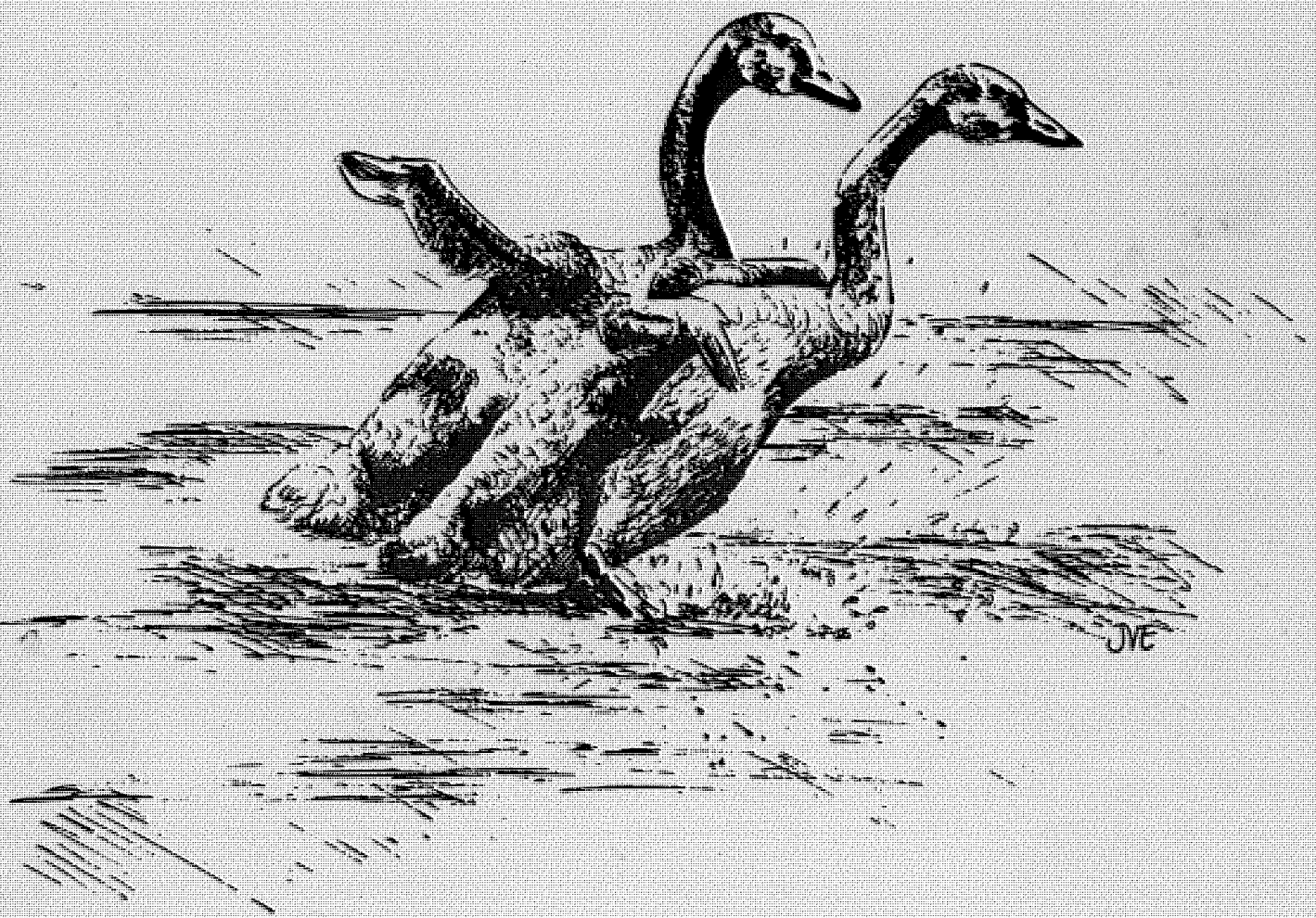
Burgess

PROCEEDINGS AND PAPERS OF THE TENTH TRUMPETER SWAN SOCIETY CONFERENCE

1986



PROCEEDINGS AND PAPERS OF THE TENTH TRUMPETER SWAN SOCIETY CONFERENCE

Donna Compton
Editor

3-6 September 1986
Grande Prairie, Alberta

Conference Chairmen

Richard W. McKelvey

Gordon R. Holton

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PREFACE

During the past 20 years, The Trumpeter Swan Society has held its biennial conferences in some remarkable areas. In 1986, the Tenth Conference was held in Grande Prairie, Alberta, the only location so far to have been visited twice. Not only is Grande Prairie an interesting place in terms of Trumpeter Swans and swan habitat, but it was a logical choice given the focus of the Ninth Conference on the Tristate area. It seemed appropriate to visit the Grande Prairie breeding area right after visiting the Tristate wintering area with questions raised about "the other half" of the range relatively fresh in our minds.

The objectives for the Tenth Conference flowed from the momentum generated by the Ninth Conference. Those objectives were to:

1. Update progress made on management and research of Tristate Trumpeter Swans since 1984.
2. Review the history of management of Trumpeter Swans in Canada with particular reference to the Grande Prairie area.
3. Review programs for reintroducing Trumpeter Swans to former ranges.
4. Review the current world status of Trumpeter Swans as revealed by the 1985 survey.
5. Encourage more Canadian membership in The Trumpeter Swan Society.
6. Provide an opportunity to view habitat of Trumpeter Swans in the Grande Prairie area.

The Conference met all objectives. Participants from all over the continent heard about and saw for themselves Trumpeter Swans and swan habitat from the heart of the range of the Trumpeter Swan in Canada. Old friendships were renewed, and new friendships were made. The papers presented and the general environment of the Conference stimulated many interesting discussions.

The accomplishments of the participants of the Tenth Conference have been recorded in these Proceedings. Let's hope that when the next Trumpeter Swan Society conference occurs in Grande Prairie, as many accomplishments in Trumpeter Swan research and conservation can be recorded as have been here.

Rick McKelvey
Conference Co-chairman
President
The Trumpeter Swan Society
July 1987

PROGRAM

3 September 1986

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4 September 1986

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The Trumpeter Swan Society's Red Rock Lakes Study Committee recommendations: a U. S. Fish and Wildlife Service update . . . . . Barry Reiswig
Trumpeter Swan population winter habitat relationships in the Tristate area. . . . . .Ruth Shea Gale
A review of wintering Rocky Mountain Trumpeter Swan Population survey estimates: 1977-1986. . . . . Barry Reiswig
Wyoming Trumpeter Swan progress report . . . . . Dave Lockman
presented by Barry Reiswig

Panel discussion: The future of Trumpeter Swans in the Tristate area . . . . . Moderator, Harold Burgess
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Minnesota Department of Natural Resources Trumpeter Swan project summary - 1986. . . . . Carrol Henderson
New goals for the second half century of Trumpeter Swan restoration. . . . . Jim King

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5 September 1986

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6 September 1986

Programs for Reintroducing Trumpeter Swans to Former Ranges . . . . . Session Chairman - Geoff Holroyd

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Status report of the Lacreek Trumpeter Swan flock management plan, August 1986 . . . . . Rolf Kraft

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Status of Missouri's experimental Trumpeter Swan restoration program . . . . . John Smith
Progress report on impact of collecting Trumpeter Swan (Cygnus buccinator) eggs in Minto Flats, Alaska-1986 . . . . . Rod King
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ACKNOWLEDGMENTS

The Tenth Trumpeter Swan Society Conference was cosponsored by the Canadian Wildlife Service and the Alberta Fish and Wildlife Division. We wish to thank all those who participated in the Conference by presenting papers or by taking part in panel discussions. The Conference would not have been possible without the support of the agencies those people represented or without the strong personal interest in Trumpeter Swan conservation by those who attended unsponsored. The Grande Prairie local committee, consisting of Beth Sheehan and Ruth Estlin, through its diligent efforts and hospitality, insured that the Conference ran smoothly.

We would also like to thank Canadian Hunter Exploration for hosting lunch during our field trip and for providing a tour of their operations; Ducks Unlimited for sponsoring the evening social; the City of Grande Prairie for making the Park Pavillion available; and all other corporate sponsors. Garnet Anthony provided us with some interesting insights and entertainment at the banquet.

Donna Compton and Ann Bassett ably managed the final preparation, organization, and typing of these Proceedings.

Rick McKelvey and Gord Holton
Conference Co-chairmen
Tenth Trumpeter Swan Society Conference
July 1987

Special commendation goes to Conference Co-Chairmen Gordon Holton, Alberta Forestry, Lands and Wildlife, Peace River, Alberta, and Rick McKelvey, Canadian Wildlife Service, Delta, British Columbia. They used much imagination and diligence in communicating with potential speakers and in developing a Conference program that emphasized Canada's involvement with Trumpeter Swans, yet touched on all facets of Trumpeter Swan management in North America.

Again, we have dedicated ourselves to helping the magnificent Trumpeter Swan survive and flourish.

Harold H. Burgess
Past President
The Trumpeter Swan Society
June 1987

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HISTORY OF TRUMPETER SWANS IN THE GRANDE PRAIRIE AREA

EARLY HISTORY OF TRUMPETER SWANS IN THE GRANDE PRAIRIE AREA

Beth Sheehan, Director, The Trumpeter Swan Society

Good Morning! Welcome to Trumpeter Swan Country!

At the outset I should say that since I did not have access to official records, except for a few instances, the material I have put together was gleaned almost wholly from newspaper articles. I think of it more as the folklore of Trumpeter Swans in our area than statistics.

How long Trumpeter Swans have been in the Grande Prairie area, as in most places, is not certain. Explorer David Thompson, in journals written while camped on the Smoky River in April 1803, mentioned swans at least twice, but in April they could have been either Trumpeters or Tundras (formerly known as Whistling Swans). As yet, I have not pinpointed the Grande Prairie area specifically in other explorers' journals. The oldest area record that was likely to have been of Trumpeters was in the diary of Oliver Johnson of Beaver Lodge, a homesteader who saw two swans on 12 June 1908, and a week later said that Indians had killed a swan at "the lake," probably meaning Hay Lake, renamed MacNeil, about 4-1/2 miles from his homestead. Swans continue to use this lake today.

W. L. Brainard homesteaded by Sinclair Lake. He said there were two Trumpeter Swans there every summer from 1910-26. He also mentioned muskrat trapping on the Lake. The island where the swans nested was burned off by the trappers, and he hadn't seen the swans since. He suggested protection of the Lake and swans (letter, Department of the Interior, Canada, courtesy Ron Mackay). This lake, too, has been used by swans fairly constantly in recent years.

In 1912, Dr. Annie Higbee, a medical doctor, told of staying with a family north of Clairmont Lake, and having stewed swan for several meals. She intimated that she didn't find the meal entirely palatable! Was it the bird or the cook? ("Pioneers of the Peace" history book.) Also, in 1912, Dan Wishart shot a swan and had his picture taken with it at Kleskun Lake, approximately 10 miles east of Sexsmith (interview with Jessie Wishart Elliott 1982). The next year, he wintered four young Trumpeters in a barn there. They left in the spring, but returned occasionally during that first summer (Grande Prairie Herald-Tribune, 22 January 1948). In 1918, Kleskun Lake was drained and turned into what promoters hoped would be the largest cattle ranch in the world. The project failed in 1927. It is now a community pasture for sheep and cattle, not a nesting site for Trumpeters (Sexsmith to the Smoky History).

J. B. Oliver, a landowner on Flying Shot Lake, said a pair of swans had been coming there each summer since he took up land in 1919 (Grande Prairie Herald-Tribune, 14 September 1944). This is the present home of collared swan 2-I. Its family has spent several winters at Red Rock Lakes National Wildlife Refuge in Montana.

Little Lake, next to Lake Saskatoon, was bordered on the southeast by Leo Ferguson's homestead. Each year, swans on the Lake molested Leo's turkeys and chickens and killed tame goslings. There was a "mighty battle" in June 1938. Mr. Ferguson described it: "The geese were assembled near the shore when the swan, which is exceptionally large, made its appearance and charged into the flock of geese. The gander stood his ground, and the fight was on. The gander put up a great battle, but the swan was too strong and heavy. Once he grabbed the gander by the back of the neck, lifted him off the ground and threw him several feet. Seeing that the gander had no chance, I drove the swan away." Mr. Ferguson was frustrated. "As these birds are protected by law, I don't know what to do," he said but planned to take the matter up with the police to see if he could get permission to shoot the marauder (Grande Prairie Herald-Tribune, 22 January 1948). I found no follow-up story, but, 48 years later, this lake is still an historic site for swans and is presently home to a pair with seven cygnets.

There was still some doubt voiced by Ducks Unlimited representatives as to whether the Grande Prairie area birds were Trumpeters. The local people were sure that they had Trumpeters. To prove their point, a local doctor sent a dead swan to the University of Alberta, in Edmonton, to be necropsied. In 1939, DU admitted that it had been proven that the Grande Prairie birds were Trumpeters (Northern Tribune, Grande Prairie, 9 June 1938).

In November 1939, Tom Corlett of Clairmont warned that it would be too bad for anyone who shot any of the eight swans he had been feeding for some time. The birds had become so tame they would eat out of his hand, and he hoped they would return in the spring (Grande Prairie Herald-Tribune, 9 November 1939).

There was no report of them coming back to him, but Clairmont Lake was an historic nesting site until 1969 when a sewage lagoon for the hamlet of Clairmont was placed at its outlet, raising the water level 2 feet. Since the Lake has been lowered and, although no swans have nested there since 1972, they do gather there in the fall. (Postscript: 22 May 1987 - a pair appears to be nesting on Clairmont Lake this year!)

Fifty Trumpeter Swans flying over Grande Prairie were news on 24 April 1947, but the story had a different twist. They flew over just after a CPA plane landed. The plane had passed close to the formation and the pilot said, "The birds were flying right on the beam, their pontoon equipment in good order for a landing on Bear Lake or Saskatoon Lake." It was reportedly the largest formation even seen here in the spring (Grande Prairie Herald-Tribune, 24 April 1947).

History was in the making in June 1947, when the Tomshak boys of Clairmont went to Ferguson Lake, which is really a large slough west of Clairmont. It had dried up, and the boys found five abandoned Trumpeter cygnets that had been unable to follow their parents to Clairmont Lake, a mile away. They took three and left two cygnets, thinking the parents might go back for them. Later, those two were found dead. Permission was given to keep the live cygnets, providing they were not constrained and were allowed to migrate in the fall (Northern Tribune, 13 November 1947).

For the next 7 years, there were no dull moments at the Tomshak farm. A hen adopted the cygnets and kept them warm until they outgrew her. She followed them to the farm dugout when they swam and waited on shore for them to come to feed. Their instinctual dislike of geese soon showed when they chased the tame geese from the farm dugout. The cygnets made no attempt to join the family of Trumpeters on nearby Clairmont Lake or others when they gathered on the lake for the fall migration. By 20 November, though the dugout and Lake were frozen, the farm was still their home (Northern Tribune, Grande Prairie, 13 November 1947).

The Tomshak boys found two more cygnets on the ice of Clairmont Lake and took them home. One died, but the second survived, although it could not fly. There were now four swans eating a large pailful of grain daily, content to stay. The press noted, "Perhaps they will start a new trend in swan history and dispense with the annual southern migration altogether" (Grande Prairie Herald-Tribune, 11 December 1947). The flightless swan and one of the original cygnets were sent to the zoo in Edmonton (Grande Prairie Herald-Tribune, 15 January 1948). The two remaining swans were named Tommy and Beulah.

There were many visitors to the farm to see the big birds. In January 1948, folks in town were also getting a show. When Mr. Tomshak drove the 7 miles to Grande Prairie, the swans followed. While he went about his business, they circled above or landed next to the car to wait. When he drove off, they flew after him. "They were well trained," Mr. Tomshak said. "If they were flying and I called, they would answer and come back." He also said they were good watch dogs. They would not let a stranger in the yard unless he wanted them to (Grande Prairie Herald-Tribune, 15 January 1948 and 24 June 1964).

In June 1948, Dr. Duane Featherstonhaugh, and two other people from the Audubon Society, came from New York to look for Trumpeters. They expected to find one pair at the most and had planned to search for Whooping Cranes farther north, as well. Dr. Featherstonhaugh was so fascinated with the Grande Prairie Trumpeters, he stayed 2 months and missed the crane hunt entirely (Grande Prairie Herald-Tribune, 1 July 1948; Natural History, October 1948). Until this trip, the Audubon photographic files had only a single picture of Trumpeter Swans. The New York State Museum in Albany had a Trumpeter specimen in a case with a Great Auk, a Passenger Pigeon, a Labrador Duck, and a Carolina Parraquet. A sign read, "Five birds you may never see again."

The researchers learned from local people of the joint migration of Trumpeters and Whistlers and that the Whistlers only stopped for a few days to rest. Dr. Featherstonhaugh concluded that "Flights such as these in which the majority of the birds were whistlers may account for the reports of the great abundance of trumpeters years ago. Many authorities today doubt that the species was ever particularly numerous."

He also wrote, "The National Audubon Society estimates that about 1,500 of these magnificent birds remain. Most of them breed in the interior of western Canada and migrate westward to winter in the milder coastal areas of southeastern Alaska and British Columbia. There is a smaller concentration of them in the Red Rock Lake-Yellowstone Park area. These are non-migratory."

Of the Tomshak swans, he said, "When we saw them they were as tame as domestic fowl...Canadian bird lovers have urged the Dominion Wildlife Service to allow the birds to remain there in the hope that they are male and female and will breed...the author also recommends this strongly. There is much to learn of the breeding habits of the trumpeter, and here is an opportunity that may never come again." He found that many published statements regarding Trumpeter Swans were wholly or partially incorrect, but some of his statements were also later found to be erroneous.

Dr. Featherstonhaugh and his crew found 41 nests in the area. Including 12 pairs of non-nesting swans, their total was 106 adults. No cygnet count was given in his write-up. Surprisingly, they found many nests close to farm dwellings, and another was close to the airport. The swans did not seem to be disturbed by work on farms or by the noise of planes. Five nests were reported on one lake. The name and location of the lake was not given, nor was any documentation offered.

The incubation period was not known. Dr. Featherstonhaugh wrote that a Clairmont man had taken a swan's egg from a nest the day it was laid and put it under a goose. It had hatched in 38 days. There were eight eggs in the Ferguson Lake nest which the researchers had been checking regularly. When the female was seen with five cygnets, the crew hastened to the Lake with cameras, not without fear of being attacked. The female paid little attention as she took the cygnets into the bulrushes and was joined by the male. At the nest, a wet cygnet, peeping, was trying to work its way out of the nest. There was an unhatched egg beside it, and the eighth egg was missing. While photographing the struggles of the cygnet, the second egg moved, and an opening appeared. For the first time in known history, the hatching of a Trumpeter Swan was witnessed and photographed. The adult swans watched but showed no signs of alarm.

Dr. Featherstonhaugh made many interesting observations and comparisons that I do not have time to recount, but, after a 2-month stay, he concluded that all was well with the Grande Prairie Trumpeters. He said, "Prohibiting of all shooting over lakes where swans breed would lessen the danger from lead poisoning. But, a more practical solution would be the use of nonpoisonous shot. There seems to be a good probability that this will become available, and the sporting public should be induced to use it."

By 26 January 1949, the Tomshak swans were spending their second winter on the farm. They flew across Clairmont Lake to call on Dick Oatway one day. He invited them in. They accepted and ate the bread he offered, stayed about 1/2 hour, then flew off (Grande Prairie Herald-Tribune, 10 March 1949). Only 3 weeks later newspaper headlines read, "Tame Trumpeter Swan Found Dead on Road, Killed by Passing Car." It had the impact of announcing the death of a V.I.P. We didn't have pavement then, and the swans had probably claimed a puddle on the highway. Beulah lost the battle with a vehicle trying to drive her off. The death was unfortunate, for there would soon have been plenty of open water elsewhere for the swans. Two days later, Tommy was reported to be menacing cars and people. Next, he attacked a team of horses, frightening them so that they ran away. He had never acted this way before, and people wondered if he was retaliating for the loss of his companion. When open water was again available, the aggressive behavior diminished (Grande Prairie Herald-Tribune, 31 March 1949).

Bernard Hamm of Wembley was appointed local Conservation Officer in 1949 and guardian of the swans, in particular. He patrolled the lakes from April to freeze-up, knew where all the swans were, and believed they recognized him. They were never afraid when he inspected their nests, but, when he put up a "Beware of the Swans" sign on Tomshak's gate, Tommy attacked him. Mr. Hamm observed that two pairs of swans will seldom, if ever, build their nests closer together than 1/2 mile, and, quite often, a bachelor swan (or two or more nonbreeders) were found on the same lake with a breeding pair. (This differs with the prevalent theory today that a nesting pair will not tolerate other swans in their territory.)

By 1950, most of the school children living in areas where swans nested had heard lectures on conservation from Mr. Hamm, with special emphasis on the Trumpeters. Warning posters were tacked up in conspicuous places in lake areas to inform the public that they were patrolled and the swans were protected all year. About 100 swans were safeguarded this way.

It was still not known where the Grande Prairie swans wintered. Quoting Mr. Hamm, "Cygnets are hatched, develop unmolested, and migrate westward with the adults in the autumn" (Grande Prairie Herald-Tribune, 7 September 1950). In 1955, Mr. Hamm helped Ron Mackay of Canadian Wildlife Service (CWS) band the first Trumpeters in this area. From the banding program, they learned that our swans go south to the United States to winter.

With snow melting in March 1950, Tommy, now almost 3, was looking for water and on the defensive again. He was frightening dogs and cattle, so Mr. Tomshak fastened one wing and grounded him. Tommy was still able to open the door with his beak and walk into the house looking for handouts.

On 18 February 1951, I wrote in my diary, "Tomshak's swans here. They knocked on the window all afternoon. Took pictures." I found no record of a second swan arriving at Tomshak's, but my pictures show an immature grey with Tommy. In February and March, they often came to our farm near Clairmont Lake. On 28 March, I recorded, "only one swan came today; heard that the younger one was electrocuted when it flew into a power line." Tommy was alone again. He came once more in August and chased me when I went out to take his picture!

In late November 1954, two cygnets landed in Tomshak's yard and were accepted by Tommy, now 7 years old. They stayed until April when they were given to the Waterfowl Research Station in Delta, Manitoba, in the first major attempt in Canada to reestablish Trumpeters within their original range (Grande Prairie Herald Tribune, 8 April 1954). When Mr. Tomshak retired from farming, Tommy was also sent to Delta, where it was learned that "he" was a "she." Her sheltered life had not prepared her for foraging for herself, and, likely, she missed her human family and the special attention she had always had. She pined away not long after. The whole district felt the loss of this celebrity named Tommy, as well as for Beulah before.

The Trumpeter Swan was officially adopted as Grande Prairie's symbol in 1975 (Grande Prairie Herald-Tribune, 20 December 1957). Beulah had been mounted, and was presented to the Mayor of Grande Prairie. She now resides in City Hall. The County chose a flying Trumpeter for its symbol in 1969 (Grande Prairie Herald Tribune, 12 June 1969).

Bernard Hamm died 18 January 1965 at age 64. "During the past 20 years, Mr. Hamm probably did more to nurse the rare Trumpeter Swans of the north back from near extinction than any other single person," said the press (Daily Herald-Tribune, 18 January 1965). His talks and displays of animals and devotion to the Trumpeters will long be remembered.

Thor Hanson, a Canadian artist, wrote, "The wild swans of the north have always been symbols of unspoiled nature, vast expanses, and man's desire for beauty and immortality" (personal letter to Beth Sheehan). Let us renew our efforts to keep them that way.

**TRUMPETER SWAN INVESTIGATIONS,
GRANDE PRAIRIE, ALBERTA, 1953-1975**

Ron H. Mackay, Retired Biologist, Canadian Wildlife Service

One of my first assignments on joining the Canadian Wildlife Service (CWS) in 1949 was to obtain information on the numbers and distribution of Trumpeter Swans (Cygnus buccinator) in Canada. My predecessor, J. A. Munro, had gathered some data in British Columbia (B. C.) by means of a questionnaire and J. Dewey Doper had made a preliminary survey of the Grande Prairie Trumpeter population in 1944. It had been departmental policy until that time to withhold information on the whereabouts of the rare birds to prevent their molestation.

HISTORICAL NOTES

The earliest reference to Trumpeters in the Grande Prairie area that I have found was a report by Raine (1894) of a collection of five eggs taken for him from a nest on Buffalo Lake, Assiniboine, on 7 April 1891. McCoun (1909), in his catalogue of Canadian birds, reported that same note as a breeding pair with a nest of five eggs on Buffalo Lake, Alberta. Reference to the same report was made by Hoyes Lloyd in the Canadian Field-Naturalist in 1922. From my field investigations from 1955 to 1963, I calculated the earliest date of egg laying to be about 25 April and tend to believe that the eggs collected for Raine were from a clutch laid the previous year, 1890.

The first record of Trumpeters in the Grande Prairie region in CWS files was reported in a letter from W. L. Brainard to J. A. Munro, dated 16 September 1926. Mr. Brainard lived on the shore of Sinclair Lake and told of a pair being on the Lake every summer since 1918. They nested on an island and raised two young in each of those summers. In another letter, dated 8 December 1930, Brainard reported that it was the 1st year that they had had more than one pair on the Lake and that six cygnets had been raised.

Dewey Soper spent 6 days around Grande Prairie from 20-26 June 1944 and counted 58 adults and 14 cygnets on 13 lakes. R. H. Smith, U. S. Fish and Wildlife Service (USFWS) counted 77 adults and 23 cygnets during an aerial survey in the summer of 1946. Art Hawkins and Lyle Sowles, also with the USFWS, made a ground survey in the same area from 17-22 July 1946 and counted 52 swans. They reported very serious drought conditions, with some of the lakes bone dry. It was so dry on one lake that the farmer had been able to burn the tules, exposing the remains of last year's nest.

Bernard (Barney) Hamm, a local taxidermist and naturalist who had done some duck banding for Ducks Unlimited, was hired as a part-time Migratory Bird Warden by the Federal Government in 1948. Barney faithfully carried out his patrols and recorded observations of the swans every summer until he was incapacitated by a stroke in 1964.

I saw the Grande Prairie swans for the first time during an aerial survey with Bob Smith, USFWS, on 23 May 1953. I returned to Grande Prairie on 29 June 1953 and carried out field investigations until 9 July, with Barney Hamm's assistance. In 1954, I made an aerial survey and banded cygnets in the Grande Prairie area from 16 August until 29 August. Another aerial survey of the area was made on 3-4 July 1955, and repeated on 30 August. Twenty-six swans were banded during the period from 25 August to 4 September 1955. The periods from 1-21 May, 19 June to 24 July, 14-30 August, and 26 September to 6 October 1956 were spent on swan investigations around Grande Prairie. Early spring observations were made from 23 April through 22 May 1957 to obtain information on swan arrival dates and occupation of territories. I returned to Grande Prairie on 14 June 1957 and spent the remainder of summer and autumn, except for short periods on other duties, until 1 October on Trumpeter field studies.

After gleaning the foregoing information from my Journal some 30 years after the fact, my wife's complaints of being a grass widow during my CWS years have finally sunk home! My responsibilities as Dominion Wildlife Officer for British Columbia were not limited to Trumpeter Swans, but covered the whole gamut of migratory bird administration in B. C. I traveled many miles throughout B. C. and other parts of Canada and was away from home a great deal of the time. Fortunately, I was able to take my family with me on occasion and had them with me for two pleasant summers at Grande Prairie in 1956 and 1957.

METHODS

During my first visits to Grande Prairie, I chartered a small plane and attempted to locate all of the swans in the area bounded by the Wapiti River on the south, the Alberta-B. C. border on the west, an east-west line through Spirit River on the north and a north-south line approximately 10 miles east of Grande Prairie. I made a few surveys beyond those borders but found no more swans.

I then attempted to visit as many of the nesting sites as possible by car and canoe. While the land in the Grande Prairie area is very fertile and productive, the side roads were not graveled or paved at the time of my investigations and turned to gumbo after the frequent rain showers. I found it impossible to cover the whole area by car, so I selected a few of the more accessible nesting lakes for my ground study.

Periodic aerial surveys were made throughout the summers of 1956 and 1957 to try to keep track of the movements of the nonbreeding swans and to monitor the whole population. Aerial observations of the swans with their cygnets in early July were quite difficult as the birds tended to stay in the dense sedge and tule fringes of the nesting lakes. Surveys later in the summer were found to be more productive after the larger cygnets were more visible. The family groups were also seen more often on the open lakes. It was found that a mid-September survey was the most reliable for a total population count. After that date, there was the possibility of Tundra Swans showing up on their southerly migration, depending on the vagaries of the weather, to skew the count.

A standard flight pattern was set in 1956 and was carried out every year until 1975 when I was transferred from Edmonton to Vancouver. I believe the annual survey has been maintained by the CWS since that time, but I do not have the details.

During my early years at Grande Prairie, I caught and banded about 100 Trumpeters, using a 14-foot canoe with a 2-horse outboard motor. Latterly, I assisted other CWS officers in banding operations, using an airboat for the capture. It was much more successful than using a canoe!

RESULTS

Because of some confusion in lake names in the area, I plotted some 82 water bodies, or potential water bodies, by section, township, and range. I then charted swan use of the lakes over the years from 1954 to 1975 and prepared Table 1 on production data. The total number of pairs fluctuated over the years from a low of 13 pairs in 1969 to a high of 31 pairs in 1975. Cygnets per brood fluctuated from a low of 2.0 in 1964 to a high of 4.2 in 1962.

Table 1. Production data for Trumpeter Swans, Grande Prairie, Alberta.

