Figure 2. Locations of all swan sightings (including incidental sightings) and 68 individual maps surveyed during the 2005 Yukon and northwestern British Columbia Trumpeter Swan survey.

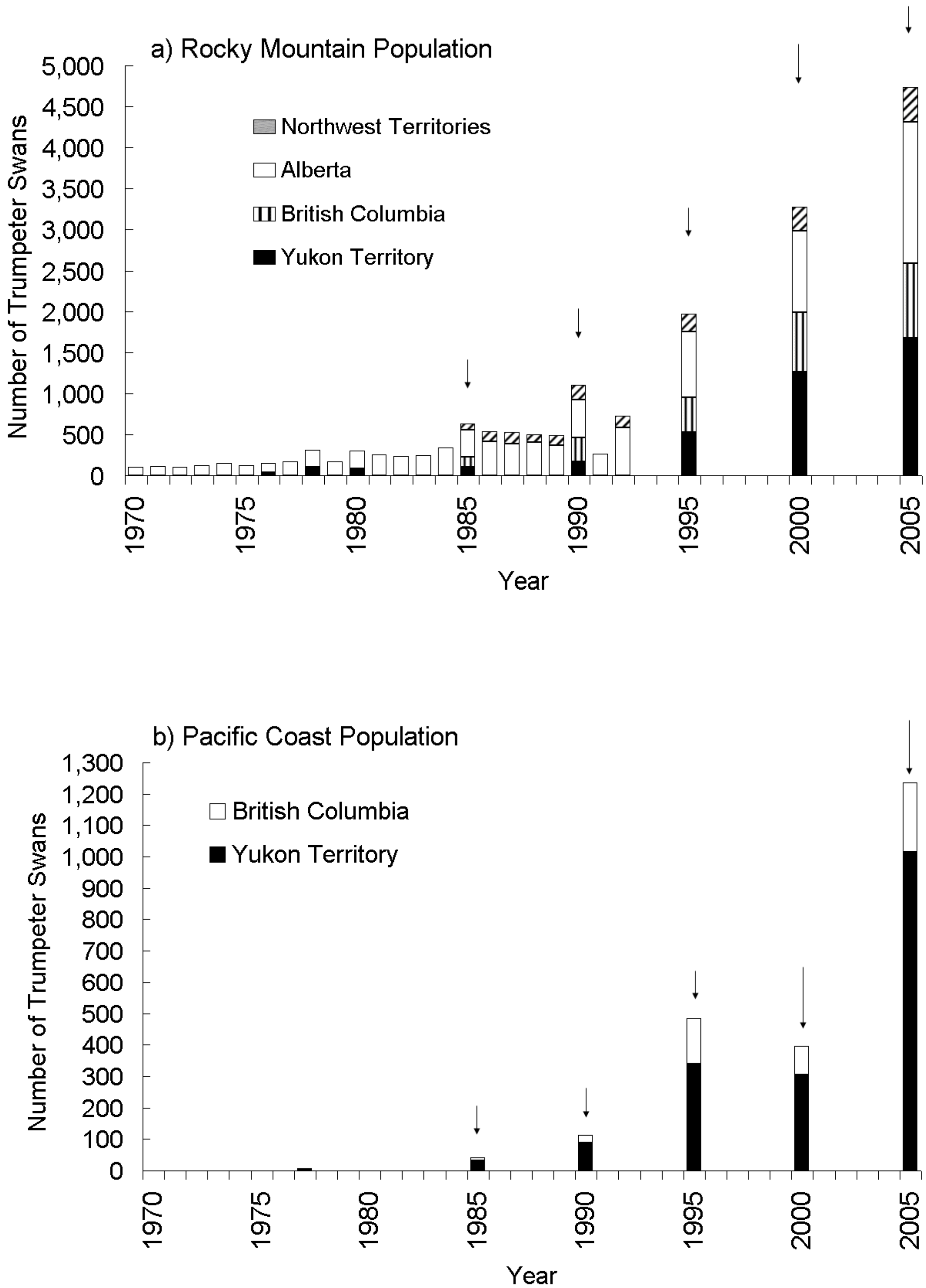

Figure 3. Results of breeding season surveys of (a) the Rocky Mountain Population and (b) the Pacific Coast Population of Trumpeter Swans in British Columbia and Yukon Territory, 1970-2005. Arrows indicate years with comprehensive, range-wide surveys in North America (1985, 1990, 1995, 2000, 2005). Note: (a) includes data gathered from portions of British Columbia outside the survey area covered by this report, as well as from Alberta and Northwest Territories.

Table 1. Data used to determine optimal allocation of sampling effort in the 2005 Yukon and northwestern British Columbia Trumpeter Swan survey.

Parameter	2005 Stratum Number 0	1	2	3	Total
Mean swans per sample unit from 2000 survey		0	3.14	19.5	
Standard Deviation (total swans) (Sd_h)			2.0	9.38	
Mean Time to Survey 1 Unit (minutes) (C_h)	13.5	22.55	23.62	33.63	
Number of sample units in Stratum in 2005 (N_h)	70	263	211	52	596
Number of units sampled in 2000	2	11	14	20	47
(**A**)square root of C_h	3.67	4.75	4.86	5.80	
(**B**)N_h* Sd_h	0	0	420.84	487.95	
B/A	0.000	0.000	86.60	84.14	170.74
proportion of total samples (f_h)	0.00	0.00	0.51	0.49	
total allowable samples (approx)					65
desired number of samples in 2005 (n)	0	0	33	32	65
modified target numbers for 2005	0	10	28	27	65
estimated total time (minutes)	0	225.45	661.23	908.05	1794.74
estimated total time (hours)	0	3.76	11.02	15.13	29.91

Table 2. Details of aerial survey flights conducted during the 2005 Yukon and northwestern British Columbia Trumpeter Swan Survey.

Date	Start Time	End Time	Flight Time	Base	General Itinerary	Maps Surveyed
11-Aug	8:30	14:00	5.3	Whitehorse	Whitehorse, Nisling R, Mackintosh Ck, Tahte Ck, Nordenskiold R, Satasha L, Kirkland Ck, Sakata L, Whitehorse	115H/14, 115H/10, 115H/09, 115H/08
11-Aug	15:00	21:00	4.6	Whitehorse	Whitehorse, O'Connor R, Tatshenshini R to Ninetyeighter Ck to O'Connor R to Pirate Ck to Goldrun Ck, Kelsall L, Blanchard L, Blanchard R, Kusawa R, Duff L, Hendon R, Kusawa L, Frederick L, Frederick Ck, Howard L, Dezadeash L, Kluhini R, Frederick L, Kusawa L, Primrose R, Fish L, Whitehorse	114P/05, 114P/06, 114P11, 114P/15, 114P/16, 115A/07, 115A/08
12-Aug	8:05	14:25	5.6	Whitehorse	Whitehorse, North Big Salmon R, Quiet L, Nisutlin R, Teslin, Nisutlin R, Johnson's Crossing, Whitehorse	105E/16, 105F/06, 105C/15, 105C/10, 105C/07, 105C/11
14-Aug	10:20	17:10	7.1	Whitehorse	Whitehorse, Teslin, Gladys L, Trout L, Gladys R, O'Donnel R, Dixie L, Nakina R, Taku R, Tusequah, Flanigan Slough, King Salmon Ck, King Salmon L, Tatsatua L, Tatsameni L, Sheslay R, Nahlin R, Gun L, Sheephorn Ck, Jennings R, Little Rancheria R, Cormier Ck, Watson L	104N/06, 104K/13, 104K/12, 104K/08, 104O/10
15-Aug	08:20	14:35	5.7	Watson Lake	Watson L, Dendale L, La Biche R headwaters, Meilleur R, Spruce L, Balsam L, Caribou R, Beaver R, Toobally Lakes, Crow R, Larsen L, Thorpe Ck, Crooked L, Smith R, Hutchison Ck, Rogers Lakes, Shaw Ck, Barney L, Blind L, Watson L	095C/15, 095C/13, 095D/16, 095D08, 095C/04, 094M/15
16-Aug	07:50	13:45	6.7	Watson Lake	Watson L, Egnell Lakes, Hillgren Lakes, Grayling R, Torpid Ck, Irene L, Toad R, Liard R,, Aline L, Nordquist L,, Liard R, Fishing L, Fishing Ck, Graveyard L, Boya Ck, Kechika R, Birches L, Twin Island L, Aeroplane L, Deadwood R, Looncry L, Dease R, Good,Hope Lake, Dease R, Boya L, Dease R, Masidoor Ck, Porter Lakes, Upper Liard, Watson L.	094N/07, 094M/07, 104P/07, 104P/06
17-Aug	08:45	17:33	7.4	Watson Lake	Watson L, Little Tom L, Tom L, Stewart L, Hyland R, Oscar L, Sambo Ck, Airplane L, Liard R, Allan Ck, Twin Lakes, Sambo Ck, Tudhitua R, Frances L, Dolly Varden Ck, Hyland R, Lower Hyland L, Little Hyland R, Upper Hyland L, Yusezyu R, Woodside R, Narchilla Brook, Yusezyu R, McPherson L, Ptarmigan Ck, McEvoy L, Olgie L, Faro	105A/10, 105A/12, 105H/04, 105H/01, 105H/09, 105H/16, 105I/04, 105H/13
18-Aug	07:55	13:35	4.2	Faro	Faro, Blink Ck, Blind Lakes, Tay L, Radar L, Otter Ck, Prevost R, Lewis L, Field L, Sheldon L, South MacMillan R, Hess R, Keele Peak, Hess R, Niddery L, Emerald Ck, Fido Ck, Swan L, Hess R, North Macmillan R, Faro	105J/07, 105J/15, 105O/08, 105O/06
19-Aug	08:05	15:35	7	Faro	Faro, Blind Ck, Tay R, Laforce L, Riddell R, South Macmillan R, North Macmillan R, Fairweather L, Hess R, Fairweather L, North Macmillan R, South Macmillan R, Macmillan R, Mist L, Stewart R, South Nelson Ck, Nelson Ck, Edwards Ck, Edwards L, Tiny Island L, Roop Ck, Keno Ladue R, Stewart R, Beaver R, Scougale Lakes, Clark Lakes, McQuesten L, South McQuesten R, Halfway Lakes, Mayo	105K/16, 105N/08, 105N/03, 105N/04, 105M/09, 105M/16, 105D/02

Table 2. Details of aerial survey flights conducted during the 2005 Yukon and northwestern British Columbia Trumpeter Swan Survey.

Date	Start Time	End Time	Flight Time	Base	General Itinerary	Maps Surveyed
20-Aug	09:30	16:55	6.6	Mayo	Mayo, Stewart R, Janet L, Williamson L, Watson Ck, Stewart R, Ethel L, Crooked Ck, Tatlmain L, Tadru L, Ess L, Kelly L, Tatlmain Ck, Yukon R, Minto, Ingersoll Islands, Dip Ck, Klotassin R, Donjek R, Mackinnon Ck, Donjek R, Kluane R, Tincup L	105M/11, 115P/08, 105L/05, 115I/11, 115J/10, 115J/11, 115J/04
21-Aug	09:55	19:05	7.7	Tincup Lake	Tincup L, Kluane R, Donjek R, Fish Hole Lake, Snag Ck, Scottie Ck, Beaver Ck, Enger Lakes, Dry Ck, White R, Koidern R, Pickhandle Lakes, Wolf Ck, Wolf Lake, Donjek R, Tincup Lake, Donjek R, Steele Ck, Donjek R, Burwash L, Brooks Arm, Brooks Ck, Serpenthead L, Talbot Arm, Kluane L, Cultus Ck, Big Joe L, Jarvis R, Kloo L, Dezadeash R, Kathleen R, Rainbow L, Kathleen L, Dezadeash L, Six Mile L, Dezadeash R, Champagne, Mendenhall R, Takhini R, Whitehorse.	115K/15, 115K10, 115F/16, 115G/05, 115G/11, 115G/10, 115A/11/115A/10
26-Aug	07:40	10:40	3	Whitehorse	Whitehorse, Taye L, Mendenhall R, Munntiger L, Quamie L, Canyon L, Giltana L, Aishihik L, Hutshi L, Sceptre L, Mendenhall R, Hutshi Lakes, Nordenskiold R, Little R, Takhini R, Whitehorse	115H/02, 115H/01

Table 3. Summary of Trumpeter Swan sightings from the 2005 Yukon and northwestern British Columbia Trumpeter Swan survey. Includes incidental sightings on maps not officially counted in the survey.

Population	Province	No. of Pairs	Adults in Pairs	Single Adults	Flocked Adults	Cygnets	Broods	Adults	Total Swans	Percent Cygnets	Cygnets per 100 Adults	Mean Brood Size
Pacific Coast Population	Yukon	143.0	286	24	130	218	57	440	658	33.1	49.5	3.82
	BC	36.0	72	1	6	51	15	79	130	39.2	64.6	3.40
	PCP Total	**179.0**	**358**	**25**	**136**	**269**	**72**	**519**	**788**	**34.1**	**51.8**	**3.74**
Rocky Mountain Population	Yukon	176.5	353	29	31	216	65	413	629	34.3	52.3	3.32
	BC	15.5	31	0	5	19	6	36	55	34.5	52.8	3.17
	RMP Total	**192.0**	**384**	**29**	**36**	**235**	**71**	**449**	**684**	**34.4**	**52.3**	**3.31**
Entire Yukon and Northwestern BC	Yukon	319.5	639	53	161	434	122	853	1,287	33.7	50.9	3.56
	BC	51.5	103	1	11	70	21	115	185	37.8	60.9	3.33
	Total	**371.0**	**742**	**54**	**172**	**504**	**143**	**968**	**1,472**	**34.2**	**52.1**	**3.52**

Table 4. Sample sizes, swans counted, and estimated means and variances (in brackets) per map by Stratum, Population, and Province for the 2005 Yukon and northwestern British Columbia Trumpeter Swan Survey. Means and totals are calculated from counts in each Stratum/Population/Province, but variances are those from Stratum/Populations only.

					Numbers of Swans Counted								Estimated Means per Sample Unit (Map)							
Strat	Prov	Pop	n[1]	N[2]	Pairs	Adults in Flocks	Lone Adults	Cygnets	Broods	Paired Adults	Total Adults	Total Swans	No. of Pairs	Adults in Flocks	Lone Adults	Cygnets	Broods	Adults in Pairs	Total Adults	Total Swans
0	BC	PCP	0	11																
0	YK	PCP	0	37																
0	BC	RMP	0	1																
0	YK	RMP	0	21																
1	BC	PCP	2	44	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	BC	RMP	3	38	2	0	0	0	0	4	4	4	0.67 (0.048)	0.00	0.00	0.00	0.00	1.33 (0.048)	1.33 (0.193)	1.33 (0.193)
1	YK	PCP	3	65	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	YK	RMP	2	116	0	0	0	0	0	0	0	0	0.00 (0.048)	0.00	0.00	0.00	0.00	0.00 (0.048)	0.00 (0.193)	0.00 (0.193)
2	BC	PCP	4	17	11	6	0	12	4	22	28	40	2.75 (0.056)	1.50 (0.068)	0.00 (0.002)	3.00 (0.215)	1.00 (0.016)	5.50 (0.223)	7.00 (0.438)	10.00 (1.144)
2	BC	RMP	2	20	1	0	0	3	1	2	2	5	0.50 (0.160)	0.00 (0.043)	0.00 (0.009)	1.50 (0.216)	0.50 (0.023)	1.00 (0.639)	1.00 (0.725)	2.50 (1.406)
2	YK	PCP	9	40	17	25	3	23	6	34	62	85	1.89 (0.056)	2.78 (0.068)	0.33 (0.002)	2.56 (0.215)	0.67 (0.016)	3.78 (0.223)	6.89 (0.438)	9.44 (1.144)
2	YK	RMP	12	134	31	5	4	32	10	62	71	103	2.58 (0.160)	0.42 (0.043)	0.33 (0.009)	2.67 (0.216)	0.83 (0.023)	5.17 (0.639)	5.92 (0.725)	8.58 (1.406)
3	BC	PCP	3	3	14	0	1	22	6	28	29	51	4.67 (0.195)	0.00 (0.360)	0.33 (0.013)	7.33 (0.463)	2.00 (0.028)	9.33 (0.779)	9.67 (2.282)	17.00 (4.397)
3	BC	RMP	1	4	1	0	0	3	1	2	2	5	1.00 (0.097)	0.00 (0.012)	0.00 (0.007)	3.00 (0.484)	1.00 (0.033)	2.00 (0.387)	2.00 (0.419)	5.00 (1.551)
3	YK	PCP	9	19	69.5	59	12	92	24	139	210	302	7.72 (0.195)	6.56 (0.360)	1.33 (0.013)	10.22 (0.463)	2.67 (0.028)	15.44 (0.779)	23.3 (2.282)	33.56 (4.397)
3	YK	RMP	18	26	101.5	8	16	138	40	203	227	365	5.64 (0.097)	0.44 (0.012)	0.89 (0.007)	7.67 (0.484)	2.22 (0.033)	11.28 (0.387)	12.6 (0.419)	20.28 (1.551)
Totals			68	596	248	103	36	325	92	496	635	960								

[1] number of maps sampled in stratum
[2] total number of maps in stratum

Table 5. Trumpeter Swan population estimates and Standard Errors (SE) for the Yukon Territory and northwestern British Columbia based on the 2005 Trumpeter Swan survey. Totals are calculated from Population/Province data in 3 density strata, but SE is calculated from population data (not by Province) in 3 density strata.

Population	Province	N*	n*	Total Stratum Area (km^2)	Total Surveyed Area (km^2)	No. of Pairs	Adults in Pairs	Single Adults	Flocked Adults	Cygnets	Broods	Total Adults	Total Swans	Percent	Cygnets per	Mean
						Total *SE*	Total *SE*	Total *SE*	Total *SE*	Total *SE*	Total *SE*	Total *SE*	Total *SE*	Cygnets	100 Adults	Brood Size
Pacific Coast Population	Yukon	161	21	118,325	15,504	222	445	39	236	296	77	719	1,015	29.2	41.2	3.83
						12.6	*25*	*3*	*15*	*23*	*6*	*39*	*58*			
	BC	75	9	59,831	7,148	61	121	1	25	73	23	148	221	33.0	49.3	3.17
						4	*8*	*1*	*5*	*8*	*2*	*12*	*19*			
	PCP Total	**236**	**30**	**178,156**	**22,652**	**283**	**566**	**40**	**261**	**369**	**100**	**867**	**1,236**	**29.9**	**42.6**	**3.68**
						13	***27***	***3***	***16***	***24***	***6***	***41***	***62***			
Rocky Mountain Population	Yukon	297	32	214,285	23,366	493	986	68	67	557	169	1,121	1,677	33.2	49.7	3.29
						60	*111*	*13*	*28*	*65*	*21*	*126*	*170*			
	BC	63	6	49,681	4,732	39	79	0	0	42	14	79	121	34.8	53.4	3.00
						12	*18*	*2*	*4*	*10*	*3*	*24*	*29*			
	RMP Total	**360**	**38**	**263,965**	**28,098**	**532**	**1,064**	**68**	**67**	**599**	**183**	**1,199**	**1,798**	**33.3**	**49.9**	**3.26**
						61	***113***	***13***	***28***	***66***	***21***	***128***	***173***			
Entire Yukon and Northwest BC	Yukon	458	53	332,609	38,869	715	1,430	106	303	853	247	1840	2,693	31.7	46.4	3.46
						61	*114*	*77*	*32*	*69*	*22*	*132*	*180*			
	BC	138	15	109,512	11,880	100	200	1	25	115	37	227	342	33.7	50.7	3.11
						12	*20*	*2*	*6*	*13*	*4*	*27*	*35*			
	Total	**596**	**68**	**442,121**	**50,749**	**815**	**1,630**	**[a]107**	**328**	**968**	**283**	**2,066**	**3,034**	**31.9**	**46.9**	**3.41**
						62.4	***116***	***13***	***32***	***70***	***22***	***135***	***183***			

* N=number of 1:50,000 map sheets in stratum, n=number of map sheets surveyed in stratum.

[a] some totals do not add correctly because component estimates in decimals were added together, yet components are reported in this table in whole numbers.

Table 6. Historical population estimates for the Pacific Coast Population and the Rocky Mountain Population segments within the Yukon and northwestern British Columbia survey area.

		Number of White Swans											
		In Pairs		As Singles									
Pop	Year	With cygnets	Without cygnets	Without cygnets	With cygnets	In Flocks	Number of flocks	Cygnets	Total Swans	No. of Broods	Average Brood Size	Percent Juvenile	Percent Pairs with Broods
	1985	2	6	3	1	23	4	6	41	2	3.00	14.6	25.0
	1990	24	24	8	0	19	4	44	119	12	3.67	37.0	50.0
PCP	1995	86	100	16	1	99	n/a	190	492	44	4.32	38.6	46.2
	2000	54	120	20	1	95	n/a	106	396	28	3.79	26.8	31.0
	2005	196	368	40	2	261	n/a	369	1236	100	3.69	29.9	34.8
	1985	14	62	16	0	4	1	16	112	7	2.29	14.3	18.4
	1990	30	66	14	1	40	n/a	44	195	16	2.75	22.6	31.3
RMP	1995	124	268	34	0	67	n/a	273	766	62	4.40	35.6	31.6
	2000	310	314	55	8	369	n/a	469	1525	163	2.88	30.8	49.7
	2005	364	700	67	1	67	n/a	599	1798	183	3.27	33.3	34.2

Table 7. Total swans counted on maps officially surveyed in both 2000 and 2005.

		Total Swans		
Population	Map	2000	2005	Change %
PCP	114P/06	2	0	-
	114P/11	7	31	+342
	115F/16	33	95	+188
	115H/01	9	20	+122
	115H/08	33	40	+21
	115I/11	0	0	0
PCP Total		84	186	+121
RMP	095C/04	35	26	-26
	095C/13	16	19	+19
	095D/08	15	10	-30
	105A/10	25	23	-8
	105C/07	23	47	+104
	105C/10	22	59	+164
	105H/04	34	21	-38
	105H/13	8	10	+25
	105I/04	27	16	-41
	105M/09	17	17	0
	105N/04	11	13	+36
	105O/06	11	4	-63
	106D/02	10	7	-30
RMP Total		254	272	+7
Grand Total		338	458	+35

Table 8. Distribution of Trumpeter Swans by Ecoregion as determined from all sightings during the 1990, 1995, 2000, and 2005 Yukon and northwestern British Columbia surveys.

Ecoregion		Year			
Number	Name	1990	1995	2000[a]	2005
62	Sibbeston Lake Plain				2
66	Muskwa Plateau				4
170	Mackenzie Mountains			17	14
171	Selwynn Mountains	38	46	55	90
172	Klondike Plateau	43	73	45	154
173	St.Elias Mountains		15	12	19
174	Ruby Ranges	29	98	166	379
175	Yukon Plateau-Central		15	125	112
176	Yukon Plateau-North	20	57	117	211
177	Yukon Southern Lakes	11	53	114	151
178	Pelly Mountains	9	11	23	19
179	Yukon-Stikine Highlands		17	32	87
180	Boreal Mountains and Plateaus		1	5	4
181	Liard Basin	54	41	110	130
182	Hyland Highland	67	71	80	64
185	Northern Coastal Mountains			56	32
Total		271	498	957	1,472

[a]includes 93 swans sighted during other surveys which were not part of the official Trumpeter Swan Survey. These additional sightings were primarily in ecoregions 174, 175, 177.

Table 9. Forty most densely populated 1:50,000 maps encountered during the 2005 Yukon and northwestern British Columbia Trumpeter Swan survey. Includes incidental sightings.

Map ID	Map Name	Prov	Population	Broods	Cygnets	Total Pairs	Single Adults	Flocked Adults	Total Adults	Total Swans
115F/16	KOIDERN	YK	PCP	7	29	22	4	18	66	95
115K/10	SCOTTIE CREEK	YK	PCP	4	16	12.5	4	24	53	69
105C/10	THIRTYMILE CREEK	YK	RMP	8	27	16	0	0	32	59
115G/13	TOM MURRAY CREEK	YK	PCP	7	28	11	0	0	22	50
105C/07	LONE TREE CREEK	YK	RMP	6	25	10	2	0	22	47
115H/08	VOWEL MOUNTAIN	YK	PCP	5	18	9	1	3	22	40
115J/04	MACKINNON CREEK	YK	PCP	4	15	8	0	6	22	37
115H/04	MCKINLEY CREEK	YK	PCP	3	14	5	0	13	23	37
115H/16	MOUNT MORRISON	YK	PCP	5	17	6	0	5	17	34
115K/15	WIENERWURST MOUNTAIN	YK	PCP	1	5	9	2	6	26	31
114P/11	CARMINE MOUNTAIN	BC	PCP	4	16	7	1	0	15	31
105M/11	WILLIAMSON LAKE	YK	RMP	4	17	6	0	0	12	29
105A/12	SAMBO CREEK	YK	RMP	3	11	8	0	0	16	27
095C/04	LARSEN LAKE	YK	RMP	2	8	8	2	0	18	26
115H/02	HUTSHI LAKES	YK	PCP	3	13	6	0	0	12	25
105J/07		YK	RMP	3	9	8	0	0	16	25
114P/15	PARTON RIVER	BC	PCP	3	10	5	0	3	13	23
105A/10	STEWART LAKE	YK	RMP	3	8	7	1	0	15	23
105H/04		YK	RMP	1	1	7	2	4	20	21
115H/01	MOUNT COOPER	YK	PCP	2	6	5	0	4	14	20
094M/13	EGNELL LAKES	BC	RMP	2	8	3.5	0	5	12	20
115A/13	KLOO LAKE	YK	PCP	3	10	4.5	1	0	10	20
115G/10	SERPENTHEAD LAKE	YK	PCP	1	3	4	1	8	17	20
115A/16	CHAMPAGNE	YK	PCP	1	5	7	0	0	14	19
095C/13	BALSAM LAKE	YK	RMP	2	7	6	0	0	12	19
105M/16	TINY ISLAND LAKE	YK	RMP	1	3	7	1	0	15	18
105N/03	MOUNT ARMSTRONG	YK	RMP	3	11	3	0	0	6	17
105M/09	EDWARDS LAKE	YK	RMP	2	7	5	0	0	10	17
115P/08	ETHEL LAKE	YK	RMP	1	3	3.5	2	4	13	16
104K/12	TULSEQUAH RIVER	BC	PCP	2	6	5	0	0	10	16
105I/04	MOUNT PIKE	YK	RMP	1	4	5	2	0	12	16
114P/14	SURVEY LAKE	BC	PCP	2	7	3	0	0	6	13
105C/02	TESLIN	YK	PCP	0	0	1	0	11	13	13
105C/15		YK	RMP	2	5	4	0	0	8	13
105H/01	LOWER HYLAND LAKE	YK	RMP	2	7	3	0	0	6	13
105M/12	MAYO	YK	RMP	3	5	4	0	0	8	13
105N/04	PLATEAU MOUNTAIN	YK	RMP	2	4	4	1	0	9	13
115K/07	ENGER CREEK	YK	PCP	1	2	5	0	0	10	12
104K/11	STUHINI CREEK	BC	PCP	2	6	3	0	0	6	12
104K/14	INKLIN	BC	PCP	1	4	4	0	0	8	12

THE 2005 INTERNATIONAL SURVEY OF TRUMPETER SWANS IN ALBERTA, SASKATCHEWAN, MANITOBA, AND THE NORTHWEST TERRITORIES.