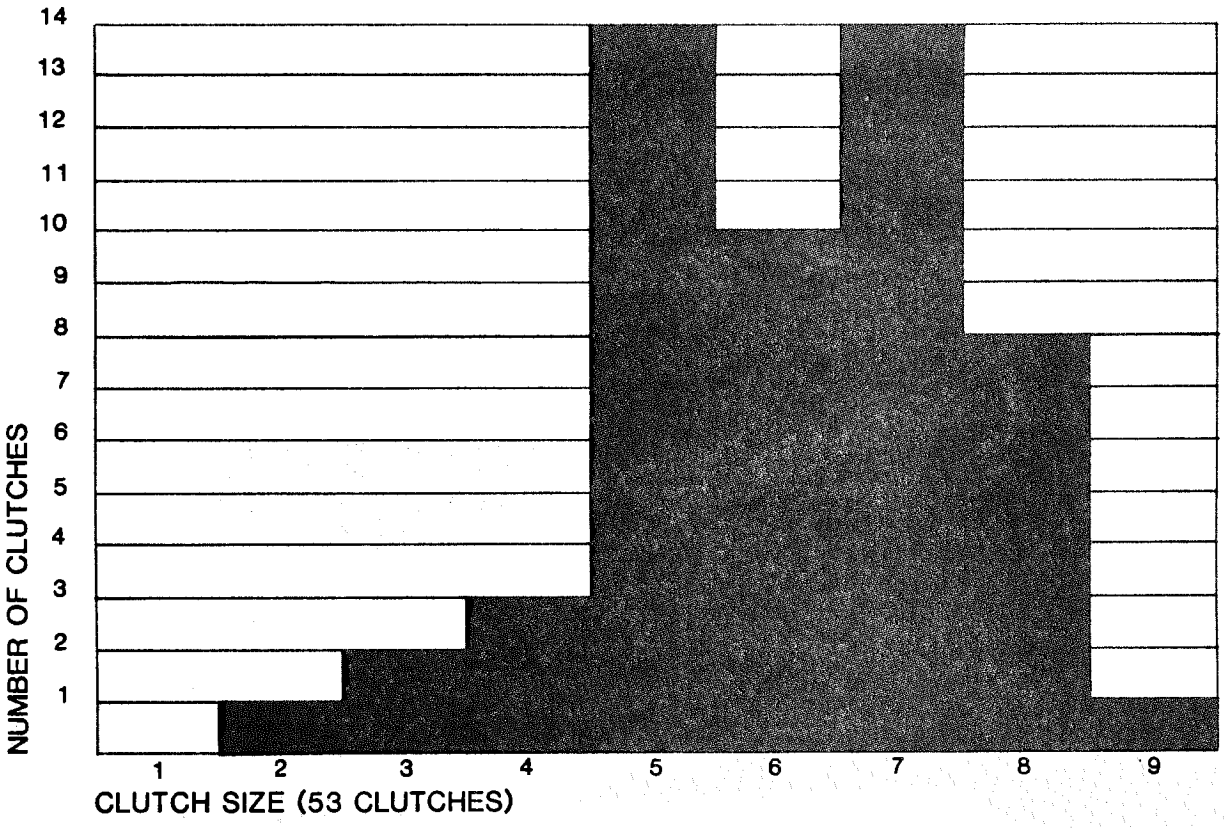
Year	Mated pairs	Broods	Cygnets	Broods/mated pairs	Cygnets/mated pairs	Cygnets/brood
1953	10	4	16	0.40	1.60	4.00
1954	21	9	28	0.43	1.33	3.11
1955	23	13	44	0.57	1.91	3.38
1956	15	6	15	0.40	1.00	2.50
1957	15	11	36	0.73	2.40	3.27
1958	21	7	20	0.33	0.95	2.86
1959	16	11	43	0.69	2.69	3.91
1960	16	10	39	0.63	2.44	3.90
1961	16	12	41	0.75	2.56	3.42
1962	19	9	38	0.47	2.00	4.22
1963	14	9	27	0.64	1.93	3.00
1964	14	6	12	0.43	0.86	2.00
1965	13	2	5	0.15	0.38	2.50
1966	15	6	21	0.40	1.40	3.50
1967	14	7	22	0.50	1.57	3.14
1968	21	10	27	0.48	1.29	2.70
1969	13	6	13	0.46	1.00	2.17
1970	14	9	24	0.64	1.71	2.67
1971	25	12	39	0.48	1.56	3.25
1972	20	12	37	0.60	1.85	3.08
1973	29	19	55	0.66	1.90	2.89
1974	26	14	51	0.54	1.96	3.64
1975	31	12	37	0.39	1.19	3.08

The Trumpeters return to the Grande Prairie region in late March or early April each year. The earliest report that I have received was of a sighting near Bear Lake on 1 April 1959. The date of spring break-up varies from year to year, of course, dictated by climatic variations. During my early spring visits to the area in 1956 and 1957, I found some of the lakes thawing earlier than others. Cutbank, Saskatoon, the south bay of Bear, and Hermit Lakes were some of those. Trumpeters congregated on the open reaches on their arrival from southern wintering grounds and moved out to their territorial nesting lakes as they opened up. Large flocks of Tundra Swans (C. columbianus) also arrived on the staging areas about the same time as the Trumpeters, making it difficult to identify the species as they intermingled. I observed about 200 swans, mostly Tundras, on Cutbank Lake on 3 May 1956, with the Lake frozen over except for small open areas at the east and west ends of the Lake.

Mrs. J. Smith, who lived on a farm along the northeast shore of Saskatoon Lake, phoned Barney Hamm on 15 April 1957 to report the arrival of two pairs of swans (probably Trumpeters) that day. I arrived at Saskatoon Lake on 23 April that year and found it frozen over except for a 25-foot band of open water along

the south shore. There were a few Tundras along the northwest shore at that time. I rented a cabin on the south shore until 20 May. There were about 500 swans, mostly Tundras, on the Lake on 26 April. They kept me awake through the night with their musical whooshings until the wee hours of the morning. When I went out to check on their numbers soon after daylight, the main body of swans had followed their urge to move northwards, leaving only a few stragglers behind. That was a symphonic night that I will remember for the rest of my days!!

Figure 1 shows the distribution of clutch sizes for 53 clutches of eggs from field observations over the years. The clutches varied from two to nine eggs per clutch, resulting in a mean clutch size of 5.53. The sample was made up of 293 eggs.



DISTRIBUTION OF CLUTCH SIZES

NO. OF CLUTCHES - 53
NO. OF EGGS - 293
MEAN CLUTCH SIZE 293/53 - 5.528

MODE 587
RANGE 2 - 9

Figure 1. Distribution of Trumpeter Swan clutch sizes in the Grande Prairie area, 1956-65.

Data on egg-laying and incubation periods are shown in Table 2. Regular visits to Lowes, McNaught's, McNeill, Saskatoon South (Little), Valhalla, and Wolfe Lakes produced information on dates of egg-laying, clutch sizes, incubation periods, and hatching dates. From early visits to nest sites, it was soon determined that eggs were laid every other day. Once I was able to identify the day an egg was laid, I could calculate the date of clutch initiation. The earliest first egg laid was on Saskatoon South Lake on 25 April 1956. The latest initiation of a clutch was on Lowes Lake on 11 May 1959. Incubation does not begin until all the eggs are laid. This makes it possible for all the eggs to hatch within hours of each other. The earliest date of hatching was recorded on 12 June 1958 at McNeill Lake. The latest hatching date occurred at Lowes Lake on 28 June 1963. Precise information on incubation periods was gathered on only six of 26 clutches. It was calculated at 32 days (approx.) in every case.

Lake	Year	Eggs laid: April 25	26	27	28	29	30									May 10	11	12	13	14	15	16	17	18	19	20	21	Hatch date / No. of cygnets	Incubation period
Lowe's	1958							1		2		3		4		5		6										Deserted	--
Lowe's	1959																1		2		3		4		5*			Jun 20--5 cygs.	--
Lowe's	1960					1		2		3		4				6	7*											Jun 15--5 cygs.	--
Lowe's	1961											1		2		3	4		5		6		7*					Jun 23--7 cygs.	--
Lowe's	1962													1		2		3		4		5		6				Jun 20--6 cygs.	--
Lowe's	1963																							May 24--5 eggs				Jun 28--4 cygs.	--
McNaught's	1959																							Jun 5--5 eggs				Jun 23--5 cygs.	--
McNaught's	1961																							May 30--4 eggs				Jun 22--4 cygs.	--
McNeill	1956												1		2	3		4		5		6		7*	7*			Jun 21--4 cygs.	
McNeill	1957										1		2		3		4		5		6		7		8			Jun 20--8 cygs.	32 days (approx.)
McNeill	1958				1		2		3		4		5		6	7			7*									Jun 12--7 cygs.	--
McNeill	1959																								7 eggs fnd.			Jun 23--5 cygs.	--
McNeill	1962																							Jun 6--5 eggs				Jun 25--5 cygs.	--
Sask.S.(Little)	1956	1		2		3		4		5*		6												Jun 4--5 eggs				Jun 13--4 cygs.	--
Sask.S.(Little)	1957														1		2		3		4		5		6		7	Jun 23--8; Jun 25--4; Jun 27--3 cygs.	32 days (approx.)
Sask.S.(Little)	1958							1		2		3		4		5*		6*		7*		8*						Jun 17	32 days (approx.)
Sask.S.(Little)	1960							1		2		3		4		5		6		7			7*					Jun 15--7 cygs.	--
Sask.S.(Little)	1961									1		2		3		4		5		6		7		7*				Jun 20--?; Jul 3--1 cyg.	--
Sask.S.(Little)	1962								1		2		3		4		5		6		7		8		Jun 5--8 eggs			Jun 20--8 cygs.	--
Sask.S.(Little)	1963									1		2		3		4		5		6		7		8		9 May 22--6 eggs		Jun 24--? cygs.; Jun 26--6 cygs;	
Sask.S.(Little)	1965										1		2		3		4		5		6		7(6*)		8			Jun 23--8 cygs.	32 days (approx)
Valhalla	1956													1		2		3		4*		5*		6*				Jun 21--6 cygs.	32 days (approx.)
Wolfe	1957												1*		2		3*		4*		5*		6					Jun 19--#1 pipping, #2 hatched, #4 dead, #5 pipping, #6 peeping	32 days (approx.)
Wolfe	1958						1		2		3		4		5		6		7					Female banded (1956); May 22--caught; died June 14; (egg bound)-- Eggs collected						
Wolfe	1959															1		2		3		4		5±	May 29--5 eggs			Jun 22--3 cygs.	1 dead young, 1 egg
Wolfe	1961											1		2		3		4		5		6±	6*					Jun 23--5 cygs.	

* Date nests found or visited.

(Information on 14 other clutches was gathered but not included in this report due to time limitations.)

Table 2. Trumpeter Swan egg-laying and incubation Grande Prairie, Alberta, 1958-65.

Information on flightless periods was recorded during banding operations in 1955 and 1956. They are summarized by sex in Table 3. The earliest flightless female was noted on Buffalo Lake on 21 June 1956, the latest on Lowes Lake on 18 July 1956. The earliest flightless male was caught at Saskatoon South Lake (Little Lake) on 9 July 1956 and the latest at Hughes Lake on 28 August 1955.

Table 3. Flightless periods for Trumpeter Swans in the Grande Prairie, Alberta, area 1955, 1956.

Dates	Location	Comments
Females		
21 Jun 1956	Buffalo Lake	Threw primaries on attempted take-off.
4 Jul 1956	Saskatoon South Lake (Little Lake)	All primaries had been molted.
9 Jul 1956	Hermit Lake	Still flightless 23 July 1956.
10 Jul 1956	Hughes Lake	
17 Jul 1956	Wolfe Lake	About 1-1/2 inches of new primaries broken from sheath. Still flightless 22 July 1956.
18 Jul 1956	Lowes Lake	Still flightless 23 July 1956.
Males		
28 Aug 1955	Hughes Lake	
9 Jul 1956	Saskatoon South Lake (Little Lake)	Primaries about half regrown. Still flightless 21 July 1956.
12 Jul 1956	Valhalla Lake	Primaries about 1/4 regrown.
14 Jul 1956	Wood (Mansfield's) Lake	Primaries half regrown. Still flightless 22 July 1956.
17 Jul 1956	Wolfe Lake	About 1-1/2 inches of primaries broken from sheath. Still flightless 22 July 1956.

There is a wealth of other data to be extracted and tabulated from the stack of summaries that I have compiled. Included with no discussion is Table 4, the best Trumpeter breeding lakes in the Grande Prairie area from 1957 through 1969.

Table 4. Best Trumpeter breeding lakes in Grande Prairie, Alberta, area, 1957-69.

Lake	No. of sightings/ no. of years surveyed	No. of broods/ no. of years surveyed
1. Updike	13/13	11/13
2. Clairmont	12/13	6/13
3. Wilkin	11/13	8/13
4. Saskatoon South (Little)	11/13	7/13
5. Lowes	11/12	5/12
6. Albright	11/13	5/13
7. Hermit	11/13	5/13
8. Wolfe	10/13	4/13
9. Jones	10/13	4/13
10. McNeill	9/13	6/13
11. Ferguson	8/13	1/13
12. Preston	9/12	3/12
13. McNaught's	6/11	4/11
14. Flying Shot	6/12	4/12
15. Valhalla	6/13	3/13
16. Valhalla S.E.	5/12	5/12
17. Crystal	5/11	3/11

Unfortunately, I have run out of time to include more in this report. Now that I have gathered up a bit of steam again, I hope to continue my consolidation and get more of my information into the hands of the Monograph Committee. I have not meant to take a dog-in-the-manger attitude on the data that I have accumulated, but it is in such a state that I don't think anyone else could sort out the chaff from the oats.

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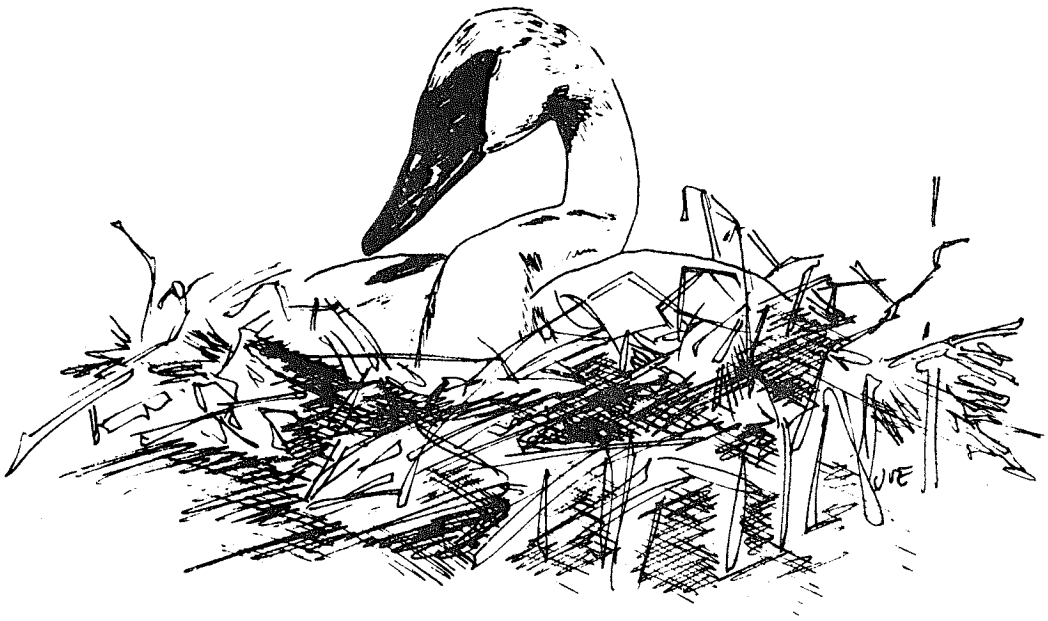

AN OVERVIEW OF TRUMPETER SWANS IN THE GRANDE PRAIRIE REGION, 1957–1986

Gordon Holton, Wildlife Biologist, Alberta Forestry, Lands and Wildlife

ABSTRACT

This narrative report outlines population characteristics of Trumpeter Swans (Cygnus buccinator) in Alberta, 1957–86, with particular emphasis on swans from the Grande Prairie region. The number of swans near Grande Prairie remained stable prior to 1970 (100 ± 30 swans based on autumn surveys) but increased 1970–86 to a peak of 347 swans.

Human demography near Grande Prairie was also reviewed to illustrate changes in land-use patterns since 1957. Changes in management considerations for the swans are outlined.

INTRODUCTION

Trumpeter Swans (Cygnus buccinator) were recorded near Grande Prairie as early as 1880 and sporadically through the first half of the 20th century (E. E. Sheehan, this publication). No systematic survey of swans near Grande Prairie was conducted in 1932, but these swans probably were included in the total of 69 Trumpeter Swans observed on wintering grounds in the United States (Banko 1960).

Ground surveys of lakes known to support Trumpeter Swans near Grande Prairie were initiated by the Canadian Wildlife Service (CWS) in 1949 (R. H. Mackay, this publication). Systematic aerial surveys were initiated in 1957 (CWS unpubl. data) and, with the cooperation of the Alberta Fish and Wildlife Division (AFWD) in recent years, have been repeated each autumn. From 1957 through 1970, this population totaled approximately 100 swans (including adults, subadults, and cygnets). It changed gradually and then increased markedly from 1970 through 1986. The highest number of Trumpeter Swans (347) was observed near Grande Prairie in 1986.

Trumpeter Swans near Grande Prairie comprise approximately one-third of the Rocky Mountain Population (based on wintering ground counts; R. Gale, this publication). Unlike the sedentary population of breeding Trumpeters in the Tristate Region, swans from the Grande Prairie region have a distinct, long-range migration pattern. Current increases in the Grande Prairie flock, coupled with the migration tradition, make this flock a potential source for transplant stock.

HABITAT CHARACTERISTICS

Grande Prairie region

Trumpeter Swans breed in a 5700 km^2 area near Grande Prairie, Alberta (55°15'N, 118°45 W; Figure 1). Approximately 40 percent of this area was originally aspen (Populus tremuloides) stands interspersed with grasslands. Most of this habitat type is privately owned and has been cleared for agriculture. This habitat type will be referred to as agricultural lands henceforth. Approximately 60 percent of the 5700 km^2 supports mixed forests of Populus sp. and white spruce (Picea glauca). These areas which are under Crown (public) ownership will be referred to as nonagricultural lands in this report.

Lakes in the agricultural area typically are ice-free from mid-April to mid-October (Holton 1982). Lakes in the nonagricultural area may be ice-free for up to 2 weeks less each year because of elevation differences between agricultural (700 m) and nonagricultural (920 m) areas. More detailed information on swan breeding habitat in the Grande Prairie region is available in Holton (1982) and Gale (in prep.).

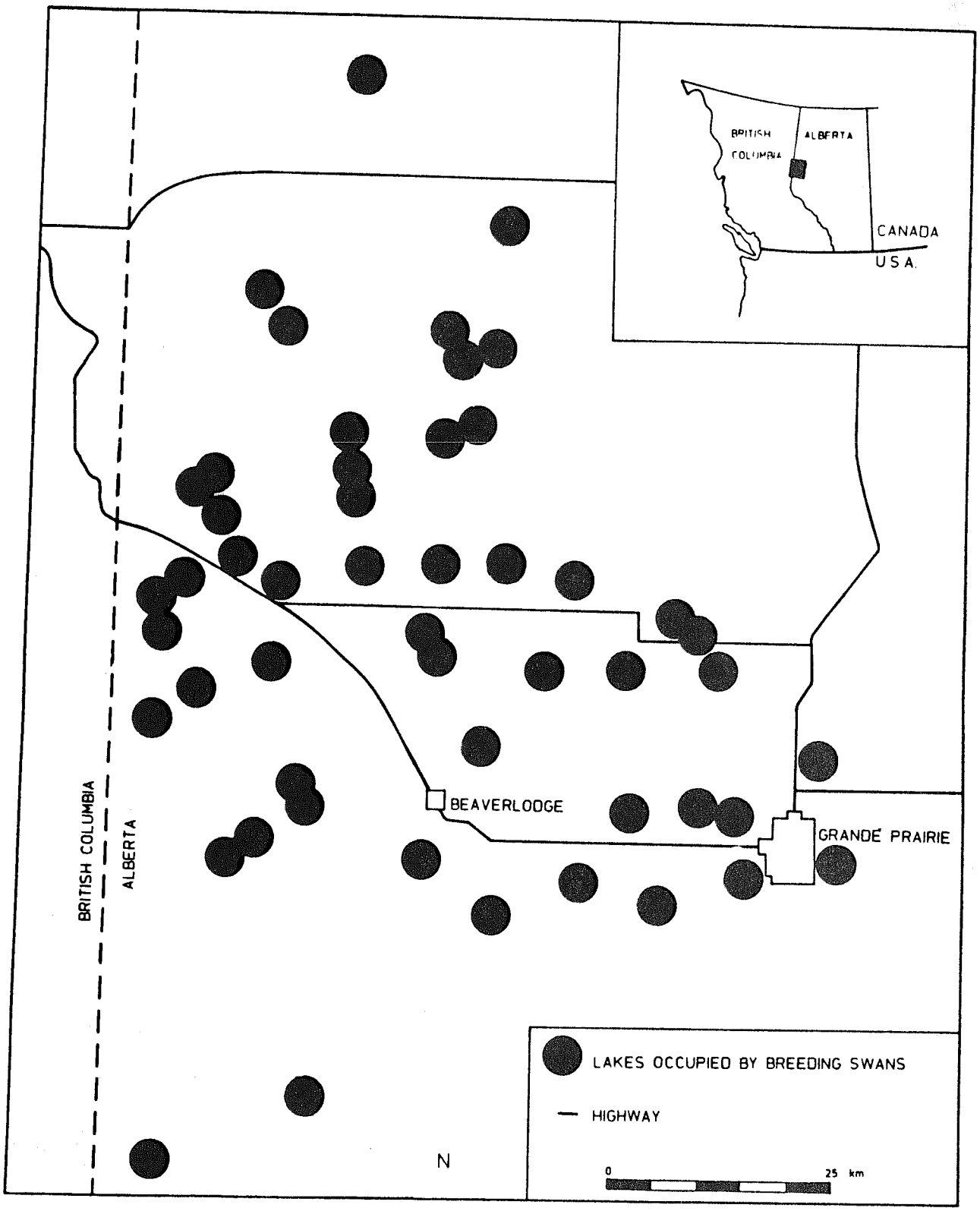

Figure 1. Distribution of lakes occupied by breeding Trumpeter Swans near Grande Prairie, Alberta, 1977-86.

Satellite Population Areas

Small numbers of Trumpeter Swans breed in Alberta at geographically isolated locations from Grande Prairie (Figure 2). They are referred to as satellite populations in this report. Habitat characteristics of the Chinchanga River (57°10'N, 119°30'W) and Otter Lake (56°45'N, 116°25'W) satellite populations are similar to those of the nonagricultural areas near Grande Prairie. The Chinchanga River satellite population actually may be a northward expansion of the Grande Prairie population, based on the distribution of swans breeding north of Fort Saint John, British Columbia (Shandruk 1986a).

Habitat available to the Edson-Whitecourt satellite population (53°45'N, 116°00'W) has a greater abundance of conifer forest types, particularly lodgepole pine (Pinus contorta) than near Grande Prairie.

Short grass prairies in a foothill location describes the habitat of the Pincher Creek-Cardson satellite population (49°10'N, 114°20'W).

Ice-free periods of lakes in these satellite areas are probably equal to or shorter than those outlined for the nonagricultural area near Grande Prairie, except in the Pincher Creek-Cardson area where longer ice-free periods occur.

Some or all of the management proposals outlined below for swans near Grande Prairie also apply to these satellite populations. Maintaining viable habitat is a more critical factor for satellite populations' survival than it is for the Grande Prairie flock. Small, island populations are predictably more susceptible to stochastic extinction than larger populations.

TRUMPETER SWANS NEAR GRANDE PRAIRIE

Systematic aerial surveys of Trumpeter Swans have been conducted each autumn since 1957 (Figure 2). Survey objectives and survey areas changed during the years due to changes in project objectives and the surveyors (cf Gale in prep.). However, these surveys probably provide reasonable documentation of changes in numbers of swans near Grande Prairie.

The total number of swans (adults, subadults, and cygnets) remained near 100 (± 30) prior to 1970 but increased to 341 by 1984 (Figure 3). A record low number of swans was recorded in 1965 when only 69 swans were observed. This included only five cygnets from a total of two broods. Poor reproductive success in this year was attributed to high water levels which curtailed nesting attempts in the spring and/or cygnet survival throughout the summer. Local landowners (pers. comm.) report water levels remained high at many lakes in subsequent years. Evidence of these changes still exists in some lakes where bands of dead willow (Salix spp.) occur in water 30-50 cm deep. These changes in water levels may partially explain changes in the use of some lakes by breeding swans (CWS unpubl. data).

Reduced numbers of swans also were observed in 1979 and 1985 (Figure 3). In these cases, lower numbers of swans compared with previous years probably were attributable to severe conditions on the wintering areas; R. Gale (pers. comm.) found these years to be the two most severe winters on record (1957-86) at the Tristate wintering area.

I discussed the population reductions in 1965, 1979, and 1985 to illustrate that factors on both the wintering and summering ranges have at least short-term effects on the number of swans near Grande Prairie.

Expansion of the swan population near Grande Prairie since 1970 was generalized into three arbitrary categories. These categories are not mutually exclusive but are used to illustrate trends.

In the early 1970's, swans expanded onto lakes in nonagricultural areas. These lakes were large (greater than 50 ha) but at higher elevations than lakes in agricultural areas. Ice-free periods are shorter, and the density and productivity of macrophytes and invertebrates might be lower on these lakes than on lakes in the agricultural area.

In the mid-to-late 1970's, expansion by the swans onto lakes in the nonagricultural areas continued. This expansion may have included formation of the satellite population in Alberta and also colonization of sites in Yukon and Northwest Territories. Admittedly, "discovery" of swans nesting in these areas could be an artifact of increased survey effort. Unfortunately, the area in British Columbia which is adjacent to the survey area in Alberta was not surveyed consistently. The timing and extent of population expansion in this area was poorly documented.

Population expansion within the Grande Prairie region in the early 1980's appeared to center on small (less than 50 ha) lakes and complexes of lakes. Lake complexes included a series of beaver impoundments utilized as a unit, and the use of beaver impoundments as nesting sites with subsequent movement of cygnets to lakes largely devoid of emergent vegetation. These observations suggest that individual lakes first used by breeding swans in the early 1980's did not provide all required habitat components.

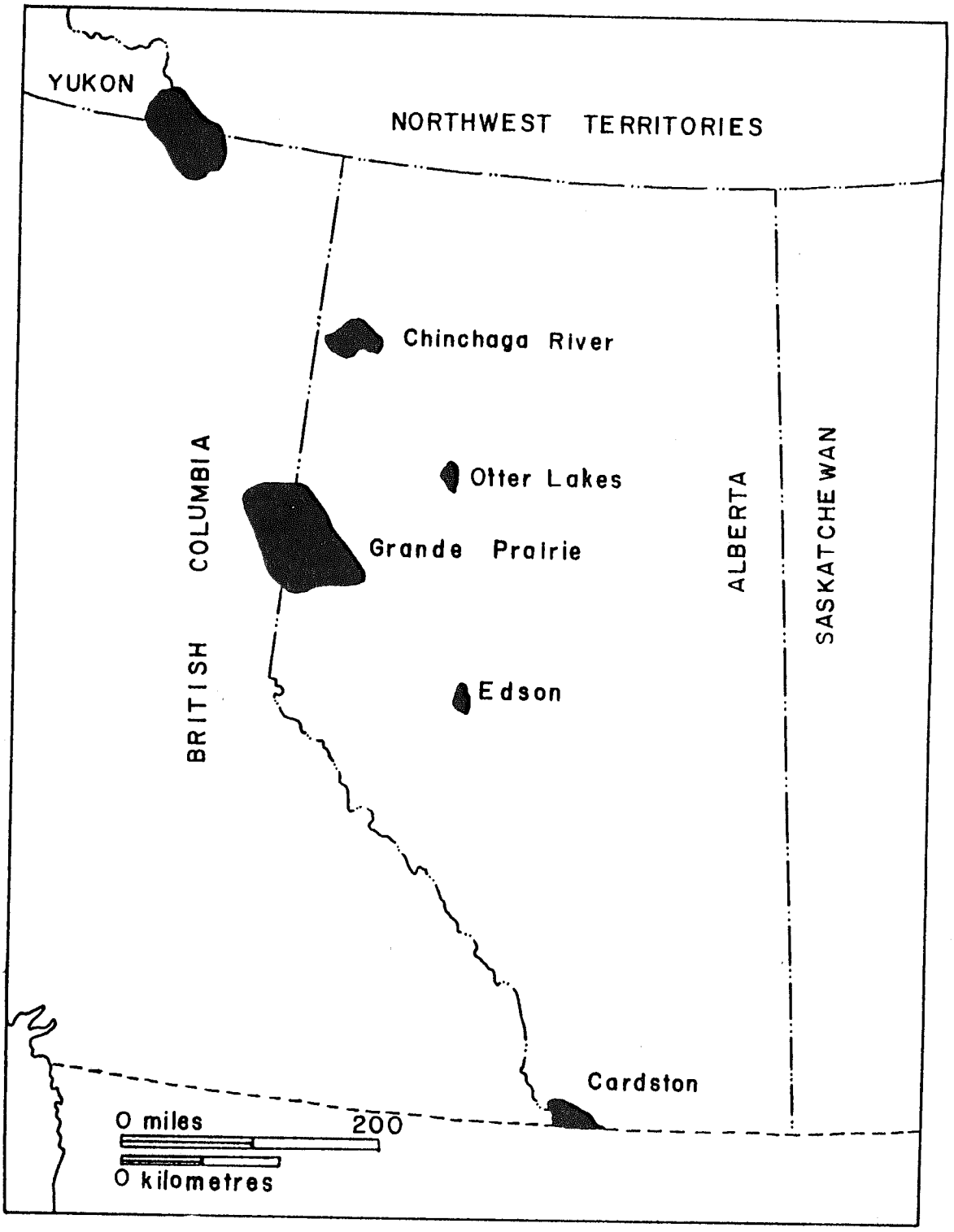

Figure 2. Satellite populations of Trumpeter Swans around Grande Prairie, Alberta.

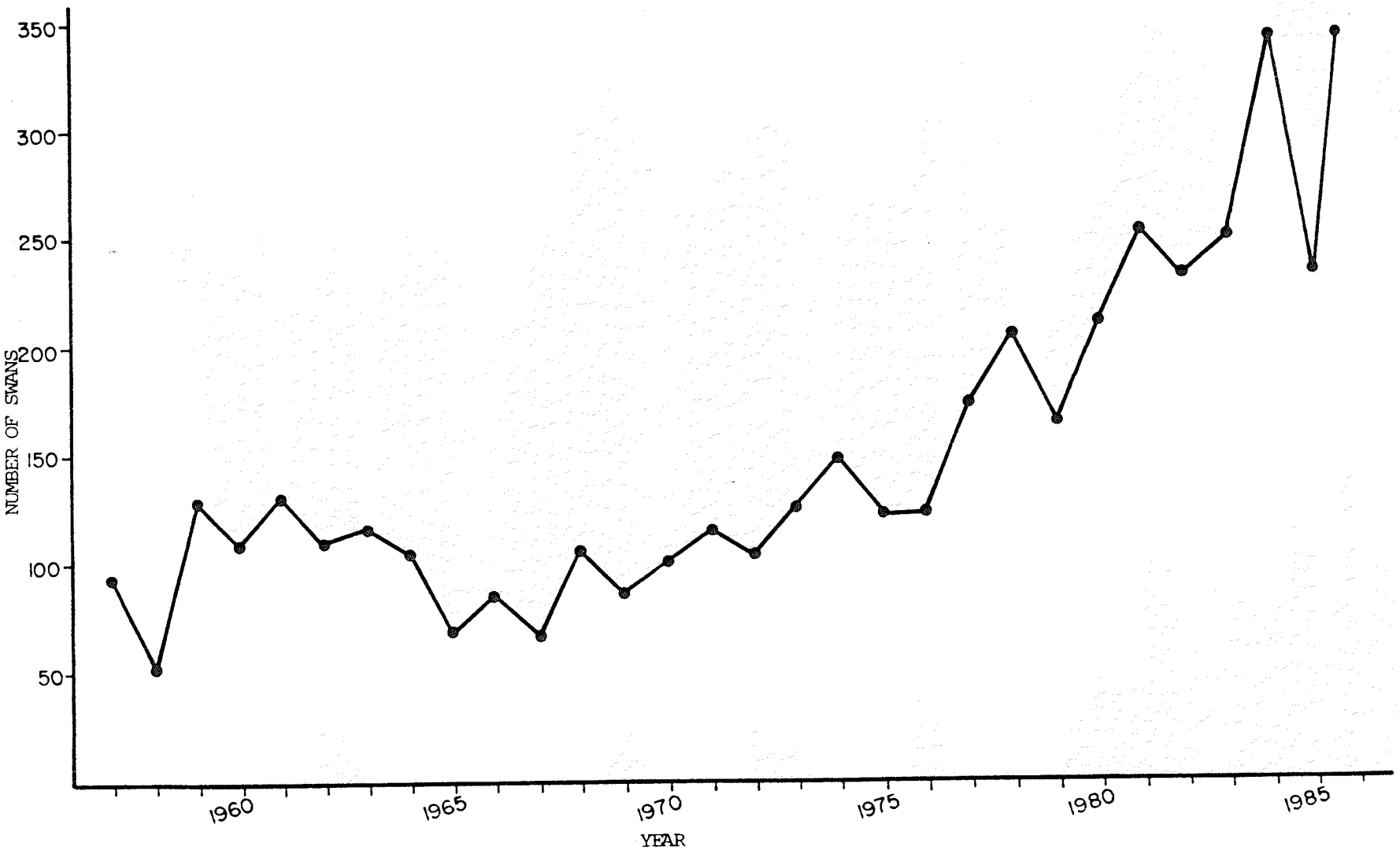

Figure 3. Total number of Trumpeter Swans (adults, subadults, and cygnets) observed on aerial surveys in Alberta, near Grande Prairie, 1957-86.