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ABSTRACT

The survey of Trumpeter Swan (*Cygnus buccinator*) breeding and summering habitat in Alberta, Saskatchewan, Manitoba and the Northwest Territories was completed in August and September 2005. Aerial survey flights totaled over 136 hours across the region. This is the first survey where swans were recorded in Manitoba with a total of 35 birds including 25 adults and 10 cygnets. Total swan numbers increased in all areas surveyed in 2005 from the counts in 2000: Alberta 1,724 birds (73.3% increase); Saskatchewan 78 birds (59.2% increase); and the Northwest Territories 415 birds (41.2% increase). The greatest increase in adult numbers occurred in Alberta 1,175 birds (+75.9%), followed by Saskatchewan 53 birds (+65.6%) and the Northwest Territories 327 birds (+60.3%). Cygnets accounted for 31.8%, 32.1% and 21.2% of the swans counted in Alberta, Saskatchewan, and the Northwest Territories, respectively. Cygnet numbers were higher than in the 2000 census in all areas except the Northwest Territories while mean brood size was lower except in Alberta which increased slightly. Trumpeter Swan numbers continue to increase across their current range with higher densities in some regions and expansion into new areas of suitable habitat in others. The Trumpeter Swans surveyed in this region are part of the Rocky Mountain and Interior Populations and currently rely on limited wintering ranges in the Greater Yellowstone and Lacreek National Wildlife Refuge areas, respectively. Restriction on expansion of the wintering areas will more likely limit population growth than will the availability of summer habitat for Trumpeter Swans in this region.

INTRODUCTION

Surveys of Trumpeter Swans are conducted across their entire breeding range once every 5 years (Caithamer 1996, Caithamer 2001). This report summarizes the results of surveys conducted across the known range of the species in Alberta, Saskatchewan, Manitoba, and the Deh Cho Region, Northwest Territories, Canada as well as in areas where they may be expanding. In Manitoba, Trumpeter Swans were reported on Pinawa Channel near Whiteshell Provincial Park in Spring 1998 (Burgess and Bote 1999). Although swans were not observed in Manitoba during the 2000 survey, recent observations (Arquilla *et al.* 2002, Patton *et al.* 2004) resulted in extensive surveys in the Duck Mountains, Porcupine Hills, Riding Mountain National Park, and Whiteshell Provincial Park of the province. In Alberta, the Cold Lake Air Weapons Range was surveyed for the first time. Existing survey areas were also expanded in some regions to cover incidental sightings outside the standard survey region.

METHODS

The majority of surveys were conducted by intensive searching from aircraft. Most surveys employed fixed-wing aircraft with an observer on either side of the aircraft, flying at elevations of 150 – 200 m above ground level and speeds of approximately 150 km/h; two regions used a helicopter (Pincher Creek - Waterton, Alberta and High Level, Alberta). Elk Island National Park surveys were also conducted as regular ground checks during the summer. Incidental observations were provided by landowners and other non-survey individuals. We consider the survey results to be total minimum counts in each area.

Surveys were focused on established or traditional breeding areas of Trumpeter Swans. All water bodies known to have been occupied by swans in previous surveys were checked. In some regions other suitable water bodies in areas adjacent to traditional lakes were surveyed. We included additional wetlands or regions in our survey based on incidental reports of swan observations made since the last continental survey in 2000. The number of birds in each survey area was tallied by adult (> 1 year) and young-of-year (cygnet) age categories.

Locations of Trumpeter Swans were recorded with GPS units and marked on 1:250000 topographic paper maps. Flight track logs were recorded on GPS units or on laptops using Moving Map Software (e.g. Fugawi). Swan locations were compared to previously documented sites and this year's numbers were added to corresponding site histories. New site locations and swan numbers were added to existing swan databases.

Surveys were conducted between 24 August and 14 September 2005 with incidental observations on 9 August, 24 September, and 3 October. Personnel from the three provincial government wildlife agencies, the Canadian Wildlife Service, Parks Canada Agency, and Ducks Unlimited Canada conducted all surveys.

RESULTS

Aerial survey flights (Table 1) totaled 93 hours in Alberta (eight crews), 9 hours in Saskatchewan (one crew), 13.5 hours in Manitoba (three crews), and 21 hours in the Northwest Territories (two crews).

A total of 2,259 Trumpeter Swans was counted in Alberta, Saskatchewan, Manitoba and the Northwest Territories which included 1,578 adults and 681 cygnets (Table 2, Figure 1). Total recorded population for each jurisdiction was Alberta 1,731, Northwest Territories 415, Saskatchewan 78, and Manitoba 35. Demographic summaries are provided in Table 2, and the distribution of adult swans in pairs, flocks or as singles is provided in Table 3.

The number of swans observed in all jurisdictions except Lac La Biche and Pincher Creek/Waterton was higher than in any previous survey. Survey coverage for some geographic sub-regions was expanded in response to the expansion of areas used by the swans and is discussed in the text below. In areas where the survey coverage was similar to that of 2000, and to the 1995 survey for several regions, comparisons of the results are made to show the increase (Table 4).

Alberta

Grande Prairie - Valleyview

Higher numbers of adults and young were found this year, with a record high total of 1,013 swans on 250 waterbodies (Table 2, Figure 1). Aerial survey coverage was largely the same as in previous surveys, with the addition of small areas with suitable water bodies southeast towards Fox Creek and north between the Smoky and Peace Rivers. Incidental observations by ground crews were also included in the total count. A number of paired swans were observed southeast of Grande Prairie on waterbodies not previously occupied near the junction of the Wapiti and Smoky Rivers. Flocks of swans were observed on local staging lakes such Bear Lake (113), Cutbank (34) and La Glace (42). These numbers may represent a cohort of nonbreeders or swans which abandoned sites in the Saddle Hills due to adverse environmental conditions affecting hatch and brood survival. However, it was observed that paired swans still occupied most lakes in the Saddle Hills.

Cygnet and brood numbers were up significantly from previous continental census in 1995 and 2000 (Norton and Beyersbergen 2000), however, cygnet numbers in the Saddle Hills were lower than in other parts of the survey area. The slight increase in survey area coverage in 2005 accounted for 35 swans, and, if removed from the total (1,013 swans), then similar survey area coverage and effort in all years allows for population size to be compared reliably between 1995, 2000, and 2005. Total adult numbers increased from 392 (1995) to 404 (2000) to 680 (2005), representing a 5.7 percent per year average growth rate over 10 years (Table 4), but the greatest recruitment occurred since the last survey.

Peace River - High Level

Surveys were conducted over a very large tract of the northwestern Alberta landscape and accounted for 420 swans on 112 waterbodies (Table 2, Figure 1). Survey effort and coverage was focused on known lakes with minimal exploration of new areas and was similar to the 2000 census with flights right up to the Bistcho Lake and Spawn Lake area on the Northwest Territories border. Surveys for Trumpeter Swans in the Hay-Zama wetland complex were completed during regular scheduled waterfowl surveys carried out by the Alberta Conservation Association. Numbers of cygnets and adults represented a 129 percent and 84.5 percent increase over those observed in the 2000 survey. Total adult numbers

(Table 4) increased from 132 (1995) to 148 (2000) to 273 (2005), an average annual growth rate of 7.5 percent per year, but the greatest increase occurred since the last survey. Observation of numerous unoccupied wetlands with suitable habitat indicates potential for continued expansion and concentration in this area.

High Prairie – Utikuma – Peerless

The 2nd year of survey coverage for this new region was similar to that in 2000 and covered an area around High Prairie, north of Utikuma Lake, west of Peerless Lake, and south of Spawn Lake. A survey flight was undertaken to cover habitat southeast to Athabasca. A total of 159 swans was found in the area, at 46 locations. Adult numbers increased by an average annual rate of 21.3 percent per year over 5 years (Table 4) with cygnet numbers slightly less than double and total swans more than double the number observed in the 2000 survey.

Edson – Whitecourt – Drayton Valley

More than double the swans were located this year in comparison to the 32 found in 2000 (Figure 1, Table 2). This year's search area included sites of incidental observations during the 2000 survey and expanded to include wetland sites with unconfirmed reports of swans in later years. The expansion area accounted for five adults while the traditional search area had 42 adults and 21 cygnets. Cygnet production was seven times higher this year than the three cygnets found in two broods in 2000 for this area. In the traditional survey area, the adult population increased by an average annual rate of 7.7 percent per year over the 5 years (Table 4).

Lac La Biche – Cold Lake

A survey area similar to the 2000 census was covered for lakes and waterbodies around St. Paul, east of Athabasca, Lac La Biche, and north to Fort McMurray (Figure 1). In addition, access to the Cold Lake Air Weapons Range, east of Lac La Biche, was granted allowing extensive surveys of the site. The lakes in the Department of National Defense (DND) range did not appear to be very suitable for swans as most are pure muskeg lakes with very little emergent vegetation and limited riparian habitat. No swans were observed in the DND area. Four adult swans were seen at three locations, but no young were observed (Table 2). A pair was present at Elinor Lake and two singles in the vicinity of Lac La Biche. This represents less than half the nine adults observed in 2000.

Elk Island National Park

Thirty five swans were counted in the Elk Island National Park area (Table 2, Figure1) in an area similar to that of the last two continental surveys (1995 and 2000). Twenty five adult swans (10 pairs and 5 singles) were resident in the survey area during summer 2005. Three pairs successfully fledged broods of five, two, and three cygnets in this reintroduced population which continues to grow each year. Total number of adults observed in 2005 represents an average annual increase of 9.0 percent per year over the past 10 years (Table 4). Trumpeter Swans continue to expand to suitable habitat outside the Park and now occupy territories up to 25 km from the Park.

Pincher Creek – Waterton Lakes National Park

Twenty eight swans including two broods (total 8 cygnets) were recorded in the Pincher Creek - Waterton Lakes National Park area on 14 waterbodies (Table 2, Figure 1). The adult numbers showed an average annual reduction of 3.2 percent per year from the 27 adults recorded in 2000. The number of broods was half this year while total cygnet numbers only dropped by two individuals. An isolated, group of three adults spent the summer of 2005 at Frank Lake, east of High River compared to the nonbreeding pair observed on Frank Lake during the 2000 surveys.

Northwest Territories

Nahanni National Park - Deh Cho Region

Surveys of the park and the Deh Cho Region, formally referred to as the Southwest Mackenzie District, resulted in a total of 415 birds found (Table 2, Figure 1), including 37 broods (88 cygnets). Survey effort outside Nahanni National Park was comparable to the 2000 survey and more birds were found in 2005 (400) than in 2000 (294). The total number of adults observed in 2005 was higher than that observed in 2000 by 123 birds which represent an average annual increase of 9.0 percent per year over the 5 years. Cygnet numbers were slightly lower by two individuals while the number of broods observed was higher in 2005; adults and young were distributed over the survey area while the Tetcela River valley showed the highest concentrations. The upper reaches of the South Nahanni River, surveyed by Parks Canada staff, was covered this year despite poor weather conditions and accounted for a total of 15 adults, but no young were observed.

Saskatchewan

Hudson Bay

The Porcupine Forest southwest of Hudson Bay, the Porcupine Hills of Saskatchewan, the southern area of the Pasquia Hills, and a lone wetland in the Cumberland Delta (Kim Eskowich, Ducks Unlimited Canada, pers. comm.) accounted for 78 swans, including 25 cygnets (Table 2, Figure 1). Adults numbers showed an average annual increase of 9.3 percent per year over the 10 years with the total observed at 51 (2005) compared to the 21 seen in 1995 and 2000 (Table 4). The number of broods increased eight times compared to those observed in 1995 while cygnet numbers only increased five times during the same period.

The majority of the Pasquia Hills wetlands checked appeared to be comprised of habitat which had lower potential for swan use compared to the Porcupine Forest and Porcupine Hills. Most of these muskeg lakes had very little emergent vegetation and limited riparian habitat. Swans observations were limited to the southern sections of the Pasquia Hills with habitat similar to the Porcupine Forest and Hills. Abundant suitable wetland habitat was unoccupied in the Porcupine Forest and Porcupine Hills survey area. The Cumberland Delta marshes north of the Pasquia Hills, which were checked during waterfowl surveys conducted by Ducks Unlimited Canada, has numerous wetlands potentially suitable for swan use.

Prince Albert – Candle Lake

No swans were observed during flights over the area on lakes where swans had been observed in the 2000 survey year. No swan survey was scheduled for the area, but regular surveillance of the lakes during aerial fire patrols in the region did not result in any swan observations.

Cypress Hills Provincial Park

No swans were observed in 2005 which was similar to the 2000 survey year. Park staff and visitors have not reported any Trumpeter Swans for quite a few years in the area. A lone adult was observed during the 1995 continental survey.

Manitoba

Duck Mountains – Porcupine Hills

The Duck Mountains are comprised of two parts: the provincial forest and the provincial park. The first confirmed observation and breeding of Trumpeter Swans in this area was in June 2002 by Ducks Unlimited Canada personnel while conducting aerial surveys for waterfowl. In 2005, extensive aerial surveys of the numerous wetlands were conducted in late summer. Swans were observed on three sites and included two pairs and a single swan. No young were observed in 2005.

Riding Mountain National Park

The first confirmed observation and breeding of Trumpeter Swans in the Park was in September 2002 by Park's staff conducting fire patrols in the Park. Annual monitoring of the swans in the Park has occurred since 2002. The total numbers of adults have remained fairly stable, although fluctuation in the number of cygnets has been observed (Wybo Vanderschuit, pers. comm.). The 20 adults and 10 cygnets observed in 2005 represents the highest total count and are similar to the numbers observed in 2003.

Whiteshell Provincial Park

In the Spring 2005, additional unconfirmed reports of Trumpeter Swans were received from the Pinawa area on the west edge of Whiteshell Provincial Park. An extensive survey flight of all the lakes and wetland complexes was conducted in late August. Trumpeter Swans are documented just across the Manitoba and Ontario border in the Kenora area, but no swans were detected during the flight in the area of Whiteshell Provincial Park.

DISCUSSION

Trumpeter Swans are doing extremely well across the region with large increases in most survey areas in 2005 compared to the 2000 survey. The exceptions are the Lac La Biche and Pincher Creek – Waterton areas which registered declines in total swan numbers. Alberta has the largest number of swans and they are dispersed across seven geographic areas or regions (birds in an area are sometimes referred to as a "flock"). Alberta's regional or flock population sizes ranged from 4 to 1,013 Trumpeter Swans for the Lac La Biche and Grande Prairie areas respectively. The Deh Cho Region, formerly the Southwest Mackenzie District, had poor cygnet production this year and observed cygnet numbers represented only 21 percent of total swans observed and the mean brood size (2.37) was the lowest for the region.

As Trumpeter Swans continue to expand across the region, it will become increasingly more difficult to make comparisons between survey years if survey effort changes to compensate for the expanded areas. This was the case for the 2000 survey and, although survey effort was expanded slightly in a number of areas in 2005, there was a minimal increase in the number of swans recorded in these expanded areas. It appeared that the density of swans and occupancy rate of survey lakes increased in a number of regions resulting in the large increases in swan numbers. It is not known why more paired and breeding adults were not observed in 2005 in the Lac La Biche area which appears to have numerous suitable wetlands. It is expected that breeding adults from the core breeding flocks in the High Prairie-Utikuma-Peerless and Peace River areas will expand into the Lac La Biche areas, although it may take several more years for this expansion to occur. However, across the survey region, overall increases in the Trumpeter Swan population were observed in Alberta (74%), Saskatchewan (100%) and the Northwest Territories (56%) while Manitoba is in its 1st survey year in 2005.

A number of survey crews noted the presence of large numbers of unoccupied, but apparently suitable, wetlands for Trumpeter Swans indicating the potential for increased swans in their areas, in future years. The Trumpeter Swans surveyed in this region are components of two distinct continental populations. Those birds which breed and summer in Alberta and the Northwest Territories are part of the Rocky Mountain Population which winter primarily in the Greater Yellowstone area. The swans in eastern Saskatchewan and Manitoba are considered part of the Interior Population and are known to winter in the region of the Lacreek National Wildlife Refuge, South Dakota. Both of these wintering areas have limited capacity for supporting increased numbers of Trumpeter Swans. Thus, restriction on expansion of the wintering areas will more likely limit overall population growth than will the availability of summer habitat for Trumpeter Swans in this region.

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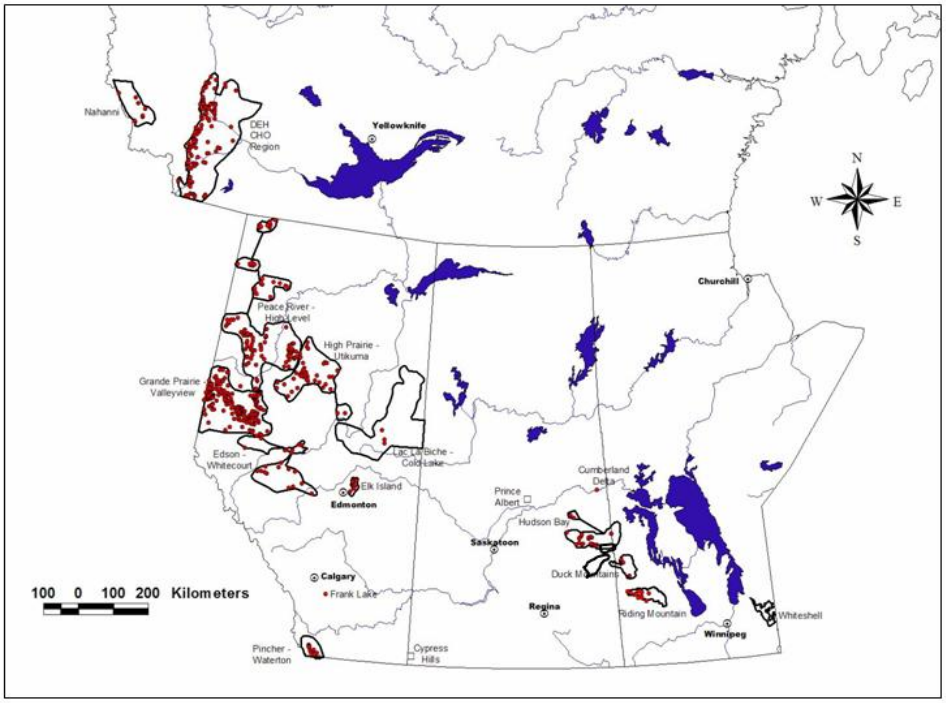

Figure 1. Survey coverage and Trumpeter Swan distribution in the 2005 survey in Alberta, Saskatchewan, Manitoba and the Northwest Territories.

Table 1. Survey dates, methods, and effort of 2005 Trumpeter Swan surveys in Alberta, Saskatchewan, Manitoba, and the Northwest Territories.

Jurisdiction	Geographic region – survey area	Dates	Survey Method	Effort (hours)
Alberta	Grande Prairie - Valleyview	24 & 25 August, 1 September	Fixed-wing	17.0 Hours
	Peace River – High Level -	29, 30 & 31 August	Fixed-wing	23.9 Hours
	Hay Zama	30 August	Helicopter	3.5 Hours
	High Prairie - Utikuma – Peerless	25 & 26 August	Fixed-wing	14.9 Hours
	Edson – Whitecourt – Drayton Valley	24 & 25 August	Fixed-wing	9.1 Hours
	Elk Island National Park – Blackfoot - Ministik	14 September	Fixed-wing	2.5 Hours
	Lac La Biche – Cold Lake – Athabasca	3, 6 & 7 September	Fixed-wing	20.0 Hours
	Pincher Creek – Waterton National Park	25 August	Helicopter	3.0 Hours
Saskatchewan	Hudson Bay – Porcupine Hills – Pasquia Hills	21 August	Fixed-wing	9.0 Hours
Manitoba	Duck Mountains – Porcupine Hills	19 August	Fixed-wing	4.3 Hours
	Riding Mountain National Park	29 & 30 August	Fixed-wing	6.2 Hours
	Whiteshell Provincial Park	30 August	Fixed-wing	3.0 Hours
Northwest Territories	Fort Liard –Tetcela R.	24 – 27 August	Fixed-wing	18.3 Hours
	Nahanni National Park	8 September	Fixed-wing	2.5 Hours

Table 2. Trumpeter Swan observations recorded for Alberta, Saskatchewan, Manitoba and the Northwest Territories in 2005. Figures are a combination of formal surveys and incidental sightings.

Jurisdiction Geographic region	Total Swans	Adults	Cygnets	% Cygnets	Number of broods	Brood Size	
						Mean	S.E.
ALBERTA							
Grande Prairie - Valleyview	1013	703	310	30.6	96	3.23	0.15
Peace River – High Level	420	273	147	35.0	41	3.59	0.19
High Prairie - Utikuma – Peerless	159	97	62	39.0	17	3.65	0.44
Edson – Whitecourt – Drayton Valley	68	47	21	30.9	7	3.00	0.82
Elk Island National Park (N.P.)	35	25	10	28.6	3	3.33	0.88
Lac La Biche – Cold Lake	4	4	0	0	0	0	0
Pincher Creek – Waterton N.P.	31	23	8	25.8	2	4.00	1.00
TOTAL	***1730***	***1172***	***558***	***32.2***	***166***	***3.36***	***0.12***
NORTHWEST TERRITORIES							
Fort Liard – Nahanni N.P. - Tetcela	415	327	88	21.2	37	2.37	0.21
TOTAL	***415***	***327***	***88***	***21.2***	***37***	***2.37***	***0.21***
SASKATCHEWAN							
Hudson Bay	78	53	25	32.1	9	2.78	0.40
TOTAL	***78***	***53***	***25***	***32.1***	***9***	***2.78***	***0.40***
MANITOBA							
Duck Mountains – Porcupine Hills	5	5	0	0	0	0	0
Riding Mountain N.P.	30	20	10	33.3	3	3.33	0.88
TOTAL	***35***	***25***	***10***	***28.6***	***3***	***3.33***	***0.88***
SURVEY TOTALS	2258	1577	681	30.1	215	3.17	0.10

Table 3. Total number of adult and subadult Trumpeter Swans in Alberta, Saskatchewan, Manitoba and the Northwest Territories observed as singles, paired, or in flocks in fall 2005.

Jurisdiction	Sub region	Singles		Paired		Flocked		Total
		No.	%	No.	%	No.	%	
Alberta	Grande Prairie - Valleyview	22	3.1	414	58.8	267	37.9	703
	Peace River – High Level	11	4.0	194	71.1	68	24.9	273
	High Prairie - Utikuma – Peerless	7	7.2	66	68.1	24	24.7	97
	Edson – Whitecourt – Drayton Valley	3	6.4	32	68.1	12	25.5	47
	Elk Island National Park (N.P)	5	15.4	20	84.6	0	0	25
	Lac La Biche – Cold Lake	2	50.0	2	50.0	0	0	4
	Pincher Creek – Waterton N.P.	4	17.4	16	69.6	3	13.0	23
Northwest Territories	Fort Liard – Nahanni N.P. - Tetcela	22	6.7	232	70.9	73	22.3	327
Saskatchewan	Hudson Bay	2	3.8	38	71.7	13	24.5	53
Manitoba	Duck Mountains – Porcupine Hills	1	20.0	4	80.0	0	0	5
	Riding Mountain N.P.	4	20.0	16	80.0	0	0	20
	Survey Totals	**82**	**5.2**	**1036**	**65.5**	**460**	**29.2**	**1578**

Table 4. Comparison of Trumpeter Swan survey results for Alberta, the Northwest Territories, and Saskatchewan. Only similar survey areas are covered in this comparison, therefore total numbers reported here will differ from previous tables. Adjustments were made to the appropriate swan numbers to exclude expansion areas from sub-region figures. Comparisons were only available with the last 5-year survey for several locations.

Jurisdiction	Sub-region	Year	No. Adults	No. Broods	No. Cygnets (mean)	Total Swans
Alberta	Grande Prairie - Valleyview	1995	392	41	141 (3.43)	533
		2000	404	60	204 (3.40)	608
		2005	680	95	306 (3.22)	986
	Peace River - High Level	1995	132	25	67 (2.68)	199
		2000	148	21	64 (3.05)	212
		2005	273	41	147 (3.59)	420
	Elk Island National Park	1995	11	0	0	11
		2000	8	2	5 (2.5)	13
		2005	25	3	10 (3.33)	35
	High Prairie - Utikuma - Peerless	2000	37	7	35 (4.5)	72
		2005	97	17	62 (3.65)	159
	Edson – Whitecourt – Drayton Valley	2000	29	2	3(1.50)	32
		2005	42	7	21(3.0)	63
	Pincher Creek – Waterton National Park.	2000	27	4	10 (3.33)	37
		2005	23	2	8 (4.0)	31
Northwest Territories	Fort Liard - Tetcela	1995	132	15	47 (3.1)	179
		2000	180	28	77 (2.75)	257
		2005	312	37	88 (2.37)	400
Saskatchewan	Hudson Bay	1995	21	1	5 (5.0)	26
		2000	21	4	17 (4.25)	38
		2005	51	9	25 (2.78)	76

ELK ISLAND NATIONAL PARK TRUMPETER SWAN REINTRODUCTION - 2005 UPDATE

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ABSTRACT

Trumpeter Swans (*Cygnus buccinator*) in the Elk Island National Park area have been monitored annually since the first reintroduction in 1987 to locate breeding pairs, to identify marked swans, and to define total population and cygnet production. The number of adult and subadult swans returning to the park has increased in each year of the last 3 years. Cygnet production ranged from 9 to 14 young hatched and a high of 10 cygnets fledged in 2005. In 2005, 27 adults and subadults, including four breeding pairs, were recorded in the spring while, in the fall, 25 adults and 10 cygnets subsequently migrated south from the park area. Trumpeter Swans continue to expand to suitable habitat outside the boundaries of the Park. The yearly increase in cygnet production and adult return rates will help meet the reintroduction program goal of 10 breeding pairs in the Elk Island National Park area.