HUMAN IMPACT ON TRUMPETER SWANS NEAR GRANDE PRAIRIE

Since 1957, the human population of the Grande Prairie region also increased substantially. Originally an agricultural center of 6300 people (City of Grande Prairie, 1956), the 1986 City population was over 26,000 people. The economic base of agriculture has since diversified to include both forest industries and petroleum exploration. Future developments may include high technology industries. Further increases in the population of Grande Prairie are anticipated.

Agriculture

Agriculture was, and remains, one of the key industries near Grande Prairie. The impact of agriculture on swans nesting in this area probably was low when surveys were initiated. From 1973-80, hatching success of eggs, survival of cygnets, and the average number of cygnets produced per brood were not significantly different between lakes in agricultural and nonagricultural areas (Holton 1982). However, the analyses also suggest that new breeding pairs select lakes in the nonagricultural area rather than lakes. Technological advances in machinery allow intensified agricultural practices and authorized or unauthorized draining programs. The end result may be a reduction in the number of lakes available for breeding swans in the agricultural area.

Intense application of agricultural chemicals also may affect some lakes used by breeding swans. However, chemical analyses of addled eggs collected from agricultural and nonagricultural areas 1978-79 showed no significant differences in contamination levels (B. Turner, pers. comm.).

Experimental seeding of wild rice (Zizania aquatica) has occurred in some lakes near Grande Prairie. Planting this crop requires a special permit, and the current referral system limits plantings to lakes not used by breeding, molting, or staging swans, or other waterfowl. The rationale for this limitation was to avoid predictable conflicts between producers and waterfowl, and future requests to develop access to lakes for mechanized harvest equipment. To date, the wild rice experiments have had limited success.

Forestry

The forest industries commenced major operations near Grande Prairie in 1964. Forestry operations occur in the winter in the nonagricultural areas, and probably have minimal direct impact on the swans. Access roads developed for winter access have not significantly increased summer access in the nonagricultural areas. Indirect effects of forestry operations on watershed patterns have been minimized by maintaining buffers of uncut forests near lakes and major streams. However, establishment of the forest industries near Grande Prairie has significantly increased the human population of the region.

Petroleum Industry

The oil and gas industry began exploratory operations near Grande Prairie in the late 1970's. Like the forest industries, the exploration phases were undertaken in the winter. In this instance, the created roads resulted in increased summer access to nonagricultural areas. The drilling of successful wells and building of production facilities required year round access and resulted in the development of a network of all-weather roads in nonagricultural areas. Development of seismic lines, well drilling, and production and support facilities are subject to referral systems which limit their proximity to lakes occupied by swans. The referral system is most effective when developments occur on Crown (public) lands.

OVERVIEW

Industrial diversification in the Grande Prairie region resulted in a four-fold increase in the human population, 1957-86. The development within the nonagricultural areas for industry has increased human access to previously isolated areas and may have a negative impact on Trumpeters nesting in those areas. Increasing human population pressures will likely have an equally significant impact on Trumpeters.

Urban development is most likely the reason that Trumpeters no longer nest on Crystal and Wembley Lakes. There are residential subdivisions on a number of other lakes where swans currently or formerly nested. The future of nesting swans on those lakes is dependent on the intensity of recreational use and the continued viability of the nest site. It is probable that swans will also abandon some of these lakes.

Increased leisure time of a large, industry-based population also may affect swan numbers and distribution near Grande Prairie. Despite the large number of lakes in this region, only four lakes support fish populations. At one of these lakes, the stocking of fish and development of related recreational facilities probably caused the nesting Trumpeters to abandon this lake. At a second lake, a winter-only recreational fishery was developed to avoid conflicts between fishermen and breeding swans. However, requests to develop or enhance fishing opportunities at other lakes continue to come in. Often, these requests conflict with current use of the lakes by breeding swans.

The use of float planes near Grande Prairie also conflicts with the needs of nesting Trumpeters. Unfortunately, regulation of float plane operation is difficult because both Federal and Provincial jurisdictions are involved.

MANAGEMENT PROPOSALS

Annual aerial surveys conducted by CWS and/or AFWD have provided considerable information about the Trumpeter Swans near Grande Prairie. Continuation of these surveys and expansion of the monitoring effort when required, can provide a basis for future management decisions. Intra-agency cooperation between the Pacific-Yukon and the Prairie-Northern Regions of CWS is the best solution to surveying problems on the Alberta/British Columbian border. It is more realistic than an agreement of wildlife priorities between AFWD and their British Columbian counterparts.

Management plans derived from these surveys must remain flexible and quickly responsive to changing situations. For example, a policy statement is needed to properly manage wild rice production in Trumpeter Swan nesting lakes. Brechtel's management plan (1982) did not address this issue.

Industrial development and expansion of the human population near Grande Prairie probably will reduce the amount of suitable habitat for Trumpeter Swans. At present, AFWD can recommend mitigation procedures for these development proposals. However, the recommendations are not enforceable for many categories of land use on private land. Control of Crown land adjacent to lakes occupied by Trumpeter Swans should be retained to limit or mitigate possible future developments on these lakes.

Habitat enhancement specifically for Trumpeter Swans may offset habitat loss in some cases. Ducks Unlimited Canada (DU) created a wetland in 1984 which was occupied by nonbreeding Trumpeter Swans in 1985 and by breeding swans in 1986. The nesting of swans at this site was fortuitous, but perhaps not in keeping with the main focus of the project. Four Canada Goose (Branta canadensis) nests on artificial platforms were abandoned near the swans' nest in 1986 (K. Lumbis pers. comm.). This DU project raises some interesting questions. Should habitat enhancement projects be undertaken as mitigation for past losses of swan habitat? If so, should future developments which jeopardize swan habitat be permitted if a habitat enhancement project proceeded simultaneously? Are development projects justifiable without mitigation when the swan population is expanding within and outside the Grande Prairie region? Current funds for habitat enhancement (i.e., Ducks Unlimited and Buck for Wildlife funds through AFWD) come primarily from hunters. Should alternative funding sources be developed?

The recent growth of the Grande Prairie component of the Rocky Mountain Population of Trumpeter Swans allows its consideration as parental stock for transplant programs (Brechtel 1982; Shandruk 1986b). However, the effect of long-term transplant programs on the Grande Prairie population should be thoroughly monitored to avoid over-exploitation. This monitoring effort also would expand the information base for management decisions within the Grande Prairie region.

Transplant programs also may produce a subtle negative effect. Some capture techniques may present a false impression to the public and government agencies that swans are tolerant of disturbances such as motorized boats, float planes, and mechanized harvesting equipment for wild rice. The subtleties of timing, frequency, and duration of disturbances may be lost to the public if biologists are perceived as harassing the swans. Clear, consistent policy statements regarding transplant programs and public disturbances are required for this population.

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MANAGEMENT OF TRUMPETER SWANS IN CANADA

WORLD WILDLIFE FUND CANADA'S WILD WEST REGIONAL CONSERVATION PROGRAM

Miles Scott-Brown, Executive Coordinator,
Wild West World Wildlife Fund Canada

I want to thank The Trumpeter Swan Society for inviting me to speak at this Conference on behalf of World Wildlife Fund (WWF). We have recently initiated our Wild West Program on the prairie, and I would like to spend the majority of my talk informing you about Wild West and what we hope to do for Trumpeter Swans.

To begin, I want you to close your eyes for a moment and imagine what the prairies were like at the time of David Thompson, nearly 200 years ago. Imagine a prairie landscape without fences, without grain elevators and tractors, a hugh expanse of grassland unmarked by roads and section lines. A landscape supporting a faunal assemblage, that in biomass alone, perhaps will be unmatched again in the history of this planet. Imagine herds of plains bison, so numerous their movements darkened the prairie sky with dust. Imagine thousands of pronghorn antelope wheeling across the prairie landscape. In the distance, you can make out groups of wapiti contentedly grazing on prairie grasses. Look closer and you see large carnivores, the plains wolf and grizzly bear stalking their ungulate prey. In the evening, you watch a family of swift foxes tugging on what remains of a bison kill. On the horizon, you can make out a black-tailed prairie dog colony and follow the antics of the black-footed ferrets dancing around their burrows.

Early the next morning, you come across a prairie slough teeming with waterfowl and shorebirds. You see hundreds of Trumpeter Swans and White Pelicans and watch several large flocks of Whooping Cranes calling to each other in the still morning air. You marvel at the diversity of prairie bird life, and, in your notebook at the end of the day, you remark that the Greater Prairie Chicken, Piping Plover, Burrowing Owl, and Ferruginous Hawks were too numerous to record.

Yet, in just over one lifetime, this multitude of wildlife was reduced to a shadow of its former abundance. In Canada, by the turn of this century, the Passenger Pigeon, Eskimo Curlew, and prairie grizzly were gone. All that remained of the plains bison were several captive herds. The Trumpeter Swan was close to extinction from over hunting, and the plains wolf was almost poisoned and trapped out of existence. The swift fox, black-footed ferret, and Prairie Chicken were soon to follow.

It was not agriculture that was responsible for this slaughter. Rather, it was the guns of market hunters, the poison baits of professional trappers, and a lack of protective wildlife legislation. Once the plains had been cleared of bison, antelope, bear, and wolf, the ranchers and farmers came with fence and plow.

However, once the animals were removed, it was agriculture that markedly altered prairie habitats. As of 1982, 200 years after Thompson, and nearly 100 years after the last buffalo was shot in Canada, most of the prairie is under intensive cultivation. Four-fifths of the short-grass prairie and three-quarters of the mixed-grass prairie lie under the plow. Less than 20 percent of the tall-grass prairie remains.

Yet, all is not without hope. Witness the success we have had in managing for pronghorn antelope and rescuing the bison and Whooping Crane from the brink of extinction. With human ingenuity, we have learned how to save species. But, we have not yet learned how to stop the relentless loss of natural habitat on the prairie.

It was the global loss of habitat that prompted the WWF to sponsor the development of the World Conservation Strategy in 1980. The goal of this document was to outline means to ensure the long-term capacity of this planet to sustain development and support all life. The World Conservation Strategy specifically identified the Canadian prairies as a region of international significance deserving priority conservation action.

With this in mind, Monte Hummel, President of WWF Canada officially kicked off "Wild West" in April 1986. This marked the beginning of a 3-year program aimed at preserving endangered species on the Canadian prairie. Wild West is the third major regional conservation program of WWF Canada which focuses on wildlife habitats of national significance. To date, we have raised 70 percent of our needed funding through the sponsorship of Canadian National Sportsmen's Shows and Esso Resources Limited. We are still hoping to secure the remaining 30 percent from western sources.

Wild West is truly a western effort. Our 12-person steering committee is composed of westerners from Alberta, Saskatchewan, and Manitoba. It is made up of government biologists, university professors, farmers, ranchers, and representatives of private conservation groups. Our office for Wild West is located in Calgary, and the program is directly administered from the West.

The objectives of Wild West follow the three major objectives outlined in our 1980 World Conservation Strategy. I will briefly summarize these for you:

1. To draft a plan for the conservation of prairie endangered species and their habitats.

2. To mount a number of demonstration projects directed toward the recovery of endangered species which emphasize cooperation with other agencies and private landowners.

3. To use both the Conservation Strategy and our demonstration projects to create public awareness of what can be done to conserve prairie wildlife and their habitats.

The first directive is the Prairie Action Plan. We are well underway with this project and hope to have a prospectus out for review by the new year. In it, we will identify what natural areas remain in prairie Canada and what should be done to preserve them. We will also prepare an inventory of rare, threatened, and endangered species, identify data gaps, where present, and make recommendations for recovery plans. The Federal and provincial authorities responsible for the drafting of prairie species recovery plans are members of our Action Plan Committee. In short, we are preparing a blueprint of how and where we will act over the next 3 years.

That time frame is important. Our goal is to act as a catalyst, to promote agencies working together, to inform the public, to provide a spark to get things rolling to ensure sustained use on a long-term basis. There are many local conservation groups already active on the prairie, doing much-needed work on behalf of many wildlife species. We at WWF wish to act in concert with these groups, to provide a national voice, if needed, and to ensure that these programs continue long after Wild West is completed.

The demonstration projects are our highest priority. In 1986, we initiated six new projects, covering a wide variety of endangered, threatened, or rare prairie species. We have sponsored projects to look at the status of Piping Plovers in Alberta and Manitoba, to produce a prairie recovery plan for the Burrowing Owl, to determine the status of reptiles and amphibians in prairie Canada, and to examine how tall-grass prairie could be reestablished in Manitoba. We have continued to sponsor the reintroduction of the swift fox, through a generous donation from Esso Resources Canada. We have undertaken a feasibility study for the reintroduction of the Trumpeter Swan to prairie Canada. I will return to this last project shortly.

These six projects join 10 others already underway, involving a total of 41 cooperating agencies across the prairie. We will begin discussion of funding for 1987 projects this October.

With regard to increasing public awareness of Wild West, we have begun a series of television commercials, with the support of Ogilvy and Mather West and Karvonen Films Limited. The initial commercial will be aired sometime in January and will form the first contact with the public, describing what Wild West is all about. In addition, we have invited H. R. H. Prince Phillip, our President of WWF, to visit several of our prairie demonstration projects next summer.

As was mentioned earlier, we will be distributing the prospectus for our Prairie Action Plan sometime in 1987. And, we hope to extend our Operation Lifeline Program to prairie school teachers so that children can be educated about the problems facing endangered species in the West. Next, the farmers. Although things look bleak here in the West with depressed grain and oil prices, we realize that the heart and soul of Wild West lies in garnering the support of prairie landowners in conservation efforts. We have started what we hope will be a trend across the prairies in the years to come; that is, involving private landowners in wildlife habitat projects. For example, we have secured a 3-year lease on a 130-acre pasture in southern Saskatchewan to protect 10 pairs of nesting Burrowing Owls. We hope to secure additional agreements with perhaps up to 250 other landowners over the next 3 years.

We are looking for a Trumpeter Swan project to support in 1987. We hired Harold Burgess to undertake a feasibility study of potential Trumpeter Swan reintroduction sites in prairie Canada. We hope to continue our cooperative support with Ducks Unlimited, the Canadian Wildlife Service, and provincial wildlife federations to reestablish these magnificent birds in other parts of the West.

So, that, in a nutshell, or perhaps more appropriately here, an eggshell, is what Wild West is all about. We may be new on the prairie, but we are well underway in our efforts. We have been overwhelmed by the cooperation we have received from provincial and Federal wildlife agencies, conservation groups, and local landowners. The next step is public involvement. As biologists, we often get too involved with the species we hold close to our hearts and forget, perhaps, the greater worth of our work. We need to reach out to the public and get them involved either financially or as volunteers in projects. Too often, we are reminded just how boring the drive east to Winnipeg is or hear comments such as, "I never realized that prairie wildlife was in trouble." Clearly, the public must be made aware of the treasures we hold here in the backyards of the Canadian prairie. Increasing public awareness should be our long-term goal.

In an ever-increasing, urbanized society, we have to be reminded of the importance of wildlife, not just in economic terms, but for its aesthetic and spiritual values. We are still blessed with a multitude of wildlife in western Canada. Let's continue to work together to leave some wild in the West.

WETLAND HABITAT MANAGEMENT IN THE GRANDE PRAIRIE REGION OF NORTHWESTERN ALBERTA

Ken Lumbis, Northern Area Biologist, Ducks Unlimited Canada

Retention and management of wetland habitat in Alberta has been an ongoing operation for Ducks Unlimited Canada (DU) since 1937. Northwestern Alberta, which is one of three operational districts for DU, has the unique opportunity to work on Trumpeter Swan (Cygnus buccinator) habitat. The Grande Prairie office presently has five permanent staff and in 1987 will spend $600,000 on 11 wetland projects. Since 1948, when DU began working in this area, 67,990 ha of habitat have been secured by 61 wetland projects. Of these, 17 could be considered Trumpeter Swan habitat.

The main emphasis of DU's work has been the preservation and management of waterfowl habitat through the installation of water control structures. Through negotiations with landowners, government agencies, and DU staff, management plans are formulated which best suit the characteristics of each wetland. Typically, these wetland management plans strive to produce an optimum emergent vegetation/water ratio and a diversity of emergent species. This management goal can be achieved from both ends of the water balance spectrum, that is, from wetlands which are lacking water and are mostly overgrown to the other end, wetlands which are deep, have stable water levels, narrow emergent zones, and all intermediate types.

The first situation typically occurs on wetlands in which the natural outlet does not maintain suitable water depths or where it has been ditched and the water levels lowered. In both cases, the basins are usually flooded for some period of time during the year, providing suitable conditions for the establishment of emergent species. However, because of the shallow water depths which occur throughout the wetland, dense vegetation communities cover a large percentage of the area, and the wetland is overgrown. To achieve the desired vegetation distribution, a control structure is installed at the outlet. This structure will maintain water levels high enough to stress portions of the vegetation community to such a degree that they are eliminated. The selection of this water elevation is based on the emergent species present, and their distribution in relation to the basin contours.

An example of this management technique occurred on the Ferguson Lake project which is 6.5 km north of Grande Prairie. This lake was partially drained by agricultural interests. It became heavily overgrown with sedges (Carex spp.), cattail (Typha latifolia), bulrush (Scirpus acutus), and whitetop (Scolochloa festucacea). At this successional stage, the wetland had 80 percent of its area covered by dense communities of these emergent species (Figure 1). The graph in Figure 2 illustrates the fluctuations in water levels prior to and during the flood-out operation. As is evident, water levels prior to the construction of the control structure in the fall of 1983 were generally .30 to .61 m below the desired full supply level (FSL). In 1984, the area filled to FSL, and the wetland underwent a significant change. The primary change in vegetation patterns was the elimination of emergent sedge communities in areas which had generally held some water for most of the year. These communities were subjected to a water depth increase of .30 to 4.5 m. The vegetation communities along a transect established in the area of greatest change are represented in Figure 3. Cattail communities were not significantly affected, even those in the central portion of the wetland. A large part of the biomass of a cattail community can be found in the roots and rhizomes. These can remain intact for several years. An organic mat often builds up under older cattail stands, while new roots and rhizomes are found intertwined in the upper layers of the organic mat. The organic mats in Ferguson were not securely anchored to the mineral substrate and were partially afloat. The change in water level did not severely stress these vegetation mats. As a result of these operations, the marsh now has an emergent plant community which covers 60 percent of the basin (Figure 1). The wetland has a suitable distribution and diversity of emergent species for nesting waterfowl and future operations will strive to maintain this condition. Each year, a .15-m drawdown will occur in May. This artificial drawdown, in combination with the normal annual evaporation of .25 m, will stabilize the communities and prevent further elimination of emergent vegetation.

Wetlands which have deep stable water levels are usually characterized by narrow bands of emergent vegetation around the periphery of the marsh. In order to promote the expansion of these communities, artificial drawdowns may be a useful management technique. The suitability of a drawdown operation is dependent on the shape of the wetland basin. Basins with shallow contours are much more suitable than those with steep contours. In addition to exposing much more of the shallowly contoured basin for emergent establishment, the water depths which occur when the wetland is returned to its normal level are shallow enough to avoid flooding out large portions of the newly established emergent communities.

Usewell Slough, which is located 18.5 km west of Grande Prairie, had basin characteristics suitable for a drawdown operation. Prior to the drawdown, sedge, cattail, bulrush, spikerush (Eleocharis palustris), and manna grasses (Glyceria spp.) were found in an emergent band generally less than 1 m in width around the periphery of the marsh. A major drawdown was initiated on this wetland in the spring of 1984 to promote the expansion of these desired emergent species. At the drawdown level, which was .76 m below the normal operating level, 14.6 ha of this 20.2-ha wetland became exposed mudflats. By July 1984, vegetation responses had been minimal, and large areas of bare mudflat existed. However, by September, responses by annual species were becoming evident throughout the drawdown zone. More importantly, some of the target species, sedge, bulrush, and cattail, were starting to appear on the mudflats. During 1985, a small spring runoff and one of the driest summers on record occurred in the Grande Prairie area. The mudflats did not receive the necessary moisture and reflooding that is so critical for successful drawdowns. As a result, the expected increases in the densities of the desired emergent species did not occur. In fact, there was an increase in the presence of perennial upland and wet meadow species. By the end of the second year of drawdown operation, the mudflat zone was entirely vegetated.

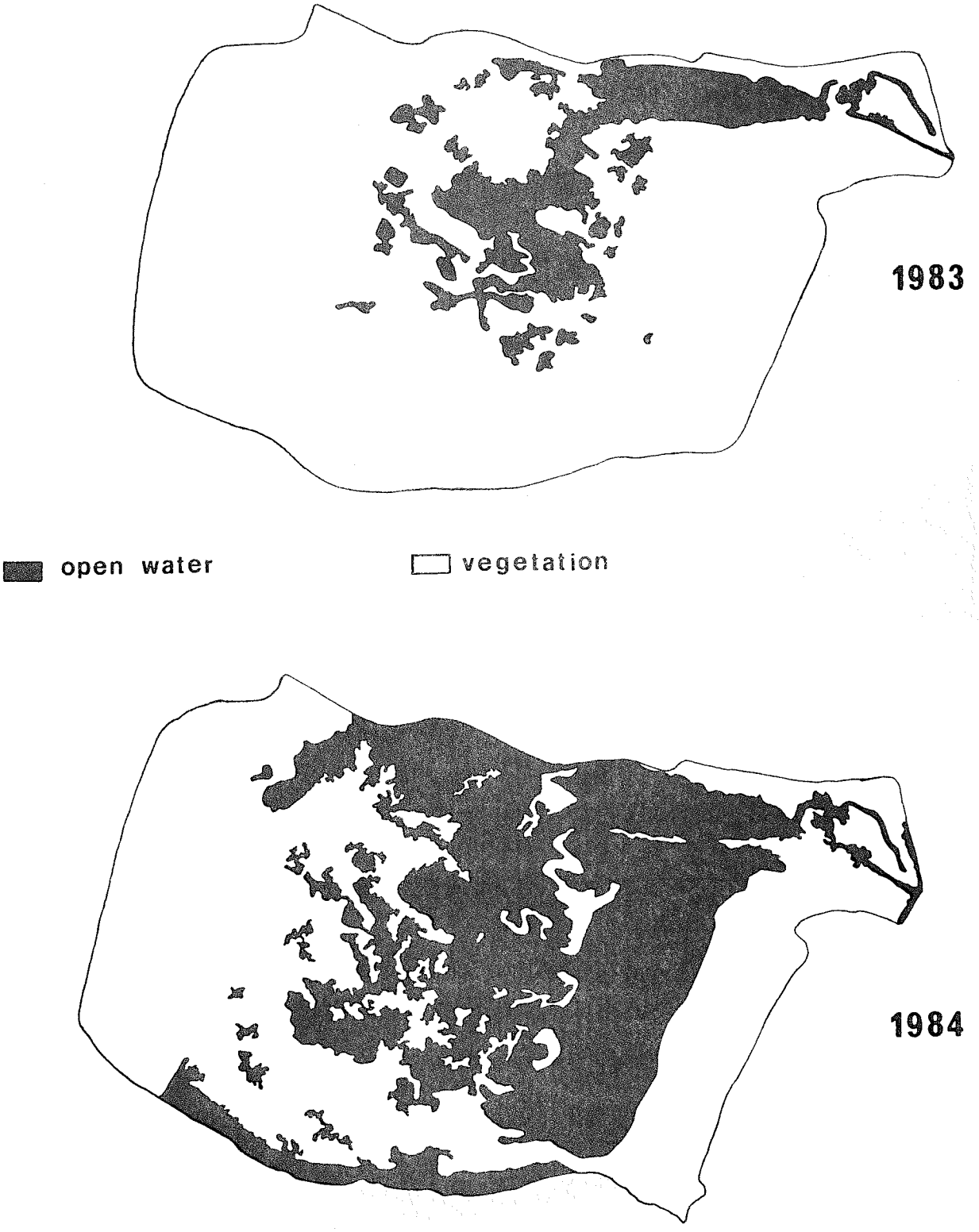


Figure 1. Vegetation communities before and after water level manipulations on Ferguson Lake, Grande Prairie, Alberta.

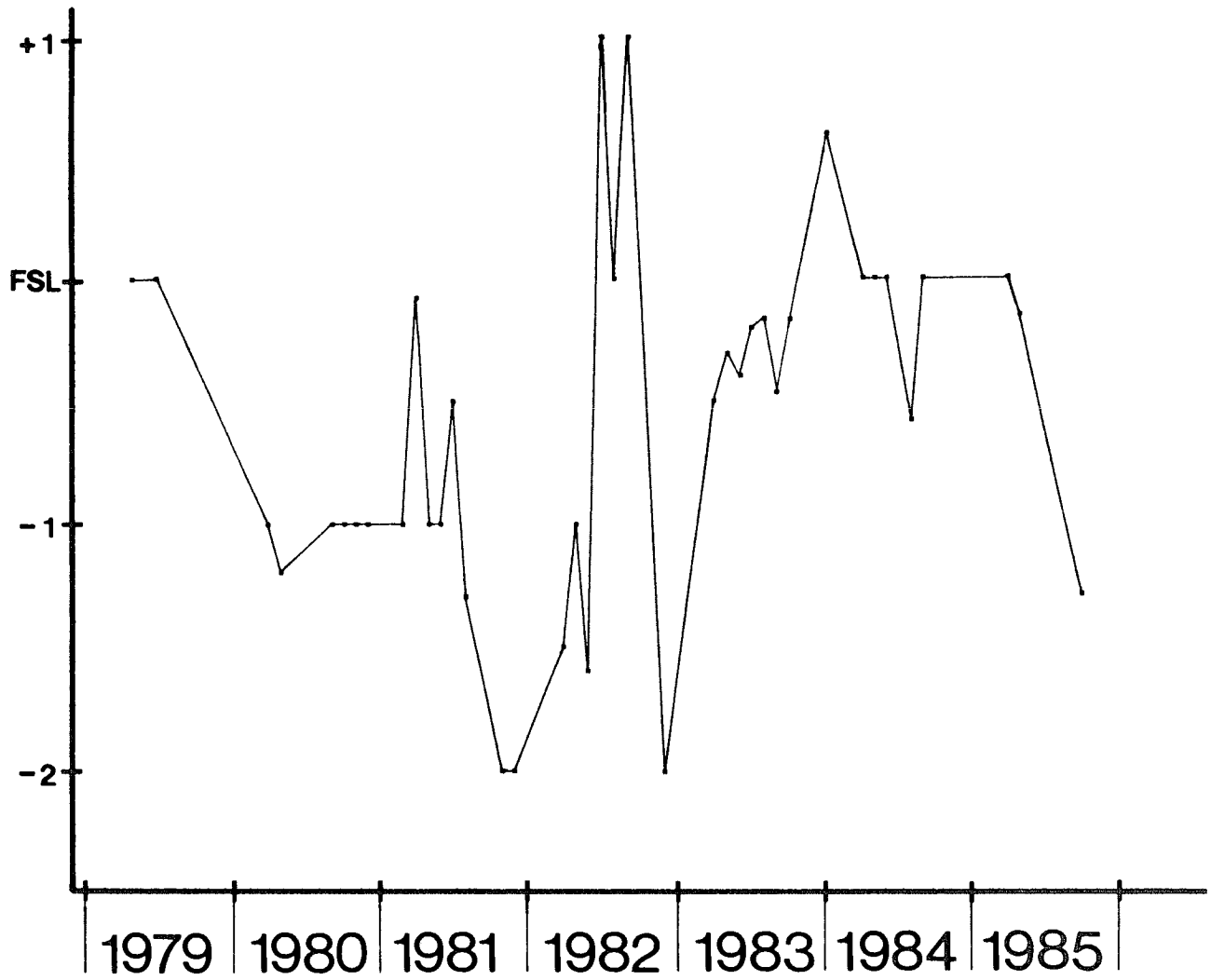


Figure 2. Water level fluctuations in relation to the desired full supply level (FSL) on Ferguson Lake, Grande Prairie, Alberta, from 1979–85.

During 1986, a better spring runoff and well-timed rains provided the necessary moisture to the mudflats. There was an excellent response from all of the desired emergent species. Good responses from spike rush, sedge, and manna grass occurred throughout the wetter portions of the drawdown zone and shallow water areas. Bulrush and cattail also experienced good responses in these zones, but their distribution was not as widespread. As previously indicated, precipitation during the growing period in 1986 was much improved over 1985. Total precipitation in 1986 was 6 percent above normal and 254 percent above the dry conditions of 1985. Thus, the drier portions of the drawdown zone received adequate moisture, and the vegetation responded to the improved conditions. Sedge and bulrush could now be found throughout most of the drawdown zone.

During this drawdown operation, the original emergent zone was essentially dry. Despite this drastic change in habitat conditions, this community was not eliminated. Sedge was the most vigorous of the remaining species. Cattail and bullrush were present but experienced a reduction in densities. Spike rush and manna grasses were eliminated from this zone. With the adequate response by the target species, water levels for this project will be restored to the normal operating level. This management will result in an increase in the quantity and quality of overwater nesting and brood habitat.