INTRODUCTION

Trumpeter Swan (*Cygnus buccinator)* reintroduction was initiated in 1987 to restore the Trumpeter Swan breeding population to Elk Island National Park (EINP) and surrounding area, and to expand the species summer range in Alberta. The evolution of this project has been documented, with the most recent published update in 2003 (Beyersbergen and Kaye 2004). The continued successful production of Trumpeter Swan young in the park area resulted in termination of wild cygnet relocation from Grande Prairie and changed the focus of the program to monitoring the breeding and summering swans in the EINP area. 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 current progress of the Trumpeter Swan EINP reintroduction program through to the fall migration in 2005.

METHODS

Monitoring

Spring arrival

Trumpeter Swans were monitored in an area that included Elk Island National Park, Blackfoot Grazing, Wildlife and Provincial Recreation Area, south to Miquelon Provincial Park and numerous lakes and wetlands within several kilometres of the park boundaries (Figure 1). Swans traditionally arrive at the park around mid-April. Between mid-April and mid-May, while large numbers of Tundra Swans (*Cygnus columbianus*) staged in the area, we conducted our monitoring surveys on foot. Aerial surveys, using a Cessna 185, were conducted after mid-May. Swan observations were ground-truthed and marked birds were identified. Ground monitoring was conducted by one or two personnel on a daily basis for 2-3 weeks until all swans had returned and those marked previously had been identified. Identification of marked adults, returning family groups, pairing of swans (marked individuals) and location of nesting and nonbreeding staging lakes were recorded during monitoring.

Nesting

Monitoring efforts focused on breeding lakes and we accessed them on foot to reduce disturbance. Information was collected on breeding behavior, nest construction, and approximate egg-laying and hatch dates. We recorded initial brood size and monitored cygnet survival throughout the summer.

Nonbreeding swans

In late June, we conducted an aerial survey to determine the number and distribution of nonbreeding adults and yearlings (including those pushed out of the family groups we observed in the spring) in the park and adjacent areas and to identify the lakes being used. Ground monitoring was performed to determine moulting sites.

Fall migration

Monitoring of all occupied lakes continued into the fall. Monitoring was primarily done on foot, but also included a single aerial survey prior to the influx of Tundra Swans in early September. Our primary focus was to determine which cygnets fledged. Fall monitoring continued until swan departure around the time the lakes froze in late October through early November.

Trumpeter Swan banding

During the early years of the reintroduction program, only released swans were banded or marked with colour markers. The increasing EINP Trumpeter Swan population required that the swans be marked to improve monitoring. In late July 2002 and 2003, aerial and ground searches were conducted to identify lakes where moulting non-breeding adults and yearling swans could be captured and marked. Canoes and large fish dip nets (Shandruk and Winkler 1988) were used to capture the swans. Captured swans were sexed, weighed, banded with USFWS metal bands and red plastic tarsal bands (Alpha/numeric/numeric), and then released together on the capture lake.

Migration and winter observations

A co-operative program of observing and reporting marked Trumpeter Swans is ongoing in conjunction with the wintering area program in the Greater Yellowstone Region (Montana, Wyoming, and Idaho). A network of wildlife agency personnel and volunteer observers, in Canada and the United States, report marked swans to the USFWS coordinator 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

Monitoring

Spring arrival

In the spring, the number of swans returning to the park increased from 20 in 2003 to 27 in 2005 (Table 1). This is the highest number recorded in the 19-year program. Returning swans continued to occupy lakes in the general area of EINP in 2003, but their range expanded southwards in 2004 and 2005 with paired and single swans observed in the landscape surrounding the Ministik Lake Game Bird Sanctuary (Table 2). In 2003, three yearlings were observed with the adult marked as Yellow 28AC on Astotin Lake and three yearlings were observed on Islet Lake in the Blackfoot Grazing, Wildlife and Provincial Recreation Area indicating 100 percent return rate for two of the three 2002 broods. In 2004, only three yearlings were definitively observed in the park. Due to the limitations of aerial survey observations and absence of ground-truthing, no yearlings were recorded as returning in 2005.

Nesting

Breeding activity by Trumpeter Swans in EINP and surrounding area was documented in 1990, 1995, and 1998-2002 (Beyersbergen and Kaye 2004). Two of the traditional breeding lakes (Running Dog and South Park) were occupied through 2003-05 while two new lakes were selected by nesting pairs in 2004 (Table 3). Although not productive every year, Running Dog has been occupied by a territorial pair for 17 years and South Park for 9 years. In 2003, the pairs on the two traditional lakes hatched and fledged nine cygnets. Of the two new nesting lakes observed in 2004, cygnets successfully fledged from only Lake A in the Blackfoot Lake area. The pair was observed on this lake in 2003 as nonbreeding swans. The nest failed on the other new lake. In 2004, the two pairs on the traditional lakes hatched four and five cygnets and fledged four and one cygnets, respectively. Fourteen cygnets were hatched and 10 were fledged on Running Dog, South Park and Lake A in 2005. Also in 2005, swan Yellow 28AC nested, but failed to hatch any young on a lake in the north area of the park.

Nonbreeding swans

Non-breeding swans were observed during the summer on a minimum of 12 lakes in 2003, 13 in 2004 and 18 in 2005. In 2003, three pairs were observed in EINP and the Blackfoot Grazing, Wildlife and Provincial Recreation Area. These three pairs were possibly in the process of selecting suitable territorial breeding or trial breeding lakes (Table 2). Additionally in 2003, two groups of three and five swans occupied a variety of lakes through the summer months. In 2004, four pairs of non-breeding swans, two singles and two groups (three and five swans) were observed using a number of different lakes throughout the study area. Two of the non-breeding pairs were observed on lakes in the vicinity of the Ministik Lake Game Bird Sanctuary and was the first record of swans this far south of the park complex. Nonbreeding swans were more evenly distributed across the landscape in 2005, with six nonbreeding pairs and five singles recorded on different lakes during the summer. Swans were again observed in 2005 on lakes around Ministik Lake Game Bird Sanctuary, thus further solidifying the range extension in the area.

Fall migration

The total number of swans migrating from the park each fall during the last 3 years has increased by 20.7 percent from 29 in 2003 to 35 in 2005. Numbers of cygnets migrating in the fall were quite variable between 2003 and 2005, ranging from 7 to 10. Adults accounted for 69.0 percent, 78.8 percent, and 71.4 percent of the total fall migration during 2003 - 2005 (Table 1).

Trumpeter Swan banding

The two lakes where swans were banded in 2002 (West Sawmill Lake and Blackfoot Lake) were unoccupied in 2003. We assume the lakes were deserted because of the previous year's disturbance during banding operations. In 2003, a pair of swans was captured on East Sawmill Lake; however the female was a recapture (A19) from the previous year on West Sawmill Lake. Another swan (A17) marked on West Sawmill Lake in 2002 was observed with a previously marked swan (Yellow 28AC) on Shirley Lake in the north end of the park. In late July 2003, three yearlings were captured on a wetland near Islet Lake and fitted with USFWS metal bands and red plastic tarsal bands (A33-A35). No swans were captured or marked in 2004 or 2005 due to time restraints and potential for possible desertion of these lakes by territorial pairs in the following years.

Migration and winter observations

In the past few years, marked swans in the park have been fitted with red tarsal bands as opposed to the highly visible collars. The last collar was applied in the park approximately 10 years ago and there are currently only two swans with collars breeding in EINP One of the collared swans, Yellow 28AC, has been observed in Jackson Hole, Wyoming, every winter since 2000/2001. No other EINP swans currently summering in the area have been observed away from the park.

DISCUSSION

Local recruitment is essential to the building of the Elk Island National Park Trumpeter Swan flock. Breeding pair survival, successful nesting, high fledging success and return rate for yearlings and adults have all added to the growth of the EINP flock over the last 3 years to a high of 35 Trumpeter Swans migrating from the park in the fall of 2005. The numerous non-breeding pairs scattered across the landscape in 2005 indicates the potential for additional breeding pairs in future years and increased potential for higher productivity. Each of these successes is taking the program a step closer to its goal of 10 breeding pairs in the EINP population.

The increased number and dispersion of swans returning to remote locations in the survey area resulted in reduced ground observation capabilities and more dependence on aerial counts. The positive identification of some marked birds and age cohorts such as yearlings will become increasingly more difficult with the expanding population.

The abandonment of lakes by Trumpeter Swans the year following banding activities resulted in our ceasing banding operations on lakes with paired birds to reduce the risk of lost breeding effort. The information to be gained from marking birds in this population will need to be evaluated and only lakes with three or more swans will be chosen for future banding operations.

Future recommended actions in the reintroduction project include:

1) Monitoring should continue at the current level of effort to ensure that all swans are located and identified where feasible in Elk Island National Park and surrounding area.

2) Banding or marking swans within EINP will need to be evaluated with respect to a balance between useful information and harmful effects on resident nonbreeding birds.

ACKNOWLEDGMENTS

The authors would like to thank all the observers, both in Canada and the United States, who provided information on the locations of marked swans. Monitoring in EINP was primarily conducted by the co-author Rob Kay with additional assistance from the Friends of Elk Island Society. Bill Long provided observations of wintering swans at Jackson Hole, Wyoming. Review of the manuscript was provided by Sam Barry and Bev Gingras of the Canadian Wildlife Service. Assistance in production of the figure was provided by Gillian Turney of the Canadian Wildlife Service. The final thanks go out to the Friends of Elk Island Society who provided the major funding support for the reintroduction program.

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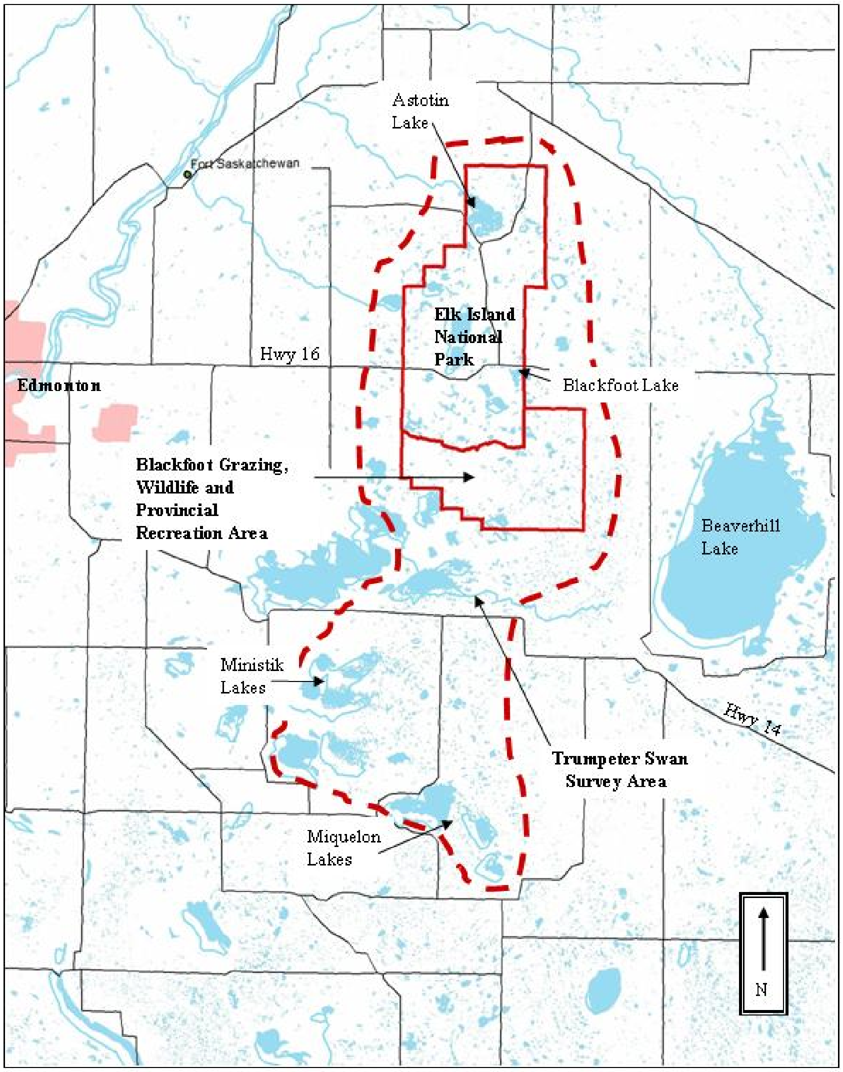

Figure 1. Elk Island National Park Trumpeter Swan reintroduction program area.

Table 1. Demographics of the Trumpeter Swan population in Elk Island National Park reintroduction program.

	Spring	Summer		Fall Migration		
Year	Swans Returned	Breeding Adults	Cygnets Hatched	Adults	Cygnets fledged	Total Migrated
1988	2	0	0	2	0	2
1989	2	0	0	2	0	2
1990	5	2	2	5	0	5
1991	2	0	0	2	0	2
1992	5	0	0	5	0	5
1993	8	0	0	8	0	8
1994	8	0	0	8	0	8
1995	12	2	5	11	0	11
1996	8	0	0	8	0	8
1997	7	0	0	6	0	6
1998	6	2	4	6	4	10
1999	8	4	9	8	3	11
2000	8	4	7	8	4	12
2001	9	4	9	9	7	16
2002	18	6	12	17	10	27
2003	20	4	9	20	9	29
2004	26	8	11	26	7	33
2005	27	8	14	25	10	35

Table 2. Trumpeter Swans observed in Elk Island National Park and surrounding area (2003 - 2005).

Year	Marker	Age (Years)	Sex	Lake Name	Comments
2003	Yellow 20 AC Unmarked	16 -	M F	Running Dog Lake	Bred – Hatched 4 cygnets. Fledged 4 cygnets.
	Yellow 28 AC Red tarsal A17	10 2	F M	North park lake	Lost mate (53AC) last summer, paired with A17 (red tarsal band) banded on West Sawmill Lake last year. They did not breed. On Shirley Lake most of summer.
	Unmarked Red tarsal A23	- 5	M F	South park lake	Hatched and fledged five cygnets.
	Unmarked Unmarked	- -	- -	Unnamed lakes	On the lakes south of Moss Lake. One of these swans likely offspring of north park pair – possibly 3 years old.
	Red tarsal A30 Red tarsal A31	- -	F M	Blackfoot Lake area – Lake A	Observed most of the year on an unnamed lake SE of Blackfoot Lake. Assumption this is the pair that were banded on Blackfoot Lake last year and have now deserted the lake due to disturbance.
	Unmarked Unmarked Unmarked	1 1 1	- - -	Astotin Lake	Likely the cygnets fledged from north park lake last year. All three were observed with 28AC then observed in early spring on Astotin Lake.
	Red tarsal A33 Red tarsal A34 Red tarsal A35 Unmarked Unmarked?	1 1 1 - -	F M F - -	Islet Lake, East Sawmill Lake	These 5 swans were observed on various lakes in Blackfoot area and park. Assume they are offspring of breeding pairs in the south park or Blackfoot area. The three yearlings were marked on Islet Lake in July.
	Red tarsal A19 Red tarsal A36	2 -	F M	East Sawmill Lake	Also observed on a few other lakes in area. Identity of A36 is unknown – banded in July on East Sawmill in company of A19.
2004	Yellow 20 AC Unmarked	17 -	M F	East Running Dog Lake	Hatched four cygnets - approx. June 15, all four fledged. Assumed the bird with the metal leg band is 20AC which lost its collar over the winter.
	Yellow 28 AC Red tarsal A17	11 3	F M	Unmarked lake	Built nest but abandoned nest after about 30 days. Checked nest – no sign of predation or eggs.
	Unmarked	-	M	South park lake	Bred – five cygnets hatched on approx. June 15 but only one cygnet fledged.
	Red tarsal A23	6	F		
	Red tarsal A30 Red tarsal A31	- -	F M	Blackfoot Lake area – Lake A	Bred – two cygnets hatched on approx. June 18. Fledged 2 cygnets. Pair banded on Blackfoot Lake in 2002, second year on this lake.
	Unmarked	-	-	Unnamed Lake	South of Moss Lake on south end of Moss Lake trail.

Table 2, continued.

Year	Marker	Age (Years)	Sex	Lake Name	Comments
2004	Unmarked Unmarked Unmarked Red tarsal A35 Unmarked	1 1 1 2 -	- - - F -	Unnamed Lakes	Five swans observed on a few different lakes, east of park boundary. The three unmarked yearlings were also observed on Astotin Lake in the spring. A35 and unknown age/sex bird could be a pair.
	Red tarsal A19 Red tarsal A36	3 -	F M	Unnamed Lake	Lake 1.5 km. east of old Isolation Warden Residence. Also on lake 1 km. north of old Isolation Warden Res.
	Unmarked Unmarked Unmarked	- - -	- - -	Coyote Lake	On Coyote Lake in spring then observed on Muskrat Lake later in summer.
	Unmarked	-	-	Mackenzie Lake	Alone on South Mackenzie Lake.
	Unmarked Unmarked	- -	- -	East Sawmill Lake	Also on Islet Lake in the spring and fall. Likely offspring from 2002 or 2003.
	Unmarked Unmarked	- -	- -	Lake A in Ministik area	First time swans have been observed south of Blackfoot area. Lake is located in the Ministik Bird Sanctuary.
	Unmarked Unmarked	- -	- -	Lake B in Ministik area	Same as above – this lake is also in the Ministik Bird Sanctuary.
2005	Yellow 20 AC Unmarked	18 -	M F	East Running Dog Lake	Bred - four cygnets hatched (June 12) and fledged two cygnets. Assuming this is still 20AC with the metal leg band.
	Yellow 28 AC Red tarsal A17	12 4	F M	Unmarked lake	Bred and nested briefly on a small pond north of where they abandoned their nest last year. Both disappeared about a week into nesting season, not seen all summer but unconfirmed return in September.
	Unmarked	-	M	South park lake	Bred - five cygnets hatched (June 12), fledged three cygnets.
	Red tarsal A23	7	F		
	Red tarsal A30 Red tarsal A31	- -	F M	Blackfoot Lake area – Lake A	Bred - 5 cygnets hatched (June 12), fledged five cygnets.
	Unmarked Unmarked	- -	- -	Alyssa Lake	Also on Birch Island Lake - where they moulted.
	Red tarsal A35 Unmarked	3 -	F -	Dickson Lake	Lake east of park boundary. No breeding activity.
	Unmarked	-	-	Astotin Lake	Also on Moss Lake and unnamed lake north of Astotin Lake.
	Unmarked Unmarked	- -	- -	Unnamed Lakes	On a few lakes in an area 3-4 km. south of Warden Office.
	Unmarked	-	-	Unnamed wetland	Northeast of Blackfoot Lake.
	Unmarked	-	-	Unnamed Lake	South of Flyingshot Lake

Table 2, continued.

Year	Marker	Age (Years)	Sex	Lake Name	Comments
2005	Unmarked Unmarked	- -	- -	Flyingshot Lake	Flyingshot Lake and other lakes in general area. Could this be A19 and A36? Did not get a chance to get close enough to verify if they had collars.
	Unmarked Unmarked	- -	- -	Islet Lake	Often at south end of Islet Lake. Likely same pair that was also observed on East Sawmill Lake last year.
	Unmarked	-	-	Unnamed Pond	East of East Sawmill Lake.
	Unmarked Unmarked	- -	- -	Lake C in Ministik area	West of Lake A in Ministik Bird Sanctuary occupied last year.
	Unmarked	-	-	Lake D in Ministik area	North of Lake B in Ministik Bird Sanctuary. Likely the same swans observed in area last year.

Table 3. Trumpeter Swan cygnet production and fledging observed in the Elk Island National Park area.

Lake Site	Pair (Marker Identification)	Year	Number cygnets hatched	Number cygnets fledged
Running Dog Lake	Yellow 20AC – Yellow 03AC	1990	2	0
	Yellow 20AC - Unmarked Female	2001	5	3
		2002	4	3
		2003	4	4
		2004	4	4
		2005	4	2
North Park lake	Yellow 53AC – Yellow 33AC	1995	5	0
	Yellow 53AC – Yellow 28AC	1999	2	0
		2000	3	3
		2001	4	4
		2002	5	3
South Park lake	Metal band - Male Unmarked Female	1998	4	4
		1999	7	3
		2000	4	1
	Metal band - Male Red tarsal A23 - Female	2001	1	0
		2002	3	3
		2003	5	5
		2004	5	1
		2005	5	3
Lake A - Blackfoot Lake area	Red tarsal A30 – Female Red tarsal A31 - Male	2004	5	2
		2005	5	5
Total			86	53

TRUMPETER SWAN TRANSLOCATION PROJECT 2001-2005 IN IDAHO: SURVIVAL AND MOVEMENT

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ABSTRACT

After the recovery of Trumpeter Swans (*Cygnus buccinator*) from near extinction in the early 20th century, the Rocky Mountain Population (RMP) rebounded to over 5,200 birds by 2005. Today the issues for the RMP have changed due to overpopulation in their wintering range. Managers have been attempting to expand the wintering range of the RMP to alleviate impacts on resources for resident breeders, reduce the risk of disease transmission due to the localized population, and establish alternate wintering grounds in areas where weather conditions are less severe. Idaho Department of Fish and Game and other government agencies collaborated to translocate 376 cygnets during the winters of 2001-05. This was the first winter translocation project to relocate only cygnets. For the 2001-05 project, approximately half of the cygnets were released at the capture site (Harriman State Park) as a control group and the other half were translocated over 200 km south to the Bear River drainage in southeast Idaho. Survival of the translocated cygnets was similar or higher than survival of control cygnets (Figures 1-2). Of particular management interest, we summarized if each group showed site fidelity to their release site as cygnets and if they remained faithful as adults. Twenty-four percent of translocated cygnets found as adults remained faithful, for all years sighted, to their translocation area (Table 1). Cygnet behavior did not necessarily determine adult behavior (Table 1). Eighty-two percent of translocated cygnets spent their first winter at their release site, which may have prevented them from establishing site fidelity to Harriman State Park or the core Tristate area. Further analysis of movement and survival will be discussed in more detail in Kilpatrick's thesis which will be available from the University of Idaho early in 2007.

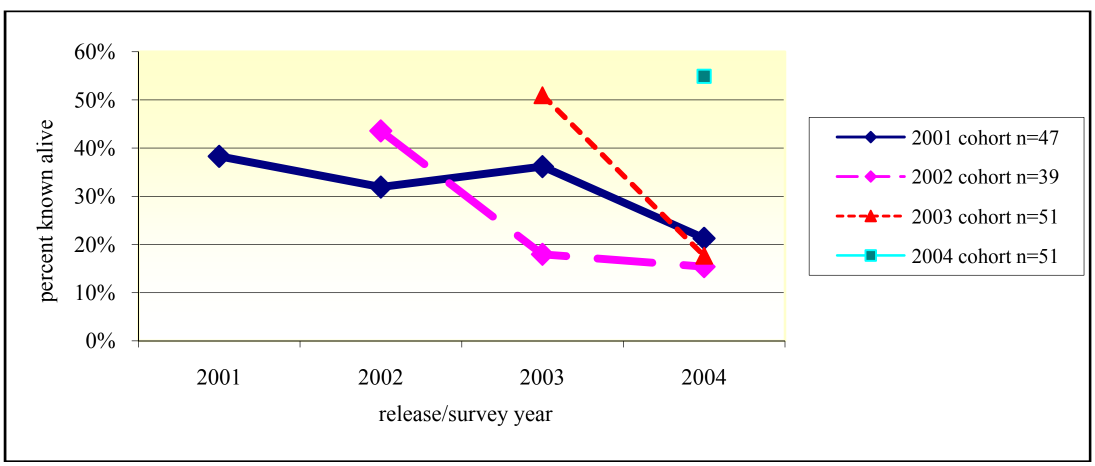

Figure 1. Estimated percent of translocated Trumpeter Swan cygnets known to be alive until end of study in late winter 2004-05. Each curve begins in the year in which the cygnet cohort was translocated.

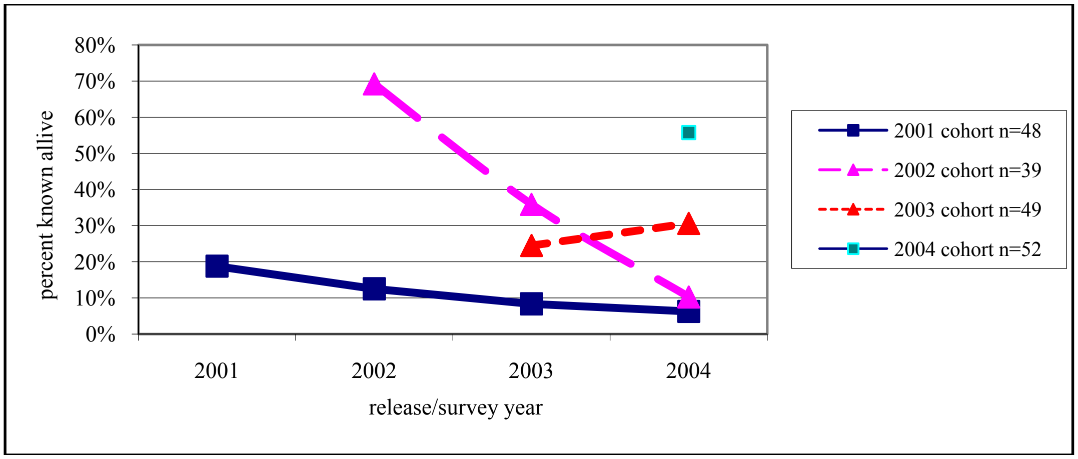

Figure 2. Estimated percent of control Trumpeter Swan cygnets known to be alive until end of study in late winter 2004-05. Each curve begins the year in which the cygnet cohort was marked.

Table 1. Classification (by percentage) of translocated and control Trumpeter Swan cygnets found as adults in four release site fidelity categories.

	Translocated	Control
Displaying site fidelity as a cygnet and adult	24	24
Cygnet not displaying site fidelity but showing site fidelity as adult	0	3
Cygnet showing site fidelity but not as an adult	58	27
Not displaying site fidelity as a cygnet or as an adult	18	46

TRUMPETER SWAN REINTRODUCTION ON THE FLATHEAD INDIAN RESERVATION

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ABSTRACT

The Confederated Salish and Kootenai Tribes, in a cooperative project with Montana Fish, Wildlife and Parks, U. S. Fish and Wildlife Service, and the Mission Valley Community Foundation, commenced a project to reintroduce Trumpeter Swans (*Cygnus buccinator*) on the Flathead Indian Reservation, Montana, in 1996. Initial efforts involved the translocation of Trumpeter Swans from Summer Lake, Oregon, and Grande Prairie, Alberta to Pablo National Wildlife Refuge. Although these reintroductions were successful, few swans returned to the Flathead Indian Reservation. In 1999, the Tribes contracted with the Trumpeter Swan Fund to produce swans in captivity for reintroduction efforts. Successes with captive propagation resulted in releases of 34, 34, and 26 swans in 2002, 2003, and 2005, respectively. The swans generally wintered in the lower Flathead River drainage and its tributaries, likely due to mild winter weather conditions, abundant open water, and ample food resources. Collisions with overhead power lines were the major observed cause of mortality. Cooperative efforts with the local electrical utility are underway to mark lines in the area. The first wild-nesting Trumpeter Swans from the reintroduction project were observed in 2004, when at least two nesting attempts were documented, resulting in production of four cygnets. Reproduction at two sites in 2005 resulted in the production of six cygnets. Ongoing efforts include continued releases of captive-produced swans, monitoring of released swans, marking of additional power lines, and monitoring reproduction.

INTRODUCTION

The Flathead Indian Reservation (FIR) encompasses approximately 500,000 ha. The Reservation was established in 1855 by the Treaty of Hellgate, between the United States and the Salish, Pend d'Oreille, and Kootenai Tribes, as the permanent homeland of these tribes. The FIR 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 wetland habitats to agriculture. A substantial expansion of the human population has also occurred. With these changes came substantial changes to the habitat of the FIR and its native flora and fauna.

Trumpeter Swans 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's 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 observations of nesting trumpeters on the Thompson River in 1871 and on the South Fork of the Flathead River in 1889 (Coale 1915, Bent 1923). Little other early detailed documentation of breeding Trumpeter Swans in northwestern Montana during pre-settlement times apparently exists.

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 utilized for subsistence by settlers and Native Americans alike. Presumably, 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 1823-1880, some 108,000 swans were harvested, as compared with only 57 during the period of 1888-1897. Presumably, a substantial number of the swans harvested were trumpeters. The Hudson Bay Company maintained a trading post on the Flathead Reservation until the mid-1800s. Whether swans from the area were exported or market-hunted locally is unknown.

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

The Confederated Salish and Kootenai Tribes of the Flathead Indian Reservation (CSKT) 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. TWMP personnel have been active managers of rare species ranging from amphibians to large carnivores.

Tribal wildlife management efforts have also focused on opportunities to re-introduce extirpated species of wildlife where current habitat and other conditions allow. These efforts have been successful for Peregrine Falcons (*Falco peregrinus*). Other projects to re-establish 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 re-establish the Trumpeter Swan as a breeding bird on the FIR. The CSKT view these lost species as missing pieces of the natural environment, and the reintroduction project discussed here is a means to re-establish 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 recommended actions that could be undertaken by wildlife management agencies and private organizations to re-establish 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 Pacific Flyway Council's Trumpeter Swan Implementation Plan (TSIP) (2002). 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 FIR 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 FIR. 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 (USFWS), 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 selected as an initial release site due to seclusion from excessive human activities, presence of abundant natural food resources, and the ability to control and maintain water levels. The Refuge is situated on land owned by the CSKT and administered by the USFWS 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 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 commenced in 1996 with the relocation of 19 trumpeters from Summer Lake in south-central Oregon. A subsequent reintroduction effort occurred in 1998, when 10 cygnets were captured near Grande Prairie, Alberta, and transported to the Reservation. Although these two efforts indicated that the Reservation could support Trumpeter Swans during the summer, the failure of any of the released Trumpeter Swans to return to the Reservation in subsequent years was disappointing. In addition, the difficulties and uncertainties involved with obtaining an adequate number of wild swans for sustained releases resulted in limited confidence of maintaining the project to ultimate success.

Re-evaluation 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 support CSKT's development of a cooperative relationship with the Trumpeter Swan Fund (TSF) at Jackson, Wyoming. The TSF had a strong track record of captive reproduction of Trumpeter Swans at its facility and subsequent introduction of captive-reared swans to the wild. With the assistance of the Lower Flathead Valley Community Foundation, the TSF was able to locate 24 adult and subadult Trumpeter Swans at a waterfowl breeding facility in Montana that were available for use in the project. These birds were originally of Rocky Mountain Population origin and had come from the Tri-state area population. These swans were desirable as breeding birds to supply cygnets for the FIR project. Under a contract with TSF, the CSKT were able to provide funding to obtain the birds and to assist the TSF in upgrading its facilities to expand its captive breeding efforts. In addition, the CSKT pursued a similar contractual agreement for captive propagation with the Montana Waterfowl Foundation (MWF) at Ronan, Montana.

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, examination of the genetic relationships of the birds was evaluated, and 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 have been traded for other captive Trumpeter Swans to reduce genetic duplication within the birds utilized in the project.

Initial success of the captive propagation project at the TSF occurred in 2000, and releases of some of these birds at the FIR was planned for 2002. Releases of 94 captive-reared Trumpeter Swans have since occurred during 2003, 2005, and 2006 (Table 1).

Reintroduced Trumpeter Swans generally remained in the area following the departure of the migrants. Most wild swans, both tundra and trumpeters, passed through the FIR by late December. Most swans wintered on the lower Flathead River, approximately 25 km southwest of the release sites. Birds that did migrate included two cygnets that were observed in northwestern Colorado (960 km southeast) during the winter of 2003-04 and another cygnet that was killed by colliding with a power line near Sula, Missoula, (160 km south) in March of 2004. In 2005, a 4-year old swan was reported as having been killed in a power line collision near Bozeman, Montana, (320 km southeast of the FIR). No additional observations of released swans were reported outside of the vicinity of the FIR. Known mortalities of released Trumpeter Swans have been primarily due to collisions with overhead power lines, although collisions with fences and unknown mortalities have also been documented (Table 2).

Attempts to reduce power line collisions

Given the high level of swan mortality due to collisions with overhead power lines, the TWMP initiated a project to mark power lines at locations of collisions and at other potential collision sites near regularly-used swan flight paths. This project resulted in power line marking at seven sites. A review of existing literature and personal contacts with several swan experts with experience in collision reduction indicated good results in the form of decreased incidences of swan collisions with power lines after installation in areas in which Swan Flight Diverters (SFD) were used. The SFDs are egg-shaped spiral attachments approximately 40 cm in length and approximately 30 cm in diameter that attach to and around the line and are manufactured to fit on lines of specific diameter. In the United States, these diverters are distributed by P and R Technologies of Portland, Oregon. The objective of diverter designs is to add visibility to the power line. No further collision-caused mortalities were noted at sites at which the diverters were installed, although local utility personnel expressed some concerns about the potential for icing during cold weather and line crossing due to wind.

To further attempt to reduce power line collision mortalities in swans, the TWMP applied for and received a Tribal Wildlife Grant in 2005. The objectives of this grant were to 1) evaluate power lines that might pose the most significant threats to Trumpeter Swans; 2) prioritize marking of these lines for installation of diverters; and 3) install diverters in as many of the prioritized locations as possible.

All overhead power lines were mapped and created as a Geographical Information System (GIS) theme. These line locations were then evaluated with consideration of known swan flight routes between wetland habitats and along major tributaries and the lower Flathead River. These sites were then targeted for flight diverters during particular years based upon recent observations of Trumpeter Swan presence and activity.

A cooperative agreement was developed with the local electrical utility, Mission Valley Power, to facilitate installation of the flight diverters. The utility's evaluation of the spiral flight diverters installed earlier resulted in concerns about potential icing problems during periods of winter fog and the potential for wind conditions to cause crossing of lines caught by the diverters and potential outages. An evaluation of other potential line-marking products resulted in agreement that the design of Firefly Diverters (marketed by FireFly Diverters, L. L. C. of Grantsville, Utah) seemed to hold good potential for success in providing visibility of the lines, as well as addressing icing and line crossing concerns.

Trumpeter Swans released in 2002 began to form pairs during the autumn and winter months of 2003-04 (Table 3). Two definite nesting pairs of swans and a probable third nesting pair collectively produced seven fledglings in 2004, and two nesting pairs produced five fledglings in 2005.

DISCUSSION

The Trumpeter Swan Reintroduction Project on the Flathead Indian Reservation has encountered both successes and failures since its beginnings. The captive propagation program has produced cygnets in adequate numbers to support the project; however, a larger number of releasable birds would likely be available if propagation efforts could be expanded. Work is currently underway to increase the number of genetically-appropriate captive breeding pairs at both breeding facilities.

Initial success of breeding pair formation and nesting activity has been rapid, but the number of pairs actually nesting is low, considering the number of potential pairs observed during the 2004 and 2005 breeding seasons.

The potential exists to place some non-flighted, paired captive adults at selected sites to establish breeding pairs on-site in the future. The potential for doing so is currently being examined, and discussions with interested landowners are underway. This technique has worked well in establishing captive producing pairs of Trumpeter Swans in Iowa (Ron Andrews, pers. comm.) and Ontario (Lumsden 2000.). As a technique for the FIR reintroduction project, it may provide an additional tool to more quickly establish Trumpeter Swans.

Although released swans have exhibited only limited migratory movements, this lack of significant movement is not viewed as a setback for the project. The failure of the released swans to migrate from the Reservation could be expected, given that no swans that had previously migrated were present among the released birds. In addition, the mild weather conditions, the availability of a substantial number of open-water areas and an abundance of aquatic plant food resources provided good fall and winter habitats for the birds.

Mortality of Trumpeter Swans following releases was due largely to collisions with overhead power lines. To decrease these high mortality rates, an active effort to identify lines that have been the sites of collision mortalities and potential mortality locations is currently underway. Initial marking of overhead lines is showing promise in reducing mortalities, and these efforts are being expanded.

The results of the reintroduction project to date are encouraging. Continuing efforts are expected to result in the establishment of a resident population of wild Trumpeter Swans on the Flathead Indian Reservation. This project, along with a similar reintroduction project being conducted in the nearby Blackfoot River drainage, has the potential to create populations that will expand to other appropriate habitats in western Montana.

ACKNOWLEDGMENTS

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Funding for the reintroduction activities was provided primarily by the CSKT, in cooperation with MFWP and the USFWS. 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 securing 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 USFWS, provided logistical support and assisted with many aspects of the releases of the swans. 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. The late William Edelman, of the Lower Flathead Valley Community Foundation, assisted with acquisition of the captive swans for the project. Bill Long, 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. 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, respectively. The interest and support of local residents, as well as their observations, are also greatly appreciated.

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Table 1. Releases of Trumpeter Swans at the Flathead Indian Reservation, Montana, 2002-05.

Year	Trumpeter Swans Released
2002	34
2003	34
2005	26

Table 2. Causes of mortalities of Trumpeter Swans released in 2002-2005 on the Flathead Indian Reservation.

Cause	2002	2003	2005
Power line collision	10	8	3
Fence collision	1	0	0
Line/fence collision	0	2	0
Unknown cause	3	6	5

Table 3. Summary of breeding pairs of Trumpeter Swans and productivity at the Flathead Indian Reservation, Montana, 2004-05.

Year	Pairs	# Nests	#Productive Nests	# Cygnets	# Fledglings
2004	6	3	3	7	7
2005	5	2	2	6	5

SURVIVAL ANALYSIS OF MALHEUR NATIONAL WILDLIFE REFUGE TRUMPETER SWANS

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ABSTRACT

We used Program MARK and model selection techniques to evaluate survival rates and factors affecting survival of the small flock of resident Trumpeter Swans (*Cygnus buccinator*) at Malheur National Wildlife Refuge in eastern Oregon. A total of 61 cygnets and 9 adults were marked with neck bands from 1980-87. Winter severity and loss of wintering habitat, caused by a major flood event which allowed carp (*Cyprinus carpio*) to destroy swan food supplies, were evaluated. Our estimates of annual survival rates were 44 percent for juveniles and 47 percent for adults. We found no support for winter severity effects on survival, while carp invasion effects were among the best models. Our data suggests that winter starvation was the major problem during this period. Such low survival rates are cause for concern and active management is needed to ensure the future viability of this local flock. Since winter feeding is not allowed by policy of the U.S. Fish and Wildlife Service, we suggest that management focus on developing a winter migration tradition in these birds and encouraging them to winter in more favorable areas.

THE 2005 CENSUS OF TRUMPETER SWANS ON ALASKAN NESTING HABITATS

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ABSTRACT

The eighth complete census of Trumpeter Swans (*Cygnus buccinator*) on their Alaska summering grounds was completed in late summer 2005. This year, 1,040 hours of flight time were expended by many survey crews to fly about 124,000 km of survey tracks (84,829 km in 2000) over all the potential Trumpeter Swan habitat (128,332 km^2 in 2005 compared to 123,864 km^2 in 2000) depicted on 780 (733 in 2000) USGS, 1:63,360 scale maps. Compared to 2000, the population was comprised of: paired birds 11,940 (+20%), singles 1,157 (+29%), flocked birds 4,148 (+36%), total white swans 17,245 (+24%), cygnets 6,447 (+100%), and total swans 23,692 (+38%). Cygnets accounted for 27% of the population (19% in 2000) and 2,084 broods (+81% from 1,149 in 2000) were found with an average brood size of 3.1 (2.8 in 2000). Although the population of white plumage (yearling and older) trumpeters summering in Alaska continues to follow a logistic growth curve, a comprehensive Alaska Trumpeter Swan Management Plan is still needed to ensure that they remain an integral part of each geographical unit of their present distribution. The continual loss of Pacific Coast wintering habitat and the recent large losses of Pacific Coast wintering swans to lead poisoning are of special concern. To provide the high quality data needed for the best management of this magnificent international resource, a complete census is recommended in Alaska every 5 years until the Alaska summering population stabilizes.

Table 1. Summary of Trumpeter Swans from censuses during August-early September, by census unit in Alaska for 1968, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Unit	Year	White in pairs	As singles	In flocks	Total White	Cygnets	Total Swans
1 Gulf Coast	1968	442	29	191	662	363	1,025
	1975	442	32	190	664	193	857
	1980	586	52	266	904	351	1,255
	1985	778	76	440	1,294	164	1,458
	1990	666	59	205	930	434	1,364
	1995	628	72	295	995	150	1,145
	2000	754	58	230	1,042	314	1,356
	2005	800	85	474	1,359	459	1,818
2 Copper Canyon	1968	56	5	53	114	44	158
	1975	56	2	72	130	49	179
	1980	70	4	33	107	33	140
	1985	74	8	108	190	11	201
	1990	88	7	0	95	21	116
	1995	76	7	15	98	21	119
	2000	68	7	12	87	25	112
	2005	56	3	33	92	24	116
3 Gulkana	1968	288	31	81	400	190	590
	1975	556	43	155	754	284	1,038
	1980	1,026	42	632	1,700	660	2,360
	1985	1,736	143	595	2,474	533	3,007
	1990	2,142	225	776	3,143	778	3,921
	1995	2,332	280	965	3,577	1,002	4,579

	2000	2,520	280	683	3,483	503	3,986
Table 1, cont.	2005	2,440	252	510	3,202	1,228	4,430
4 Kenai	1968	86	3	27	116	65	181
	1975	72	5	29	106	39	145
	1980	90	12	8	110	65	175
	1985	92	5	40	137	51	188
	1990	114	5	7	126	78	204
	1995	130	11	29	170	79	249
	2000	200	15	34	249	105	354
	2005	282	20	91	393	172	565
5 Cook Inlet	1968	224	19	50	293	124	417
	1975	340	36	60	436	181	617
	1980	608	38	186	832	369	1,201
	1985	800	66	454	1,320	241	1,561
	1990	904	79	162	1,145	516	1,661
	1995	838	91	269	1,198	330	1,528
	2000	938	57	219	1,214	331	1,545
	2005	1,470	196	310	1,976	694	2,670
6 Lower Tanana	1968	224	21	94	339	137	476
	1975	518	21	185	724	388	1,112
	1980	746	16	585	1,347	773	2,120
	1985	1,202	113	426	1,741	503	2,244
	1990	2,070	179	559	2,808	1,072	3,880
	1995	2,268	219	987	3,474	1,315	4,789
	2000	2,788	227	1,026	4,041	901	4,942
	2005	3,054	305	1,040	4,399	1,786	6,185
7 Kuskokwim	1968	--	--	--	--	--	--
	1975	20	6	4	30	7	37
	1980	60	0	22	82	63	145
	1985	122	0	62	184	55	239
	1990	386	21	141	548	233	781
	1995	454	42	134	630	248	878
	2000	662	40	177	879	226	1,105
Table 1, cont.	2005	1,016	69	338	1,423	535	1,958
8 Koyukuk	1968	--	--	--	--	--	--
	1975	94	6	45	145	35	180
	1980	124	4	27	155	104	259
	1985	206	23	29	258	45	303
	1990	366	40	86	492	133	625
	1995	524	56	158	738	228	966
	2000	772	80	162	1,014	248	1,262
	2005	950	104	467	1,521	460	1,981
9 Yukon Flats	1968	--	--	--	--	--	--
	1975	2	0	0	2	1	3
	1980	2	0	0	2	4	6
	1985	10	0	0	10	3	13
	1990	66	8	22	96	56	152
	1995	200	26	107	333	90	423
	2000	412	35	173	620	129	749
	2005	632	40	374	1,046	324	1,370
10 S.E. Mainland	1968	--	--	--	--	--	--
	1975	2	0	0	2	0	2
	1980	6	0	3	9	11	20

	1985	16	1	7	24	16	40
Table 1, cont.	1990	34	1	23	58	50	108
	1995	58	2	18	78	61	139
	2000	64	4	24	92	70	162
	2005	76	10	56	142	70	212
11 Upper Tanana	1968	--	--	--	--	--	--
	1975	--	--	--	--	--	--
	1980	6	1	4	11	4	15
	1985	84	14	43	141	64	205
	1990	220	23	58	301	224	525
	1995	438	53	207	698	310	1,008
	2000	808	96	309	1,213	369	1,582
	2005	1,164	73	455	1,692	695	2,387
TOTAL	1968	1,320	108	496	1,924	923	2,847
	1975	2,102	151	740	2,993	1,177	4,170
	1980	3,324	169	1,766	5,259	2,437	7,696
	1985	5,120	449	2,204	7,773	1,686	9,459
	1990	7,056	647	2,039	9,742	3,595	13,337
	1995	7,946	859	3,184	11,989	3,834	15,823
	2000	9,986	899	3,049	13,934	3,221	17,155
	2005	11,940	1,157	4,148	17,245	6,447	23,692

Table 2. Summary of Trumpeter Swan production from censuses during August-early September, by census unit in Alaska for 1968, 1975, 1985, 1990, 1995, 2000, and 2005.

Unit	Year	Number of Cygnets	Number of Broods	Average Brood Size	Percent Juvenile	Number of Pairs	Percent Pairs w/Broods
1. Gulf Coast	1968	363	93	3.9	35	221	41
	1975	193	61	3.2	23	221	27
	1980	351	99	3.5	28	293	33
	1985	164	57	2.9	11	389	14
	1990	434	125	3.5	32	333	37
	1995	150	57	2.6	13	314	18
	2000	314	99	3.2	23	377	25
	2005	459	141	3.3	25	400	35
2. Copper Canyon	1968	44	13	3.4	28	28	39
	1975	49	16	3.1	27	28	57
	1980	33	10	3.3	24	35	29
	1985	11	3	3.7	5	37	8
	1990	21	9	2.3	18	44	20
	1995	21	7	3.0	18	38	18
	2000	25	7	3.6	22	34	21
	2005	24	7	3.4	21	28	21
3. Gulkana	1968	190	52	3.7	32	144	36
	1975	284	93	3.1	27	278	33
	1980	660	194	3.4	28	513	36
	1985	533	191	2.8	18	868	22
	1990	778	276	2.8	20	1,071	25
	1995	1,002	310	3.2	22	1,166	26
	2000	503	187	2.7	13	1,260	14
	2005	1,228	393	3.1	28	1,220	31
4. Kenai	1968	65	21	3.1	36	43	49
	1975	39	15	2.6	27	36	42
	1980	65	19	3.4	37	45	42
	1985	51	16	3.2	27	46	35
	1990	78	23	3.4	38	57	40
	1995	79	29	2.7	32	65	42
	2000	105	35	3.0	30	100	34
	2005	172	52	3.3	30	141	36
5. Cook Inlet	1968	124	36	3.4	30	112	29
	1975	181	61	3.0	29	170	36
	1980	369	103	3.6	31	304	34
	1985	241	85	2.8	15	400	21
	1990	516	157	3.3	31	452	34
	1995	330	107	3.1	22	419	25
	2000	331	105	3.2	21	469	22
	2005	694	216	3.2	26	735	28
6. Lower Tanana	1968	137	42	3.3	29	112	33
	1975	388	112	3.5	35	259	42
	1980	773	202	3.8	36	373	54
	1985	503	179	2.8	22	601	29
	1990	1,072	336	3.2	28	1,035	32

	1995	1,315	426	3.1	27	1,134	37
	2000	901	340	2.7	18	1,394	24
	2005	1,786	607	2.9	29	1,527	39

Table 2. continued

Unit	Year	Number of Cygnets	Number of Broods	Average Brood Size	Percent Juvenile	Number of Pairs	Percent Pairs w/Broods
7. Kuskokwim	1968	---	---	---	---	---	---
	1975	7	3	2.3	19	10	30
	1980	63	16	3.9	43	30	53
	1985	55	18	3.1	23	61	30
	1990	233	68	3.4	30	193	34
	1995	248	71	3.5	28	227	30
	2000	226	81	2.8	20	331	24
	2005	535	186	2.9	27	508	35
8. Koyukuk	1968	---	---	---	---	---	---
	1975	35	16	2.2	19	47	34
	1980	104	36	2.9	40	62	55
	1985	45	16	2.8	15	103	13
	1990	133	50	2.7	21	183	26
	1995	228	85	2.7	24	262	31
	2000	248	104	2.4	20	386	26
	2005	460	163	2.8	23	475	33
9. Yukon Flats	1968	---	---	---	---	---	---
	1975	1	1	1.0	33	1	100
	1980	4	1	4.0	67	1	100
	1985	3	1	3.0	23	5	20
	1990	56	18	3.1	37	33	55
	1995	90	25	3.6	21	100	25
	2000	129	51	2.5	17	206	25
	2005	324	103	3.1	24	316	32
10. S.E. Mainland	1968	---	---	---	---	---	---
	1975	0	0	---	---	1	---
	1980	11	2	5.5	55	3	67
	1985	16	3	5.3	40	8	38
	1990	50	10	5.0	46	17	59
	1995	61	19	3.2	44	29	66
	2000	70	22	3.2	43	32	69
	2005	70	22	3.2	33	38	50
11. Upper Tanana	1968	---	---	---	---	---	---
	1975	---	---	---	---	---	---
	1980	4	1	4.0	27	3	33
	1985	64	19	3.4	31	42	45
	1990	224	53	4.2	43	110	48
	1995	310	82	3.8	31	219	37
	2000	369	118	3.1	23	404	28
	2005	695	194	3.6	29	582	33
Total	1968	923	257	3.6	32	660	37
	1975	1,177	378	3.1	28	1,051	35

	1980	2,437	683	3.6	32	1,662	40
	1985	1,686	588	2.9	18	2,560	23
	1990	3,595	1,125	3.2	27	3,528	31
	1995	3,834	1,218	3.1	24	3,973	30
	2000	3,221	1,149	2.8	19	4,993	22
	2005	6,447	2,084	3.1	27	5,970	34
AVERAGE				**3.2**	**26**		**32**

FACTORS AFFECTING THE GROWTH AND DISTRIBUTION OF TRUMPETER SWAN POPULATIONS IN ALASKA FROM 1968-2005 (PRELIMINARY RESULTS)

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ABSTRACT

Surveys of all known Trumpeter Swan breeding habitats in Alaska were first conducted in 1968. Beginning in 1975 and every 5 years thereafter the survey has been repeated, and the numbers and locations of every swan sighting were recorded. The number of swans counted increased from 2,845 in 1968, to 17,157 in 2000, and the amount of area surveyed increased four-fold during the same period in response to perceived expansion of the population. This increase in coverage creates substantial problems for standard analytical techniques because it is difficult to separate increased coverage from actual increases in the population. Recent advances in computing power and statistical methods have allowed us to create models that account for the increased area and provide accurate estimates of population growth rate. Our preliminary analysis of the 1968-2000 data shows that the number of adult swans has increased at an annual rate of 0.076 (95%CI 0.072-0.080) after controlling for individual survey unit and latitude. The best model also indicates that adult swan numbers in later years increased at higher rates at higher latitudes, which had been suspected previously based on pilot observations. One possible reason for this pattern could be an increase in the average number of ice-free days at higher latitudes, which may allow Trumpeter Swans enough time to nest and rear young. Cygnet numbers grew at a slower rate than adults and show evidence of slowing in later years, which may indicate that breeding habitats are becoming saturated. Future analyses will investigate the influence of fire, elevation, vegetation, and development activities on Trumpeter Swan nesting and brood-rearing locations. Final analysis of the 5-year survey data is expected to be completed by the Spring of 2006, and the analyses of the nesting and brood-rearing data should be completed by the summer of 2007.