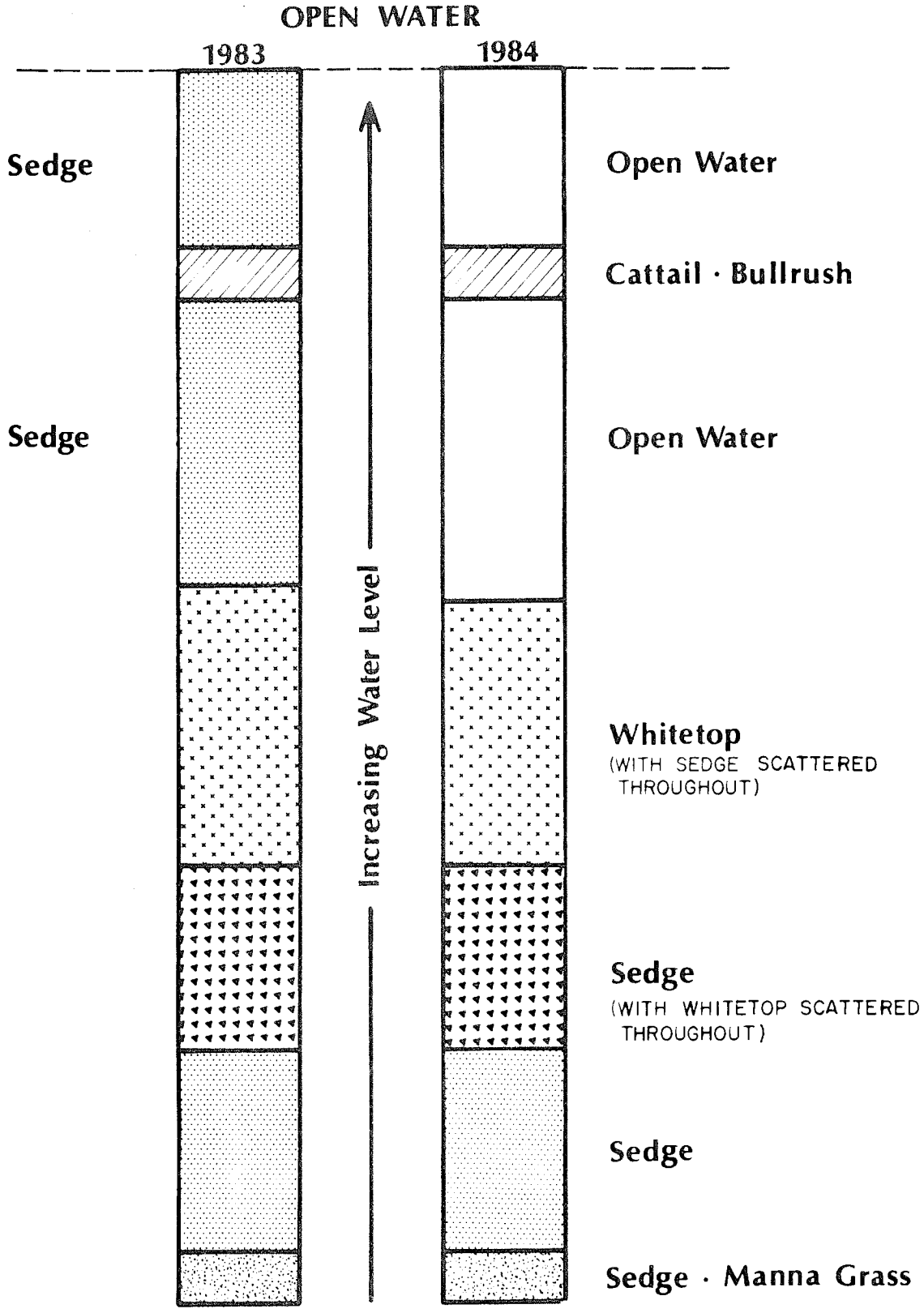


Figure 3. Changes in emergent vegetation communities on a transect line from wetland edge to area of greatest water depth in response to increased water levels during 1984 on Ferguson Lake, Grande Prairie, Alberta.

Typically, DU involvement on Trumpeter Swan wetlands is initiated because of a drainage threat; that is, excessive flooding around these wetlands impact adjacent landowners to the point of suggesting drainage. Flooding in the agricultural zones of northwestern Alberta is often the result of the conversion of forested lands to agricultural lands in combination with alterations in the upstream drainage patterns. Therefore, flows into the wetlands are increased. However, the outlets of these areas evolved under a much different hydrologic regime and, consequently, cannot compensate for these increased flows. Not only do these increased inflows cause flooding of adjacent agricultural lands, but they can have negative impacts on breeding habitat for Trumpeter Swans. A second group of flood-prone agricultural lands are the areas which are immediately adjacent to the wetland and have been brought under cultivation during dry years or because of improved agricultural equipment. Upon a return to a more normal precipitation pattern or with flood events, these areas are reflooded. A natural factor which often results in flooding is the activity of beaver.

DU is often involved in trying to solve these flooding wetland problems. The primary objective is to assess the habitat and hydrology of the wetland and its contributing drainage basin and to develop a management plan which will maintain habitat in its natural state and, at the same time, control the amount of flooding. A recent example of this process occurred on Hermit Lake. The landowners along the outlet were experiencing flooding problems. Hermit Lake was an important Trumpeter Swan and waterfowl wetland, so DU was concerned about its preservation. The swans usually nested in the emergent zone along the southwest portion of the Lake. Any management plans had to ensure that this habitat was secured and maintained. The emergent zone, a narrow peripheral band around the wetland, was dominated by sedge. An additional concern addressed in the management plan was that two wide arms of the Lake which were dominated by sedge be maintained. After completing a contour survey of the Lake and determining inflows into the area, the effects of various water levels on the emergent communities were determined. Figure 4 illustrates the relationship of the plant communities to the contours in the southwest portion of the wetland. The 99.0 contour was chosen as the FSL for this project. This water level allowed for spring flooding into the willow zone. An adequate flooding of the sedge zones would ensure a healthy plant community. In addition to being able to maintain this water level, the structure was designed to pass the 1-in-100-year flood event. This would not only prevent peripheral flooding of adjacent agricultural lands, but would also prevent excessive water level increases during summer rains and extended periods of flooding. Prevention of excessive water level increases during the nesting period was of considerable importance to all overwater nesting species.

Water loss over the summer was also determined. Annual evapo-transpiration losses for the area will result in the water level dropping approximately .25 m over the summer. This lowering of the water level from the spring FSL will approximate natural conditions and prevent any flooding-out of the emergent community. This is typical management on Trumpeter Swan wetlands where the main objective is to maintain and secure the existing habitat. Approximation of the natural, historical water regime is the primary management goal.

This is not to say that other habitat management options are ignored. The control structures on wetlands which have the proper basin morphometry often have drawdown capabilities built in during the initial construction. However, the stoplog bays which would be used to manipulate water levels are welded shut to prevent unauthorized use of the drawdown capabilities.

Due to the topography of much of the Peace Country, DU does not have the opportunity to create any significant amounts of new waterfowl habitat, especially for Trumpeter Swans. However, we do have the opportunity to improve existing wetlands for this species through our habitat management programs. The flood-out conducted on Ferguson Lake will provide more suitable breeding habitat. Trumpeter Swans last raised young on this wetland in 1966, when habitat conditions were more open, similar to what they are now.

An exciting project which will see the conversion of 1174 ha of essentially dry, dense, sedge meadow into a permanent wetland will be the Kleskun Lake project just northeast of Grande Prairie. Currently, this area floods during the spring and by early summer is quite dry. The construction of long dykes will create a permanent wetland with increased water depths. Vegetation distribution will be positively affected through this flooding-out operation. This management should produce a marsh with a good distribution of sedge-bulrush communities, similar to what Kleskun Lake was like in the early 1900s, prior to the drainage efforts by agricultural concerns. This will, at the very least, provide habitat for nonbreeding and staging populations of Trumpeter Swans where currently none exists. If pioneered by breeding Trumpeter Swans, it will provide habitat in a grazing reserve with limited disturbance by humans.

The general DU program of wetland development and management of habitat for ducks produces habitat for Trumpeter Swans. The Elvestad Project, which saw the stabilization of a wetland area at a water elevation which optimizes the water-vegetation ratio, has for the first time been successfully used as breeding habitat by Trumpeter Swans.

Drawdowns remain a management option for the creation of nesting habitat on wetlands where the lack of emergent vegetation has become limiting. Ensuring a sufficient area of brood habitat and the provision of artificial nesting sites may allow for production during drawdown periods. Fortunately, many of the habitat management options that are designed into projects to address the needs of ducks also address the needs of Trumpeter Swans. As more information becomes available on the biology and habitat needs of Trumpeter Swans, DU will have more opportunities to work on the preservation and management of Trumpeter Swan habitat in the Grande Prairie region of northwestern Alberta.

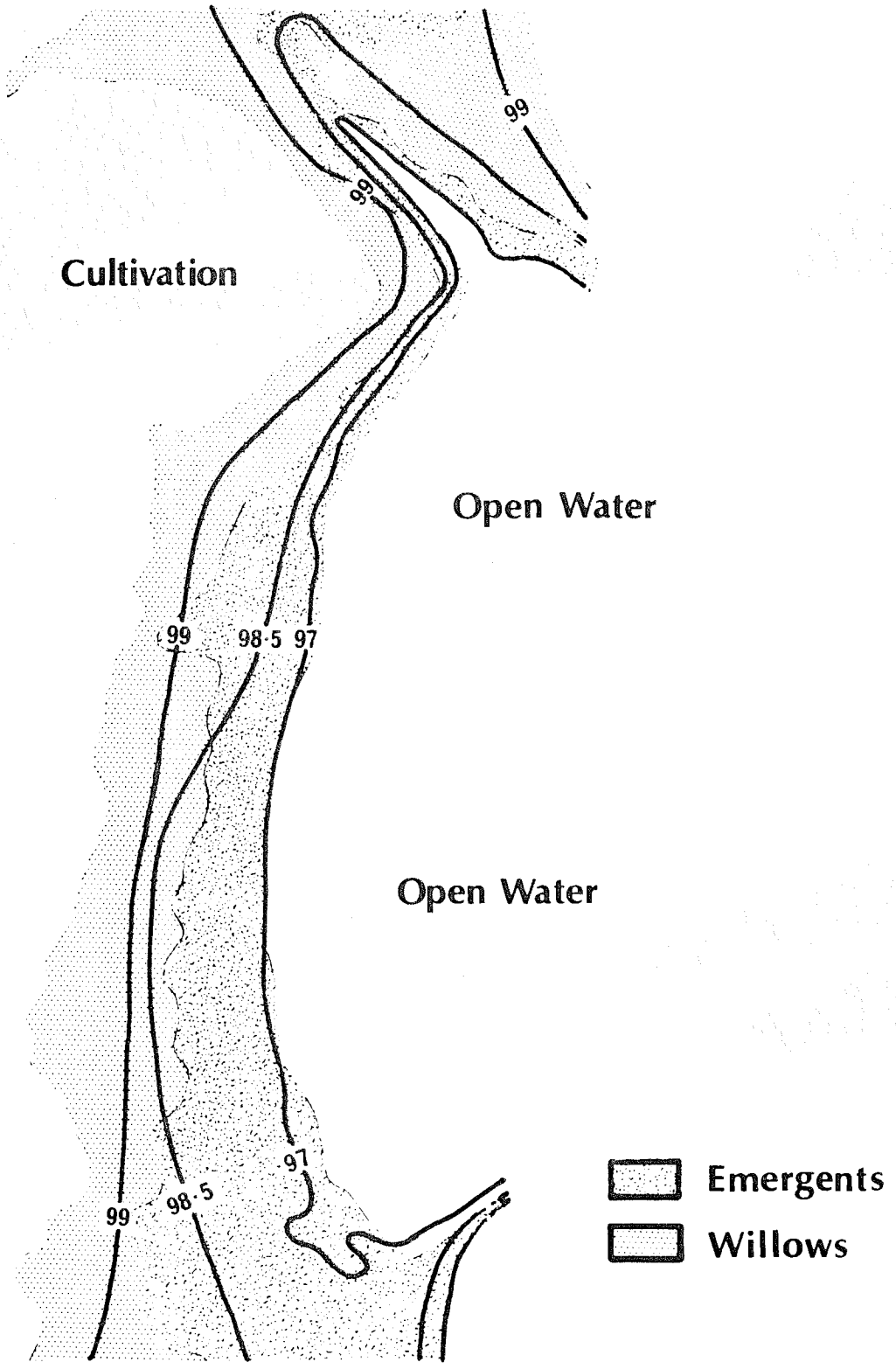
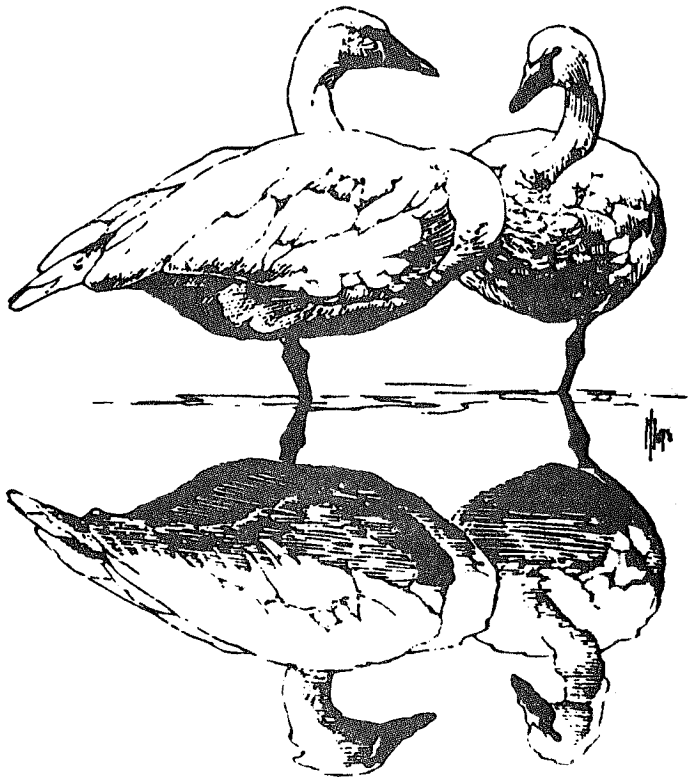


Figure 4. Relationship of vegetation communities to water depths on Hermit Lake, Grande Prairie, Alberta.

SUMMARY OF RESULTS OF GRANDE PRAIRIE TRUMPETER SWAN COLLARING PROGRAM

Bruce Turner, Habitat Biologist, Canadian Wildlife Service

The Canadian Wildlife Service's program of collaring Grande Prairie Trumpeter Swans (Cygnus buccinator) has yielded much information on the habits of these birds and furthered our knowledge of the life history of the species. Migration from the Grande Prairie area commences as early as the second week in October and all birds have reached the wintering area before mid-November, suggesting that fall migration is both rapid and direct. Family bonds dissolve toward the end of the first winter, while sibling bonds are common in the second year and sometimes persist into the third. Pair formation occurred among some 2-year-old birds, and the earliest age for successful reproduction was 35 months. Circumstantial evidence strongly suggests that pair formation occurs in the fall before the birds reach the wintering area. If such is the case, the Grande Prairie and Tristate flocks will remain genetically isolated despite sharing a common habitat for part of the year. The swans demonstrated a remarkable affinity to discrete wintering and breeding areas, and the health of the population is inextricably linked to the quality of those habitats.



POTENTIAL TRUMPETER SWAN NESTING HABITAT IN NORTHEASTERN BRITISH COLUMBIA

Brian P. Churchill, Habitat Biologist, Ministry of Environment, British Columbia

The return of Trumpeter Swans (Cygnus buccinator) from the brink of extinction challenges wildlife managers to move from preservation mode to management mode. However, the management of a relatively widespread species that has the potential to fill all suitable habitat is a different challenge than the challenge of bringing a species back from the brink of extinction. In northeastern British Columbia, I foresee that Trumpeter Swan management in the next 20 years will be the challenge of managing a widespread and relatively abundant species. A welcome challenge it is, thanks to the efforts of many of you assembled here today.

Northeastern British Columbia is fortunate to be able to provide nesting habitat for a portion of the Interior Canada Subpopulation of the Rocky Mountain Population (North American Trumpeter Swan Survey - 1985). The potential for northeastern British Columbia to host Trumpeter Swans was not recognized until the late 1970s when some nesting pairs were noted. Initially these birds were thought to be part of the Grande Prairie flock. Large numbers of swans were not anticipated early on. However, evaluation by Canadian Wildlife Service (CWS) and British Columbia Wildlife Branch biologists has indicated that the habitat exists for a large nesting population, depending on how suitable the pioneering birds find the area. Increases in both the Grande Prairie and Yukon flocks may spill over into northeastern British Columbia, and, as numbers build, the potential exists to form one continuous flock.

Impact assessment studies for coal development in northeastern British Columbia in combination with the North American Trumpeter Swan Surveys of 1980 and 1985 have provided the impetus for analyzing the current numbers of swans and nesting potential in the region. Surprisingly, Trumpeter Swans seem to be quite catholic in their choice of nesting habitat. They have amazed us year after year by successfully raising young in what appears to be marginal habitat, such as in small beaver ponds and meandering streams.

Presented here is an analysis of the potential nesting habitat in northeastern British Columbia. Air photo mosaics and topographic maps at the 1:50,000 and 1:250,000 level were analyzed for suitable swan habitat, the intention being to use this information as a starting point for future surveys. It was assumed that this swan population would not wander to the west of the Continental Divide and that the most suitable nesting habitat was the shallow, eutrophic lakes of the Alberta Plateau. Most of the current sightings of summering swans have been in slightly higher elevation lakes of the benchlands adjacent to the foothills. At this time, it is not known if this is an artifact of the inventory, due to the location of airports at Fort Nelson, Fort St. John, and Dawson Creek, or if these waterbodies are more suitable for swans. Future inventory should provide the answer.

British Columbia, east of the Rocky Mountain foothills, totals some 147,000 square km. In this area, there are approximately 1,790 small lakes (5-50 ha in size) and an additional 40 large lakes (greater than 50 ha) that have some potential to provide nesting habitat for Trumpeter Swans. In addition, some 71 streams were identified as potential nesting habitat where 1:50,000 scale maps were analyzed. The arbitrary choice of size of waterbodies considered suitable, and the scale of the maps and photos used, yield very subjective numbers of potential nest sites. Field studies and surveys will likely result in considerable changes in the figures.

The relative density of the potential habitat by mapsheet should be comparable to the results of this analysis and could be used for allocation of survey time. Table 1 and Figures 1, 2, and 3 show the numbers of waterbodies by mapsheet. The distribution is not uniform. Figure 4 indicates the distribution of waterbodies with recent sightings.

Recreation poses the most serious threat for Trumpeter Swan nesting habitat. Seventeen of the 40 large lakes currently have levels of disturbance that could preclude swan nesting. The most evident of these are Charlie Lake, near Fort St. John, and Swan Lake, between Grande Prairie and Dawson Creek, where fishing, water skiing, and other recreational activities are apparently excluding swans. Small lakes in the region, on the other hand, due to their limited potential for recreational activities and usually poor access are not subject to much disturbance. Only 14 were judged to currently or potentially have conflict between activity and swans.

The impact of oil and gas exploration and development currently has been minimal, due primarily to access that is restricted to winter periods. However, guidelines to mitigate the impact of petroleum development should be prepared to prevent major losses of habitat in the region.

There exists in northeastern British Columbia a large number of waterbodies suitable for nesting Trumpeter Swans. Management for swans should include increased effort in nesting surveys, research to identify the components of good swan nesting habitat, and protection of nesting areas from industrial and recreational concerns. If sufficient wintering habitat can be provided, the outlook for Trumpeters in northeastern British Columbia is one of major growth.

Table 1. Northeastern British Columbia Trumpeter Swan habitat inventory by mapsheet.

Mapsheet	Large lakes	Small lakes	Streams	Waterbodies with sightings
9318		3	1	
9319		8		
93110E		7		
93115	1*	20	2	2 streams 6 small lakes
93116		25	1	7 small lakes
93P1	2*	21		4 small lakes
93P2E	1**	20		2 small lakes
93P7		12		2 small lakes
93P8	1+2*	17	3	1 large lake 8 small lakes
93P9		6	1	
93P10		2		
93P11	2*			
93P13	4+5*	3	1	1 large lake 3 small lakes
93P14	2+1*	27		1 large lake 2 small lakes
93P15		3*		
93P16	1***			1 large lake
94A1		1		
94A2		1		
94A3		19		4 small lakes
94A4		6		2 small lakes
94A5		7		
94A6	1*	1*		
94A7	1	2+7**		1 large lake 1 small lake
94A8		6		
94A9		9	2	
94A10		3	1	
94A11		2		
94A12		1*		
94A13				
94A14			1	
94A15		4		
94A16		6	1	
94B1		6		
94B8		1		
94B9				
94B16				
94H1		16	2	
94H2		2	2	
94H3		2	2	
94H4			1	
94H5		9	2	
94H6		19		
94H7		35		
94H8		25	3	
94H9		16	1	
94H10		13	1	
94H11		15	3	
94H12		1	2	
94H13	1	6	1	
94H14		10	3	
94H15		3	2	
94H16		7	3	
94G1				
94G2		2		
94G7				
94G8				
94G9				
94G10		2		
94G11				
94G14		2		
94G15		4		

Table 1. (Cont'd.)

Mapsheet	Large lakes	Small lakes	Streams	Waterbodies with sightings
94G16		3		
94I1		20		
94I2		25	1	
94I3	1	29	1	
94I4		48	2	
94I5		27	2	
94I6		180	6	
94I7		26		
94I8		37	2	
94I9			2	
94I10	1	1	1	
94I11		64	2	
94I12	1	79	3	
94I13		34	4	
94I14		78	7	
97I15		3		
94I16				
94J	4+1*	72	N/A	12
94P	6+2*	420	N/A	
94O	1*	190	N/A	
94N		5		

* Habitat disturbance
** Potential habitat disturbance
*** Special protection

SUMMARY

1:50,000	13 11* 1** 1***	1,089 7* 7**	71	41 small lakes 5 large lakes 2 streams	83,000 km^2
1:250,000	10 4*	684 3*	N/A N/A	5 small lakes 6 large lakes 1 stream Total	64,000 km^2 147,000 km^2

[Editor's Note: There are some discrepancies between the totals in the summary and the table totals. For more information, please contact the author.]

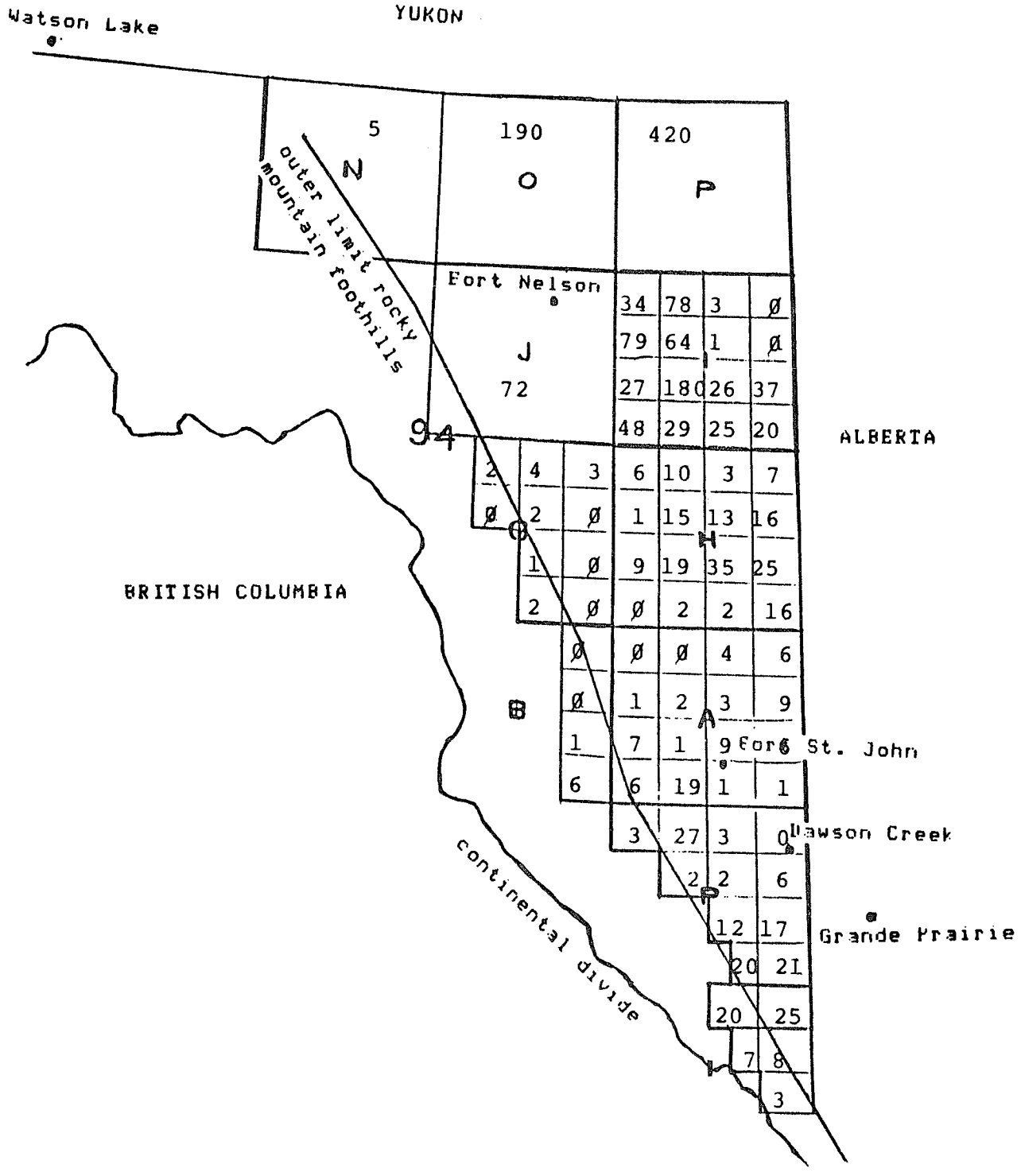


Figure 1. Northeastern British Columbia swan habitat inventory - Number of small lakes within a mapsheet potentially suitable for nesting Trumpeters.

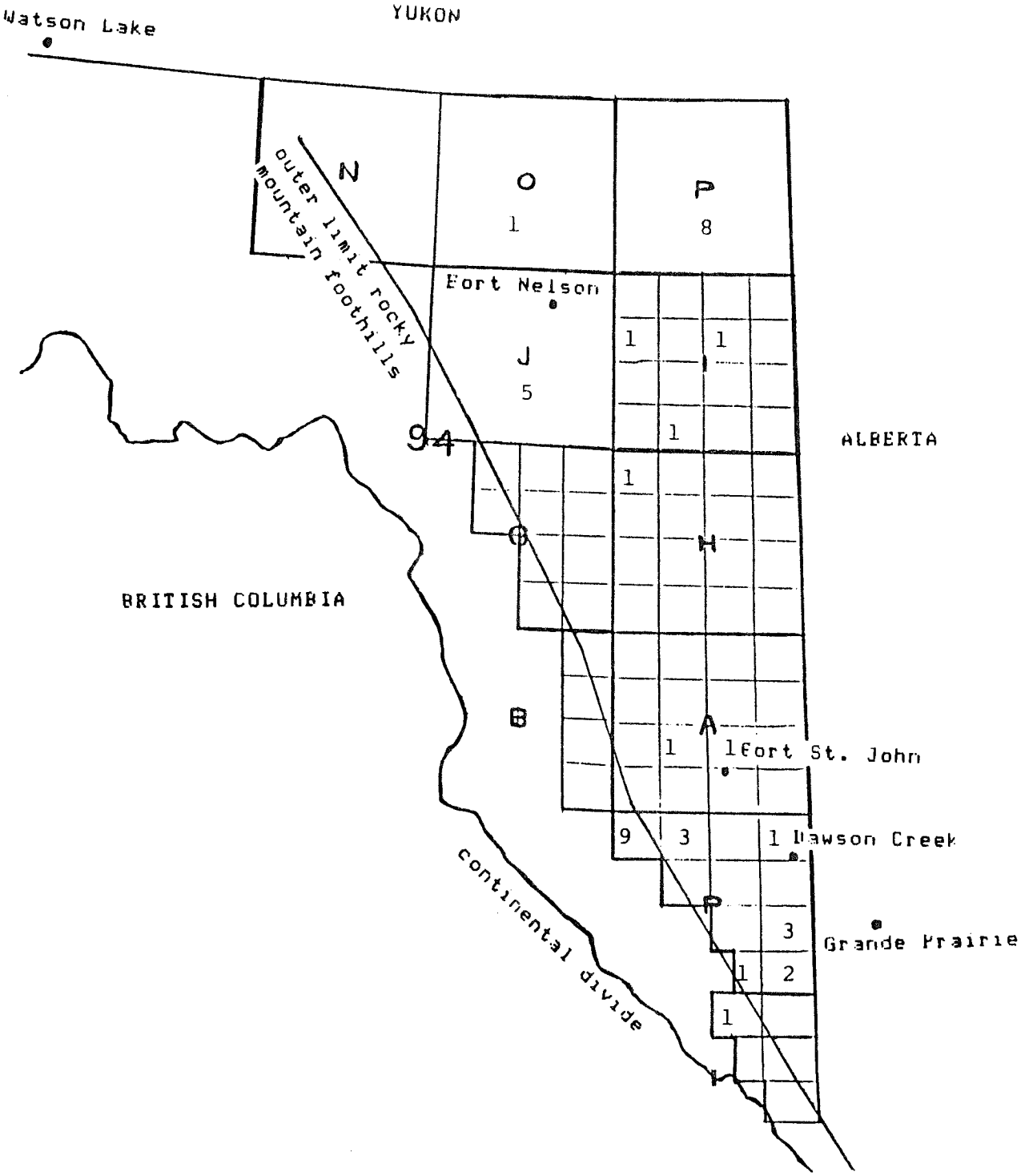


Figure 2. Northeastern British Columbia swan habitat inventory - Number of large lakes within a mapsheet potentially suitable for nesting Trumpeters.

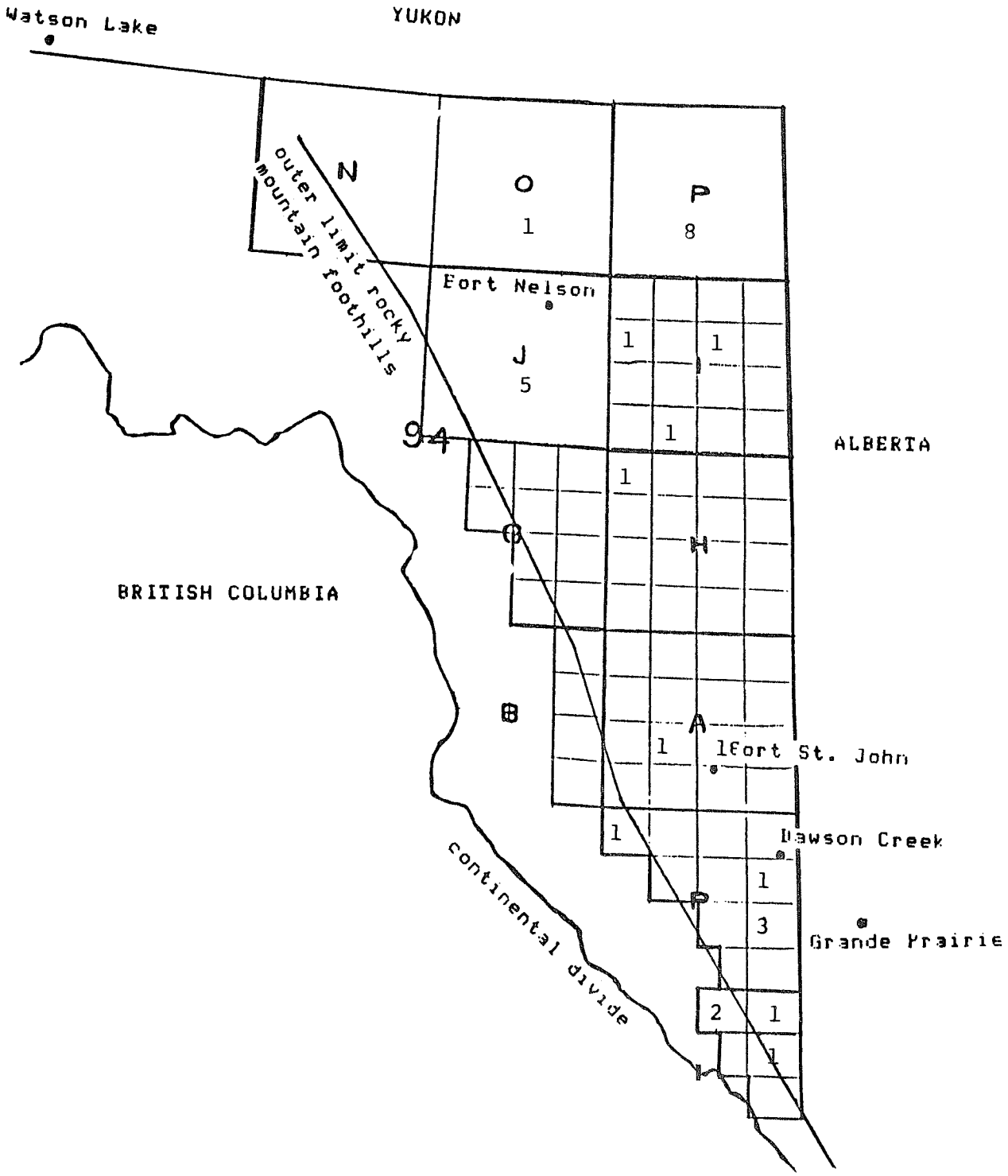


Figure 3. Northeastern British Columbia swan habitat inventory - Number of streams within a mapsheet with potential Trumpeter Swan nesting habitat.