MORTALITY OF SWANS DUE TO INGESTION OF LEAD SHOT, WHATCOM COUNTY, WASHINGTON, AND SUMAS PRAIRIE, BRITISH COLUMBIA

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INTRODUCTION

Poisoning of swans from the ingestion of lead pellets has long been known to affect populations wintering in the Pacific Northwest (Munro 1925, Eklund 1946, Cowen 1946, Kendall and Driver 1982, Blus *et al*. 1989, Lagerquist *et al*. 1994, Wilson *et al*. 1998). Recent mortalities of swans wintering in northwest Washington State and the Sumas Prairie of British Columbia have totaled at least 1,800 individuals, with over 1,100 of the mortalities being collected in Washington State. The first large scale die-off in this area was in the winter of 1991-92 and involved over 100 individuals. There were no reported mortalities between 1992 and 1998. Since 1999, there has been a large scale die-off in each subsequent year. Approximately 70 percent of mortalities have been attributed to lead poisoning. Mortalities occur in both Trumpeter and Tundra Swans, but over 92 percent have been Trumpeter Swans.

Swans arrive on the wintering grounds in this area near the end of October-early November. Mortalities generally increase sharply around the middle of December, peak around the first of January, and decline sharply in February. One-day counts performed each winter by Washington Department of Fish and Wildlife (WDFW) indicate the population has grown by approximately 15 percent each year since 1999, despite the mortalities.

In 2001, WDFW, Canadian Wildlife Service, the U.S. Fish and Wildlife Service and additional stakeholders from various government and non-government agencies began a joint initiative to locate the source(s) of the lead pellets. The Washington Cooperative Fish and Wildlife Research Unit (University of Washington) joined the effort in 2004. The study area is centered in Whatcom County, Washington, and the Sumas Prairie of British Columbia as that is where the majority of the mortalities are occurring. The study area encompasses approximately 100 ha, 58 percent in the U.S. and 42 percent in Canada.

Ingested lead is broken down with the grinding action of the gizzard, enters the bloodstream, and paralyzes the internal organs (Shillinger *et al*. 1937; Bellrose 1975; Washington Department of Fish and Wildlife 2001). Waterfowl in general may succumb to lead poisoning within 21 days of ingesting as few as 2-3 pellets (USGS-National Wildlife Health Center, Madison, Wisconsin pers. comm.). There is some thought that as the number of pellets ingested increases, the time from ingestion to death decreases (Bellrose 1975, Pain 1990).

PACIFIC NORTHWEST UPDATE

In the Pacific Northwest, swans forage during daylight hours in agricultural fields (predominantly corn with a winter wheat or rye grass cover crop) and return to roost at a lake, flooded gravel pit or pond each evening. In addition, certain flooded agricultural fields may intermittently be used by swans as roosting habitat. As swans begin to suffer the symptoms of lead poisoning, they will typically remain at the roost site until death. Carcass collections at the roost sites as well as at agricultural fields and necropsies have been routinely performed since 1999. Carcasses recovered during the previous 6 years have averaged over 20 lead pellets each. The contents of a subset of over 900 gizzards were examined. Approximately 60 percent of these gizzards contained more than 10 lead pellets and nearly 75 percent of them contained fewer than 10 steel pellets. Pellets collected from over 300 gizzards were of sizes used in both upland game and waterfowl hunting. We have calculated "exposure windows" by back-dating carcass collection dates 28 days. This is a conservative estimate, in case swans survive slightly longer than other waterfowl. These exposure windows indicate that swans are accessing pellets soon after arriving on the wintering grounds.

Between November 2001 and December 2004, 311 swans were captured with rocket nets. General body condition was assessed and a blood sample was collected and tested for blood lead content. Trumpeter Swans were marked with coded neck bands and vhf radio transmitters (245) or satellite transmitters (6); Tundra Swans were marked with coded neck bands (43) or Federal tarsus bands (17). Swans were monitored both day and night through ground-based and/or aerial telemetry. Population surveys were also conducted semi-weekly from November through December each year, but extended through January this past winter, to monitor population movements as well as validate our telemetry results.

To date, we have recovered 55 marked mortalities. Twenty of these were collar recoveries only where the carcasses were scavenged before located. Thirteen of the 55 had low blood lead levels at the time of capture and laboratory tests concluded lead poisoning as the cause of death. The cause of death of four of the 55 was not due to lead and 18 were lead exposed prior to capture, having high blood lead levels. Only one of the 55 was a Tundra Swan and that bird was exposed to lead prior to capture. Two of the satellite marked swans died shortly after capture in 2004-05; one was lead exposed prior to capture and the other suffered a severe wing injury. In addition, two of the remaining four satellite transmitters ceased operation soon after being fitted.

At the conclusion of the 2003-04 and 2004-05 field seasons, data from swans confirmed as being lead poisoned post capture were entered into kernel home range (ArcGIS 3.2) software to produce "activity centers" encompassing 50 percent and 90 percent of all detections of these swans. These activity centers were designated as "areas of interest" for the subsequent telemetry field season. These areas of interest were visited at least twice per day by telemetry personnel in 2003-04 to replicate swan locations as well as document individual foraging locations. Identification of the areas of interest has decreased the potential source area for lead pellets by more than 90 percent, from 100,000 ha to less than 10,000 ha.

Soil core sampling has occurred in both forage fields and roost sites identified as possible sources early in the study effort. To date, soil sampling work has not identified a point source of lead pellets and indicates greater lead shot densities in some forage fields than at roost sites. We have found high variability in shot density within some forage fields, indicating a need for foraging observations (included in 2004-05 telemetry efforts). In addition, we have found shot throughout the core column in some locations which is indicative of historic deposition. Recovered shot has been of sizes used in both upland game and waterfowl hunting.

FUTURE PLANS

Future plans for the 2005-06 field season include the continuation of ground based telemetry surveys twice daily, coordinated by The Trumpeter Swan Society, in the areas of interest. Carcass collections will again be conducted at roost sites and forage fields as needed; necropsies will be conducted on at least the recovered carcasses of marked birds. Aerial surveys will be increased in frequency in an effort to increase the number of carcasses of marked birds recovered before scavenging occurs. In addition, soil sampling will be conducted in parts of the areas of interest. Sampling efforts will include investigation into the use of metal detectors as a means of identifying areas with high shot densities prior to coring.

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THE WINTER DISTRIBUTION OF TRUMPETER SWANS IN RELATION TO BREEDING AREAS: THE FIRST NECKBAND STUDY, 1972-81

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ABSTRACT

Between 1957 and 1968, 186 Trumpeter Swans, *Cygnus buccinator*, were marked in their Alaskan breeding grounds with U.S. Fish and Wildlife (USFWS) metal tarsus bands only. Only two (1%) of these were subsequently recovered. Both, banded in the Copper River Delta area, were found dead off Vancouver Island, British Columbia. This paper reports results from the first use (1972-81) of color coded neckbands on Trumpeter Swans. A total of 231 Trumpeter Swans was banded in the Pacific Coast Population (PCP), and 79 in the Rocky Mountain Population (RMP). Of the 310 total that were neckbanded, 78 (25%) were subsequently resighted. Forty one (18%) of those neckbanded in the PCP, and 19 (24%) of the 79 neckbanded in the RMP were resighted in their wintering grounds. The PCP wintered along the Pacific coast, whereas the RMP wintered in Montana's Red Rock Lakes National Wildlife Refuge (NWR) and Vancouver Island. Neckband resightings also demonstrated that each population had unique migratory and wintering tendencies, although populations sometimes mixed in wintering grounds and frequently mixed on migration.

INTRODUCTION

From 1957-68, a total of 186 Trumpeter Swans was banded with USFWS metal tarsus bands in Alaska, mostly in the Copper River Basin. During two of these summers, color dyeing was unsuccessfully attempted on 42 swans and in 1958, nine were experimentally marked with blank colored plastic neckbands (Hansen *et al*. 1971, Hansen 1973). The only long-distance results recorded from this effort, involving 228 trumpeters, appear to be two recoveries on Vancouver Island, British Columbia. The first was a swan originally tarsus banded in 1958 as a female cygnet in the Copper River area which was found dead during her second winter after banding at the mouth of the Nanaimo River. The second swan was banded in 1960 as an adult female in the Copper River Delta and shot over 7 years later on the Ucona River. Hansen *et al.* (1973) concluded, presumably with these two recoveries in British Columbia as the main evidence together with circumstantial evidence from sight records of non-banded birds, that the Alaskan trumpeters wintered from southeast Alaska as far south as southern Washington State.

In addition to the need to supplement this scant knowledge on the winter dispersal of Trumpeter Swans, there were two other good reasons for initiating a neckbanding program:

(i) By 1972, the Swan Research Program of the Johns Hopkins University and the Chesapeake Bay Foundation (now with Environmental Studies at Airlie) had completed 2 successful years of neckbanding Tundra Swans (*Cygnus columbianus columbianus)*. Resighting rates of neckbanded Tundra Swans in the 1st year were from 80% to 90% in contrast to a recovery rate (recaptures or dead) of 7% from metal tarsus bands only (Sladen 1973, Sladen 1975). Because of the high resighting rate of neckbanded Tundra Swans, it was likely that this method would work for Trumpeter Swans as well.

(ii) Impact Statements on the Copper River area and the 1968 Alaska census (Hansen *et al*. 1971) emphasized that one-third of the world population of Trumpeter Swans (about 1,180 birds) was not only concentrated in the Copper River area, but within 70 miles of the terminus of the proposed Alaska oil pipeline at Valdez. Oil spills in the Copper River Delta where the entire population was likely to concentrate in the spring and fall could have very serious consequences.

The National Audubon Society, sharing our concern, contributed $1,000. In July 1972, armed with this small grant and with our usual excellent cooperation from USFWS and the Alaska Department of Fish and Game, we launched our *Trumpeter Swan Migration Study*. In this paper we will present data from our initial neckbanding program during the late summers from 1972-73, and summarize the total results of neckbanding from 1972-81 in the PCP and RMP.

MATERIALS AND METHODS

The color and codes of the plastic neck and tarsus bands followed the circumpolar protocol established through the Swan Research Group of the International Waterfowl Research Bureau (now Wetlands International) (Sladen 1973, 1976, Sladen and Kistchinski 1977). Thus, the neckbands used in Alaska were blue and those used in Saskatchewan and Alberta were yellow. The four-digit codes engraved vertically and repeated four times around the bands were approved for Trumpeter Swans (with two numbers followed by two letters, e.g. 23VY). This distinguished them from Tundra Swans, also being neckbanded blue in Alaska, which were engraved with a code of one letter followed by three numbers (e.g. A304). Identical codes were engraved on the tarsus bands of the same color. Both neck and tarsus color bands were designed with an overlap that was permanently fixed by fast-drying cement.

The North American metal tarsus band design (size nine), while a satisfactory size for Tundra Swans was, in 1972, considered too small for trumpeters. Instead, trumpeters were fitted with a special double inscription overlap aluminum band of size eight, designed for albatrosses (Sladen *et al*. 1968). Though still far from satisfactory, it enabled us to use the extra length available in the overlap for this large swan and thus prevent injury from the smaller standard USFWS design.

Following international protocol, all swans of known age (i.e. banded as locals or with juvenile-gray plumage) were metal-banded on the left tarsus while all swans of unknown age (adult plumage) were metal-banded on the right tarsus. The color-coded band was attached to the tarsus opposite the metal band.

Swans were caught during the flightless stage of the molt (King 1973). A USFWS Piper Cub airplane on floats was used in the Cook Inlet Basin. Molting nonbreeders were captured from an aircraft as well as a light, aluminum, motor-propelled boat in the Copper River Delta. This boat was transported to Peninsula and Bering Lakes on the float of a single-engine Beaver aircraft. A long-handled net was used for the final capture. The swans were brought to land where they were carefully processed, each bird taking at least 15 minutes. These methods were also employed in Montana's Red Rock Lakes NWR, Alaska's Lower Tanana River, Alberta, and Saskatchewan.

Subsequent observations were made with a spotting scope and zoom lens of x20 to x60 mounted either on a steady tripod or a car-window mount. Two people (if possible) independently read and recorded the code and then compared observations. The letters were first noted and the code read up or down using the letters as a guide. The codes were only recorded when both observers were certain they were correct. If the slightest doubt existed, the uncertain digit of the code was recorded with a question mark (e.g., 2(?3)VY).

RESULTS

Pacific Coast Population 1972-73

In our first effort in Alaska, 44 trumpeters were marked. Nineteen trumpeters were neckbanded in the Cook Inlet Basin and 25 in the Copper River Delta between July and September 1972. On 29 October, our first neckbanded trumpeter, 48VY, was reported from Port Alberni, Vancouver Island, British Columbia. That winter and spring (1972-73), we received (some seen by ourselves) resightings of seven individual trumpeters; four from Vancouver Island, British Columbia, and three from Washington State. Our most southerly record was from Ilwaco, Washington, close to the mouth of the Columbia River. This 16% resighting rate in their wintering grounds for the first year and from such a small sample far exceeded our expectations and aroused a great deal of interest in the project, particularly among private citizens in Canada. It also instantly and very accurately confirmed the Hansen *et al*. (1971) conjecture that the Alaska trumpeters wintered as far south as southern Washington and were confined to the Pacific Coast.

In July 1973, 22 more Trumpeter Swans were neckbanded in the Cook Inlet Basin, mostly in the Lower Tanana River, and another 12 in the Copper River Delta, making a grand total of 78 trumpeters for the first two summer activities.

From this small sample we were able to plot the winter distribution of trumpeters in British Columbia for nine individuals on Vancouver Island, concentrated in six locations. Most were in the river estuaries along the eastern coast and in one other location in the coastal mountain region near Terrace, British Columbia. Three scattered locations close to the west coast of Washington (Clear Lake, Skagit

County; Ilwaco, Pacific County; Ocean Shores, Grays Harbor County) were also identified.

The location of these long-distance resightings in relation to the location of original banding suggests an equal scatter into Washington and Vancouver Island. For example, two from Kenai were resighted in Washington, two from the Lower Tanana River on Vancouver Island and a third form the Lower Tanana River at Terrace, British Columbia. All but one of the eight individuals resighted in winter that were originally neckbanded in the Copper River area were resighted on Vancouver Island. Moreover, the single resighting of a Copper River swan at Ilwaco, Washington, identified that location as the most southerly of the Alaskan records at that time.

This initial success encouraged further banding in the same areas, as well as in some breeding habitat near Fairbanks, Alaska. Between 1977 and 1980, a second round of neckbanding was undertaken in these areas, after which a total of 114 swans had been neckbanded in Kenai, 88 in the Copper River Delta, and 29 in the Lower Tanana River area. In total, 231 Trumpeter Swans were neckbanded in the PCP. In addition, in the RMP, 29 were neckbanded in Alberta, 8 in Saskatchewan, and 42 in Red Rock Lakes NWR, Montana (Figure 1, Table 1).

Pacific Coast Population 1972-80

Cook Inlet

Twenty of the 114 (18%) Trumpeter Swans neckbanded in the Cook Inlet were later resighted in their wintering grounds (Figure 2, Table 1). Of these, 10 (50%) were resighted two or more times in their wintering grounds. Eighty percent of winter resightings were recorded in Skagit County, Washington, 2% were recorded in Grays Harbor County, 2% were recorded in Prineville, Oregon, and 10% were recorded near Vancouver Island, British Columbia (Figures 2 and 3). Fifty-four percent of the resightings recorded on migration occurred at Blind Slough, Alaska; 15% were recorded in Cordova, Alaska; 8% were recorded in the Snake River, Idaho; Petersburg, Alaska; and Comox Harbor, British Columbia. All resightings during the breeding season were recorded near Cook Inlet.

Copper River Delta

Eighteen of the 88 (20%) individuals neckbanded in the Copper River Delta were later resighted in their wintering grounds (Figure 2, Table 1), of which nine (50%) were resighted two or more times in their wintering grounds. All individuals except one (34VY) were resighted around Vancouver Island, British Columbia (Figure 3). 34VY was resighted in Pacific County, Washington, on 16 November 1972, but was found dead two days later in the same location. Of the 18 individuals resighted in the winter, 16 (89%) were reported around Vancouver Island, BC (Figure 3). The remaining individual was resighted in Illwaco, Washington, occurred within 2 days of each other. Both of these reports identified the same bird (34VY), with the second report being the recovery of this bird after it had died. Thirteen observations of Trumpeters banded in the Copper River Delta were recorded on migration. Eleven of these resightings were recorded within six days of each other at Blind Slough, Alaska. The remaining two resightings were reported within two days of each other at Barnes Lake, Alaska. All resightings during the breeding season were reported in the Copper River Delta.

Lower Tanana River

Three of the 29 individuals (10%) neckbanded in the Lower Tanana River were resighted in their wintering grounds (Figure 2, Table 1). One of these swans was resighted twice. All winter resightings occurred around Vancouver Island, British Columbia (Figure 3). However, two swans banded in the Lower Tanana River were seen in Skagit County, Washington, during November, and one was seen in the Copper River Delta staging for migration. No swans banded in the Lower Tanana River were observed during the breeding season.

Rocky Mountain Population 1973-81

Saskatchewan

Of the eight banded in Saskatchewan, two were resighted during the winter. One individual was resighted three times at Red Rock Lakes NWR during the winter, fall, and spring (12 February 1974, 26 October 1975, and 8 March 1975). A second was observed during the winter, also at Red Rock Lakes NWR. Overall, these two individuals comprise 25% of the swans banded in this area (Figure 2, Table 1).

Alberta

Of the 29 banded in Alberta, two individuals (7%) were re-sighted during the winter (Figure 2, Table 1). One swan was observed on consecutive days between 30 December and 10 January 1975 at Ravalli NWR, Montana. Four years later, this swan was again observed this time at Blind Slough, Alaska during

November 1979. The other was observed twice on its Vancouver Island wintering grounds on 26 March and 8 April 1975.

Red Rock Lakes National Wildlife Refuge, Montana

Of 42 Trumpeter Swans banded in Red Rock Lakes NWR, 20 (48%) were resighted. All of these resightings occurred on the Refuge during all seasons. Though they did not migrate, these birds were not isolated from other populations. Swans banded in Alberta, Saskatchewan, and Cook Inlet were seen wintering on or near the Refuge.

The total individuals re-sighted

In total, 310 Trumpeter Swans were marked with neckbands, and 78 were resighted (25%). Twenty nine individuals (9%) were resighted in their breeding territories, 31 individuals (10%) were resighted on migration, and 60 individuals (19%) were resighted on their wintering grounds (Table 1). One hundred eighty six Trumpeter Swans were banded with metal bands only between 1957 and 1968. From this effort, only two were resighted (0.09%), both recovered dead off Vancouver Island, British Columbia.

DISCUSSION

The overall resighting rate of Trumpeter Swans wearing neckbands (25%) (Table 1) exceeds those wearing only metal bands (1%). Furthermore, resightings of neckbanded swans showed where breeding populations staged for migration, wintered, bred, and died. Using only metal bands on Trumpeter Swans demonstrated where the birds died. This result is comparable to the results gathered from the first neckbanding experiments on Tundra Swans (Sladen 1973) when 151 of 179 (84%) neckbanded in 1970 were resighted in their wintering grounds. The resighting rate of Tundra Swans was a result of the concerted effort made to resight neckbanded Tundra Swans around the Swan Research Program headquarters near the Chesapeake Bay.

Each breeding population of Trumpeter Swans had distinct wintering habits. Some populations were almost completely separated, and some mixed with other breeding populations substantially in the wintering areas. No populations were completely isolated.

Trumpeter Swans breeding in Cook Inlet, Alaska, showed a strong preference for wintering grounds in Skagit County, Washington. One swan from this population was observed in Prineville, Oregon, to date the most southerly reporting of an Alaskan Trumpeter Swan. This swan was recovered dead at the same location the day after it was first observed. However, its movement so far south may not have been a migratory movement, but an anomalous movement due to the bird's health, and should not be considered the southerly range of Alaskan Trumpeters banded during this time.

Trumpeter Swans breeding in the Copper River Delta were most likely to winter further north at Vancouver Island, British Columbia. The swans of the Lower Tanana River wintered at Vancouver Island, British Columbia as well. However the swans banded here were observed in Skagit County, Washington, during November indicating that they may have migrated past their wintering grounds into a more southerly staging area in Skagit County, then moved north to Vancouver Island. This is supported by the observation of one individual (06UJ) observed in Skagit County, Washington, in November 1978, and then seen on Vancouver Island in January of 1980. All of these populations also staged at Blind Slough, Alaska, along with some of the swans breeding in Alberta. Therefore, these three Alaskan breeding populations intermingled during the migration, but the Cook Inlet Population remained separate during the winter and summer. The swans banded in the Lower Tanana River and those banded in the Copper River Delta mixed with each other during all seasons except during the breeding season.

Trumpeter Swans breeding in Alaska were also seen mixing with the RMP. Our most frequently resighted swan, (00VT) was observed in Skagit, Washington, but was twice observed near Red Rock Lakes NWR in Ennis Lake, Montana, on 14 December 1974, and again on 30 December 1974 at Ravalli NWR, Montana. One swan banded in Alberta (42TY) was observed staging at Blind Slough, Alaska, as well as wintering at Red Rock Lakes NWR.

Trumpeter Swans banded in Alberta wintered in Red Rock Lakes NWR and Vancouver Island, British Columbia. Those banded in Saskatchewan were only observed wintering in Red Rock Lakes NWR. Those swans banded at Red Rock Lakes NWR were only resighted near these breeding grounds, regardless of season, showing this flock to have been resident, but interacting with migratory swans from the RMP and PCP.

These trends were recently supported through genetic research (Oyler-McCance *et al.*, in press). The breeding populations were shown to have genetic similarities common within the breeding populations, with some genetic markers common between populations. However, analysis of Trumpeter Swan nuclear DNA showed a marked separation between the RMP and the PCP.

ACKNOWLEDGMENTS

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Editors' Note: This paper was not presented at the 20th Conference, but is included here because of its relevance to the PCP.

Figure 1. Banding locations in the Pacific Coast and Rocky Mountain Trumpeter Swan populations. Black stars on the map represent each banding location and their labels indicate the number of swans neckbanded in each location.

Figure 2. Wintering locations of neckbanded Trumpeter Swans.

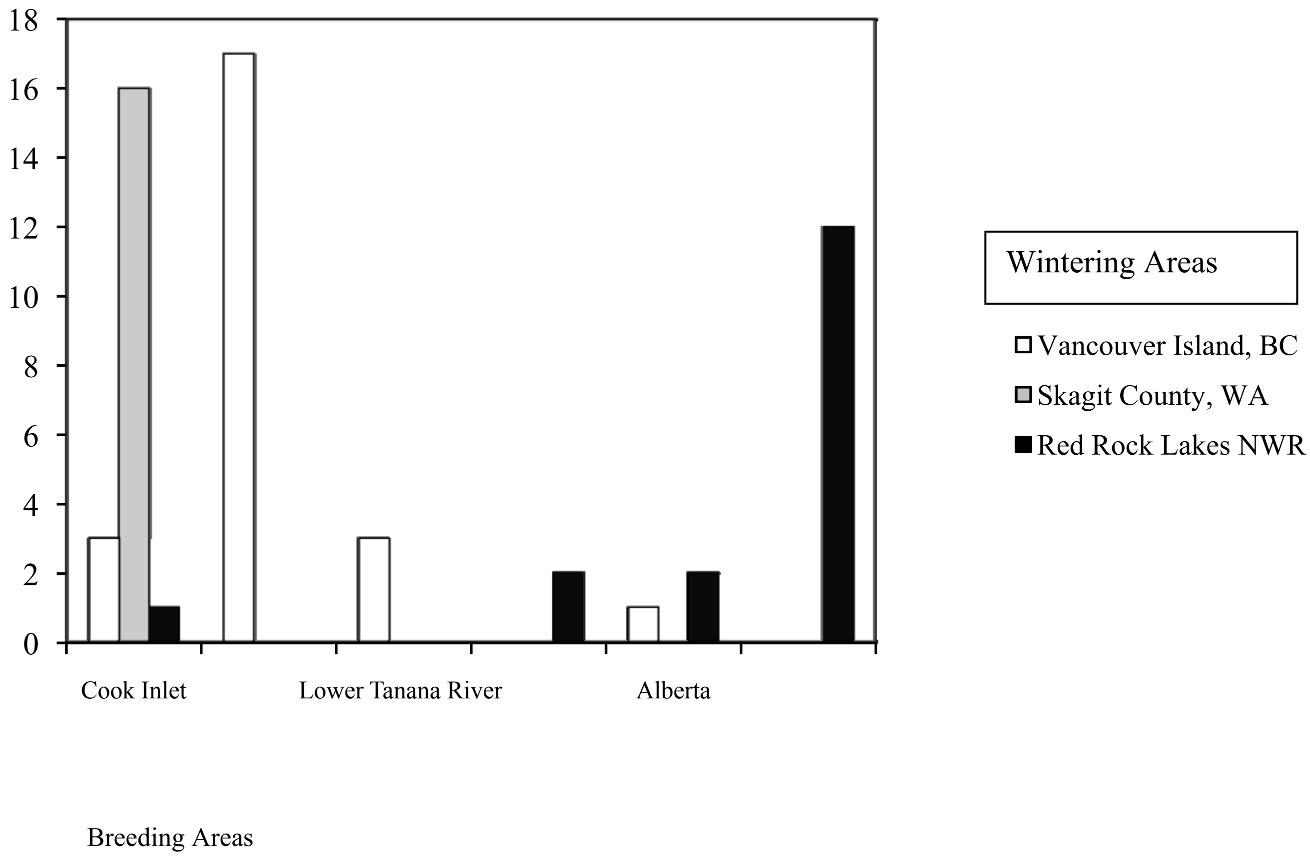

Figure 3. The number of Trumpeter Swans from each of the six breeding territories that were resighted in each of the three main wintering locations.

Table 1. Resightings of individual Trumpeter Swans neckbanded during summers 1972-73.

Location and Code	Total Banded	Individuals Resighted*			Total Unique Individuals Resighted
		Breeding Season	Migration	Wintering Grounds	
PACIFIC COAST POPULATION					
Cook Inlet Basin	114	14 11%	7 6%	20 16%	31 25%
Copper River Delta	88	5 2%	9 11%	18 16%	23 26%
Lower Tanana River	29	0 0%	3 10%	3 10%	4 14%
Pacific Coast Pop. Total	231	19 8%	19 8%	41 18%	58 25%
ROCKY MOUNTAIN POPULATION					
Saskatchewan	8	0	0	2 25%	2 25%
Alberta	29	0	1 3%	3 10%	2 10%
Montana	42	10 24%	11 26%	14 33%	20 48%
Rocky Mountain Pop. Total	79	10 13%	12 15%	19 24%	20 25%
Grand Total	*310*	29 9%	31 10%	60 19%	*78* 25%

* Some individuals were resighted in more than one category .


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NORTH AMERICAN TRUMPETER SWAN STATUS AND TRENDS

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ABSTRACT

Preliminary quinquennial data presented by various authors suggest that the continental population is estimated to be 34,500, a record high and up 47 percent from 2000. A record high of 25,300 in the Pacific Coast Population, up 42 percent from 2000. A record high of 4,500 in the Rocky Mountain Population, represents mostly an increase in the Canadian portion of this flock. Another record high of 4,700 in the Interior Population, up over 90 percent from 2000. Final population estimates will be published in 2006 by the U.S. Fish and Wildlife Service (Moser, in press).

Table 1. Preliminary estimates of North American Trumpeter Swan populations.

	2000	2005
Pacific Coast	17,552	25,300
Rocky Mountain	3,665	4,500
Interior	2,430	4,700
TOTAL	23,647	34,500

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Moser, T. J., compiler. In press. The 2005 North American Trumpeter Swan Survey. Division of Migratory Bird Management, U.S. Fish and Wildlife Service, Denver, Colorado, USA.

COMPARISON OF 290 PHOTOS OF WILD SWAN NESTS

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ABSTRACT

One hundred sixty Trumpeter Swan (*Cygnus buccinator*) nest photos are compared with 130 similar photos of Tundra Swan (*Cygnus columbianus*) nests, taken from a small airplane approximately 500 feet (152 m) above ground. The photos include an area about 200 by 300 feet (61 by 91 m) when taken perpendicularly, more if taken at an angle. The male swan was not in the photo for 33 percent of the Trumpeter Swan nests and 78 percent of the Tundra Swan nests. The trumpeter nests were 100 percent in or very near (average 3 ft (0.9 m) a rearing lake while 56 percent of the 108 Tundra Swan photos showed a rearing lake averaged 36 feet (11 m) from the nest. Beaver structures were important for trumpeters. Tundra polygons were important for Tundra Swans. Man made structures showed in 2 percent of photos for each species. Litter showed in 7 percent of tundra photos, but not in trumpeter photos. Other less obvious characteristics are described. Discussion includes possible improvements in photographic technique and the potential value of such photographs for future scientists and wildlife managers dealing with problems we can not conceive of today.

STUDY AREA

Wild swans nest on most of the lowlands of mainland Alaska. Trumpeter Swans (*Cygnus buccinator*) use the temperate rain forest region of the south coast and the boreal forest region of the Interior. The Tundra Swans (*Cygnus columbianus*) use the treeless habitat of western and northern Alaska. Some overlap occurs where these distinct habitats meet. One hundred and sixty trumpeter nest photos are compared with 130 similar pictures of Tundra Swan nests taken from a small airplane approximately 500 feet (152 m) above. The trumpeter nests were on the Copper/Bering River deltas near Cordova, Alaska, at about 60 ° north latitude. The tundra nests were in the treeless Arctic oil fields some 750 miles (1,200 km) farther north at about 70 ° north latitude. The trumpeters were photographed in the last week of May 2004 and the tundras about 3.5 weeks later. Rainfall for the nesting months May through July averages 14.6 inches (37 cm) at Cordova and only 1.3 inches (3.4 cm) at Barrow in the Arctic. Temperatures for those 3 months average about 50 °F (10 °C) at Cordova and 32 °F (0 °C) at Barrow (Figure 1).

METHODS

The U.S. Fish & Wildlife Service (USFWS) has been plotting the location of trumpeter nests at various locations in Alaska for nearly 50 years. Oil companies – first ARCO Alaska then ConocoPhillips Alaska – have employed ABR, Inc. to plot Tundra Swan nests in their Kuparuk oil field since 1988 (Anderson *et al*. 2003) so their engineers can avoid these sensitive areas when designing oil field structures. The author has been participating in these surveys for a number of years and has taken advantage of this opportunity to photograph swan nests. This paper deals only with photos taken in 2004.

The camera used was a Cannon EOS Rebel S II with a 35-70mm zoom lens. This camera has an automatic setting for sports events that uses maximum shutter speed for the available light and instantly adjusts for focus. This camera gives a point and shoot capability that minimizes extra flight time. The lens was set at 35mm to include maximum habitat, thus the swans appear as white dots. The photos include an area of about 200 by 300 feet (61 by 91m) when taken perpendicularly, larger if at an angle. ASA 400 print film was used. The location of each nest was plotted and numbered on 1:63,360 scale U.S. Geological Survey maps. The observation number was recorded with a dot and a number on the margin of each map. The film and exposure numbers were also recorded on the map margin. Later, a small sticker with this information was placed on each print so it could easily be identified with its map location.

A high wing, single engine, light Cessna airplane flown at about 100 mph (167 km per hr.) was used. The photographer rode in the right front seat, kept the camera turned on and hung around his neck so no time was lost when a photo opportunity occurred. For this, paper photos were compared but the maps were not used. Tables were developed so the photos could be easily scored on 23 criteria (Table 2, Table 3).

RESULTS

It appears that the presence of the off duty bird, generally the male for each species, at or near the nest is much more important for trumpeters than for tundras (Table 1). In contrast, both parents of each species are equally attentive once the young are hatched. The trumpeter nests are in or immediately adjacent to the rearing wetland, averaging less than 3 feet (9m) that the cygnets would have to toddle for their first swim. A rearing wetland did not even show in 19 percent of the tundra photos. In the 108 instances where a rearing wetland was visible, the average distance was 36 feet (11m). Thus, newly hatched tundra cygnets are clearly expected to be better walkers than the only slightly larger trumpeters of the same age.

Nearly half the trumpeter nests are off shore either as a mound or on a tiny islet surrounded with not more than 20 inches (.5m) of perennial vegetation. Only 4 percent of tundra nests are on such islets. Larger islands are only moderately attractive and used at the same rate of 9 percent by both species. The "donut" image described by Hansen *et al.* (1971) for Trumpeter Swan nests where there is a moat around a nest mound in emergent vegetation occurred in 21 percent of the trumpeter pictures, but in none of the tundra photos.

Beaver activity, including lodges and dams, appear in 9 percent of the trumpeter photos, but are not a part of tundra habitat. It is obvious that beaver dams beyond the photos were far more important than indicated.

Patterned ridges sometimes found in otherwise wet tundra, known as polygons from their shape, seem to offer attractive nest sites for Tundra Swans (Figure 2).

Stirred up, muddy water suggested bottom feeding in some photos or perhaps nest building for trumpeters. There was evidence of mammals showing in several photos: beaver (*Castor canadensis*), muskrat (*Ondatra zibethica*) in 37 percent of Trumpeter pictures and caribou (*Rangifer arcticus*) trails in 21 percent of the tundra photos. There is no evidence of interference by these species, although the occasional presence of caribou may be a factor in the inclination of Tundra Swans to build nests on mounds.

The presence of man-made structures, recent or abandoned, at 2 percent for both species suggest that such structures are a minor factor. Vehicle tracks that can last for years on the tundra are likewise a small feature of this active oil field. Litter appeared in 7 percent of the tundra pictures, mostly in the form of wind distributed plastic.

DISCUSSION

This paper really describes an experiment in techniques rather than offering new scientific information. The data basically supports swan behavior that was described years ago by Hansen *et al.* (1971). Well organized photos can provide a solid record that could be useful to current land managers, but will have increasing value to biologists 50 or 100 years hence wrestling with problems of climate change and human technology we can not even imagine today. Some thoughts on how to develop a record for the ages immerge.

A permanent archive will be essential. Universities and museums know how to do this. There is a good deal of inducement, at this time, to use electronic images stored in computer files. There are still some questions as to whether such records will be as permanent as the black and white images archived for the past 150 years.

How to correlate images to a location on a map is a problem. USGS maps are the result of painstaking interpretation of stereo photos by expert cartographers providing detail not available from satellite images. But this was done before the Global Positioning System (GPS) was in place so there are small differences in the latitude/longitude positions. The Tundra Swan photos were all located on USGS maps and are fairly precise for obvious locations such as islands or lake shorelines, but are less so for nests in open meadows. A trumpeter nest was located by the GPS system in the airplane which was not exactly over the nest. Perfecting these imperfections may not be possible now, but such limitations need to be considered.

New digital cameras are comparable in price to the film camera we used and could result in cost savings for film, for the moments of air time used while changing film, for labeling and archiving the images, for zooming in on nest and vegetation details, and other activities.

Taking pictures at 35mm from 500 feet may be too distant. These photos do not show much about actual nest detail such as its size, type of mound, whether on a beaver house. I could not identify species of emergent vegetation in many cases. The photos are sharp enough so that they could be enlarged. This would be a simpler with digital photography. Photos at 70mm from 400 ft (122 m) might give more useful detail. The analysis described in this paper is rather superficial in that it covers only 1 year and is not correlated with what shows on the maps. These areas may not be representative of the entire range of these birds, even for Alaska.

Biologists with ABR, Inc. have analyzed 10 years of Tundra Swan photos and maps (Anderson *et al*. 2003). They found that, in 2003, 30 percent of 75 active nest mounds in the Kuparuk had been used the preceding year and that some nest mounds had been used as many as 6 of the past 10 years. They described the plant communities surrounding the nests and a distance to the nearest rearing lake for all nests.

An expanded photo project would be required to really understand the difference between the selection requirements of the two species. A sample of trumpeter nest photos should include the Cook Inlet, Gulkana, Tanana and Yukon Flats regions as well as the Copper River Delta. Tundra samples would need to include the Alaska Peninsula/Bristol Bay area, Yukon Delta, Kotzebue Sound, and a broader range of the North Slope. A plot sampling system could be developed perhaps using USGS maps. A minimum of 5 years would be essential. An adequate project might not be unreasonable as there are National Wildlife Refuges with aircraft support in most of these areas.

How grateful modern biologists would be if Lewis and Clark had been able to photograph a sample of all swan nests as they crossed the land. They could not do that, but they did a superlative job of recording what they could and we still use their records. How grateful future biologists will be, if we do an equally good job of recording what we can in our time.

ACKNOWLEDGMENTS

Thanks to Caryn Rea of ConocoPhillips Alaska, Inc. and to Bob Ritchie of ABR, Inc. for making the Tundra Swan surveys possible. Bruce Conant of USFWS coordinated the Trumpeter Swan survey. The careful attention of pilots, A. J. Jain of ABR, Inc. and Ed Mallek of USFWS, made the photography possible. Thanks to Mary Lou King, James King, Steve Lewis, and Bruce Conant for help with this manuscript.

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Table 1. Presence of swans at 290 swan nests.

	160 Trumpeter Swan		130 Tundra Swan	
Presence of swans	Number	Percent	Number	Percent
Single bird on nest	133	83%	123	95%
Pair on nest	20	13%	7	5%
No bird on nest	7	4%	0	0

Table 2. Nest site location for 290 swan nests.

	160 Trumpeter Swan		130 Tundra Swan	
Location	Number	Percent	Number	Percent
Mound in open water	31	19%	2	2%
Mound in emergent vegetation	66	41%	5	4%
On islet	38	24%	4	3%
On island	15	9%	12	9%
On peninsula	3	2%	12	9%
On shoreline	6	4%	22	17%
On upland	1	1%	73	56%

Table 3. Observations made from photos of 290 nest sites.

	160 Trumpeter Swan		130 Tundra Swan	
Characteristic	Number	Percent	Number	Percent
Male not seen in photo	53	33%	102	78%
Donut shape	34	21%	0	0%
Old nest present	22	14%	8	6%
Polygon high center	0	0	31	24%
Polygon low center	0	0	19	15%
On ridge	0	0	32	25%
Open meadow	0	0	51	39%
Stirred up mud	34	21%	2	2%
Beaver structures present	15	9%	0	0%
Other mammal sign	59	37%	27	21%
Lingering ice or snow	13	8%	33	25%
Evidence of flooding	7	4%	0	0%
Manmade structure	2	2%	1	1%
Vehicle tracks	0	0%	7	5%
Oilfield structure	0	0%	1	1%
Litter	0	0%	9	7%

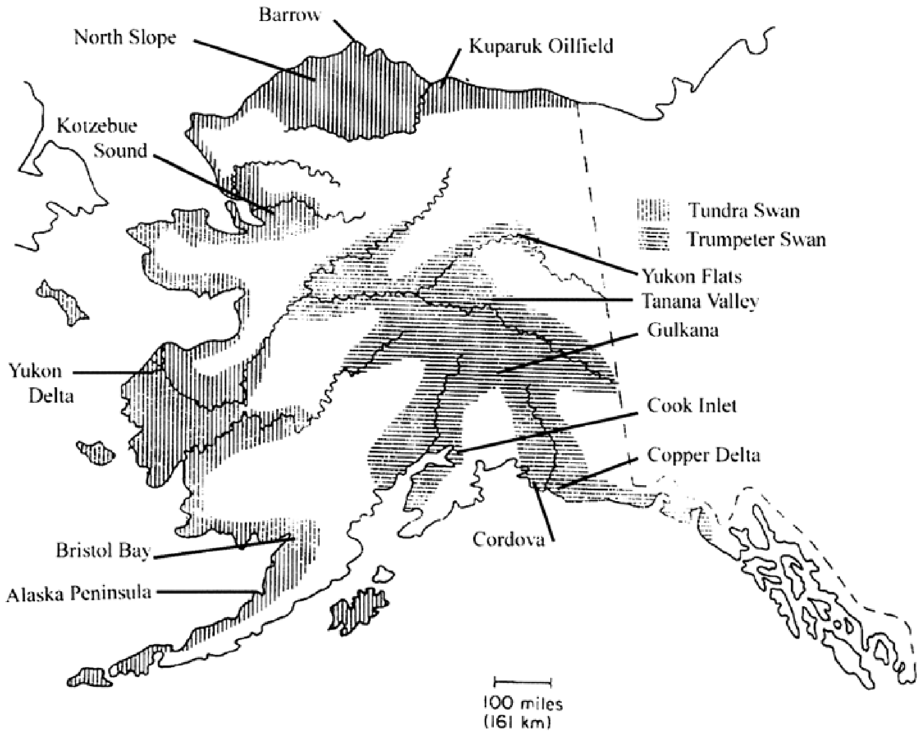

Figure 1. Approximate swan breeding range in Alaska.

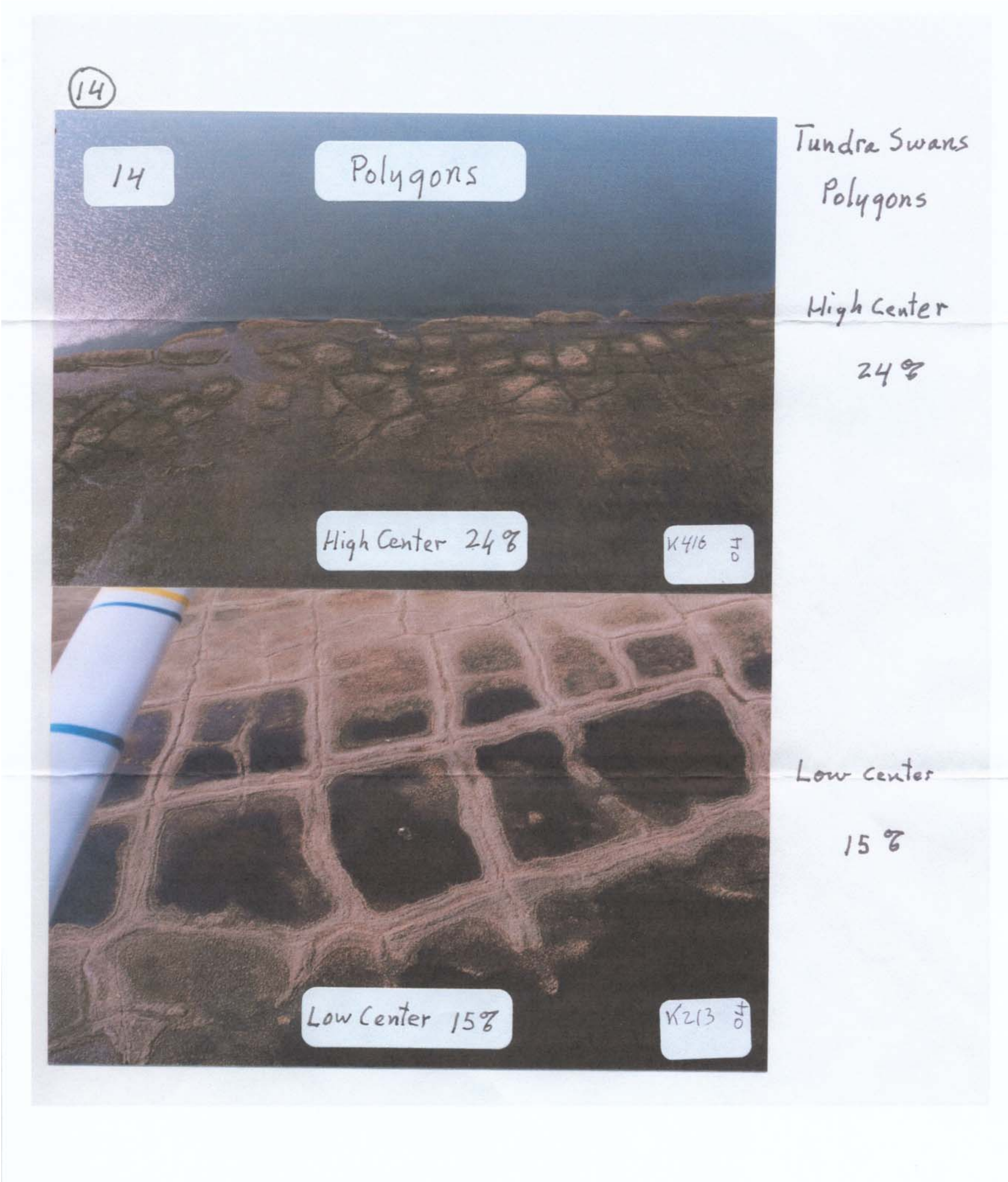

Figure 2. Aerial view of Tundra Swan nesting habitat.

MULTI-YEAR MONITORING PROGRAM FOR TUNDRA SWANS ON THE NORTH SLOPE OF ALASKA

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Editors Note: Following is a summary prepared from a PowerPoint presentation given at the 20th Conference. Only a few selected figures from slides are presented here along with the highlights of text taken from selected slides.

INTRODUCTION

ConocoPhillips, Alaska, Inc. is not required by any regulatory permit stipulations to perform Tundra Swan monitoring activities and surveys. However, swans are considered a key focal species for study due to their tendency to return to the same breeding area location each year, the relative ease of identification during aerial surveys, and because we believe the Tundra Swan would help us assess the overall health of the water bird communities that visit our oil fields.

We consider this program as a report card on how we are doing. I explain to my managers that this type of study would fall under a category I call "maintaining our license to operate." To their credit, they have supported this program since 1988 and these surveys are now included in all baseline data programs as a way to assess potential effects on Tundra Swans by monitoring their distribution and abundance before and after development in the oil fields. Information on nest locations has also been used during project design to route roads away from these areas.

Prior to regional aerial surveys beginning in the 1960s, Tundra Swans were described in terms of a few swans (Bailey 1948) or scattered pairs more or less irregularly (Gabrielson and Lincoln 1959) occurring each season.

With the onset of aerial surveys in the late 1960s and 1970s (King 1970, Welling and Sladen undated, Angus Gavin 1972), better information on distribution and abundance of Tundra Swans on the North Slope was collected.

Ground surveys, including Bill Sladen's marking program (Sladen and Kistchinskii 1977), behavior and habitat studies on the Colville River by a number of researchers (Hawkins 1986, Earnst 1992), productivity surveys in the Arctic National Wildlife Refuge (Monda 1991), and Lisburne disturbance monitoring by ABR, Inc. (Murphy and Anderson 1993), in the 1970s and 1980s improved our understanding of the Tundra Swan's ecological role on the north slope and on staging and wintering areas.

The region saw more intensive aerial surveys again in the 1980s, as U.S. Fish and Wildlife Service and the oil companies increased their interest in the overall health of this population as oil fields expanded, culminating in a long-term semi-annual survey of the Greater Kuparuk Oilfield beginning in 1988.

SURVEY AREAS

Areas surveyed for Tundra Swans, 1989–2005 (Figure 1):

- Ranged in size from 2,200–6,000 km² annually.
- Initially covered the Greater Kuparuk Area oilfield and Oil and Gas Lease 54.
- Expanded to cover the Colville River Delta and National Petroleum Reserve-Alaska (NPR-A), to the west of the Greater Kuparuk Area field.

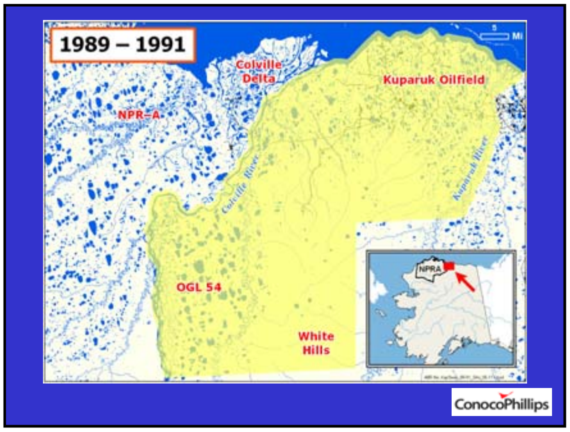

Figure 1. North Slope of Alaska. Note locations of the Colville River Delta and the Greater Kuparuk Area oilfield.

Tundra Swan Study Elements

- 1988: lake to lake brood-rearing survey Kuparuk
- 1989–2005: nesting and brood-rearing surveys following USFWS (1987) protocol: Kuparuk, Colville Delta, NPR–A

Kuparuk Oilfield (1988–2005)
- Distribution & Abundance
- Distance to: Infrastructure, Coast
- Lake Selection Analysis
- Multiyear territories: habitat use, fate by location, use
- Brood movements

Colville Delta (1992–2005)
- Distribution & Abundance
- Habitat Selection
- Disturbance Monitoring

NPR–A (1999–2005)
- Distribution & Abundance
- Habitat Selection

Figure 2. Survey methodology, years of data collection, and types of analysis.

It is important to note that there are 17 years, beginning in 1988, of consistent data from the Greater Kuparuk Area which represents the longest running swan data set in Alaska (Figure 2).

Figure 3. Tundra Swan nest habitat.

NEST HABITAT AND STUDIES

Tundra Swans prefer to nest in (Figure 3):

- Moist tussock or shrub tundra
- Complex polygonized tundra
- Salt-affected habitats
- Patterned wet and moist tundra complex

Nesting activity on the North Slope is highly correlated with spring temperatures. Comparing nest numbers with thawing degree-days (the number of degrees above 0° C) in the swan arrival and nesting period over 16 years, we found nest numbers were highest in warm springs with early snow melt and lowest in cool springs with late snow melt.

Based on 17 years of data in the Greater Kuparuk Area oilfield, the number of nesting swans increased in the early years to a peak in 1996 with 116 breeding pairs and has fluctuated between 72 and 115 breeding pairs since (Figure 5). Spring weather conditions influence nesting activity, and the data indicate that the best habitat may already be occupied by territorial swans, possibly limiting future increases in nesting. More fluctuations occur in the number of nonbreeding swans each year. Figure 4 illustrates swan nest distribution and oilfield infrastructure. 2002 was a high year for all three areas.

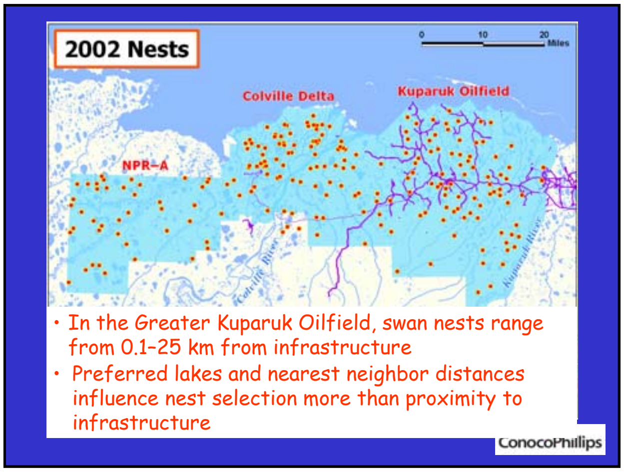

Figure 4. Tundra Swan nest distribution in 2002 on the North Slope.

Nest fate studies (2 years)

- Fate of nests close to infrastructure (90%) were similar to nests located in remote areas (85%).
- Fate of territories with >3 years of use were no more successful than those with single year of use.

Brood movements

Eleven broods were followed for 40 days in 1999:

- 2 broods remained on their nest lake.
- 9 broods moved between ≥ 2 lakes, not necessarily farther from infrastructure.
- 1 brood crossed moderately busy road twice during observation period.

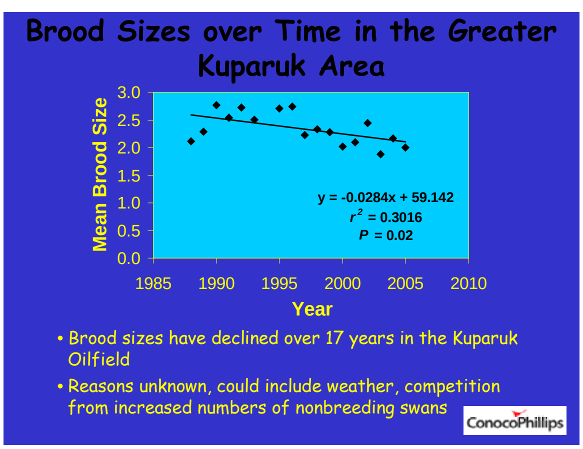

Figure 5. Brood sizes 1985-2005.