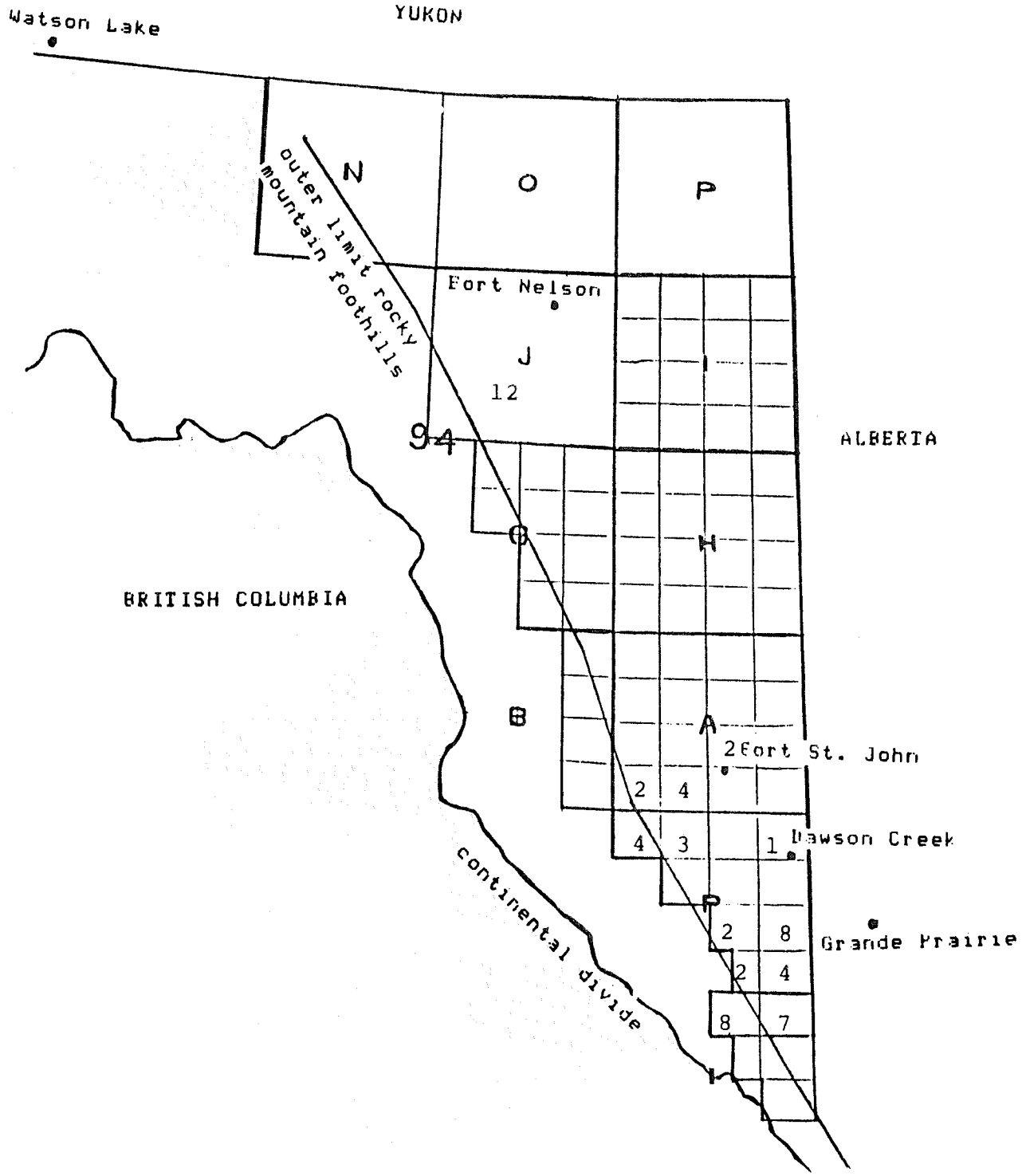


Figure 4. Northeastern British Columbia swan habitat inventory - Number of waterbodies with recent sightings of Trumpeter Swans.

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TRUMPETER SWAN HABITAT IN SOUTHERN YUKON

Malcolm Dennington, Habitat Biologist, Canadian Wildlife Service

OVERVIEW

Trumpeter Swans (Cygnus buccinator) occur in Yukon Territory both as migrants and as summer residents. Most migrants are observed during the early spring in the large lakes area of south-central Yukon, and are probably birds from the Pacific Coast Population enroute to breeding grounds in central Alaska. Although Trumpeters are observed again during the fall migration, we do not witness the population build-up seen at spring staging sites, possibly as a reflection of the much greater number of available open-water sites.

Breeding pairs, individuals, and small groups of nonbreeding Trumpeter Swans have been recorded during the summer months at isolated sites across southern Yukon, as far north as latitude 64° (roughly approximating Hansen's theoretical northern limit).

SPRING STAGING AREAS

Major spring staging areas for Trumpeter Swans are found at the outlets of larger lakes in southern Yukon. Generally, some open water occurs at the lake outlets throughout the winter months, and frequently these are the only areas offering open water when the Trumpeter Swans arrive in early April. Areas supporting higher numbers of Trumpeter Swans at that time (see Figure 1) are Teslin Lake outlet (A), Tagish Narrows (B), M'Clintock Bay - Yukon River (C), and Kluane Lake outlet (D). Surveys conducted at Teslin, Tagish, and M'Clintock (Johnston and McEwen 1983, Mossop 1976, and Milligan 1978) provide the following information on numbers of Trumpeters, generally at the peak of migration:

Table 1. Trumpeter Swan numbers at four areas during the peak of migration, Yukon Territory.

Year	Tagish Narrows	M'Clintock Bay	Teslin Lake	Kluane Lake
1977	158	222	29	26
1978	65	171		
1982	123	308	67	
1983	55	727	30	

Features of importance to swans, which are common to these sites, include extensive ice ledges adjacent to open water available for loafing/resting areas, mudflats, and associated shallow water areas for feeding (Johnston and McEwen 1983). Studies at Teslin, M'Clintock, and Tagish (Johnston and McEwen 1983) have shown that there are very small quantities of "new growth" aquatic plants available to swans in April at the lake outlets, but low water levels, common to all areas, provide swans with access to roots and rhizomes of plants such as pondweed (Potamogeton spp.), horsetail (Equisetum spp.), water milfoil (Myriophyllum spicatum), and mare's-tail (Hippuris vulgaris).

Several other lake outlets (Little Atlin, Bennett, Laberge, Dezadeash, Kathleen, Aishihik, Big Salmon, and Frances) are known to have attracted a few Trumpeter Swans during the spring migration, but are considered to be minor staging areas.

Swans with collars have been seen at Tagish, M'Clintock, and Teslin Lake outlet on most years during which concerted inventory efforts were undertaken. With the exceptions of one bird which was collared in Alaska, and one from Alberta (apparently a transplant from the Powell River wintering area), all birds had initially been collared at Powell River. It seems likely that the vast majority of Trumpeter Swans using the staging areas in south-central Yukon during the early spring is from the Pacific Coast Population.

BREEDING AREAS

Trumpeter Swan pairs, and pairs with cygnets, have been observed during summer months across southern Yukon to approximately 64°N latitude (see Figure 1). Most of the lakes where broods have been found are separated by considerable distances, even though there would appear to be many other suitable lakes between occupied sites which should satisfy the habitat requirements of breeding pairs. However, in south-eastern Yukon there appears to be a concentration of nesting activity within an area roughly centered around Toobally Lakes. This area has been systematically surveyed over the past few years. Rick McKelvey will provide population data later in the Conference.

Lakes selected by Trumpeter Swans during summer months in southern Yukon are generally located at elevations of 2,000 feet to 4,000 feet above sea level (average for 17 sites is 2,850 feet). It is quite probable that lakes at 4,000 feet elevation are near the maximum elevation for suitable breeding habitat at this latitude due to the short amount of time between spring break-up and fall freeze-up. Most of the lakes where broods have been observed (may not always be the nest lake because of post-hatching movements) could be classified as small lakes, having surface areas of approximately 1/2 square mile. We have little site-specific information on the physical and vegetational characteristics of these lakes, but they do appear to have similar inflow-outflow features, very irregular shorelines, small offshore islands, peripheral sedge or sedge-willow communities, and proximity to other, frequently larger, waterbodies.

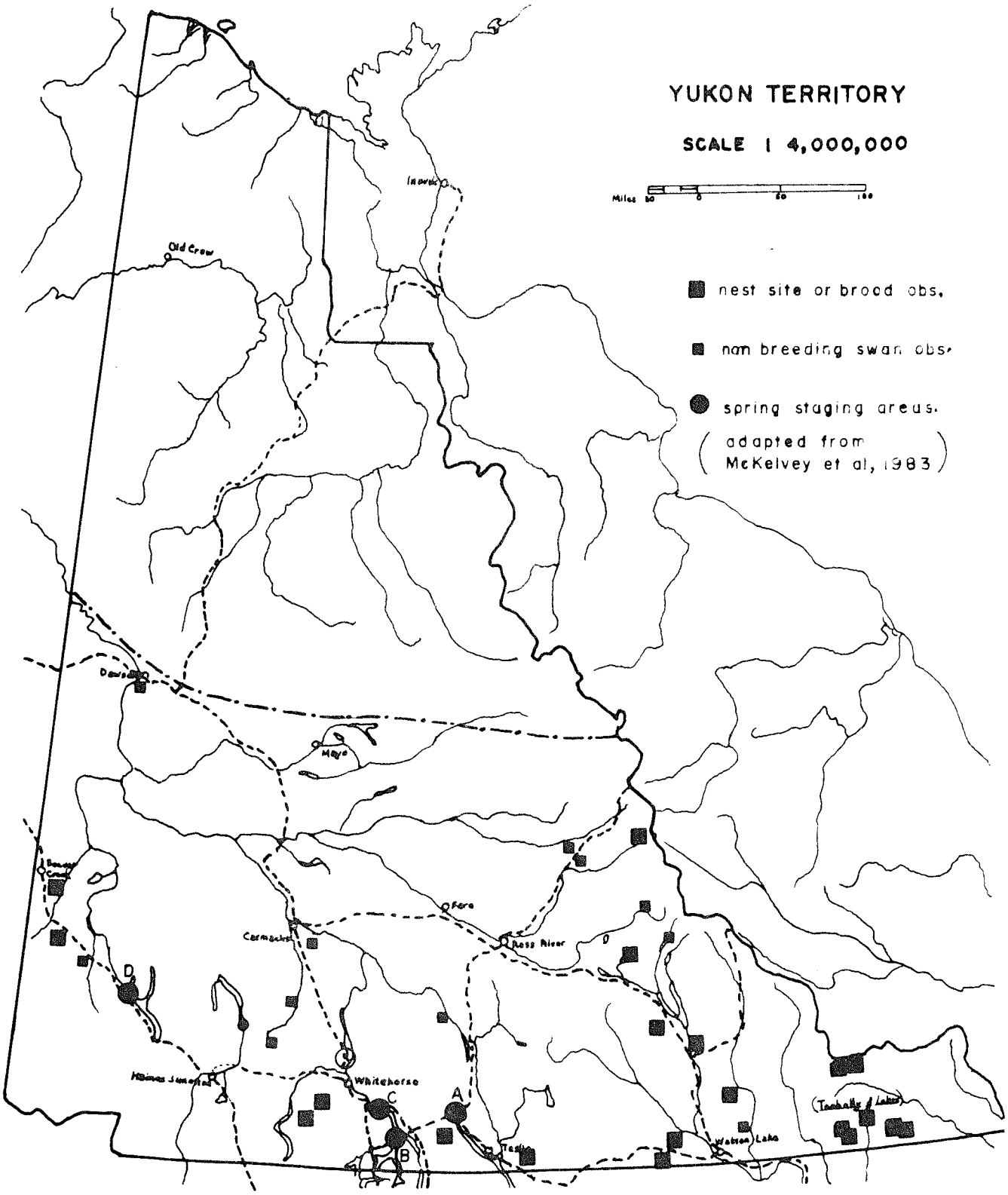

Figure 1. Areas of importance to Trumpeter Swans in Yukon.

Some of the lakes in the Toobally area of southern Yukon were initially examined during the course of population surveys (Dennington and McKelvey 1986). Water depths were found to be quite variable, but most of the lakes examined had extensive shallow water areas. Pondweed (Potamogeton spp.) predominated in some lakes. Shoreline emergents were primarily sedges (Carex spp.), although horsetail (Equisetum sp.) occasionally occurred in pure stands, particularly in the vicinity of in-flow channels. Cattail (Typha spp.) and bulrush (Scirpus spp.), two emergents common to wetlands across the prairies, are not common in southern Yukon, and were not found at all in the Toobally Lakes area.

Analyses of water samples collected from 15 lakes in the Toobally area showed most lakes to be neutral to slightly alkaline (pH 7.2 to 8.6), having low conductivity, and no measurable salt concentrations. Initial sampling for invertebrates showed a good diversity of species, but few conclusions could be drawn from the limited data regarding availability of invertebrate species as a food source for swan cygnets.

LIMITING FACTORS

An account of breeding populations of Trumpeter Swans in southern Yukon leads to the question of habitat limitations. How could the population expand (providing that wintering areas can accommodate an expanding population)?

We have little information on spring arrival dates of Trumpeter Swans in southeastern Yukon, but it is doubtful that the peak of migration would differ much from the mid-April peak observed in the Whitehorse area. Using average dates from southeastern Alaska and Red Rock Lakes in Montana (Hansen et al. 1971), the following schedule seems reasonable for southern Yukon:

Spring staging	10-20 April	
Nest initiation	20 April - 23 May	(22 days)
Incubation	15 May - 19 June	(35 days)
Development of flight stage	19 June - 2 October	(105 days)
Total		165 days

Because of the relatively long time period required for Trumpeter Swans to rear young to the flight stage, it is possible that in the northern parts of the range, the time period between spring break-up and fall freeze-up is a major limiting factor.

Using from 5 to 20 years data from each site, Fisheries and Environment Canada (Allen 1977) have produced a set of maps showing isopleths for first deterioration of ice in lakes, clearing of lakes, first ice in lakes, and freeze-over of lakes in Canada. Assuming that the first deterioration of ice in lakes and freeze-over of lakes are the critical conditions for waterfowl, Figures 2 and 3 have been prepared to show those parameters for Yukon Territory. Through simple interpolation, the "open water days" have been calculated and the figures presented between the isopleths in Figure 3. On the basis of this information, we find that the line indicating the northern limit of 165 open-water days (the probable limit for Trumpeter Swan production) is approximately 63°30'N latitude at the Alaska-Yukon border, and curves southeastward to cross the Yukon-British Columbia border east of Watson Lake. Our information on the location of swan broods (Figure 1) indicates that this line is only a rough approximation of the northern limit for swan production in Yukon. Local variables that might influence freeze-up and break-up, would include size and depth of the lake basin, inflow-outflow characteristics, local topography, and elevation above sea level. We are developing a picture of the potential limitation that ice conditions may impose on breeding swan populations in Yukon. It also appears that the time of first deterioration of ice in lakes (exclusive of the early open water staging areas discussed earlier) may be more critical to Trumpeter Swans than the time of freeze-over of lakes in the fall. It is interesting to speculate whether individual Trumpeter pairs may, on given years, delay nest initiation and incubation, or simply fail to nest at all, as a result of late spring break-up.

Another factor, which is currently of minor significance in terms of the distribution of breeding populations of Trumpeter Swans in southern Yukon, is disturbance. Nearly all swan nests and/or broods observed in recent years have been on wetlands removed from major highways, and most often away from any form of access road. A major portion of the nesting lakes are too small to accommodate float-equipped aircraft, although several of the larger lakes that have supported broods have, at times, received considerable use by aircraft. While we know that Trumpeters do breed successfully in areas subject to human disturbance, it is likely that in pioneering new areas, breeding pairs seek out sites which are relatively remote.

HABITAT MANAGEMENT

None of the currently-known staging or breeding areas for Trumpeter Swans in Yukon have the benefit of protection through parks, wildlife preserve, or wilderness areas legislation. Most of the breeding areas appear relatively secure, at present, due to their remote locations. However, spring staging areas continue to receive pressure, particularly through development of subdivisions and activities of weekend recreationists.

In an information package on Trumpeter Swan breeding areas in southeastern Yukon, prepared for the Canadian Wildlife Service (Dennington and McKelvey 1986), we have suggested that the rationale for

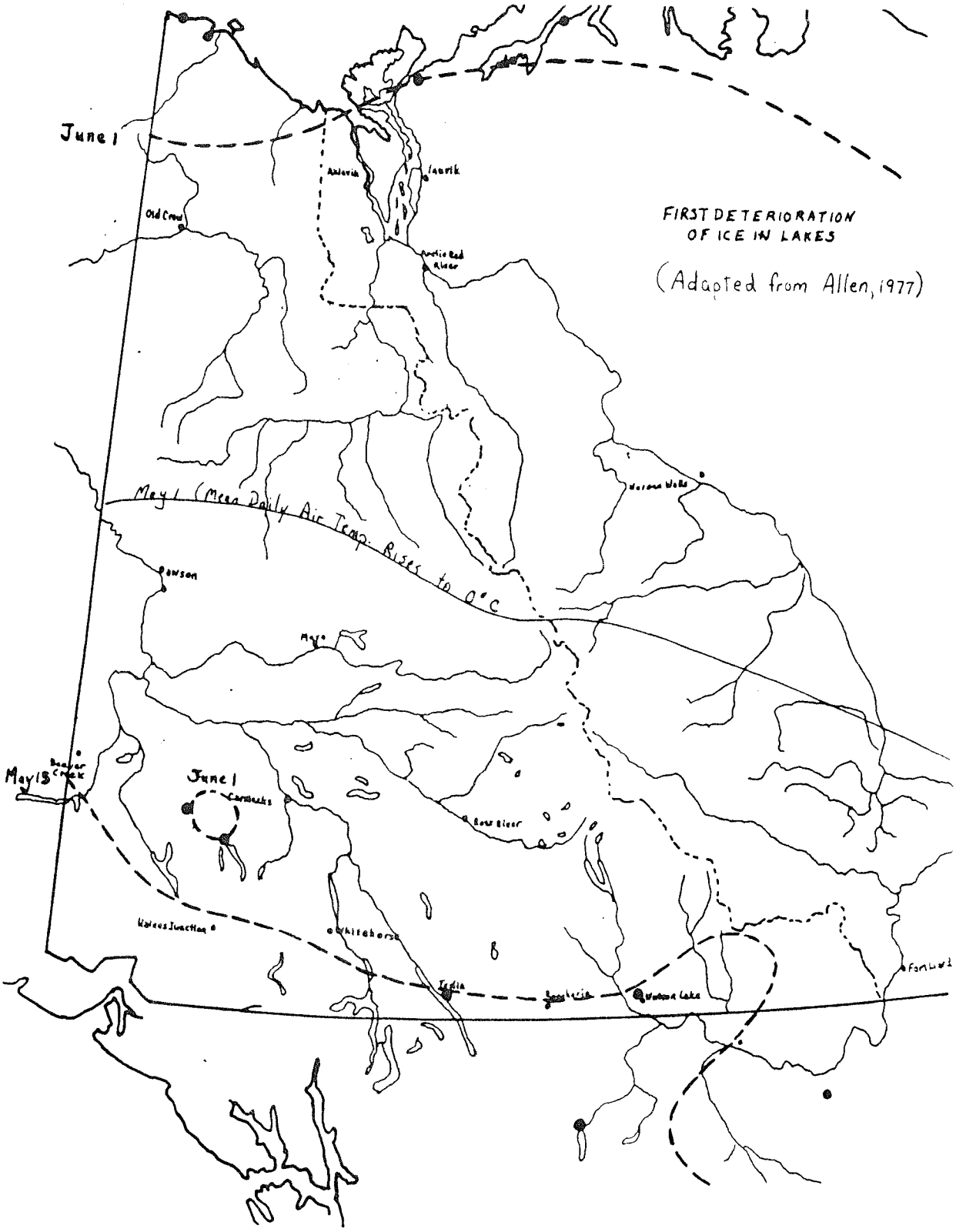

Figure 2. Isopleths of dates of first deterioration of lake ice in Yukon. Adapted from Allen, 1977.

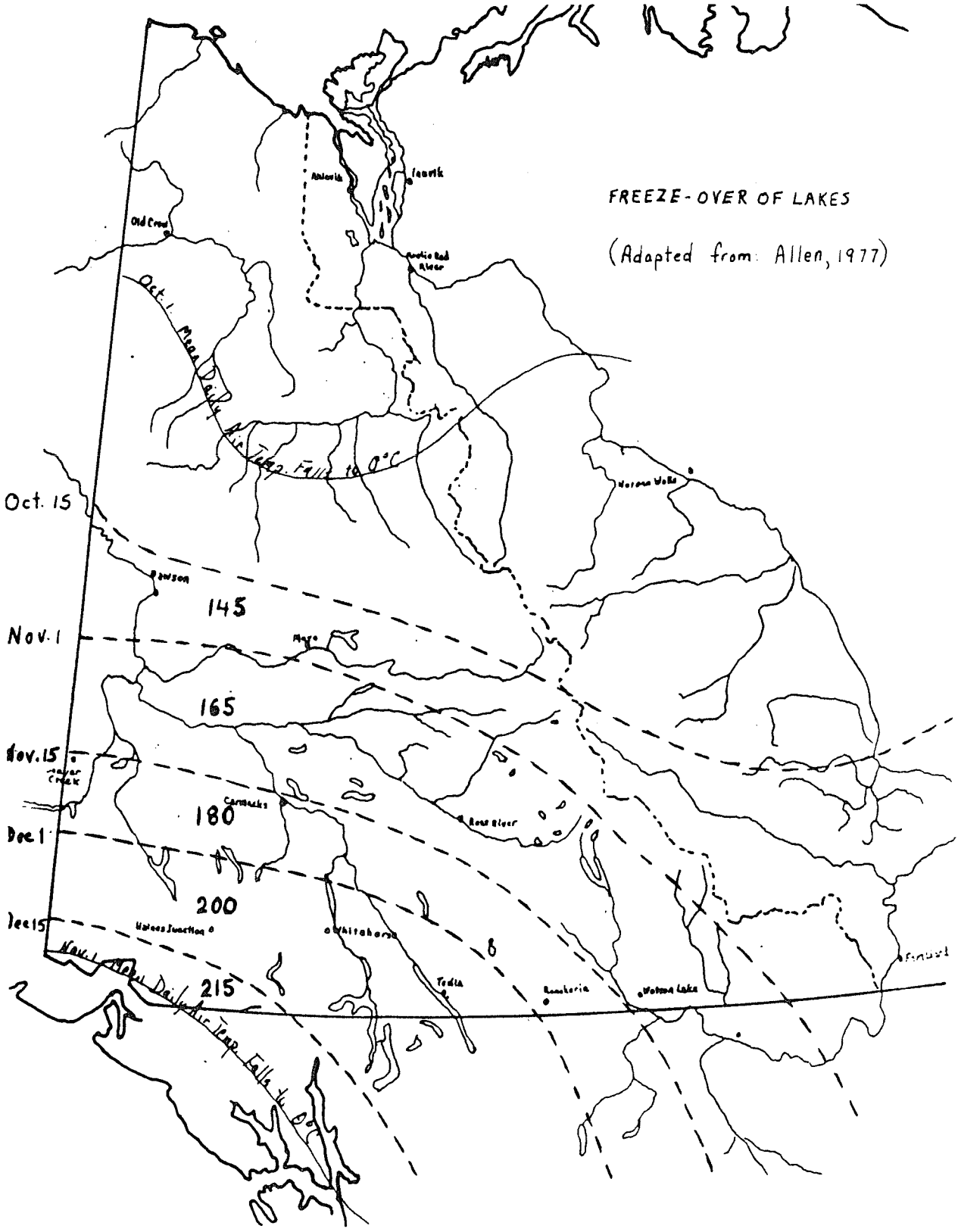

Figure 3. Isopleths of dates of freeze-over of lakes in Yukon. Adapted from Allen, 1977.

conserving/protecting Trumpeter Swan habitat in Yukon lies not so much with concern for the status of Trumpeter Swan populations on a continental basis, as with the role of the species as an integral part of Yukon's wilderness resources. In southeastern Yukon, there appears to be an opportunity to combine protection of swan nesting habitat with preservation of representative and/or unique landscape features, through establishment of wilderness-recreation areas. Future consideration of this concept could be undertaken within the ongoing Southeast Yukon Planning initiative, being conducted by the Northern Land Use Planning section of the Department of Indian Affairs and Northern Development.

Spring staging areas, because they are generally used by waterfowl for a brief period each year, will require a different regulatory regime. The habitats of most importance are the open water areas and the surrounding ice-edge shelf. The surrounding uplands adjacent to the staging areas are mostly in private ownership, and access to the staging areas is readily available. The major factor potentially degrading the staging habitats is disturbance. Staging areas are no longer available for acquisition. Designation of the offshore habitat as a seasonally protected area, with adequate enforcement, is likely the most workable alternative.

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STATUS OF TRUMPETER SWANS IN THE SOUTHERN MACKENZIE DISTRICT, NORTHWEST TERRITORIES

Leonard J. Shandruk, Habitat Biologist, Canadian Wildlife Services

The 1984 edition of the North American Management Plan for Trumpeter Swans suggested that "Trumpeter Swans [Cygnus buccinator] summer and likely nest in and near the Nahanni National Park, N.W.T." The Northwest Territories (NWT) population was estimated at 10 birds. This estimate was probably based on casual observations which had been recorded over the previous 10-15 years.

Although the first observation dates from 1970, swans were not seen regularly until 1977. The first breeding was recorded at Yohin Lake in 1978, and a second brood was recorded near Glacier Lake in the same year. All subsequent breeding records prior to 1984 have been from Yohin Lake.

A total of 48 observations have been made in the area prior to 1984. Two areas of concentration were Yohin Lake and the South Nahanni River floodplain downstream from the junction of the Rabbitkettle and Broken Skull Rivers. These concentrated observations probably reflect the activities of Parks Canada personnel who have been active in the area since 1970. Notable exceptions (Fishtrap Creek, Lake Bovie, Broken Skull River) are outlying observations which were made in the course of other field studies.

Nahanni National Park is located in the southwest corner of NWT, proximal to the Yukon border. The nearest communities are Fort Simpson, Nahanni Butte, Fort Liard, and Tungsten (Figure 1). The major rivers in the area include: Mackenzie, Liard, South Nahanni, and the Flat. Yohin Lake is the only major wetland of significance to waterfowl in the area (Figure 2).

1984 SURVEY

A survey of Nahanni Park and vicinity was conducted in 1984 in response to:

1. The North American Management Plan for Trumpeter Swans which identified a population survey of the area as a priority.
2. A request from Parks Canada to identify existing and potential swan habitat in the Park and to recommend monitoring and management practices for the protection of swans within the Park.

The June 1984 survey revealed 18 adult swans, consisting of seven pairs and four single birds. Three breeding pairs were located. Swans were observed at Yohin Lake, within a complex of ponds and floodplains adjacent to the South Nahanni River on Irvine Creek, and on an alpine lake (2650 feet) south of the South Nahanni.

1985 AND 1986 SURVEYS

The 1984 survey prompted us to do more extensive surveys in 1985. Our major objective in 1985 was to get the best count possible of the total swan population in the area. In 1986, our objectives were to improve our survey, to collar at least five adults, and to verify that these birds were, in fact, Trumpeter Swans. In 1986, we altered our survey route to cover the key concentration areas discovered in 1985 and to check out some new areas. During the 1986 survey, we eliminated the northern portion of the 1985 survey from Tungsten to Norman Wells. We increased our survey area south of Fort Liard and added the east side of the Mackenzie River on Irving Creek, and an alpine lake (2650 feet) south of the South Nahanni.

1985 SURVEY RESULTS

The 1985 survey yielded a total of 51 adults, including 17 pairs. Twenty-four cygnets, in seven broods, were also observed. The majority of the birds observed in 1985 was encountered in the Nahanni Butte area and in the vicinity of Carlson Lake (Figures 2 and 3). Six of the seven broods observed were also proximal to Nahanni Butte.

1986 SURVEY RESULTS

During our late-July 1986 survey, we observed a total of 85 adult Trumpeter Swans. Fifty-five cygnets in 14 broods were documented. The mean brood size was 3.93 which is extremely high. One brood of seven cygnets was observed on an oxbow lake of the Liard River. These observations suggest extremely productive wetland habitats. Other than 11 white birds and one brood of four cygnets, all other swans were observed around Nahanni Butte and north to Camsell Bend, along a north-south line west of the Nahanni Range.