FUTURE MONITORING PROGRAM

ConocoPhillips plans to continue its Tundra Swan study and will:

- Continue aerial surveys to obtain broad regional population information.
- Conduct habitat selection analyses for Greater Kuparuk Area locations and compare with data from Colville Delta and NPR-A.
- Evaluate brood use of lakes to assess which lakes get repeated use over the years.
- Evaluate pre-/post-development use of the NPR-A and Colville Delta.
- Evaluate whether swans avoid areas developed for oil production by combining data on infrastructure and years before development from each region.
- Analyze declining brood size in Greater Kuparuk Area.
- Incorporate telemetry and banding to the program at a pilot scale in 2006.

Obtaining habitat information for the Greater Kuparuk Area oilfield could allow us to evaluate the multiyear territory data set we have to determine if habitat differences exist between long-term territories and those of single use and to look at possible differences (or similarities) in habitat selection within the other areas studied to the west (Colville Delta and NPR-A).

Applications of telemetry data

The addition of telemetry data will refine our understanding of:

- traditional use of nesting and brood rearing areas
- use of staging areas inside and outside of the oilfields
- wintering areas used by oilfield swans
- chronology of use

EDUCATION AND OUTREACH

ConocoPhillips plans to ultimately involve North Slope Borough students in the satellite tracking program by:

- Developing curriculum on swan biology in coordination with village educators
- Involving students in swan capture(s)
- Website development by schools

- Pen Pals with schools on East Coast

In addition, we will continue to educate ConocoPhillips employees and involve ConocoPhillips employees in swan capture(s).

In summary, ConocoPhillips will continue these studies in expanded areas as its commitment to monitor these birds as part of our License to Operate.

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PREDICTIVE MODELING FOR SUBMERGED AQUATIC VEGETATION (SAV) DECLINE DUE TO MUTE SWANS IN THE CHESAPEAKE BAY

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ABSTRACT

Mute Swans (*Cygnus olor*) have the potential to contribute to a reduction in Submerged Aquatic Vegetation (SAV) in the Chesapeake Bay, USA, owing to their high preference for SAV as a food resource, high population, year-round inhabitation of the bay, and great appetite. However, quantitative data on SAV decline due to Mute Swan herbivory along with other potential factors have not been hitherto generated for the entire bay. Based on biology and current knowledge of SAV and Mute Swans in the bay, we developed a suite of 15 *a priori* candidate models that could potentially predict SAV cover decline in the bay. Each model had Mute Swan population and/or one or more other potential environmental factors as independent variables (predictors) and SAV-percent-cover decline as the dependent variable. We generated data by measuring SAV percent cover reduction, water depth, extent of light penetration, salinity, and number of Mute Swan at 18 sites. Using these localized data, we further ranked all the candidate models through Akaike's Information Criterion (AICc) model selection. Based on the smallest value of AICc, we selected the predictive model including four predictors (water depth, extent of light penetration, salinity, and number of Mute Swans) as the most parsimonious model. It is clear that Mute Swans contribute to SAV decline, but it is not the most important factor.

INTRODUCTION

Mute Swans (*Cygnus olor*) are native to Eurasia and were introduced into North America in the late 1800s and early 1900s (Bellrose 1980, Ciaranca *et al.* 1997). Since the mid-to-late portion of the 20th century, Mute Swan populations have been rapidly expanding particularly along the Atlantic coast (Scott 2004). The portion of the Chesapeake Bay located in Maryland has greatly contributed to the expansion as the population increased at an annual rate of 23% between 1986-92 and 10% between 1993-99 resulting in the population as high as 4,000 individuals (Hindman and Harvey 2004). The phenomenal population growth of Mute Swans is harmful to Submerged Aquatic Vegetation (SAV) in the bay as it is the mainstay of their diet (Bellrose 1980). There is anecdotal information to conclude that Mute Swans impact SAV in the bay (Hindman and Harvey 2004, Perry *et al*. 2004). SAV in the Bay has been playing a vital role in providing habitat and food to numerous native organisms and performing several other ecological functions (Maryland Department of Natural Resources (DNR) 2001). It is a stressed resource since the 1960s due to several man-induced and natural factors (Hurley 1990, Naylor 2004). The increased population of Mute Swans has put additional pressure on SAV (Hindman and Harvey 2004).

Although Mute Swans are believed to contribute to the SAV decline and hamper SAV restoration activities in the Chesapeake Bay, quantitative data on reduction of SAV by Mute Swans is limited (Hindman and Harvey 2004).

Numerous other factors affect SAV growth in the bay including weather events (e.g., storm), natural population cycles, animal grazing and foraging, industrial pollutants, agricultural herbicides and general decline in water quality due to increased loadings of nutrients sediment from the surrounding watersheds (Hurley 1990). However, the relative importance of Mute Swan herbivory compared to abiotic factors is unknown. Therefore, we carried out this study with the primary objective to develop the best approximating parsimonious predictive model for SAV cover decline in the Bay using an information-theoretic approach.

STUDY AREA

We collected localized data on the eastern shore of Chesapeake Bay, Maryland (Figure 1). The bay is formed by over 150 rivers and streams and tidal waters of the Atlantic Ocean and is one of the primary waterfowl wintering areas in the Atlantic Flyway (Hindman and Stotts 1989, Meyers *et al.* 1995). The Chesapeake Bay traditionally has played a vital role in providing habitat to wintering native waterfowl, but now has been inhabited by thousands of resident exotic Mute Swans since the 1990s.

Chesapeake Bay is a 8-48-km-wide and 288-km-long shallow estuary, that lies in a north-south direction, roughly parallel to the Atlantic seacoast. The study area covered 18 sites in the mid-bay (8 in Talbot County and 10 in Dorchester County). The sites were located between 38° 25' 00" N and 38° 52' 30" N latitudes and 76° 07' 30" W and 76° 22' 30" W longitudes. SAV species in our study area were widgeon grass (*Ruppia maritime*), horned pondweed (*Zannichellia palustris*), slender pondweed (*Potamogeton pusillus*), and sago pondweed (*P. pectinatus*). Widgeon grass, which has tolerance to wide range of salinities, was wide-spread and most dominant (Tatu 2006). The population of Mute Swans was highest (total 3,286 individuals) along the eastern shore of the Chesapeake Bay (Hindman and Harvey 2004). Specifically, Dorchester (1,638 swans) and Talbot (1,023 swans) Counties in the mid-bay area supported the largest number of Mute Swans (Maryland DNR 2002, Hindman and Harvey 2004). Portions of these two counties were selected as our study sites.

METHODS

Data Collection

We established 18 study sites with SAV beds and Mute Swans (pairs/flocks) in Talbot and Dorchester Counties, Maryland, in 2003 and 2004. To assess the SAV cover decline under the influence of Mute Swan foraging at each site, we established multiple sets of treatment (exclosures) and control (open) plots in the SAV beds at each site before the on-set of the SAV growing season. Each site had three sets of 5x5 m control and treatment sampling plots. All sampling plots in a set were established in an SAV bed with uniform density level. Using a Daubenmire frame, we measured percent cover of SAV in all the sampling plots at each of the 18 sites at the end of the second consecutive season of SAV growth after the establishment of the sampling plots (Tatu 2006). Based on these measurements, we determined the difference in percent cover of SAV between 54 2-year-treatment and 54 2-year-control plots for each of the 18 sites. The percentage difference represented SAV cover decline for each site. Detailed information on exclosures and study design can be found in Tatu (2006).

We also measured environmental factors for each site. They included water depth (WD), extent of light penetration (LP), and salinity (S). Water depth was measured to the nearest 1 cm on a permanently marked pole, extent of light penetration (i.e., the ratio of Secchi depth to water depth) was measured using a Secchi disk, and salinity was measured using a YSI salinity meter. Moreover, we also estimated average Mute Swan population (SP) for each site by counting the swans fortnightly.

Model development

We considered a basic *a priori* model in which the predictors (covariates) for SAV cover decline (Y) were selected based on our current knowledge regarding SAV and Mute Swans in the bay. Its structure can simply be expressed as:

$$Y = (WD) \pm (LP) \pm S \pm SP.$$

We further translated it into statistical model in the form of linear regression model as given below:

$$Y = \beta_O - \beta_1 (WD) - \beta_2 (LP) + \beta_3 (S) + \beta_4 (SP), \text{ where}$$

Y = SAV cover decline at a site in the bay, β_0 = intercept, β_1 (WD) = slope on water depth, β_2 (LP) = slope on extent of light penetration, β_3(S) = slope on salinity, and β_4 (SP) = slope on average population of Mute Swans.

In developing the model we hypothesized that SAV-percent-cover decline (Y) had a negative linear relationship with water depth (WD) and extent of light penetration (LP), but had positive linear relationship with salinity (S) and average Mute Swan population (SP). Based on the basic model, we further developed 14 other *a priori* candidate models by considering biologically meaningful associations of the covariates (i.e., WD, LP, S, and SP) used in the basic model. As a result, we had a suite of 15 *a priori* candidate models, each having an unique structure (Table 1). In our *a priori* models, we did not include any interactions of covariates as there is typically only one model without interactions, but an infinite number of models with interactions because the interaction can be characterized by any function of the covariates (Mangel *et al.* 2001). We used an information theoretic approach to select the relatively best predictive model among the general linear models for SAV-cover-decline (Burnham and Anderson 1998). This method allows model uncertainty to be included in model evaluation and the derivation of parameter estimates (Hepp *et al.* 2005). The best approximating and competing models were identified using Akaike's Information Criterion corrected for small sample size (AIC_c) in Proc Mixed (SAS 2001), which determines AIC values based on likelihood. Model comparisons were made with ΔAIC_c, which is the difference between the AIC_c for each individual model and the lowest observed AIC_c value (Burnham and Anderson 1998). Models with $\Delta AIC_c \leq 2$ have substantial support from the data (Burnham and Anderson 1998). To evaluate support for model parameters, we summed AIC_c model weights across all models (parameter likelihood; Burnham and Anderson 1998). The AIC_c weight of a model signifies the relative likelihood that the specific model is the best of the suite of all models (Hepp *et al.* 2005). It was premised that the parameters with good support will have high summed AIC_c model weight values (near 1) due to that parameter's inclusion in most of the better models (Hepp *et al.* 2005).

RESULTS

Table 2 presents the data from the 18 sites that we used to evaluate the predictive models. Of the 15 candidate models, 8 models included swan population as one of its covariate either singly or in combination with one or more covariates. The remaining seven models did not involve the SP covariate, but we still retained them as we expected that the comparison of AIC values for such models with those involving SP might reveal the significance of swan population as a predictor for SAV decline. The best model (selected using the minimum AICc value = 127.5) contained the combined effects of water depth (WD), extent of light penetration (LP) (i.e., light penetration depth relative to total depth), salinity (S), and average Mute Swan population (SP) to predict SAV-percent-cover decline (Y) (Table 1). Thus, the most plausible model (which also was our basic model) is:

$$Y = 55.2929 - 10.7255WD - 38.3855LP + 8.1752S + 0.6477SP$$

DISCUSSION

In the selected parsimonious model, SAV-percent-cover decline (Y) had a negative linear relationship with water depth (WD) and extent of light penetration (LP), but had a positive linear relationship with salinity (S) and average Mute Swan population (SP). The model indicates that SAV decline would increase with increasing salinity (S) or average swan population (SP) at a site, and it would also increase with a decrease in depth of water (WD) or decrease in extent of light penetration (LP) at a site. An increase in SAV decline with decreasing water depth was predicted due to the possibility of greater destruction of SAV in shallower water because of its greater exposure to Mute Swan herbivory and other environmental factors (e.g., storms, strong wave action). An increase in SAV decline with increasing salinity was predicted considering that with the exception of eelgrass (*Zostera marina*), no SAV species in the bay is a true sea grass and so increasing salinity would be an adverse environmental condition for most SAV species in the bay (Hurley 1990, Short *et al.* 2001). Likewise, we predicted that SAV decline would increase with a decrease in extent of light penetration because less light penetration would decrease primary productivity of SAV.

There are no other competing models (as $\Delta AICc > 2.0$ (Burnham and Anderson 1998). The Akaike weights (Table 1) indicate that the best model selected based on minimum AICc values is very likely as well, with no other models coming close in terms of their relative likelihood. The Akaike weights for all the models in the candidate set sum to 1(Franklin *et al.* 2001). Therefore, the best model has a substantial proportion (84.3%) of the weight associated with all the models. In terms of strength of evidence, the best model is 8 times (0.843/0.108) more likely than the second-ranked model which did not involve the covariate of swan population. Moreover, the selected parsimonious model was 34 times more likely than the third-ranked model, which involved the covariate of swan population but not salinity. There was no support for the models involving only number (population) of Mute Swans as predictor variable or its association with water depth, salinity, or extent of light penetration.

We initially considered inclusion of nutrients (i.e., nitrogen and phosphorus) as one of the potential predictor variables in the basic *a priori* model, but after careful consideration about the nutrient-rich status of the bay, we did not include it. We considered that the increasing load of nutrients in water is ultimately linked with light penetration, the variable which we had already included in our basic *a priori* model. This is because excess amounts of nutrients like phosphorus and nitrogen cause rapid growth of phytoplankton, creating dense populations or blooms reducing the amount of sunlight available to SAV (Chesapeake Bay Program 2005). Measurement of extent of light penetration at 18 study sites (localities) on the eastern shore of the bay revealed that there was considerable variation in extent of light penetration from site to site. Thus, at seven sites extent of light penetration was as high as 100%, at two sites it was less than 50%, at another five sites its extent was 50% to 75%, and the remaining four sites had over 75% to less than 100% light penetration. Thus, considering variation in extent of light penetration from site to site, the relevant predictor variable (LP) might have high site-specific (i.e., locality wise) relative importance with respect to growth and survival of SAV in the bay. In Chesapeake Bay, the most important factor determining growth and survival of SAV is light (Chesapeake Bay Program 2005). In the best model selected by us, highest relative importance of the relevant predictor variable (i.e., extent of light penetration) can be judged from its highest weight (Table 1).

The other two predictor variables (water depth and salinity) also are important in determining growth and survival of SAV in the bay. This is because SAV is mainly restricted to water less than 2 m deep and different species of SAV have different salinity requirements (Hurley 1990, Chesapeake Bay Program 2004). Therefore, the most parsimonious model selected by us has appropriately included these two predictor variables. However, for the middle portion of the Bay (Talbot and Dorchester Counties), where the maximum population of Mute Swans in the bay was concentrated (Hindman and Harvey 2004), the locality-wise relative importance of these two factors might be lower as compared to that of extent of light penetration. Overall uniformity of water depth and salinity in mid-bay was the potential cause for the lower relative importance of the relevant predictor variables (i.e., WD and S). Thus, measurement of environmental factors at 18 study sites in the mid-bay portion revealed that water depth and salinity were more or less uniform among individual sites. At seven (39%) sites, water depth was 0.50 to 0.75 m, at another seven (39%)sites, the depth was over 0.75 m but less than 1 m and only four (22%) sites had 1 m (or slightly more) depth. At 15 (83%) sites, salinity was around 9-10 ppt, and the remaining 3 (17%) sites had salinity over 10 ppt. In our view, the relative importance of the salinity variable also would be low because 30 of the 34 SAV beds (88%) consisted of *R. maritima* only (Tatu 2006). The SAV beds consisting of only *R. maritima* covered about 97% of the total SAV bed area at our study sites (Tatu, in press) indicating its predominance in our study area. Because *R. maritim,* is a eury-haline species (Hurley 1990), salinity would not have a substantial impact on its growth and survival.

The relative importance of the predictor variable of the Mute Swan population (SP) might be lower than that of other predictor variables because Mute Swans are not the primary cause for SAV decline in the bay, but an additional factor (Maryland DNR 2001). Accordingly, the weight of this predictor variable was lower than that of other predictor variables in the best selected model (Table 1). Mute Swans likely cause a synergistic effect with abiotic variables, resulting in increased SAV decline in the Bay. Mute Swan control should be used along with other practices to combat SAV decline in the Chesapeake Bay.

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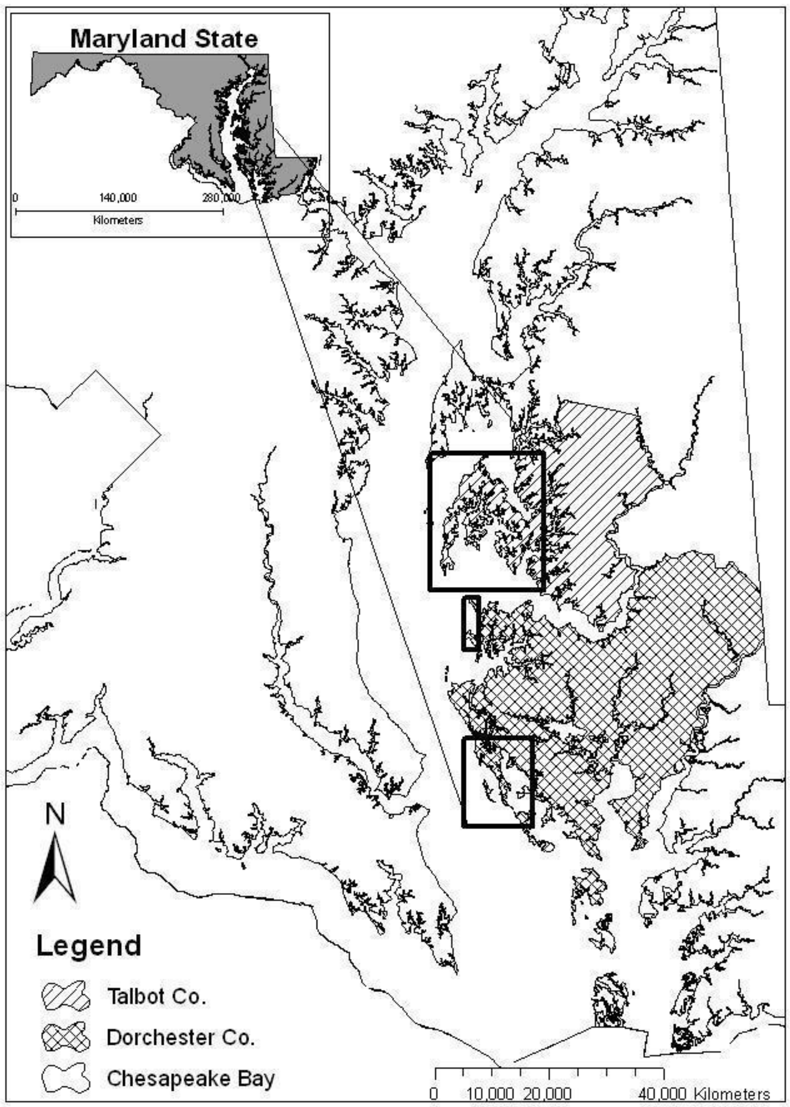

Figure 1. Portions of Talbot and Dorchester Counties, Maryland (marked) on the eastern shore of Chesapeake Bay where 18 sites for data collection were located, 2003-04.

Table 1. Ranking of 15 *a priori* candidate models relating Submerged Aquatic Vegetation cover decline to predictor variables (water depth [WD], light penetration [LP], salinity [S], and Mute Swan population [SP]) for Chesapeake Bay, Maryland, 2003-04. Models were ranked using Akaike's Information Criterion for small sample size (AICc).

Model structure	*Equation*	*AICc*	*ΔAICc*	*K*	w_i
Y = Decline in percent cover					
Y = WD ± LP ± S ± SP	55.2929 - 10.7255WD - 38.3855LP + 8.1752S + 0.6477SP	127.5	0	6	0.8430
Y = WD ± LP ± S	28.127 - 0.2264 WD - 21.0908LP + 3.3922S	131.6	4.1	5	0.1080
Y = WD ± LP ± SP	39.4587 - 5.0608WD - 27.1802LP + 0.5804SP	134.5	7.0	5	0.0250
Y = LP ± S ± SP	35.7047 - 33.6013LP + 7.5071S + 0.6303SP	136.0	8.5	5	0.0120
Y = WD ± S ± SP	40.0742 - 6.8446WD + 3.3218S + 0.5424SP	137.8	10.3	5	0.0050
Y = WD ± LP	66.1595 - 1.7946WD - 16.9337LP	137.9	10.4	4	0.0050
Y = LP± S	28.5030 - 20.9971LP + 3.3805S	140.2	12.7	4	0.0020
Y = WD ± S	76.6266 - 9.1784WD + 0.9758S	142.7	15.2	4	0
Y = LP ± SP	45.2999 - 25.2724LP + 0.5746SP	142.9	15.4	4	0
Y = WD ± SP	72.9620 - 7.1079WD + 0.5244SP	143.9	16.4	4	0
Y = S ± SP	33.8981 + 3.3724S + 0.5458SP	146.1	18.6	4	0
Y = LP	64.1566 - 17.5823LP	146.5	19.0	3	0
Y = WD	86.1549 - 9.2344WD	146.7	19.2	3	0
Y = S	68.6378 + 1.0239S	149.2	21.7	3	0
Y = SP	67.0658 + 0.5277SP	152.2	24.7	3	0

Table 2. Localized data on Mute Swan population and other environmental variables used to predict the best approximating model for Submerged Aquatic Vegetation decline using information theoretic approach (Burnham and Anderson 1998) on the Chesapeake Bay, Maryland, 2003-04.
[a]Total water depth (m).

WD[a]	*LP*[b]	*S*[c]	*SP*[d]	Y[e]
0.95	77.40	9.20	2	55.55
0.75	100.00	9.24	44	100.00
0.79	100.00	10.20	7	63.05
0.75	68.30	9.70	22	88.88
0.69	74.30	10.44	44	92.62
0.91	93.50	9.03	2	36.71
0.59	100.00	9.73	27	83.17
1.00	43.70	11.26	2	76.92
0.97	100.00	9.96	2	89.88
0.64	100.00	8.65	12	88.93
0.95	96.40	9.46	48	92.86
1.10	65.40	9.50	50	81.20
1.02	50.20	9.60	30	92.96
1.07	93.50	9.60	9	90.54
0.50	100.00	10.62	10	75.00
0.76	62.00	9.66	18	31.58
0.77	52.70	9.73	39	75.07
0.54	100.00	9.38	25	100.00

[b]Extent of light penetration= [Secchi depth/Total water depth]x100.
[c]Salinity of water (ppt).
[d]Mute Swan population.
[e]Decline in SAV percent cover due to Mute Swan herbivory, i.e. % difference in SAV cover in exclosure and open plots.

THE EARLIEST HISTORICAL RECORDS OF TRUMPETER SWANS - EXTRALIMITAL TO TODAY'S DISTRIBUTION

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Editors' Note: This paper was presented as a poster at the 20th Society Conference.

The earliest historical mention of swans in North America found by Banko (1960) extends back to 1632, when Thomas Morton wrote about their occurrence in New England. The next record mentioned by Banko is from John Lawson, who in 1709 documented their occurrence in North Carolina and was the first to differentiate between Trumpeter and Tundra swans; Lawson referred to them by name as "trompeters" and alluded to their nesting on lakes. Banko then comments that it was another century before Trumpeter Swans specifically appeared in the literature again, this time in the journals of Lewis and Clark; and that swans, in general, did not appear in the literature until 1795 when Samuel Hearne published his Hudson Bay/Arctic diaries from the period 1769-72. However, Banko contradicts himself after mentioning Belkamp's 1784 description of trumpeters in New Hampshire. Banko (1960) and Mitchell (1994) document fossil records from Florida; former breeding as far south as the Carolinas, Tennessee and Mississippi; and former wintering along the Gulf Coast to central Florida, along the Atlantic coast northward, and two winter records from Mexico as far south as Tamaulipas.

I have found an earlier record of swans in the literature, and it is a record that is extralimital from today's known historic distribution of swans. In 1587, John White recorded swans in the East Caicos Islands, southeast of southern Florida that, at that time of year, could only have been Trumpeter Swans. At the time he was leading an expedition to Virginia to establish a colony of which he would be the governor. White was an accomplished artist, of both Native Americans and wildlife in detail, and he had been part of the 1585 expedition to Roanoke in which he and Thomas Harriot accomplished an immense natural history survey of the region's flora, fauna, people, geography and geology. Some of his paintings even depict swans flying in the background. Previously, he had also been on one of Frobisher's expeditions to Baffin Island in 1577. Therefore, there is no reason to question his identification in the excerpt from his journal that follows:

"The sixt of Julie wee came to the Islande Caycos... others spent the latter part of that day in other parts of the Island ... some fowling, some hunting Swannes, whereof we caught many. The next daye earely in the morning we waied anker, leaving Caycos, with good hope, the first lande that wee sawe next, should be Virginia. About the 16. of July we fell with the maine of Virginia ..." (David Beers in Quinn and Quinn, 1985).

There is no other species of swan that this could be other than the Trumpeter Swan, presuming that Tundra Swans vacated the Atlantic seaboard then as they do now in spring and summer. Tundra Swans have been recorded as accidental in Bermuda, Cuba, and Puerto Rico (Limpert and Eamst 1994). It is interesting that White uses the phrase "...whereof we caught many," instead of "shot" many. Does that imply flightlessness, perhaps as cygnets or molters? Regardless, this is a significant extension of the known historical range of Trumpeter Swans whether they were breeders or nonbreeders. If these were molting birds, than that would further suggest Trumpeter Swans instead of tundras. Trumpeters typically molt in late June and July (Mitchell 1994), e.g., 13 July 1823 in Minnesota (Banko 1960) whereas tundras typically molt late July through mid-August (Limpert and Earnst, 1994; pers. observation).

OTHER EARLY SWAN RECORDS

In the interest of historical accuracy, it should be noted that there are other early records of swans that Banko (1960) overlooked. Thomas Harriot (1588) wrote "...and in winter great store of Swannes and Geese ..." occurred at Roanoke, North Carolina, in 1585-86. Although Hamot's account predates White's account, Harriot's swans cannot be prescribed as trumpeters or tundras because of the time of year. And, although White's paintings from the 1585-86 expedition depict swans, there is uncertainty to what time of year they were painted. Captain John Smith (1630) mentioned encountering swans in coastal Massachusetts during the summer and/or fall of 1614. Alexander Henry, one of the few English traders to survive the Ojibwa massacre of the British at Fort Mackinac on June 4, 1763, wrote, "I had, in the room in which I was, a fowling piece loaded with swan shot [at the onset of the attack]" (in Warren 1984, page 205*)*. Lastly, Jonathan Carver included swans among "a vast resort of all sorts of water fowl" along the Minnesota River, Minnesota, in the fall and spring of 1766-67 (Parker 1976).

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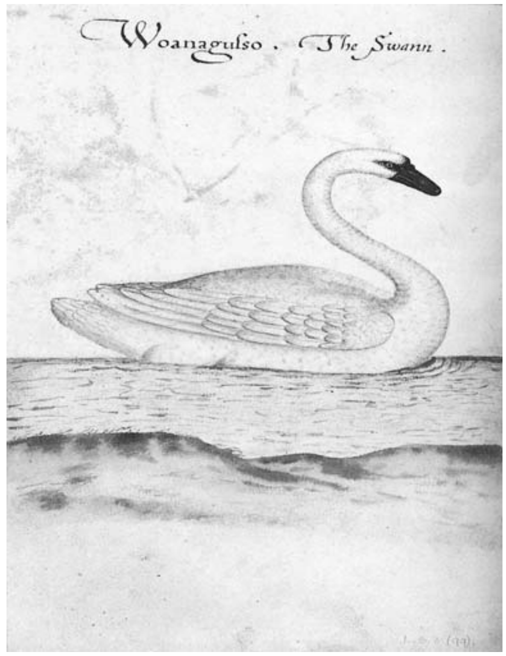


Figure 1. Swan painting by John White, 1585. From: Hulton, P. 1984. America 1585, The Complete Drawings of John White. University of North Carolina Press. © The Trustees of the British Museum.

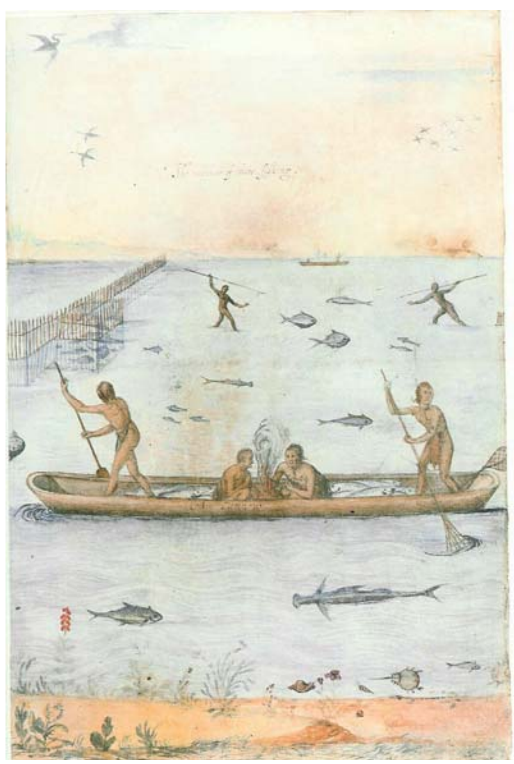
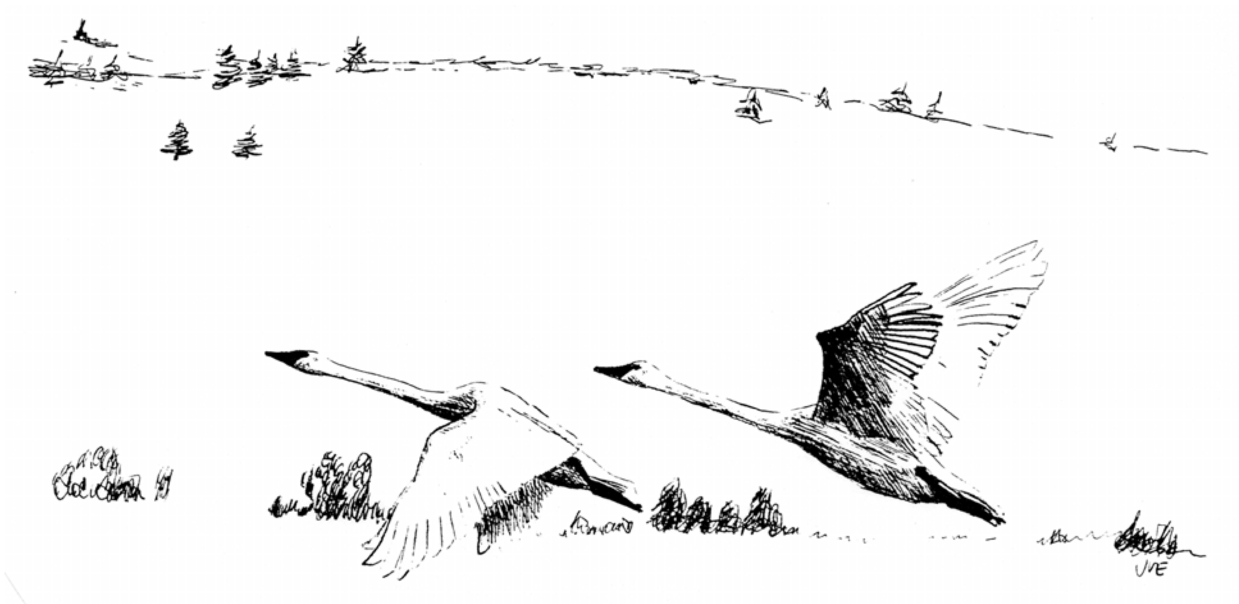


Figure 2. Indians fishing, with swans flying in background, John White, 1585. From: Hulton, P. 1984. America 1585, The Complete Drawings of John White. University of North Carolina Press. © The Trustees of the British Museum.

THE PRIVATE SECTOR'S ROLE IN RESTORATION



THE TRUMPETER SWANS OF MONTICELLO, MINNESOTA

Sheila Lawrence, 117 Mississippi Drive, Monticello, MN 55362

I am Sheila Lawrence and I live next to the Mississippi River in Monticello, Minnesota. Our stretch of the Mississippi has been a winter home for hundreds of ducks and geese since the start up of Monticello's nuclear power plant in the 1960's. During normal winters the warm water discharge keeps the river open for approximately 6 miles down stream. When winters are mild, the river remains open for 10, perhaps 20 miles.

We moved to Monticello in 1984. I enjoyed watching the ducks and geese and started putting corn out for them. One evening in 1985, I was watching the local news and they had a segment about a Trumpeter Swan being released. A woman was carrying a huge swan and when she got to the water she set it down and let it go. The swan took off running across the water flapping its wings the whole time. I was amazed at such a sight and thought wouldn't it be wonderful to work with those beautiful swans? You know the old saying, "Careful what you wish for, you just might get it." Little did I know then what fate had in store for me or just how much the Trumpeter Swans would change my life.

When I started seeing swans on the river I called around to report the sightings and was put it touch with Donna Compton. Once I met Donna in person, I realized it was her I had seen on the news that night. For those of you who didn't know Donna, she was a wildlife technician for Hennepin Parks and a very active member of The Trumpeter Swan Society. We all miss her dearly.

Fifteen swans wintered in Monticello for the first time during the season of 1987-88. By 1994, the count had grown to 90 swans and Donna asked how I would feel if sometime in the future there would be more than 300 swans wintering here. I clearly remember saying, "Donna, that would be wonderful, but I don't think I would be able to feed that many birds." I guess I never realized how far I'd go for those magnificent swans. Last winter it was estimated that over 1100 trumpeters were on our stretch of the river. This winter will mark the 19th year that the swans have graced our shores.

The swans come to Monticello when the lakes and ponds in our area are freezing over which has been as early as November 1st and as late as December 20th. At first they come in gradually and then sometimes there can be an increase of 400 birds in 1 day. It still astonishes me whenever that happens. With the first warm up in February, there is a noticeable drop of four to five hundred swans within a week's time. It is generally reported during the same time frame that an increase of a similar number of swans is observed on the Otter Tail River system, which is northwest of Monticello near the City of Fergus Falls, Minnesota. Based upon this, I am of the opinion that the birds nesting in the northwest area might have established a habit of leaving earlier than the ones from the central area where we are located. During mild winters on our stretch of the river, the majority of swans are here for 6 weeks or less. A person can usually see swans at Monticello from December into March, but I always tell people, "To see the largest number of birds you should come in January, since the other months are "iffy" and weather dependent."

Last year, I fed 1,200 pounds of corn a day when the whole group was here and adjusted it down as they started leaving. I figure the swans got 1,000 pounds daily and the ducks and geese 200 pounds or so. I have been feeding this ratio for the past 3 years. I put the corn in tubs that are high enough that a swan can easily eat from, but a goose has a harder time. Until 2 years ago, I logged countless hours hauling corn down to the river either using a sled or a wagon depending upon how much snow we had. Now, thanks to the insight and generosity of some wonderful people, there is an auger that moves the corn from the gravity wagon that sits in our driveway to the riverbank, a distance of almost 200 feet. With the auger my work has been cut by more than half. It is through this same generosity of private donations that most of the corn being fed is paid for each year.

Based upon my records and information that has been available to me, I feel the attrition rate has been small compared to the number of birds that winter here. The past 10 years have shown an attrition rate of less than 2% per winter with some years being less than 1%. However, I am certain that more swans have probably died on this stretch of the river during this time frame, but their carcasses were never recovered.

Over the past 18 years, my records show there have been 32 deaths caused by lead poisoning. There have been 26 fatalities due to collisions. Twenty-two of these were with power lines; three swans hit the Highway 25 bridge and one swan hit a water tower. One swan was found dead with its foot caught in a rope that was tied to a cement block. One cygnet died from a lung infection and there were at least seven unknown causes due to the fact that the bodies were either scavenged or I was not informed of the necropsy results. Even though their bodies were not recovered, I believe at least five swans died from extreme ice build up on their collars. I say this because of the conditions I witnessed and the fact that the collared swans did not return to their family groups and were never seen again.

I attempt to catch as many swans "in need" as I can, whether it be the classic "look of lead poisoning", broken wings or fishing line and lures. There have been several times when I've walked up to the house, dripping wet carrying a sick or injured swan and my husband Jim will shake his head and say, "You know Sheila, some day they're going to find you down at the Coon Rapids Dam."

Jim and I also check out reports of dead or injured swans in the area at the request of Three Rivers Park District, the Minnesota Department of Natural Resources (DNR) or concerned citizens. We do what we can to help in those situations. Sometimes it involves attempting to catch an injured swan or retrieving a dead one.

Although the swans have had to endure some harsh conditions, generally speaking, life is pretty good for them at Monticello. The swans that winter here appear to be thriving. During the first 10 years, the average increase from 1 year to the next was 38 percent with the lowest year being a minus 10 percent and the highest year being 88 percent. The 88 percent represents an increase in the flock size from 48 to 90 swans. For the past 5 years the average growth from year to year has been 21 percent.

For 18 years, I have kept track of and recorded the number of swans wintering on our stretch of the river. In years past, counting used to be so easy. Now it is challenging to remain focused and to concentrate on achieving a fairly accurate count. I have also kept track of the color and numbers of the collars and wing tags, plus all leg band numbers that I've had the opportunity to read with binoculars.

For the most part, the swans are relaxed around me, but they are not tame swans. They are wary of unfamiliar people and situations. In general, seemingly insignificant occurrences will alarm them. This can take the form of someone fishing from shore, neighbors doing normal activities in their back yards or park visitors going beyond the designated fenced area.

There was a time when I knew the personality of each trumpeter that ate at Sheila's Diner. It was like a soap opera from year to year. I followed the continuing change in the flock relating to which swan had lost a mate, which one found a mate, how many cygnets did each pair have and which youngsters felt grown up and strong enough to challenge the older birds.

A Hennepin Parks (since renamed Three Rivers Park District) swan, 54NA, spent 13 winters at Monticello and over those years she brought 27 cygnets with her. She died at the age of 19. My all time favorite swan, Minnesota DNR Number 7, spent 14 winters at Monticello and over the years she showed up with a total of 23 cygnets. She died at the age of 17. A cygnet from Number 7's first brood is MN DNR 9. If she returns this season, it will be her 17th winter at Monticello. Over the past 12 years, MN 9 has done her part to help increase the flock size by having raised 32 cygnets. Together these three remarkable female trumpeters have brought 82 cygnets to winter at Monticello.

My favorite couple was MN 7 and MN 8. They met and fell in love at the Minnesota Zoo and were then given to the Minnesota DNR. The pair was released with plenty of fanfare as that event celebrated the beginning of the DNR's Trumpeter Swan restoration program. Number 7 was a busybody and liked excitement, always instigating little battles even though she couldn't fight worth a darn. Number 8, on the other hand, was mellow and easygoing. He was a good fighter and defended her faithfully. The 3rd year, they brought their first cygnet to Monticello, which was MN 9. That same year Number 8 died when he hit the Minnesota State Highway 25 bridge on a windy day. The rest of the season, Number 7 seemed withdrawn, but she must have snapped out of it, because the next year she returned with a new mate and seven cygnets. It was rumored that Number 7 had only six cygnets that year and kidnapped the seventh one. It was good to see her up to her old tricks again. As fate would have it, 2 years later she lost her second mate. The following 2 years she wintered alone, but then, once again, Number 7 returned with a mate and cygnets by her side.

The swans have received plenty of media coverage both on television and in the newspapers. They have been featured on the evening news many times and on just about every outdoor TV program in the Minnesota area. Last year, an article was written in the St. Paul *Pioneer Press* and was picked up by a news agency and published in newspapers all over the country, even as far away as Hawaii. Word of the Monticello swans has, indeed, gotten around.

For the past 3 years, the Monticello Chamber of Commerce has been promoting the swans for tourism. It must have been fate again, as the city just happened to own a small lot right next door to where I live. They put up a split rail fence and warning signs to keep the swan viewers in the park so they would not disturb the birds. The City put in a walking path to make the winter walk up to the fence easier for the elderly and handicapped. They erected an informational sign about Trumpeter Swans and have a pamphlet and donation box in the park area. Two years ago, in addition to regular advertising, the Chamber of Commerce rented billboard space to catch the attention of travelers on Interstate 94.

Three years ago, a local artist was hired to make a beautiful swan sculpture that is on display outside the Monticello Community Center. Now there is a rumor concerning a plan to put in approximately 20 off-street parking spaces for the swan visitors in order to reduce traffic congestion on our little residential dead-end street. People have come from as far away as California, New York, Texas, and Connecticut to view the swans. The Chamber of Commerce estimated the number of visitors to the City Park last winter at 6,000.

Because of the swans, I have met and enjoyed the company of many interesting and good-hearted people. My life certainly is richer for the experience. The swans have led me on a remarkable journey, one that is still unfolding. I have had the privilege of watching the trumpeters grow from that small flock of 15 in 1987 to over 1,100 this past winter. For 18 years I've witnessed their antics, all the displaying, the trumpeting, courting and mating rituals, all those good fights, and how proud they can be of themselves and their families. To stand on shore at dusk and have 400 trumpeters fly in from all directions and land in front of you is truly an amazing experience. Memories like these I will always treasure. The way I see it, the swans have given me much more than I have given them. I would like to thank each of you for any part you may have played in making all this possible.

TRUMPETER SWANS FROM A VOLUNTEER'S PERSPECTIVE

Beverly and Ray Kingdon, 5024 Cenaber Court, Burlington, ON L7L 5G7

I began my second career in 1989 having answered an advertisement from Scott Paper Ltd. outlining a need for funding for a Trumpeter Swan reintroduction program for the Province of Ontario. I was recently retired from the Bank of Montreal due to health problems and felt the need to be involved in more than a financial way, in something that returned a benefit to society.

I answered the ad suggesting that perhaps a physical contribution would be more meaningful and I was referred to a gentleman named Harry Lumsden who suggested that, if I really wanted to be involved, I should dig a pond, fence it, and become a co-operator for the production of cygnet swans for release to the wild.

We owned a farm in Northern Ontario near North Bay and I immediately set about to satisfy his requirements. In the spring of 1990, Harry delivered a pair of captive, magnificent swans for our pond and I was officially a co-operator. It was fun and meaningful, but in the winter of 1993, this became a diminutive part of my Trumpeter Swan involvement.

Harry called in early December to advise that the first Trumpeter Swans to mate in the wild and migrate in Ontario in nearly 200 years were observed in the west basin of Lake Ontario, close to my winter home. Overnight, my life and priorities changed as I became responsible for six cygnets and their parents.

It was imperative that we keep this brood healthy and prevent any further migration south because the danger from power lines and lead poisoning was, in our opinion, a significant impairment to their survival. The swan family thrived and every winter the pair returned with their current year's cygnets and past year siblings until the numbers grew to a point where some structure in our system became necessary.

The need for information regarding nest sites, routes of migration, brood sizes, and health and habitat conditions became more critical and a volunteer group was necessary to provide this information for the overall coordinator of our Province. I knew that we needed many eyes in the sky and province-wide information availability, so I set about to cultivate birding groups, horticultural groups and all people interested in the preservation of nature and wildlife.

Accomplishing these critical points would require a considerable number of dedicated volunteers. To gain an appreciation for the magnitude of our current volunteer group, in a recent application for a funding grant from the Trillium Foundation of Ontario, our donated hours to the program were valued at $268,000.00 per year, using $12.00 (Canadian) per hour to arrive at the total.

Included in the volunteer hours are the co-operator participants who raise cygnets for release to the wild and Ron and Michael Bauman at Fair Lake who cared for and fed the cygnets in the pens owned by the Grand River Conservation Authority for 2 years prior to their release.

Over and above my involvement in the points addressed, it became obvious that we had a requirement for funding to carry on with the valuable work that was being done in the reintroduction program. I was personally involved in securing private funds to assist the swan reintroduction program at Wye Marsh Wildlife Centre (Wye Marsh) in Midland, Ontario, which was a principle release site and to erect a small hospital for recovery of sick and injured swans at that centre.

I was also fundamentally involved in securing a grant from the Trillium Foundation to cover a portion of 4 years of expenses for the Ontario swan program.

To maintain continuity and allegiance, I served on the Board of Directors at Wye Marsh, South Peel Naturalists' Club and the Callander Horticultural Society. I also became a member of the Amhurst Wildlife Foundation, who bank the donations and pay the bills for the Ontario Trumpeter Swan program, as well as a member of Nipissing Naturalists' Club, Friends of Mashkinonje, Royal Botanical Gardens and am an active member of the Bird Wing of Nipissing. I also maintain a working relationship with Canadian Wildlife Service who assists us in reporting bird mortality along the beach strip in the west basin of Lake Ontario.

My volunteer activity has placed me in a close working relationship with the Wild Bird Clinic at the

University of Guelph who provide medical treatment and scientific information on all of the injured and dead Trumpeter Swans.

Several of our volunteers, including myself, are involved in aerial surveillance of nest sites and cygnet counts as well as expanded locations as the swans move further and further into Northern Ontario.

Three dedicated volunteers, my husband Ray, and I are responsible for the winter feeding program in the west basin of Lake Ontario which winters 25% of the total Ontario Trumpeter Swan population.

During the winter 2004/05, our numbers were 132 birds and they, along with some other wintering waterfowl, consumed 2,200 pounds of whole shelled corn. Our winter feeding program is considered essential since our numbers are fragile and we wish to prohibit further southward migration until we have a self sustaining population of trumpeters. At the winter feeding site, our volunteers assist in sexing, banding and tagging, throughout the winter months.

The over-wintering program has provided me with the opportunity to spend considerable time with the trumpeters. I have had the leisure to befriend and study behaviour patterns of parents, families, and individuals on their own. Some of my observations have been unique and considered valuable by Harry Lumsden who is the recipient of this information.

Further into my involvement with the feeding program, I was able to collect data on a particularly hazardous stretch of west basin beach between Burlington and Hamilton, a direct swan flyway from Lake Ontario to Burlington Bay along which run several strands of high tension power lines.

With the assistance of the Canadian Wildlife Service and South Peel Naturalists' Club, we had positive meetings with Ontario Hydro One who, after reviewing the facts we presented, agreed to place bird flight diverters on their lines by the Burlington Bridge, which resulted in a substantial reduction of mortality of all bird types, including swans.

In 2002, it was determined that Lake Nipissing near North Bay in northern Ontario would be an ideal release site for Trumpeter Swans and, over the next 3 years, 26 swans were released in that area.

I am particularly gratified that the Bell Telephone Company of Canada, that is responsible for all phone services, considered our project important enough to places a pair of magnificent Trumpeter Swans on the cover of their 2006 telephone listing edition for the entire North Bay area. North Bay is my birthplace.

The Ontario program has been very successful. We currently have 523 free-flying birds and 82 pairs of breeding age and are nearing our objective for a self sustaining population.

These 15 years have been wonderful, fulfilling, and gratifying, giving me an overall feeling of returning something back to the world.

My mentor, benefactor, and very dear friend Harry Lumsden was rightfully awarded the Order of Canada for his tireless efforts in bringing the Trumpeter Swans back to Ontario. This is the highest recognition in our country for an individual and Harry has many times credited the entire success of the program to our strong and dedicated volunteers.

It is a pleasure and an honour to present this information to you, a dedicated group who are overall responsible for the successful reintroduction and protection of one of the magnificent birds of North America and I am pleased to play a small part in such an overwhelming success.

THE NESTING TRUMPETER SWANS OF DAWN, MISSOURI

Bud Neptune, 19154 County Road 100, Dawn, MO 64638

My wife Debbie and I live in Dawn, Missouri, south of Chillicothe, along the Livingston - Carroll county line. We have a 1.5 acre pond on our property that is located in the timber. This summer we were extremely blessed to host a breeding pair of Trumpeter Swans. Much of the land near our house is in timber, brush, hay pasture, and row crops. There are 6 square miles south of our house that are wild with no roads running through. There is a Missouri Department of Conservation (DOC) Wildlife Area not too far away where crops such as soybeans, wheat, and corn are planted to provide food for the wildlife. There are no power or telephone lines on our property that would present any obstruction or danger for waterfowl landing in our pond. In fact, there is a 100 - 150 yard-long strip of clear flying towards the pond dam. Behind the dam is a cornfield.

Our swan story started when one of our sons, Scott, was down turkey hunting at our pond earlier this spring and saw what would have been a male Trumpeter Swan. He did not see the female who we now know must have been sitting on a nest. In early June 2005, I was down at our pond catching blue gills for bait for lines for the Grand River and saw the pair of swans with what looked to be two very small babies in between the parents. About a week later, Debbie was with me and we confirmed that there were actually three babies. The babies stayed very close to the parents who were very protective.

Once we realized we had Trumpeter Swans on our property, a couple of friends from Chillicothe who belong to the local Audubon Society brought down a spotting scope and were able to read a red neck band "J94" on one of the birds. I had also e-mailed the National Wildlife Society who then contacted Ron Andrews, a biologist with the Iowa Department of Natural Resources (DNR). As it turned out, Ron Andrews and his assistant Dave Hoffman were aware that the trumpeter pair had been in our area in 2004. I had seen the swans flying as well, since the pair had been visiting area ponds and lakes within a 5-mile radius from our property. We were told by the Iowa DNR that J94 was a male trumpeter born in northwest Iowa in 2000 and was released in Southeast Iowa in 2001.

The DOC Wildlife Area may be one reason the swans stayed in our area. Last winter, it was mainly open and there was a lot of available planted winter food. Also, the Grand River that is 12 miles north of our farm, just south of Chillicothe, stays open most of the winter. Further, we live about 30 swan-flight miles west of the Swan Lake National Wildlife Refuge, Sumner, Missouri, where the Iowa DNR had reports of these swans being spotted 2 years ago.

We limited our visits to the pond to about once a week so as not to scare the swan family. We bought a new camera to take photos and I also have about 20 minutes of video of the swans. The birds seemed to be getting used to us. I e-mailed The Trumpeter Swan Society who sent me a packet of swan information and also read whatever else I could find out about swans on the Internet. The Iowa DNR folks were quite excited that this was the first documented successful nesting of Trumpeter Swans in Missouri since 1876!

We kept the swans a carefully guarded secret most of the summer since we did not want to scare them off their breeding pond. But, we knew that once the young learned to fly, they would be flying in the area and local people needed to know about them to help keep them safe, especially during goose hunting season. The swans made the front page of *The Kansas City Star* in August 2005 with a large color photo of the two adults and the three large cygnets. There are also plans for the Missouri Department of Conservation to run a story in some of their state wildlife publications.

I believe that there definitely would be more interest from other private landowners in the Mississippi Flyway if the private land owners thought they could develop a nesting lake with the right habitat on a smaller acreage – perhaps between 6-120 acres.

We are glad that God blessed us with the feathered visitors from Iowa and for all the hard work that you and the various conservation personnel in the various states have performed in preserving this magnificent bird.

Figure 1. Scene showing the Neptune's pond habitat in Dawn, Missouri.

Figure 2. Trumpeter pair and three cygnets on the Neptune's pond, Dawn, Missouri.

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 ~ 500 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 Swan 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. The Society headquarters is located at Three Rivers Park District, Plymouth, Minnesota. We publish our newsletter *Trumpetings* three times per year and *North American Swans*, schedule determined by the Executive Committee. We are a nonprofit, tax exempt corporation under Section 501(C)(3) of the Internal Revenue Code. Contributions are tax deductible. To find additional information and a listing of the Board of Directors, please visit the TTSS web page at www.trumpeterswansociety.org

Category of Membership - (Membership year is January 1 to December 31)
Please check one:

☐ Student	$ 15.00	**AFFILIATE MEMBERSHIP CATEGORIES**		
☐ Retired	15.00	☐ Supporting	$	100.00
☐ Regular	25.00	☐ Contributing		250.00
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☐ Organization	50.00			
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An Affiliate membership will be accorded to any persons or organizations paying $100 or more per year for membership, excepting life memberships which are paid only once.

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Please make checks payable in U.S. Dollars to The Trumpeter Swan Society.
Canadians please indicate "in U.S. Dollars" on check. U.S. contributions are tax-deductible.

Mail to: The Trumpeter Swan Society, 12615 County Road 9, Plymouth, Minnesota 55441.