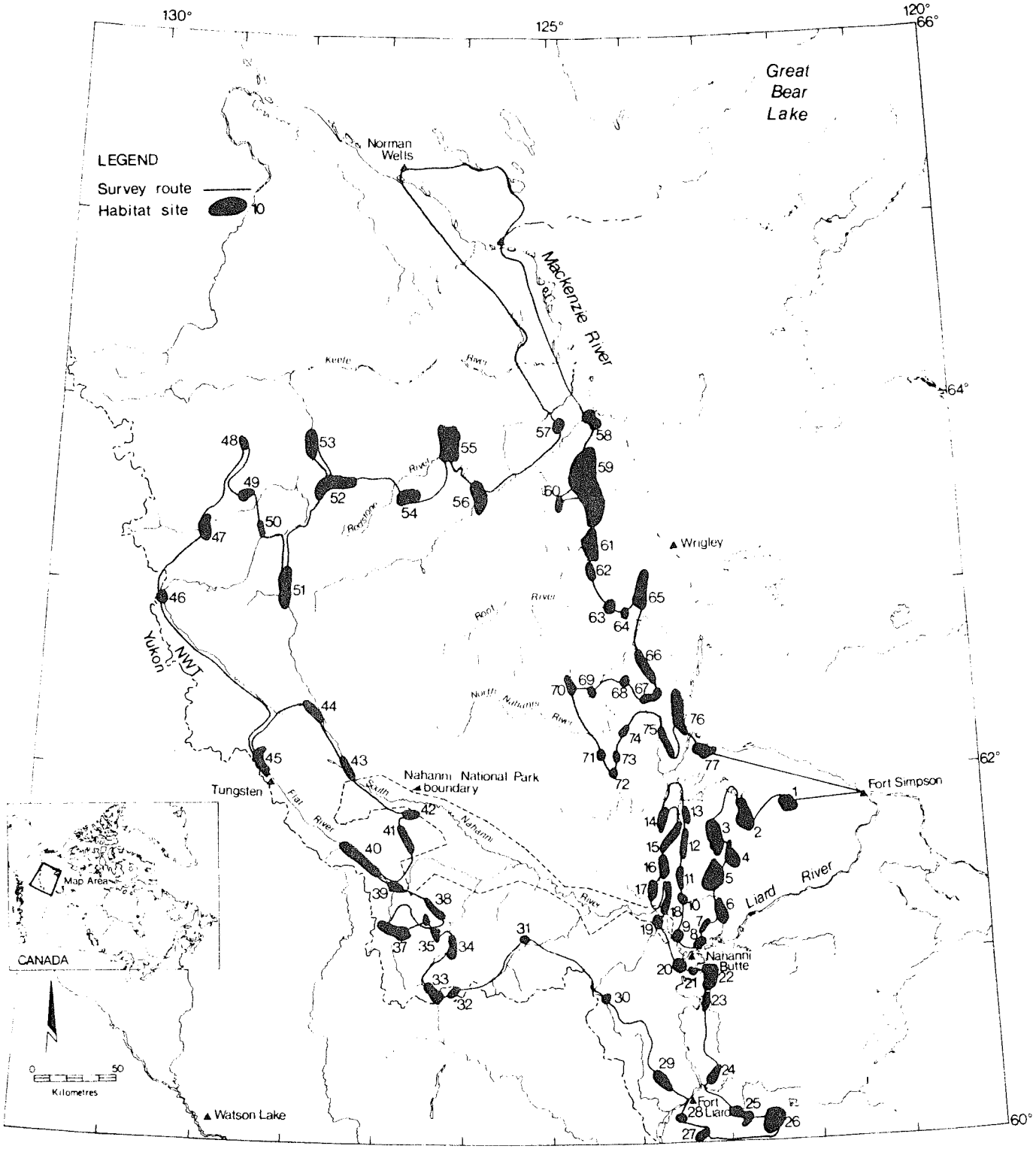

Figure 1. Location of the study area within Northwest Territories.

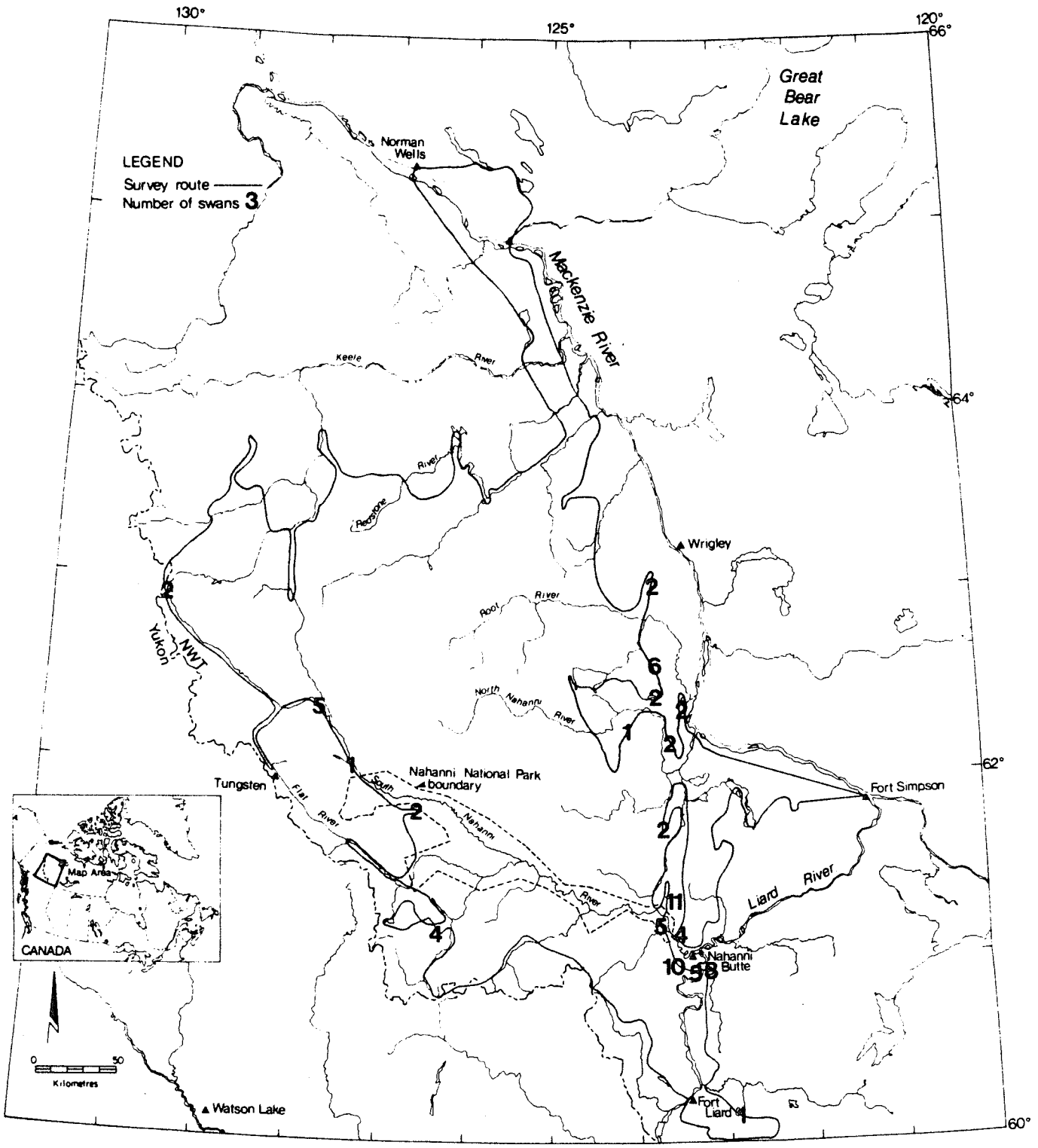

Figure 2. Distribution of Trumpeter Swans in the southern Mackenzie District, Northwest Territories, August 1985.

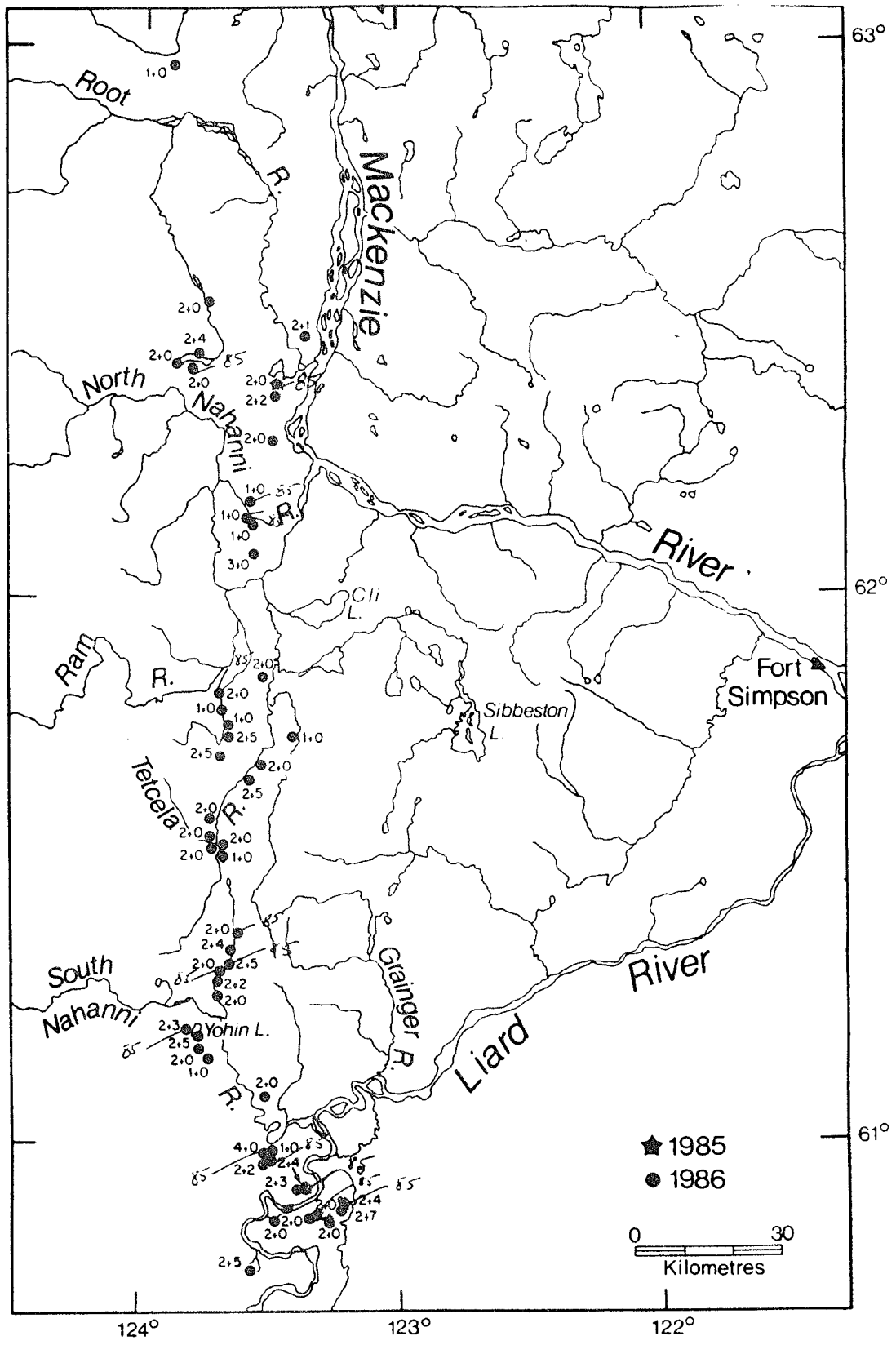

Figure 3. Distribution of Trumpeter Swans in the southern Mackenzie District, Northwest Territories, summer 1985.

COMPARISON OF SURVEY RESULTS

Table 1. Summary of Trumpeter Swan observations, southern Mackenzie District, Northwest Territories, 1985 and 1986.

	Paired	Cygnets	Singles	Flocked	Total
1985	34	24 (7)	6	11	75
1986	66	55 (14)	12	6	139

( ) Number of broods

If one compares the 1985 survey results to 1986 (Table 1), two questions arise immediately. Did the 1985 survey not account for all the swans, or was there an influx of swans in 1986 from areas not surveyed in 1985? I suggest that we may have considerably more Trumpeters in the NWT than we accounted for. The late, cold spring may have short-stopped birds which might normally use habitats further north along the Mackenzie Valley.

HABITAT USE

With few exceptions, Trumpeter Swans in this area were associated with lakes and wetlands which occurred on floodplains adjacent to rivers or creeks. Other important breeding habitats were flooded ponds with trees in them along the Tetcela River and Fishtrap Creek (Figure 3). Oxbow lakes along the Liard and Netla Rivers were also utilized by breeding swans. Prevailing surficial materials in these areas include silts and clays which are extremely fertile and thus conducive to wetland vegetation production. Major plant species associated with these wetlands were horsetail, sedges, cattails, rushes, yellow pond-lily, duckweeds, and several species of pondweeds. The majority of wetlands used by breeding swans was below 300 m in altitude.

Throughout the survey we were struck by the availability of apparently good habitat. There were many unoccupied areas that appeared to be equally suitable to those occupied. Thus, there appears to be considerable potential for the expansion of this species in the NWT. Another observation of note is that birds observed with broods at Carlson Lake, T63 N, were approaching the northern limit suggested by Hansen *et al*. (1971).

COLLARING AND BANDING

A second objective of our 1986 fieldwork was to try to collar and band at least five adult Trumpeter Swans in the southern Mackenzie District. Using the information on location of pairs from the survey, we were able to capture and collar 20 adult birds. In addition to banding and collaring, we took morphological measurements and body weights of all birds captured. Eight pairs, two yearling birds, and two adult females were collared. We were most successful in capturing pairs with cygnets, since most pairs without cygnets were already flying. In the end, we did collar four pairs with cygnets and four without.

The use of both fixed-wing and rotary-wing aircraft to survey the main concentration of breeding swans enabled us to gain an insight on some possible survey biases. We found that our fixed-wing survey omitted six white birds and consistently underestimated the size of broods if they were larger than four cygnets.

Measurements of primaries and observations collected will provide some information on the phenology of molt for this flock. Also, thanks to the cooperation of captured adults, we have 12 fecal samples which will be analyzed for information on feeding.

MANAGEMENT CONCERNS

With the exception of some hunting near Nahanni Butte, there are few man-induced threats to this swan flock. A proposed hydroelectric dam on the Liard River in northern British Columbia may have some impact on the wetlands adjacent to the Liard River. This proposal is temporarily on hold.

Management priorities should be:

1. Clarify the total distribution, abundance, and productivity of the NWT population.
2. Continue banding and collaring to determine population affinity, migration routes, and wintering areas of this flock.

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TRUMPETER SWAN HABITATION AND PROPOSED MANAGEMENT IN SASKATCHEWAN

Marlon Killaby, Wildlife Biologist,
Saskatchewan Parks and Renewable Resources

HISTORY AND POPULATION TRENDS

Almost all of present day Saskatchewan falls within Hansen's (1973) historic Trumpeter Swan (Cygnus buccinator) breeding range limit. Hudson Bay Company fur records document the widespread presence of this species and the successful marketing of swan pelts from western Canada to Europe. Uncontrolled exploitation and, later, habitat disruptions no doubt contributed to the decline of the Trumpeter Swan in Saskatchewan.

Cypress Hills remains as the only area to have sustained a breeding population of swans in Saskatchewan. Local residents claim nesting swans have occurred within the Cypress area since the turn of the century.

Records kept from 1951 until 1971 document a fluctuating breeding population of one or two pairs with two to seven cygnets produced per nest site. Three pairs produced nine cygnets in 1971 and 10 cygnets in 1972. More recently, only one pair on Coule Lake Reservoir successfully fledged three cygnets in 1983 and 1984 and two cygnets in 1985. The nest and eggs were abandoned the spring of 1986 -- human disturbance at the nest site was suspected.

Breeding Trumpeter Swans have also been recorded in the southwest portion of the Province. Since 1983, early summer aerial surveys have been flown over what was considered likely Trumpeter habitat in the Maple Creek-Cypress Hills area. Swan residency was then followed throughout the remainder of the season by random ground observations.

Adam's Lake Reservoir, 2 km west of Coule Lake, contained three adult-plumaged birds both in 1983 and 1984. One adult-plumaged bird was observed from the air the first week of July in 1986, but subsequent ground surveys turned up no birds after that point.

One adult-plumaged Trumpeter summered on the Andrews-Reedy Lakes complex in 1985. Three birds inhabited this complex in 1986. Of the two lakes, Reedy Lake appears to have the greatest potential for nest initiation.

In an attempt to discover winter range and immature swan summer range, Dan Nieman, Canadian Wildlife Service, Saskatoon, leg-banded and collared four cygnets and one adult female in mid-July 1972 and six cygnets and two adults males on 21 August 1973. Two collared swans, one adult male and one cygnet, were located on MacDonald Pond, Yellowstone River on 12 February 1974. Similar observations were made in 1975 and 1976. Collared, breeding adults continued to return to the Cypress Hills. The fate of the banded young was never ascertained, but it is felt these immatures become components of either the American or the Grande Prairie - Yukon Flocks, or both.

LIMITING FACTORS

Three factors are believed to come together to limit Trumpeter Swan numbers in Saskatchewan. These are: 1) saturated or, at least, congested wintering grounds, 2) the secretive nature of the species when nesting, and 3) an insufficient reproduction base (i.e., only one breeding pair).

The Tristate wintering grounds have been reported to be near or at its saturation point. Any attempt to introduce more swans on these grounds may meet with high mortality in new flocks, as well as negative impacts on traditional populations.

Gordon Holton and Harold Burgess (pers. comm.), as well as other authorities in the literature have commented on the apparent need for seclusion by breeding pairs. This has been specifically noted for newly-formed pairs and for pairs nesting for the first time on a specific waterbody. However, once the bond to a breeding ground has been established, an increased level of human disturbance will be tolerated. Many potential breeding habitats in agricultural Saskatchewan would appear to have limited value to Trumpeters because of this behavioral attribute.

One breeding pair and its progeny can not restore historic or desired population levels on available wetlands. Loss of one or both adults may mean the extirpation of the species in Saskatchewan.

OBJECTIVES

1. By 1990, have a minimum of two breeding pairs in the Cypress Hills. This will be accomplished by regulating human disturbance and maintaining water regimes on the breeding wetland to protect the existing swans. A second step will be the reconstruction of a nearby reservoir to specifications suitable for Trumpeter Swan nesting.

2. By 1990, have an operational recovery plan in place with the cooperation of Federal, provincial, and state agencies.

3. By the year 2000, have established a minimum of 10 breeding pairs in Saskatchewan. The recovery plan will be in place, along with a stocking program.

CURRENT AND RECOMMENDED ACTION

1. Saskatchewan's present breeding pair inhabits a reservoir partially within Cypress Hills Provincial Park and partially on privately-owned or Provincial Crown leased land. Following negotiations with landowners and lessees, this reservoir will be officially recognized and protected under Saskatchewan's "Special Areas and Boundaries Regulation" of the Wildlife Act. Furthermore, a 100-meter restriction of access will be enacted through the general regulations of the Wildlife Act from 15 April to 15 September.

2. In cooperation with Ducks Unlimited (Canada) and area ranchers, Adams Lake Reservoir will be reconstructed in 1987, with the following objectives:

    a. Establish and maintain a proper breeding environment for Trumpeter Swans.
    b. Provide information regarding Trumpeter Swan management and marsh design for a long-term recovery plan.
    c. Provide improved habitat for other wildlife inhabiting Cypress Hills and the surrounding plains.
    d. Increase public awareness of the Trumpeter Swan and its rare status in Saskatchewan.
    e. Secure a water source for local agricultural interests and create flood control capabilities.

3. Assist and support the creation of a Federal, provincial, state, and special interest group committee(s) to develop and institute a recovery plan for Saskatchewan. Elements such as the identification of breeding and wintering areas, source of eggs/cygnets for transplant, initiating migration patterns (through use of guide birds), monitoring, and public information will be a few of the essential components necessary for such an undertaking.

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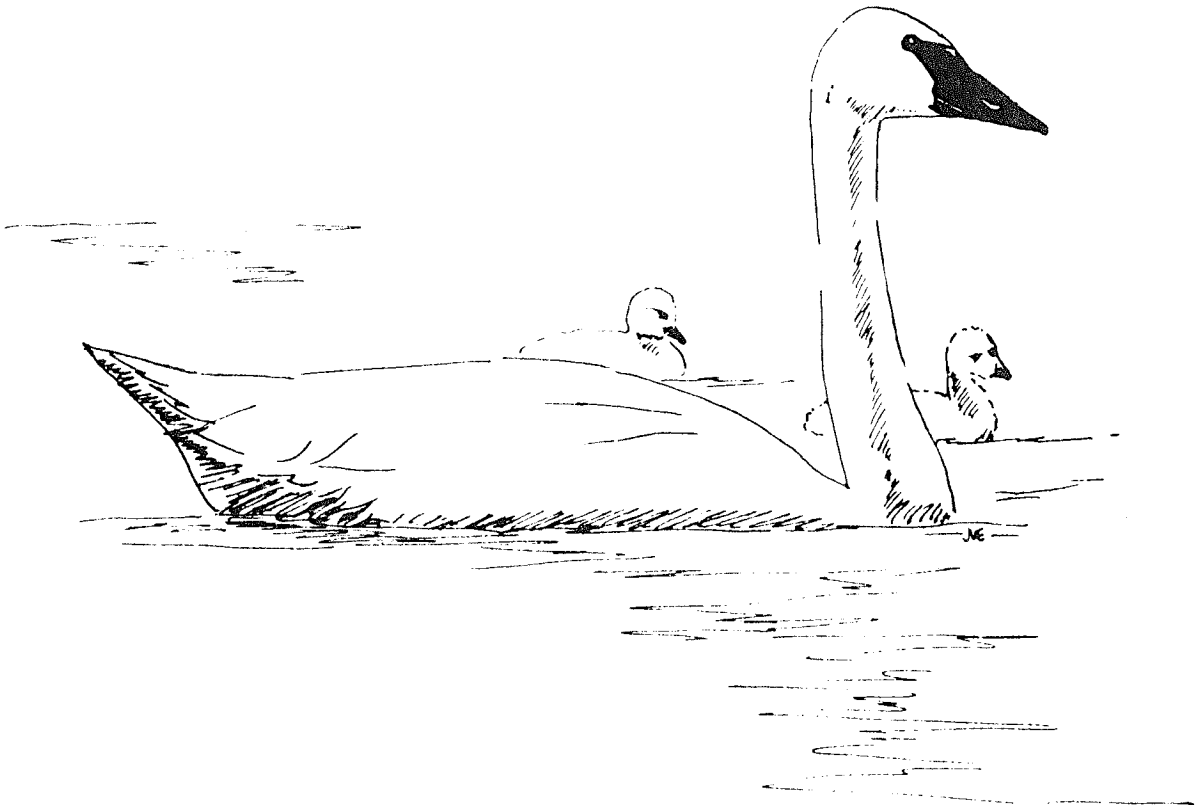
TRISTATE SUBPOPULATION



THE TRUMPETER SWAN SOCIETY'S RED ROCK LAKES STUDY COMMITTEE RECOMMENDATIONS: A U. S. FISH AND WILDLIFE SERVICE UPDATE

Barry Reiswig, Refuge Manager, U. S. Fish and Wildlife Service

INTRODUCTION

During the summer of 1984, The Trumpeter Swan Society (TTSS) assembled an eminent group of biologists headed up by Art Hughlett to look into a decline in Trumpeter Swan (Cygnus buccinator) production at Red Rock Lakes National Wildlife Refuge (RRLNWR). Retired refuge manager and TTSS President Harold Burgess spent several months on the Refuge going through the biological files and looking at the Refuge on the ground. Prior to the Society's 9th Conference in West Yellowstone, Harold Burgess was joined by the rest of the Committee.

The Study Committee developed a series of 12 recommendations which they felt should be adopted by the U. S. Fish and Wildlife Service (USFWS) to improve swan production on the Refuge. These recommendations were presented to the general membership at its Conference in West Yellowstone.

Since that time, the USFWS has taken a number of steps based on these recommendations to improve Trumpeter Swan habitat conditions on the Refuge, and planning is currently underway for the implementation of additional recommendations.

In addition, the USFWS has taken several steps on behalf of Trumpeter Swans at Red Rock Lakes. With the assistance of the states of Montana, Wyoming, and Idaho, and TTSS, the USFWS has funded a study of the Rocky Mountain Population of Trumpeter Swans by Ruth Gale and Joe Ball of the Montana Cooperative Wildlife Research Unit at the University of Montana in Missoula. With the assistance of a number of experts in the wildlife field, Ruth and Joe have synthesized the data on the Rocky Mountain Population and are currently in the process of writing. This study will likely have significant management implications for the Refuge and other swan habitats in the Yellowstone ecosystem (Ruth Gale, pers. comm.).

The USFWS has identified four inholdings in the southeast portion of the Refuge which, if developed for subdivisions or other incompatible uses, would have deleterious impacts on Trumpeter Swan habitat on the Refuge. The USWFS, the Conservation Endowment Fund, and The Nature Conservancy are actively working on the acquisition of these inholdings. When acquired, these tracts will provide additional security and habitat protection for Trumpeters, as well as other species.

RECOMMENDATIONS AND RESPONSE

In response to the Society's recommendations for swan management on the Red Rock Lakes Refuge, the Service has taken the following actions, to date:

Society Recommendation 1. Provide the latitude for the Refuge manager to pass flood waters and manipulate water levels by, if necessary, modifying or replacing the existing fixed-crest water control structure and spillway.

The Service, in cooperation with Ducks Unlimited, retained the engineering firm of HKM Associates of Billings, Montana, to study the hydrology of the Centennial Valley and to make recommendations as to the best way to redesign the water control structure to accomplish the following goals:

1. Pass a 100-year flood event.
2. Pass a 10-year flood event without increasing the level of the Lower Lake more than 6 inches.
3. Allow for maximum drawdown of the Red Rock Lakes system.

HKM Associates found that because of the lack of gradient in the upper Centennial Valley, the goals prescribed above could be accomplished during only approximately 50 percent of the years, and only then by raising the lake level early in the spring, encouraging the swans to nest at a high lake level and, subsequently, lowering the lake level during the remainder of the spring and early summer.

This recommended plan requires the storage of water owned by downstream users. We are currently in the process of negotiations with downstream water users and landowners to gain their approval for these needed changes. A Memorandum of Understanding has been developed with the East Bench Irrigation District of Dillon, Montana, the Irrigation Water Users Company of Lima, Montana, and the Bureau of Reclamation, and should be signed by all parties soon.

The recommended plan would lengthen the emergency spillway from the current 110 feet to 600 feet and raise the flow elevation from 6608 to 6609 feet. The current concrete sill would be refit with six gates, and the bottom of the structure would be lowered approximately 3 feet from its current elevation.

We are currently working our way through the environmental assessment, 404 permit, and state water permit process and hope to begin construction in July 1987, with completion later in the summer. We feel the proposed changes in the structure will give us the greatest management flexibility possible under the hydrologic constraints of the system. Ducks Unlimited has most generously agreed to fund the entire project which is expected to cost about $300,000.

An additional wetland which is capable of holding nesting Trumpeters was built on the Refuge in fall 1985 by Ducks Unlimited. This wetland, Sparrow Slough, should provide outstanding habitat for Trumpeters and other waterfowl. This project was funded entirely by Ducks Unlimited for a cost of about $60,000.

Under the direction of Assistant Manager Kurtenback, the Refuge has also initiated a program of planned drawdowns of Refuge ponds capable of providing nesting sites for swans. All ponds are now fitted with control units, and ponds will be drawn down as aquatic plant conditions dictate on a rotating basis. Our initial drawdowns have been encouraging from the plant production standpoint.

Society Recommendation 2. Continue the Rocky Mountain Population Subcommittee recommended moratorium on the removal of Trumpeter Swan eggs (except salvaged eggs), cygnets, subadults, and adults from the Tristate Subpopulation of the Rocky Mountain Population until 15 October 1986 (commenced 15 April 1984).

The Rocky Mountain Population Subcommittee favors extension of this moratorium until the completion of Ruth Gale's swan research project which is due 1 May 1987 (Ruth Gale, pers. comm.). At that time, the study will be evaluated by the Subcommittee, and a further recommendation will be developed. The USFWS supports this approach.

Society Recommendation 3. Continue current aquatic vegetation surveys to provide long-term food availability information and initiate a less intensive survey in late June or early July to determine availability of food to cygnets.

Research completed by Ruth Gale, Dave Paullin of the Malheur NWR, and Dr. Garton of the University of Idaho, indicates that the aquatic vegetation survey has little statistical validity (Ruth Gale, pers. comm.). The Service will attempt to institute some type of vegetative monitoring on the Refuge, based on the recommendations from Gale's research when available. In the interim, the aquatic vegetation survey has been terminated.

Society Recommendation 4. Continue to investigate all factors causing mortality in cygnets at Red Rock Lakes National Wildlife Refuge.

No efforts have been made to follow up on this recommendation. We have been waiting for the completion of the Gale study and have not wanted to initiate any activities which would cause undue disturbance to cygnets on the Refuge until management recommendations are developed.

Society Recommendation 5. Investigate the importance of invertebrates in the diet of adult Trumpeter Swans in early spring and of invertebrates and aquatic plants in the diet of cygnets in early summer.

Again, we have taken no action on this recommendation to allow Ruth Gale to complete her research. After a review of Ruth's findings, we will consider further research into this area by a competent scientist.

Society Recommendation 6. Continue the supplemental winter feeding program at RRLNWR until it is determined that excessive Trumpeter Swan mortality and poor productivity will not result from a cessation of the feeding program; enrich the grain with a high-protein addition such as the turkey finisher fed in dry-land hoppers.

Preliminary data by Gale indicates that the winter feeding program has been an important factor in Trumpeter Swan survival and subsequent swan production in the Centennial Valley (Ruth Gale, pers. comm.). McEneaney (1986) found that Trumpeters wintering in the Centennial Valley utilized the supplemental feed during spells of cold weather when other wintering areas were frozen. He termed the feeding program "supplemental" and found that swans preferred natural foods and utilized them instead of feed except during spells of extremely cold weather. McEneaney also found that the feed provided a stable food source for subadult birds and allowed increased survival of birds in this age class.

Feeding rates have been increased significantly in the past 2 years at Red Rock Lakes from the 200-300 bushels to 800-1000 bushels. The feeding of turkey finisher has continued in the dry-land feeders.

It is apparent from recent research by Gale, McEneaney, and others that the feeding program is extremely important to Trumpeters wintering in the Centennial Valley. Strong emphasis on this aspect of the Refuge's swan management program will be developed in the next few years. Any feeding program is based on three fundamentals: quality of feed, quantity of feed utilized, and distribution of feed to insure adequate availability to all individuals. We are also manipulating water levels in Refuge wintering ponds to make feed, both aquatic and supplemental, available to the birds.

In the coming years, the Service will be exploring feeds which best meet the needs of the swans, closely monitoring the amounts of feed necessary, and looking at different distribution methods. The service of competent scientists may be sought to do needed research for this program.

We are currently working with nutritionists from the Ralston Purina Company in developing a ration that is best suited to the needs of the swans.

We are also mindful of the potential disease problem where so many birds are crowded together in a somewhat stressful situation. Dr. Chris Franson of the National Wildlife Health Laboratory visited the Refuge this past winter and reviewed the current program. Dr. Franson made a number of recommendations which would keep the disease potential to a minimum and provide for monitoring of the birds and feed. He also recommended the development of a disease contingency plan.

Society Recommendation 7. Monitor areas contributing to siltation of RRLNWR and identify methods for reducing silt flow.

Dr. Cliff Montagnue, soils professor from Montana State University in Bozeman, with funding from the Conservation Endowment Fund, has completed a study of the Odell Creek watershed, the principal tributary to the Lower Red Rock Lake. He inspected the watershed for possible sources of silt and has developed methods for reducing this silt load to the Refuge. Field work was completed in summer 1985, and a final report is pending.

The Service is planning to acquire a tract of private land above the Refuge which contains significant amounts of Odell Creek. This tract was identified by Dr. Montagnue as a principal silt producer in the watershed (Cliff Montagnue, pers. comm.). The Service is planning to terminate the cattle grazing along the entire length of the Creek which it controls. Under the current grazing system, the creek bottom is in an active grazing unit every third summer for a period of about 15 weeks. However, current plans call for elimination of grazing on the creek bottom starting in 1987. Portable electric fencing will be used to protect the riparian habitat. This will aid greatly in the stablilization of the Creek banks which are highly erosive and will significantly reduce the silt entering Lower Red Rock Lake.

Society Recommendation 8. In cooperation with the wildlife agencies of Montana, Wyoming, and Idaho, and with the appropriate flyway councils, require the use of non-toxic shot for waterfowl hunting in all areas used by Trumpeter Swans during the 1985-86 hunting season and thereafter.

In 1983, the Refuge initiated the procedure of sending carcasses of dead swans found on the Refuge to the National Wildlife Health Laboratory for a determination of cause of death. This procedure has been followed to the present time. To date, a total of eight carcasses has been sent to the Lab for analysis. In addition, blood samples were taken from three birds during the summer of 1985 during collaring operations. An initial analysis showed one of the three to have an elevated lead level. This individual died within a week. Of the 11 carcasses and blood samples analyzed, a total of four, or 36 percent, had either an elevated lead level or lead poisoning was the cause of death.

Larry Blus, from the Patuxent Wildlife Research Center, collected blood samples from 22 Trumpeters on Lima Reservoir west of the Refuge in July 1984. Sixty-one percent of the birds sampled had been exposed to lead. About 22 percent of the birds sampled showed blood levels of more than .2ppm, a level which is considered to be elevated in waterfowl (Larry Blus, pers. comm.).

These findings are extremely significant. Lead poisoning is one of the most serious problems Trumpeter Swans face in the Tristate area at the present time. Steel shot will be required on the Refuge starting with the 1986 waterfowl season. Steel is expected to be phased-in, Nationwide, by 1991. It is not known at the present time whether other heavily-used swan habitat in the Tristate area will be converted to steel before the 1991 deadline. The Service has banned the use of lead sinkers on all fishing waters to eliminate this potential lead source to Trumpeters on the Refuge.

Society Recommendation 9. Expand the use of aerial photography to describe Trumpeter Swan territories and successful nest sites and to increase the accuracy of waterfowl censuses.

The use of aerial photography for swan management in the manner recommended has not been adopted by the Service at this time. However, the Refuge has started intensive record keeping on swan nest sites through a nest register which provides detailed information on all nest sites in the Centennial Valley. The system will be converted to a computer in the near future.

Society Recommendation 10. Explore techniques to monitor movements and concentrations of Trumpeter Swans in the Tristate Region that will not require a capture and physical handling of individual swans.

No specific action has been taken by the Service on this recommendation.

Society Recommendation 11. **Continue to identify specific nest sites prone to flooding and relocate these nests to floating platforms, minimizing disturbance to nesting pairs.**

The Refuge has attempted to provide flood-proof nest sites in areas of the Refuge prone to flooding. There are sites on the Lower Lake and River Marsh prone to flooding in high-water years. Floating structures, placed where swans are likely to nest, have met with some success. In 1984, four cygnets hatched from structures; in 1985, seven cygnets hatched from structures; and, in 1986, a total of five cygnets hatched from structures in the Refuge and at Elk Lake on the Beaverhead National Forest. Other agencies such as the National Park Service, Idaho Parks and Recreation Department, and the Forest Service have adopted these structures developed by McEneaney and are using them with some success in their areas.

Society Recommendation 12. **Recognize through funding and staffing levels that RRLNWR produces significant numbers of other waterfowl species and other wildlife, as well as representing the premier Trumpeter Swan area, and provide additional financial and staff support in implementing these recommendations.**

Despite tight financial constraints in the Federal government, the Refuge has enjoyed significant budget increases recently and an increase in staff to better manage the resources of the Refuge. We are hopeful this will continue into the future.

Speaking for the Fish and Wildlife Service, I can say we have greatly appreciated the tremendous interest shown in the Refuge by The Trumpeter Swan Society as a whole and the expertise given by several Society members in the cause of Trumpeter Swan management.

We feel the current measures being taken, and those to be initiated in the near future, will have a positive impact on the Tristate Trumpeter Swan Subpopulation and will return the Subpopulation to a growing status.

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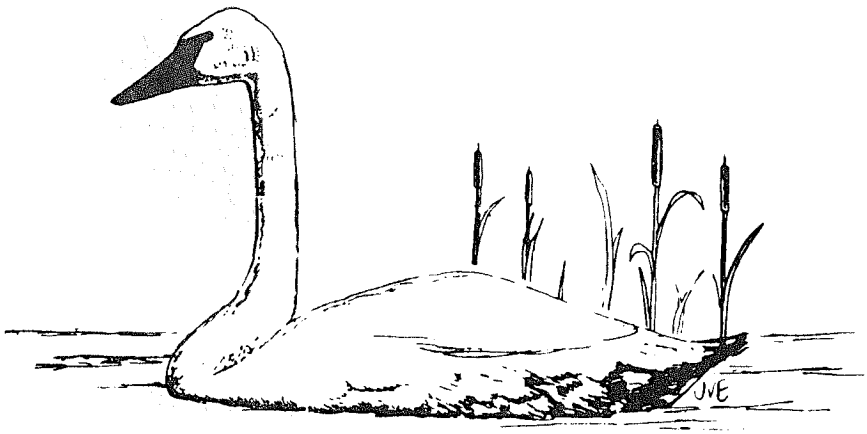

TRUMPETER SWAN POPULATION WINTER HABITAT RELATIONSHIPS IN THE TRISTATE AREA

Ruth Shea Gale, Research Associate, Montana Cooperative Research Unit

I would like to discuss the relationships which we recently have detected between winter habitat conditions and swan mortality rates. I would also like to discuss some of the changes in Trumpeter Swan (Cygnus buccinator) winter distribution which have occurred in the Tristate area over the last 15 years.

First, it is important to realize that the swans that winter in the Tristate area have access to two very different food sources. The first is the submerged aquatic vegetation in several ice-free locations, most notably the Henry's Fork, Teton, Yellowstone, and Madison Rivers, Hebgen Lake, and the Snake River/Flat Creek area near Jackson Hole, Wyoming. The second major food source is the grain provided at Red Rock Lakes National Wildlife Refuge (RRLNWR). Although submerged aquatics are available in limited quantities in the Refuge feeding ponds and nearby streams, there is very little natural habitat in the Centennial Valley that remains ice-free throughout the winter. Without the grain subsidy, very few, if any, swans would be able to spend the entire winter in the Centennial Valley. Historically, the Centennial Valley did not provide significant winter habitat. It is only the man-made ponds and the supplemental grain that make it possible for swans to winter there.

As Barry Reiswig has described, the number of wintering swans in the entire Tristate area has increased from about 700 in 1974 to about 1600 in 1987. Their use of the available winter food sources, however, has not increased in direct proportion to the increase in swan numbers. Despite the more than doubling of the number of swans wintering in the Tristate area, the number wintering at RRLNWR on grain is about the same as it has been since the late 1950's, with monthly high counts ranging from 250 to 350 swans. In the last 12 years, the large increase in wintering swan numbers has occurred among swans that rely on the submerged vegetation in areas outside of the Centennial Valley.

Over the last 2 years, Dr. Oz Garton, University of Idaho, and I have been analyzing the historic relationships between the availability of winter swan food and mortality of swans in various subcomponents of the Rocky Mountain Population (RMP). In order to quantify the supplemental grain food source, I used the original feeding records in the RRLNWR files to reconstruct the amount of grain fed each winter since 1934-35. I also used the Refuge weekly winter swan count data to estimate the amount of grain fed per swan each winter. Although the earlier descriptions of the grain feeding program, written by Winston Banko (1960) and Roger Page (1976), suggested that the amount of grain fed at RRLNWR had roughly increased over the years as the numbers of wintering swans increased, we concluded otherwise. Detailed examination of the actual feeding records showed that the amount of grain that was fed has fluctuated greatly, from over 1500 bu in the late 1960s to less than 200 bu in 1982-83. Over the last 50 years, the changes in feeding rates seemed to relate more to changes in Refuge personnel than to any other obvious factor.

We also quantified food availability at the most important wintering site on the Henry's Fork River, downstream from Island Park Dam. The amount of water released from the Dam directly determines the amount of water available to wintering swans in the old Railroad Ranch/Harriman State Park (HSP) area. Using Bureau of Reclamation (BOR) water release records from Island Park Dam, I reconstructed the monthly mean water releases. In many of the years from the Dam's construction in 1938 until a change in water management in 1968, winter water releases at the Dam were near zero for weeks or months at a time as the BOR filled the reservoir. I constructed a variable which quantified the number of months in any particular year in which the winter flow of water through the HSP was very low. My reasoning was that very low releases probably resulted in substantial freezing over of the river after the swans had arrived, and the aquatic vegetation was, therefore, unavailable to the swans for extended periods. We used these measures of the amount of grain available and the duration of low-water flows to test for significant relationships with swan mortality rates.

In order to understand the results of our analyses, we must consider where the various flocks of Trumpeters winter. Although a few swans were routinely located in Yellowstone National Park (YNP) and on the Henry's Fork above Island Park Dam, Tristate winter surveys show that, prior to the 1970s, most wintered in the Centennial Valley (RRLNWR) and on the Henry's Fork. Red Rock Lakes Refuge files and observations from various observers at HSP noted the regular movement of swans between the Henry's Fork and the Refuge. Collaring data from marked Grande Prairie (GP) Trumpeters also showed that, at least during the 1970s and 1980s, relatively few GP Trumpeters used the grain at RRLNWR. It is primarily the Centennial Valley swans that make the heaviest use of grain at the Refuge, but they also make periodic flights to the Henry's Fork, where they obtain submerged aquatics. The GP Trumpeters, on the other hand, depend primarily upon ice-free rivers where they can obtain aquatic vegetation. They have focused much of their use in the HSP since at least the 1950s, when GP Trumpeters were first marked. In the last decade, the GP and other Interior Canada Subpopulation (ICSP) Trumpeters have greatly increased their use of both HSP and other sites in the Tristate area.

We estimated the annual loss of swans from the Refuge flock by subtracting the number of white swans censused in September of year X from the total numbers of swans counted during the previous September. For example, if 119 adults and cygnets were censused in September 1984, and only 108 adults were censused in

September 1985, then the loss was 11/119 or 9 percent. Over the period 1934-86, there was a highly significant negative correlation (p=.016) between the bushels of grain fed per swan at RRLNWR and the percent of swans lost from the Red Rock Lakes flock during that year. This means that proportionately more swans either died or immigrated from the Refuge in years when small quantities of grain per swan were fed, rather than in years when large amounts were fed.

We also found a highly significant positive correlation (p=.009) between the number of months that water releases on the Henry's Fork were drastically reduced and the rate of loss of swans from the Refuge flock. In years when the water was reduced for 3-4 months, the flock suffered proportionately higher losses than in years when the flow was reduced for only 1 month or not at all. Analysis of the mortality rate of the entire Centennial Valley flock showed the same relationships as the Refuge flock. Further analysis suggests that the detrimental effects of low water releases can be moderated by increased levels of grain feeding at RRLNWR.

We also constructed a winter severity index based upon mean daily temperatures. We detected no significant relationship between winter severity and losses to the Red Rock Lakes flock. This indicates that the fluctuating availability of the two primary food sources of the Red Rock Lakes flock, the grain and the aquatic plants at HSP, was the major biological factor influencing the mortality rates and that the fluctuations occurred for reasons that had no particular relationship to winter severity.

In contrast to the Refuge flock, which winters mainly in the Centennial Valley and on the Henry's Fork, the GP Trumpeters have a more dispersed winter distribution. They use a variety of sites and depend mainly upon submerged aquatics. Using GP flock census data from 1959 to 1985, we found a very highly significant positive correlation between winter severity and annual loss rates in this flock (P<.0003). In severe winters in the Tristate area, the GP flock lost a higher proportion of swans. We suspect this was due both to the freezing over of feeding sites and to the increased caloric demands caused by severe cold weather. We did not detect significant relationships between losses of GP Trumpeters and either the extent of low flows on the Henry's Fork or the amount of grain fed at RRLNWR. This is probably because, for the last decade, the GP Trumpeters have expended their use of several other sites in the Tristate area and are not so closely tied to the fluctuations of any one particular site. They are, however, quite vulnerable to severe winter weather which impacts most or all of the river wintering sites.

In recent years, the winter distribution of Trumpeters has changed. Our review of the Tristate winter swan census data, from the 1950s to the 1970s, found that the majority of wintering swans was located on the Henry's Fork and at RRLNWR. In 1968, the water management policy at Island Park Dam changed. Instead of abruptly turning off the water in December or January, higher, more regular, flows were maintained throughout the winter. Within the next 4 years, the numbers of swans wintering below Island Park Dam increased by several hundred. By the late 1970s, following the buildup of Trumpeters on the Henry's Fork, swan use greatly expanded at Hebgen Lake, Jackson Hole, YNP, and the Teton River. This expansion into various wintering sites coincided with an observed increase in the GP flock and other ICSP flocks. We suspect that prior to 1968, GP swans focused mainly on winter habitat in the HSP, where they were subject to frequent high winter mortality, when water flows were curtailed for weeks and months at a time. The swans could have moved to other sites in the Tristate area as the river froze, but there is no evidence that they did. During this period, summer surveys in GP often found high cygnet production, but the flock failed to expand. I believe that this lack of growth was due, in large part, to chronic high winter losses. After 1968, the swans had access to high-quality winter habitat that was ice-free, except for short periods. This increase in winter habitat availability probably resulted in reduced winter mortality and is a likely factor causing the growth and expansion of the ICSP in the 1970s, which continues today.

The continuing increase in the numbers of wintering swans still has some puzzling aspects. The 1986 midwinter Tristate census found 1304 adults/subadults and 299 cygnets. However, in the summer of 1986, a rangewide survey of the Tristate and ICSP only found a total of 761 adults/subadults and 325 cygnets. That means that there were at least 543 adult/subadult swans wintering in the Tristate area that could not be accounted for on their summer range or about one-third of the entire RMP. Assuming that cygnets suffer about 25 percent mortality between the late summer and the following midwinter census, there also was a slight excess of cygnets wintering in the Tristate area.

There are at least five ways to explain these unidentified wintering swans:

1. A substantial number of Tundra Swans (C. columbianus) are wintering in the Tristate area without being detected, and the RMP is not really as large as we think.
2. Canada has one or more large breeding populations of Trumpeter Swans that have not yet been located. This would imply that while 393 adult Trumpeters were located in Canada in 1985, 543 were overlooked. Neither Rick McKelvey nor Len Shandruk (principal surveyors in Canada) will vote for this option.
3. A segment of Alaskan Trumpeters has split off to migrate southeasterly and winters with the RMP in the Tristate area.
4. An undetected molt migration of subadult RMP Trumpeters is occurring to areas outside the RMP summer census area. These subadults may either have been censused within the PCP range or have been overlooked entirely in the 1985 census.
5. The unidentified swans may represent some blend of the above.

As the numbers of swans wintering in the Tristate area continue to reach new record levels annually, we need to determine the origin of these unidentified migrants. In our efforts to stabilize the Tristate Subpopulation and to correct some of the problems caused by their grain dependency, it will be important to understand which flocks and populations share the natural winter range. We need to understand what competitive advantages the migrants may have over the Tristate Trumpeters. Knowledge of the origins of the wintering swans may also provide more management options in our efforts to increase both migratory traditions and genetic diversity in the Tristate Subpopulation.

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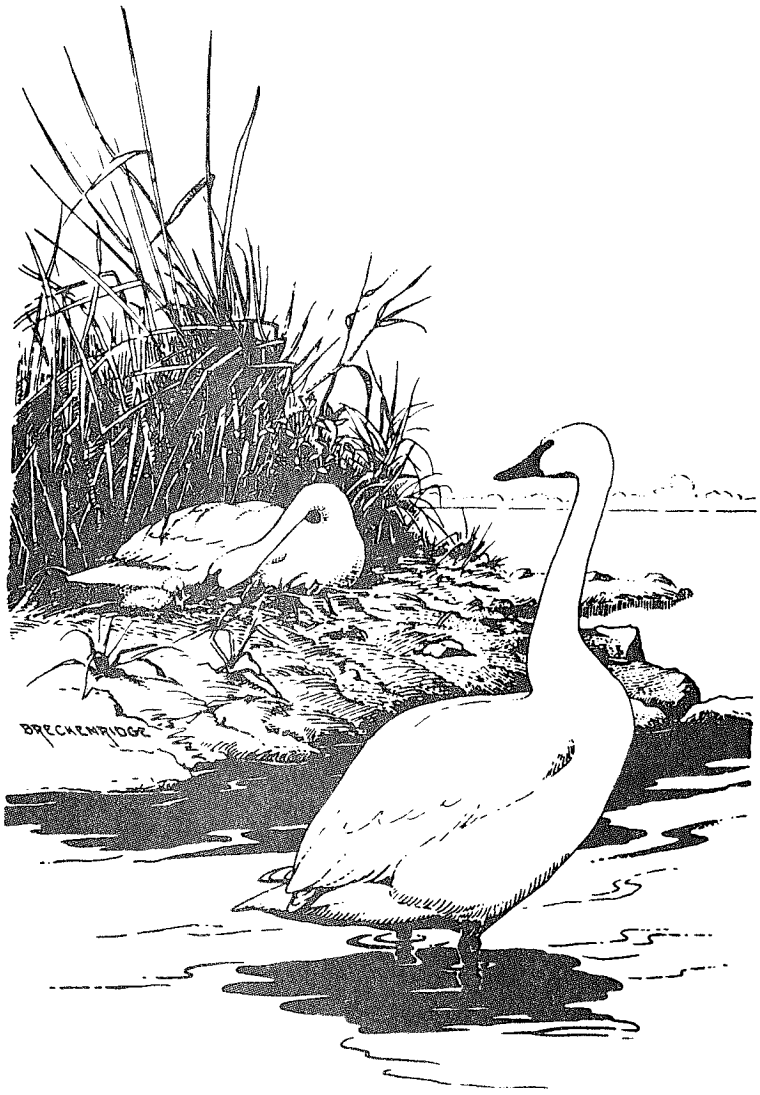

A REVIEW OF WINTERING ROCKY MOUNTAIN TRUMPETER SWAN POPULATION SURVEY ESTIMATES: 1977-1986

Barry Reiswig, Refuge Manager, U. S. Fish and Wildlife Service

ACKNOWLEDGEMENTS

The efforts of a number of pilots and observers who collected and compiled the data used in this paper need to be recognized. These include pilots Bob Twist and David Stradley and observers Terry McEneaney, Jim Roscoe, Dick Sjostrom, Ruth Gale, and Dave Lockman.

RESULTS AND CONCLUSIONS

An aerial survey of the Tristate Region is conducted every February by the U. S. Fish and Wildlife Service (USFWS) and cooperators from various state and Federal agencies to determine population levels of the Rocky Mountain Population of Trumpeter Swans (Cygnus buccinator). All known Trumpeter Swan winter habitats are flown, and a census of the population is determined. In addition, ground observers visit major winter habitats and attempt to determine numbers of wintering Tundra Swans (C. columbianus) in the wintering areas for use in the development of a correction factor for aerial observations.

Over the past 10 years, the Rocky Mountain Trumpeter Swan Population has nearly doubled (Tables 1 and 2, Figure 1) from 800-1000 level to 1600 in 1986.

Table 1. Midwinter Rocky Mountain Trumpeter Swan survey data 1977-86.

Year	Adults/ subadults	Cygnets	Total
1977	839	178	1017
1978	695	179	874
1979	743	123	866
1980	767	172	939
1981	1000	247	1247
1982	952	266	1218
1983	1025	207	1232
1984	1128	332	1460
1985	1326	190	1516
1986	1304	299	1603

Table 2. Tristate Trumpeter Swan survey data 1977-85.

Year	Adults/ subadults	Cygnets		Total
1977	403	82		485
1978	--	--	(no survey)	--
1979	462	87		549
1980	462	23		485
1981	--	--	(no survey)	--
1982	--	--	(no survey)	--
1983	398	54		452
1984	424	53		477
1985	368	139		507

[Editor's Note: The Tristate survey is conducted in early fall to determine population levels and cygnet production of the Tristate Subpopulation prior to the arrival of migrating Trumpeters from northern areas.]

The percentage of swans wintering in each state has remained relatively constant during the past decade. Idaho has wintered 49 percent of the birds, Montana 34 percent, and Wyoming 17 percent (Table 3). There is growing evidence of some migration out of the Tristate Region during the winter months prior to the midwinter census (McEneaney 1986, Ruth Gale pers. comm., band returns, Refuge files).

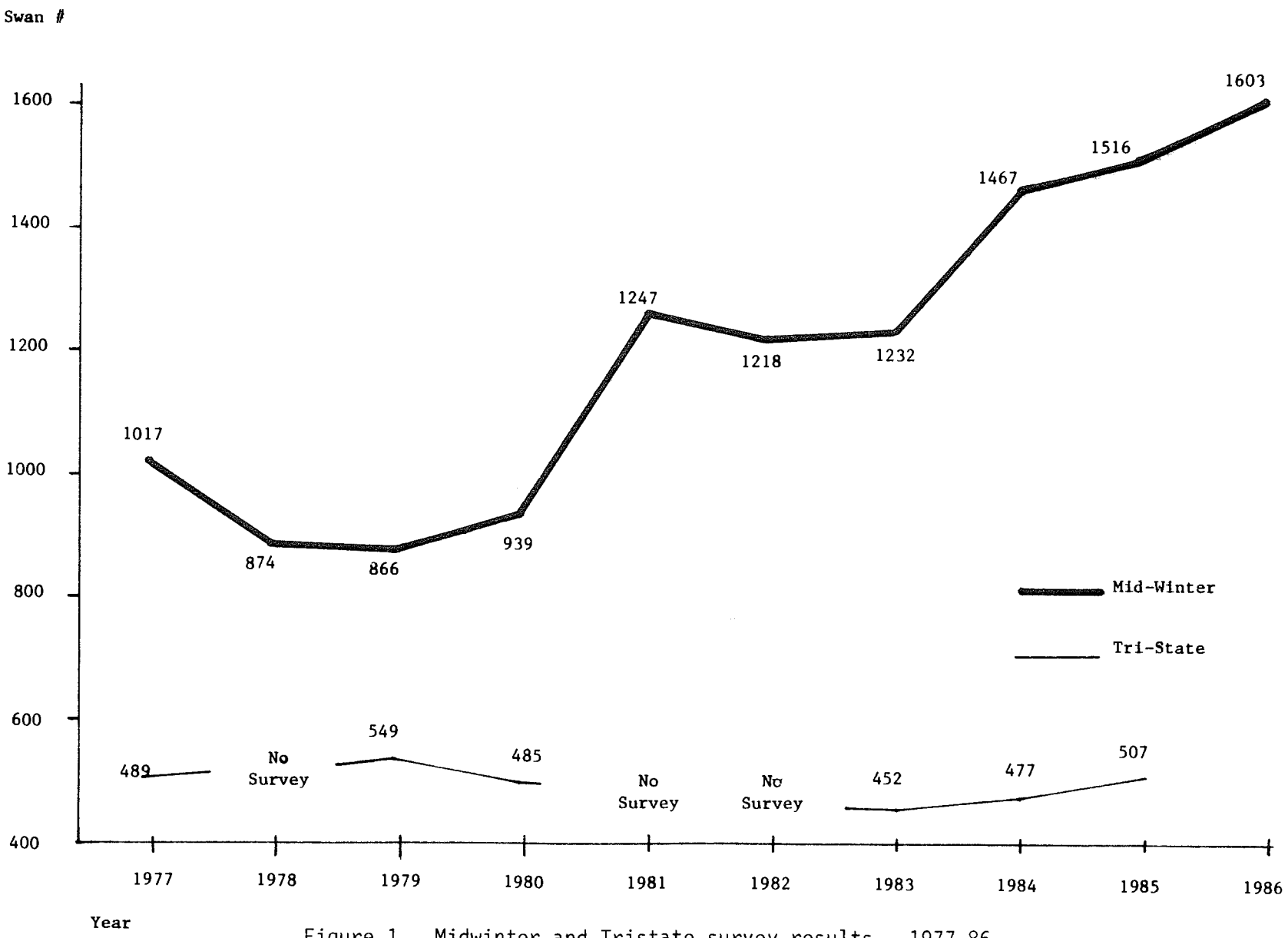

Figure 1. Midwinter and Tristate survey results - 1977-86.

Table 3. Midwinter Rocky Mountain Trumpeter Swan survey data by state 1977-86.

Year	Montana			Wyoming			Idaho			Total		
	A/s	C	T	A/s	C	T	A/s	C	T	A/s	C	T
1977	315	43	358	129	9	138	395	126	521	839	178	1017
1978	194	68	262	109	15	124	392	96	488	695	179	874
1979	304	26	330	86	16	102	353	81	434	743	123	866
1980	374	80	454	143	22	165	250	70	320	767	172	939
1981	352	36	388	278	101	379	370	110	480	1000	247	1247
1982	390	90	480	133	39	172	429	137	566	952	266	1218
1983	363	59	422	169	26	195	493	122	615	1025	207	1232
1984	389	109	498	236	61	297	503	162	665	1128	332	1460
1985	393	31	424	232	15	247	701	144	845	1326	190	1516
1986	380	73	453	180	43	223	744	183	927	1304	299	1603

[Editor's Note: A/s = adults/subadults; C = cygnets; T = total.]

It is obvious that the Interior Canada Subpopulation and possibly other unknown swans have contributed almost entirely to the wintering population increase, as the Tristate Subpopulation has remained relatively static over the past decade. Various theories exist as to the reasons for the dramatic increases in the Rocky Mountain Population; however, none have been confirmed.

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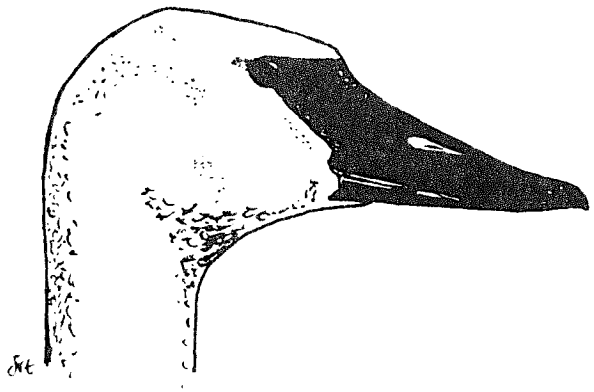


Trumpeter Swan
(Cygnus buccinator)

WYOMING TRUMPETER SWAN PROGRESS REPORT

Dave Lockman, Wildlife Biologist, Wyoming Game and Fish Department
Presented by: Barry Reiswig, Refuge Manager, U. S. Fish and Wildlife Service

MANAGEMENT OBJECTIVES

1. To maintain 30 nesting pairs of Trumpeter Swans (Cygnus buccinator) and begin increasing the nesting population to reach 80 nesting pairs by the year 2005.
2. To maintain a fledging rate of 28 young per year and begin to increase production to the level of 100 young fledged per year by the year 2005.
3. To maintain a wintering Trumpeter Swan population of 300 birds and begin to increase to reach a wintering population of 600 birds by the year 2005.
4. To expand the winter and summer distribution of swans in Wyoming to potential habitats presently not occupied.

These objectives assume maintenance of past Trumpeter population levels in Yellowstone National Park and increases outside of Yellowstone.

MANAGEMENT STRATEGIES

The phases we have employed since 1982 to gain more competence in Trumpeter Swan management, direct and coordinate management efforts, achieve short-term objectives, and develop specific long-term objectives and strategies are outlined below:

Phase 1

Identify:	seasonal habitats individual age class movements flock pioneering and dispersal mortality rates survival rates breeding pair recruitment	Phase 1 initiated in 1982 and ongoing.

Phase 2

Characterize the attributes of:	wintering habitat	1982-86
	prenesting habitat	1983-ongoing
	production habitat	1983-ongoing
Energetics research		initiate 1987
Determine winter habitat productivity and availability		1982-86
Evaluate swan habitat relationships		1982-ongoing
Develop winter habitat and production habitat evaluation format		1988

Phase 3

Develop methods for relocating swans into new breeding and wintering habitats while inducing a migratory and pioneering behavioral strategy	1986-ongoing

Phase 4

Prescribe measures for protection, maintenance, and/or improvement of current habitat to land managers	1986-ongoing
Submit habitat enhancement proposals	1985-ongoing
Evaluate habitat enhancement needs	1984-ongoing
Identify potential seasonal swan habitats	1985-ongoing
Evaluate potential seasonal swan habitats	1986-ongoing
Prescribe management measures on potential habitats	1986-ongoing

Phase 5

Full scale implementation of developed management proposals to achieve long-range objectives	1991

Management strategies were initiated in 1982 and are in various stages of involvement today. As the program gains momentum, it also gains public support. I hope the Department will continue to provide support and emphasis to this species and the habitats which it represents.

Now that you have an idea of where we desire to go and how far we desire to go in the long term, I would like to review some of the highlights of what we have learned and what we are currently working on.

We are analyzing and writing up our last 5 years of data on Trumpeter Swan behavior, movements, habitat use, and characteristics. This summer, we have continued our monitoring of marked swans, but our main emphasis has been on evaluating and prescribing management needs for potential winter habitats, potential production areas, and existing use areas.

A few of our most significant findings, to date, in Trumpeter Swan ecology are given below.

TRUMPETER SWAN BEHAVIOR AND MOVEMENTS

1. Sibling (brood mate) group associations persisted into the second winter and, in some groups, into the third winter.

2. At least three yearling, sibling groups dispersed out of the Green and Snake Rivers about 2 weeks prior to the molt. They could not be found in the drainage during the summer, nor could they be found in the southern half of Yellowstone Park. It is unknown whether they ever returned to the drainage. We have not been marking cygnets. Therefore, yearling sibling groups are not individually identifiable. Based on our periodic aerial and ground surveys, we suspect that yearling sibling groups occasionally pioneer into other Tristate areas.

3. Early pair bonds were established during late winter and early summer of the second and third age classes. Initial pair bonds were not necessarily long-term. It appears that early courtship interactions may function to disrupt the strong relationships between siblings.

4. Early pair associations in the second and third winters and subsequent movements of identifiable individuals (of known origin, age, and sex) yielded the following: Females tended to return to their natal areas (general area of origin) with males from the wintering areas to seek sites for territorial establishment; 2- and 3-year-old males produced in the Jackson area dispersed into Yellowstone and Idaho and occupied territories far from their natal areas. We have documented that some of the dispersed males have also wintered in Idaho with what appeared to be their mates, remaining in Idaho thereafter. Male dispersal may function to promote genetic interchange. If it occurs in birds produced in Wyoming, it is reasonable to suspect that it also occurs on the Idaho wintering areas. The probability of males produced in the Tristate area hitching with a female from Canada and going north to find a territory, increases as the number of Canadian birds on the wintering area increases. The reciprocal would also be true.

5. The first year of a new pair's life is one of wandering until they find a site with good food and security from human disturbance and territorial strife.

6. First nesting attempts (egg laying) by young females have occurred as early as the second territorial year (4-year-olds, following the fourth winter). However, in some cases, we have had 4 or 5 years of territorial occupancy without a nesting attempt. We have noted that a new pair's attachment to a site strengthens every year. This phenomenon has a negative impact when productive pair numbers are low. Although we have many sites with apparently good habitat (diverse and abundant food plants and aquatic invertebrates through a wide range of depth, good emergent/water interspersion, available nest sites, early ice-off conditions, etc.), few of these sites are secure from excessive human activity during the nesting period. Therefore, some pairs have selected secluded sites with good adult food characteristics, but poor characteristics for nesting and/or brood survival. We have pairs attached to such sites that nest every year, but consistently fail to raise young past 4 weeks of age. Some pairs will tolerate human activity more than others, but, in all cases, the habitat size and habitat element dispersion seems to affect their ability to tolerate encroachment. We have one pair that seems to tolerate intermittent intrusion around its pond throughout summer occupancy. However, after 5 years, the female has yet to lay an egg. This year, we watched her go through nest building activities and thought things were going to happen. When people started using the shoreline, her nesting activity ceased. I suspect while swan numbers are low, habituation to some level of human disturbance will be poor but will improve with an increase in numbers.

   To prevent young pairs from moving into poor production habitats, we are working on 25 soon-to-be sites on private and U. S. Forest Service lands in the Snake and Green River drainages to minimize human disturbance, delete fenceline and powerline barriers, and/or modify habitats as needed. When productivity has been increased in our nucleus flock, we then hope to be off and

running toward breeding range expansion into at least two other Wyoming drainages. Coincidental with this project are projects to increase winter habitat capacity by improving existing habitats and by securing a new wintering area in the Salt River drainage. We are also developing an experimental program to relocate swans to more suitable production sites and to stimulate movements to and from new wintering areas.

7. We have documented three instances in which an individual of a pair died in the winter, one male and two females. Each of the remaining birds found a new mate and returned to its former territories or to within a few kilometers of them. The female and her new mate nested and raised five cygnets on the same site at which she had nested with her former mate. The two males, with their new mates, did not return to exactly the same sites, but they spent time within a few kilometers of their former sites. During the second year, one of the male pairs established a new territory within 2.5 kilometers of his former site. The second male pair was slower to establish a territory, but it was within a few kilometers of the male's former territory during their second summer together.

   These observations suggest that the female is integral in the selection of a nesting territory. Once nesting has occurred on a territory, both pair representatives have developed the tradition to return to the territory or at least to those areas they are most familiar with, in close proximity to the territory, even in the absence of their original mate. Our data also helps explain why many territories in the Tristate Region have such a long, continuous history of territorial pair occupancy.

TRUMPETER SWAN HABITAT USE AND ENERGETICS

1. In 1985, we completed a two-stage survey of all Trumpeter Swan winter habitat outside of Yellowstone National Park. We will have completed data analysis and will have a report out by spring 1987. There are approximately 792 surface acres of open water riverine and palustrine wetlands used by swans, annually from 1 November - 1 April as winter habitat. About 23 percent or 186 acres are considered good-quality foraging habitat, but are intermittently frozen. These sites are used most in early and late winter or in mild winter periods. About 11 percent or 92 acres provide only open water, lacking the substrate to produce aquatics. About 49 percent or 390 surface acres have poor-to-fair aquatic production, excessive human activity, lack loafing site components, have high water velocity, or have other attributes not conducive to foraging by swans. In the winters of 1982-86, a mean 16,988 swan-use days were recorded. An estimated 30,000 goose-use days and 150,000 duck-use days were estimated for the same areas and time period per year.

   Fine-leaved Potamogeton spp. comprise about 60 percent of the aquatics on our winter range. Water milfoil (Myriophyllum sp.), water buttercup, and water weed elodea (Elodea canadensis) were also dominant species. We found that the above substrate plant mass was used by swans before we noted use of tubers. Tubers were the most significant food resource after the above substrate plant material was consumed, usually mid-January through early April. We collected data on over 500 plots on species composition, substrate depths, etc., as well as biomass on 65 plots. Our transects were selected following our first-stage survey and the mapping of substrates and aquatic beds. Each transect traversed the stream or pond bed with a sample plot every 2 meters along a tape. Sampling was done using the rake cast method by Jessen and Lound, as modified by Lockman. Square foot weights were taken from each half of the transect line in representative aquatic beds. We could not come up with a feasible method for sampling tubers. The sampling scheme and stratification we used may be useful elsewhere. Based on current aquatic production and use patterns, this area is saturated with swans.

   We are currently working with our fisheries habitat folks to encourage integration of winter swan habitat improvements into stream rehabilitation projects for fish. This is not easy to promote, as the creation of good cutthroat trout spawning habitat does not create substrates which grow food for swans. We are designing an experimental winter habitat improvement project for swans on a State management area near Jackson and will propose it for funding in fiscal year 1989. We hope to use this as a demonstration project for some serious work to be done on private lands for swans.

   We have investigated 250 surface acres of open water aquatic habitat in the Salt River drainage about 70 miles southwest of Jackson, which could be used by swans. We hope to present an in-depth analysis and recommendations by October 1987 and to then secure these areas for wintering swans.

   We have found that our most productive breeding pairs move to creeks or ponds in close proximity to their breeding territories by late March or early April in most years. They use these same sites each year. The sites support good, diverse stands of aquatics and appear to have an abundance of invertebrates. They will remain on these sites feeding voraciously until, or even after, their nesting ponds open up. We believe that these transition spring habitats are very important in preparing the pair physiologically for egg production. They probably function in the same manner as staging areas used by Canadian migrants. Therefore, we are also looking at improvements of these transition habitats which are frozen in midwinter but, generally, open up before the territorial areas open up.

2. We have recently developed a hypothesis from our work and are trying to get some research dollars to test it. Our hypothesis is this: cygnet survival on Wyoming territories is strongly linked to the availability and abundance of aquatic macro-invertebrates and macrophytes during the first 4 to 6 weeks following hatch.

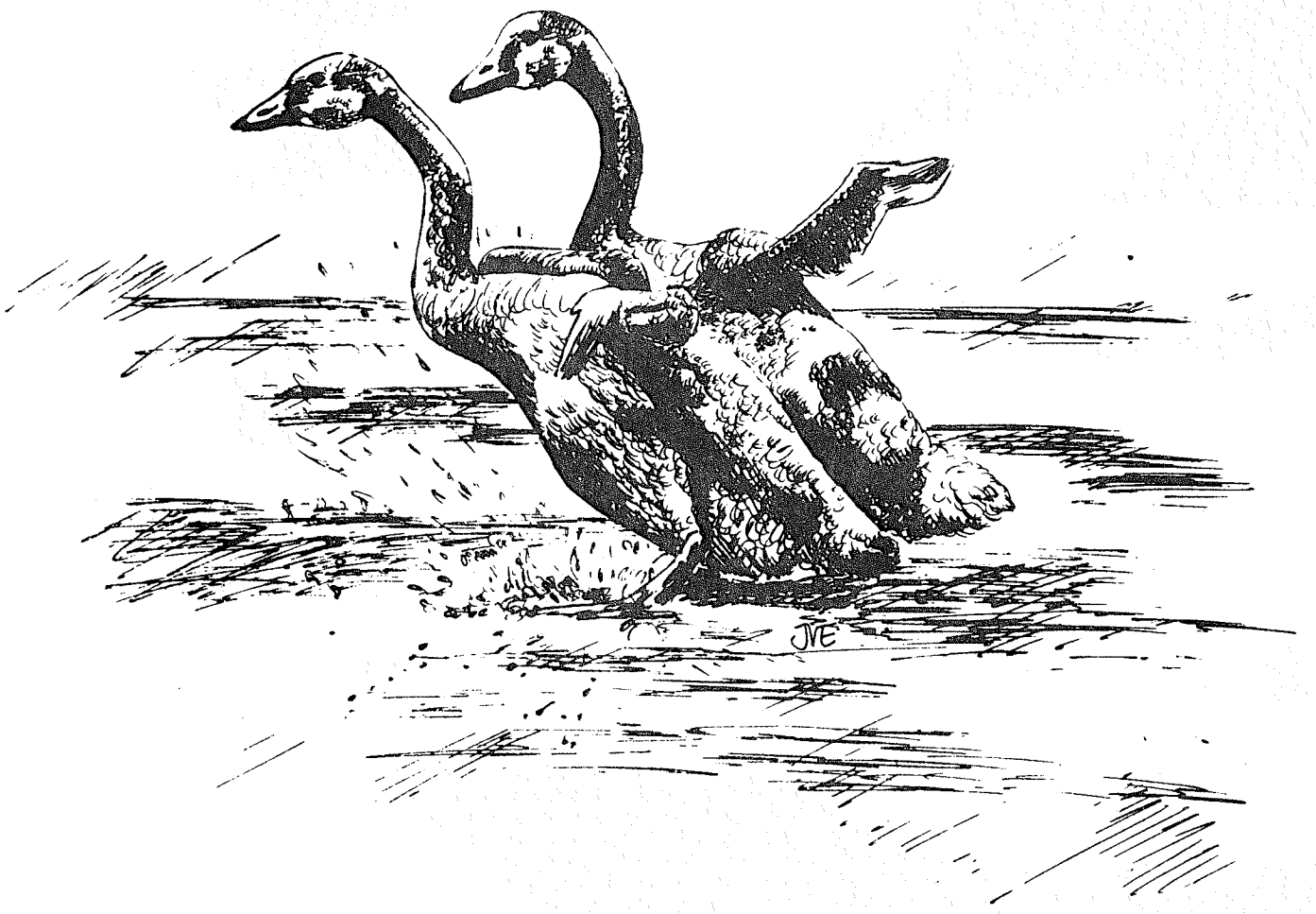
   The evidence that has led us to this hypothesis is as follows: in 1985, we compared invertebrate abundance on a pond site from which the adults remove their young every year to a site on the National Elk Refuge consistently used by a pair for feeding cygnets in their early life. Both pairs have a good history (also consistent) of production and fledging success. We found 10 times more invertebrates on the National Elk Refuge site than on the site from which the pair removed their young. We then looked at sites with a consistent history of hatching but poor cygnet survival beyond 4 weeks of age and no better quality brooding areas within close proximity. We found monotypic and/or poor quality aquatic plant communities, low aquatic invertebrate numbers on submergents in water depths of less than 18 inches, and relatively constant water levels over several years. Harold Burgess, a retired refuge manager responsible for wetland management, stated, "anyone who has managed wetland water levels knows that periodic drawdowns after a few years of stable water levels, exposes bottom soils and stimulates nutrient releases upon refilling." Having had experience in developing a water management program on waterfowl impoundments on our State management areas about 15 years ago, I knew that such drawdowns could increase aquatic plant diversity and invertebrate abundance. When we contrasted some of our consistently good cygnet rearing sites with the consistently poor producing sites we found relatively monotypic aquatic plant communities on poor sites and diverse communities on good sites. We also found that broods with higher survival were feeding in diverse communities with what appeared to be good available invertebrate populations, either in standing water less than 18 inches deep or in slow-moving water at the lower end of dense and diverse aquatic vegetation beds. In the standing water, intensive effort by the adults was required to make plants and insects available to the cygnets. In slow-moving creeks, the water current moving through upstream beds, coupled with the adults churning immediately upstream from the cygnets, provided plant and insect materials to the cygnets.

   Based on our knowledge of other waterbirds and their early growth demands for invertebrates, I would surmise that it is no different for the Trumpeter Swan. Young swans, immediately after hatch, appear to consume fine greens very well. However, they cannot survive without large amounts of protein which, in the wild, are best provided by insect matter. Insect abundance and availability are probably a strong determinant of survival after hatch. If the cygnets can make it through the first 4 to 6 weeks, then their survival rate increases significantly.

   From examining some of our heavily-used winter areas early last winter, it appears that our wintering swans are consuming a lot of invertebrates in the aquatic beds and perhaps in the substrate. Invertebrates are also likely to be very important dietary components to breeders on the spring transitional range.

3. We conducted one other experiment last year to test habitat-related effects on cygnet survival. The site was a back-country wilderness high-elevation site with 9 consecutive years of egg-laying and cygnet production, but no cygnet survival beyond 2 weeks of age. We took three viable eggs from a clutch of four, at 3 days prior to hatching. At this stage, the embryos were imprinted to vocalization of adults and each other. I hatched the eggs and brooded the cygnets for 5 days, keeping their contact with human beasts to a minimum. I then placed them with a pair that had three cygnets, the youngest of which was about 24 hours old. This pair moved five cygnets from the site 2 days later. Of the three adopted cygnets, two survived to flight and are still alive today. These cygnets from hatch to fledging were very thrifty and vigorous. This little experiment further demonstrated to me that our problem of cygnet survival "on the back 40" is habitat related. The back-country site probably does not provide adequate feed for the young. If the problem was predator related, an occasional young would have survived in 9 successive years of nesting.

RESTORATION PROJECTS



ELK ISLAND NATIONAL PARK TRUMPETER SWAN TRANSPLANT PILOT PROJECT - FINAL REPORT

Leonard J. Shandruk, Habitat Biologist, Canadian Wildlife Service

ABSTRACT

A pilot Trumpeter Swan (Cygnus buccinator) transplant project was initiated at Elk Island National Park (EINP), Alberta, in 1983. The purpose of this pilot project was to test and evaluate techniques and methodologies for the establishment of a new swan breeding flock, wintering on the Canadian Pacific Coast. The rationale for this project was based on the concern that all Trumpeter Swans breeding in Canada winter in the overcrowded Tristate Region of USA. Thus, this population may be subject to catastrophic die-offs.

The major objective of this pilot project was to test and develop Trumpeter Swan transplant techniques. Eggs were collected from nests in the Grande Prairie area, and Pacific Coast adult guide birds were obtained to form artificial family groups. Hatching of eggs and preconditioning of adults to cygnets was done at the Brooks Wildlife Centre.

In 1983, 17 eggs were collected and hatched. Three artificial family groups of five cygnets each and their guide parents were subsequently released on three separate wetlands at EINP. In 1984, 16 eggs were collected and 11 cygnets hatched. Three artificial family groups of four, three, and three cygnets, respectively, were created and released on two separate wetlands.

Due mainly to equipment failure, minimal monitoring and information on swan movements were collected in 1983. It was determined that two guide birds wintered at the Keephills Cooling Pond near Wabamum, Alberta. One of these swans wintered on this same site in 1984 and was last observed outside of Whitehorse, Yukon Territory, during the spring of 1985. No other confirmed observations of 1983 transplants have been obtained.

In 1984, an unusually early onset of cold weather resulted in a rapid freeze-over of marshes at EINP. This resulted in excessive losses of swans to coyote predators and cold weather stress. Only one family group plus a single adult guide bird survived. Swan movements were monitored by ground personnel and aircraft for about 3 weeks. The results of this intensive tracking indicated that the Pacific Coast guide birds were unable to migrate to wintering habitats.

Many successful techniques for transplanting Trumpeter Swans were developed and tested during this study. However, other strategies and methods must be developed to ensure that transplanted Trumpeters migrate to desired wintering areas.

ACKNOWLEDGEMENTS

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INTRODUCTION

A Trumpeter Swan (Cygnus buccinator) transplant project was first proposed in Alberta by Brechtel (1982), "Management Plan for Trumpeter Swans in Alberta." In July 1983, Alberta Fish and Wildlife Division (AFWD) and Elk Island National Park (EINP) entered into a cooperative agreement for the purpose of reintroducing a population of Trumpeter Swans to EINP. The rationale for this pilot project was based on the concern (Brechtel 1982) that all Trumpeter Swans currently breeding in Alberta, winter in a relatively small and restricted landscape commonly referred to as the Tristate Region (Idaho, Montana, Wyoming). The potential overcrowding problems on wintering habitat and vulnerability to catastrophic losses were major concerns. This led to the development of a project to investigate the feasibility of establishing a new Alberta breeding population of Trumpeter Swans which would winter away from the Tristate Region. The proposed overall goal was to establish two new Trumpeter Swan populations which winter away from the present concentrations in the Tristate and breed in unused suitable habitats in Alberta. After initiating and participating in the project in 1983, AFWD (due to funding restrictions) withdrew formal support of the project. Since the objectives of the project were of interest, and the population status of Trumpeter Swans in Canada a concern to the Canadian Wildlife Service (CWS), CSW assumed the coordination of the project in 1984.

OBJECTIVES

The overall objective of this pilot project was to develop, implement, and test transplant techniques for the reintroduction of Trumpeter Swans in Alberta. In addition, an attempt was made to determine whether a new breeding flock with a new migration and wintering tradition could be established. The specific objectives were:

1. To develop and test techniques for capturing, transporting, and holding adults; collecting, transporting, and incubating Trumpeter Swan eggs taken from nests in the wild; rearing and bonding cygnets to guide birds to form artificial family groups (Gillette and Dyhr 1977, Ripley 1984).

2. To release three adult guide birds and 15 captive-reared cygnets (all radio-tagged) in family groups on wetlands in EINP.

3. To determine suitability of EINP wetlands for rearing and fledging Trumpeter Swans.

4. To monitor migration and destination of transplants and to determine whether cygnets will return to EINP as adults.

METHODS

The first field phase of this project involved capturing four adult Trumpeter Swans at Powell River, British Columbia, during February 1983 and 1984, and transporting the swans to the Brooks Wildlife Centre (BWC) by aircraft. These birds were held in separate pens until cygnets were available for bonding.

During late May and early June 1983 and 1984, an aircraft survey of wetlands west of Grande Prairie was conducted to select suitable Trumpeter Swan nests for egg collection. Nest access to obtain partial clutches was gained by the use of canoes, rubber floaters, and a Hughes 300 helicopter. Eggs were collected over a 12- to 24-hour period, candled, and kept warm (28-30^{o}C), using hot-water bottles. Once an adequate number of eggs was obtained, they were placed in specifically designed handling crates and flown from Grande Prairie to BWC and Ontario (Lumsden 1984). At BWC, swan eggs were placed in incubators, and the resultant cygnets were reared using techniques developed for Canada Geese (Branta canadensis) (Ripley 1984).

At about 3 weeks of age, cygnets were placed into outside pens with their adult foster parents to initiate the bonding process. Visual barriers between pens were erected, and, as in 1983, it was found that this aided the bonding of the adults to the cygnets. Prior to transport and release of family groups onto wetlands in EINP from BWC, swans were captured in the pens, sexed, leg banded, and fitted with a battery-powered radio transmitter mounted on a yellow plastic swan collar with black alphanumeric markings.

Radio collars used in 1984 were redesigned to overcome problems encountered in 1983. First, the whip antenna on the collars was replaced with a loop antenna which is part of the collar. This eliminated radio failure due to antenna loss. Second, lithium batteries were used to power the radio transmitters rather than solar panels used in 1983, ensuring that the radio transmitters functioned under all weather conditions. Third, the radio transmitters were encased in dental acrylic rather than silicone to waterproof the transmitters. In addition, backpack transmitters were placed on two of three adult guide birds. This increased signal power and range as compared to the radio collars. Depending on age and size of cygnets, family groups were released on separate lakes (Walter, Bailey, and Flyingshot) at EINP in late August or early September (Figure 1). Prior to release on a specific wetland, guide birds and cygnets were held in pens on the lake to ensure a uniform release of each family group, thereby minimizing stress to the swans.

EINP wardens monitored swan locations and activities on each wetland on a weekly basis initially and, as the onset of freeze-up occurred, swans were monitored more intensely (every second day) during the 1984 field season. Aerial surveys and tracking were conducted on several occasions at EINP and surrounding areas in 1983 and 1984. Because of problems with radio collars, virtually no migration tracking of Trumpeter Swans was undertaken in 1983. AFWD flew several reconnaissance flights, but had limited success once the Trumpeter Swans left the Park area. In 1984, migrating swans were followed south to the Red Deer River for a total of about 35 hours of monitoring and radio tracking, using a Cessna 206 and a Cessna Super Skymaster based at the Edmonton Municipal Airport. Park wardens utilized hand-held portable yagi antennas and Telonics and AVM receivers to monitor swans in the Park. Aircraft were equipped with a two-element directional yagi antenna and a Telonics scanner-receiver. A truck with a Telonics receiver and an outside mounted antenna was used to track and monitor migrating radio-collared swans outside the Park. Communication between the tracking truck and aircraft was maintained using PT500 motorola portaphones. Swan locations and movements were plotted on 1:250,000 topographic maps.

RESULTS

Guide birds

In both 1983 and 1984, four Trumpeter Swan adult guide birds were successfully captured at the Redberry Lake Municipal Bird Sanctuary, Powell River, British Columbia, and flown to the BWC. These birds were held in captivity at the BWC in individual pens until they were bonded to cygnets in June and July of each year.

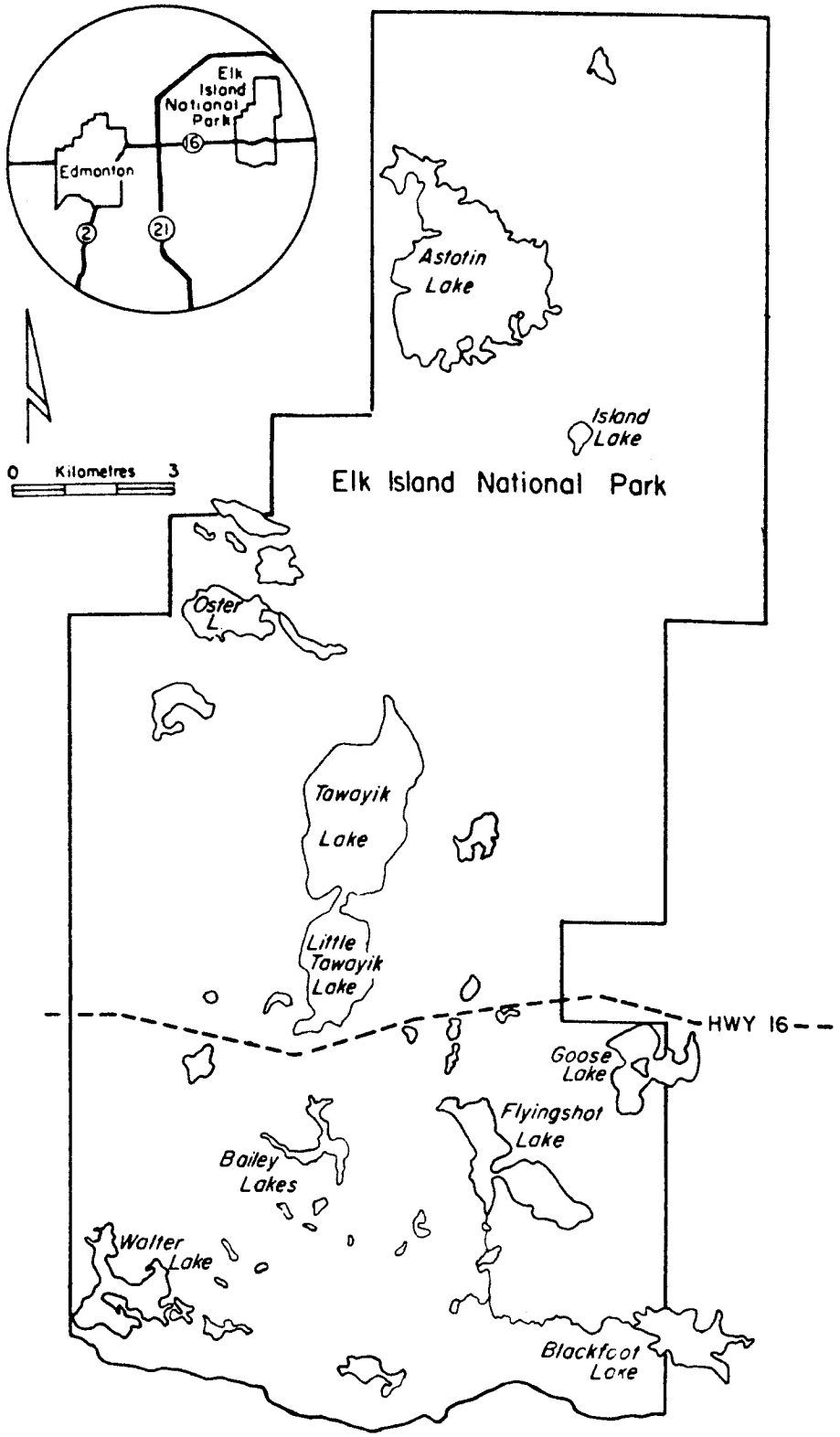

Figure 1. Locations of 1983 and 1984 Trumpeter Swan pilot project release sites, Elk Island National Park, Alberta.

Grande Prairie egg pickup and cygnet hatch

In 1983, AFWD staff successfully took 23 eggs from nine nests transported 17 eggs to BWC and sent six eggs to Ontario. At BWC, hatching success was 100 percent as 17 cygnets were hatched. In 1984, CWS and AFWD staff took 26 eggs from 12 nests. Using field candling techniques (Weller 1957), it was found that one egg had no embryo development. In 1984, 16 eggs were taken by Alberta provincial aircraft to the BWC and 10 eggs were taken via commercial aircraft to Ontario. Eleven of the 16 eggs were hatched successfully at BWC. One cygnet was born with neck and leg deformities and eventually died. Thus, 10 cygnets were produced for bonding with the adult guide birds. For specific information on incubation and rearing of newly hatched cygnets, see Ripley 1984. The project impact on populations from the 1983 and 1984 egg pick-ups are presented in Table 1. The projected loss of cygnets due to egg removals in 1983 and 1984 was calculated to be 13 and 11 cygnets, respectively.

Table 1. Projected number of cygnets removed from the Grande Prairie, Alberta, population of Trumpeter Swans resulting from 1983 and 1984 egg removals.[1]

Lake	1983 Number of eggs[2] In clutch	Taken	Left	Number of cygnets	Survival ratio[3]	Projected loss of cygnets[4]
Albright	5	2	3	3	1.00	2.00
Anderson	6	3	3	3	1.00	3.00
Buffalo	7	3	4	4	1.00	3.00
Dimsdale	5	2	3	0	0.00	0.00
Henderson	7	3	4	4	1.00	3.00
McNaught	6	3	3	1	0.33	0.99
Wolfe	3	0	3	0	0.00	0.00
Wood	6	3	3	1	0.33	0.99
Yoke	8	4	4	0	0.00	0.00
1983 Totals[5]	53	23	30	16		12.98(13.00)

Lake	1984 Number of eggs[2] In clutch	Taken	Left	Number of cygnets	Survival ratio[3]	Projected loss of cygnets[4]
Albright	6	3	3	0	0.00	0.00
Boone	6	3	3	0	0.00	0.00
Boone E.	5	2	3	2	0.67	1.33
Chain S.W.	5	2	3	2	0.67	1.33
Dickson	6	2	3	0	0.00	0.00
Intermittant	5	2	3	1	0.33	0.67
Kamisak	7	3	4	4	1.00	3.00
Kamisak E.	6	1	5	3	0.60	0.60
Ponita	5	3	2	2	1.00	3.00
Preston	4	1	3	0	0.00	0.00
Preston Creek	3	1	2	2	1.00	1.00
Wolfe	5	2	3	0	0.00	0.00
1984 Totals[6]	63	25	37	16		10.93(11.00)

[1] From Shandruk and Holton 1984.
[2] One egg taken showed no embryo development and is excluded from the analysis.
[3] Number of cygnets surviving in the wild divided by the number of eggs left in the nest.
[4] Number of eggs taken X the survival ratio of eggs in the wild.
[5] 1984 based on 11 July aerial survey.
[6] Based on 8 September aerial survey.

Establishment of artificial family groups

During the summer of 1983, 15 cygnets were bonded to three adult guide birds. Two groups of cygnets bonded well to both adult guides, but one guide bird did not accept the cygnets. This situation was remedied by replacing this adult with another bird and erecting visual barriers between holding pens so that the adult birds were unable to view and interact with neighbouring guide birds. In 1984, 10 cygnets were split among three guides with two receiving three cygnets each and one receiving four. Visual barriers were maintained between pens. This improved and reduced the bonding period. One group of swans was bonded so well that the adult guide bird actually exhibited a threat posture when a person entered her pen and approached the family group.

Transport and release at EINP

In 1983, AFWD staff transported family groups on 24 August, 31 August, and 7 September and released birds at Flyingshot, Bailey, and Walter Lakes, respectively,in EINP (Figure 1). During 1984, CWS and EINP wardens transported family groups from BWC to EINP. The first family group of four cygnets and an adult were transported by CWS and released on Walter Lake 28 August 1984. EINP wardens subsequently picked up the other two family groups from the BWC and transported and released these birds on Bailey Lake on 13 September 1984.

EINP monitoring

Trumpeter Swan families at each lake were monitored by Park wardens every third day in 1983 and every second day in 1984. During freeze-up, attempts were made to monitor all lakes daily, weather and logistics permitting. A log was kept of locations of direct observations or signals received during both field seasons. In 1983, several aerial flights were made over the Park to monitor radio-collared swans and test equipment. In 1984, aerial monitoring was initiated when wardens were unable to account for all swans during the onset of freeze-up. In 1984, unusually cold temperatures (-2.5°C to -20°C) during the latter half of the month of October resulted in an early and rapid freeze-up of the Park wetlands.

Migration Monitoring

On 20 October 1984, Parks Canada wardens reported that they were unable to obtain signals from any of the radio-collared Trumpeter Swans at Walter Lake. Only two signals from collars 4W and 4E were heard by wardens on Bailey Lake on this date. On 21 October, P. Goossen initiated an aerial search for Trumpeter Swans. After searching the EINP, Hastings Lake, and Cooking Lake, a signal from collar 4F (the adult guide bird of the Walter Lake group) was received on the west side of Beaverhill Lake. Shortly after receiving the initial signal, the air crew located the adult and four cygnets from Walter Lake on a small pond 5 km north of Tofield and 22 km southeast of Walter Lake (Figure 2). Although the ground crew detected radio signals coming from this location, the Trumpeter Swan family group was not observed. None of the eight swans released on Bailey Lake were observed by the aerial searches. During the period from 21 October to 2 November, Park warden ground monitoring picked up signals from all radio collars and backpacks from the Bailey Lake group including collars 4C and 4K. These signals were not heard during aerial monitoring. Signal overlap from other collars during ground monitoring may have resulted in the confusion.

On 22 October, another aerial search was initiated to relocate the Walter Lake group since it had moved. The ground crew was unable to relocate it. The air crew located the swans on a small lake about 3 km south of Tofield and 7 km south of the 21 October location (Figure 2). On 22 October, an aerial reconnaissance of EINP and area resulted in locating adult guide bird 4E alone on open water in Ross Creek, approximately 5 km northeast of Bailey Lake (Figure 2).

On 23 October, the ground crew was again unable to locate the Walter Lake group, and another aircraft survey was undertaken. The adult and four cygnets were located on a small lake adjacent to the 22 October location (Figure 2). On the return to Edmonton, a flight over EINP again resulted in the location of adult 4E on Ross Creek.

On 24 October, the Walter Lake group remained at the Tofield site, and, therefore, no aerial monitoring was conducted.

On the morning of 25 October, the air crew located the 4E adult in open water on Ross Creek and the Walter Lake group on the Tofield site. A landowner observed the Walter Lake group leaving the Tofield site at about 1630h. He reported that it flew northeast towards Beaverhill Lake.

Ground crew personnel located and initiated monitoring of the Walter Lake group at 0800h on 26 October. At about 1630h, the Walter Lake group left the Tofield site and flew southwest.

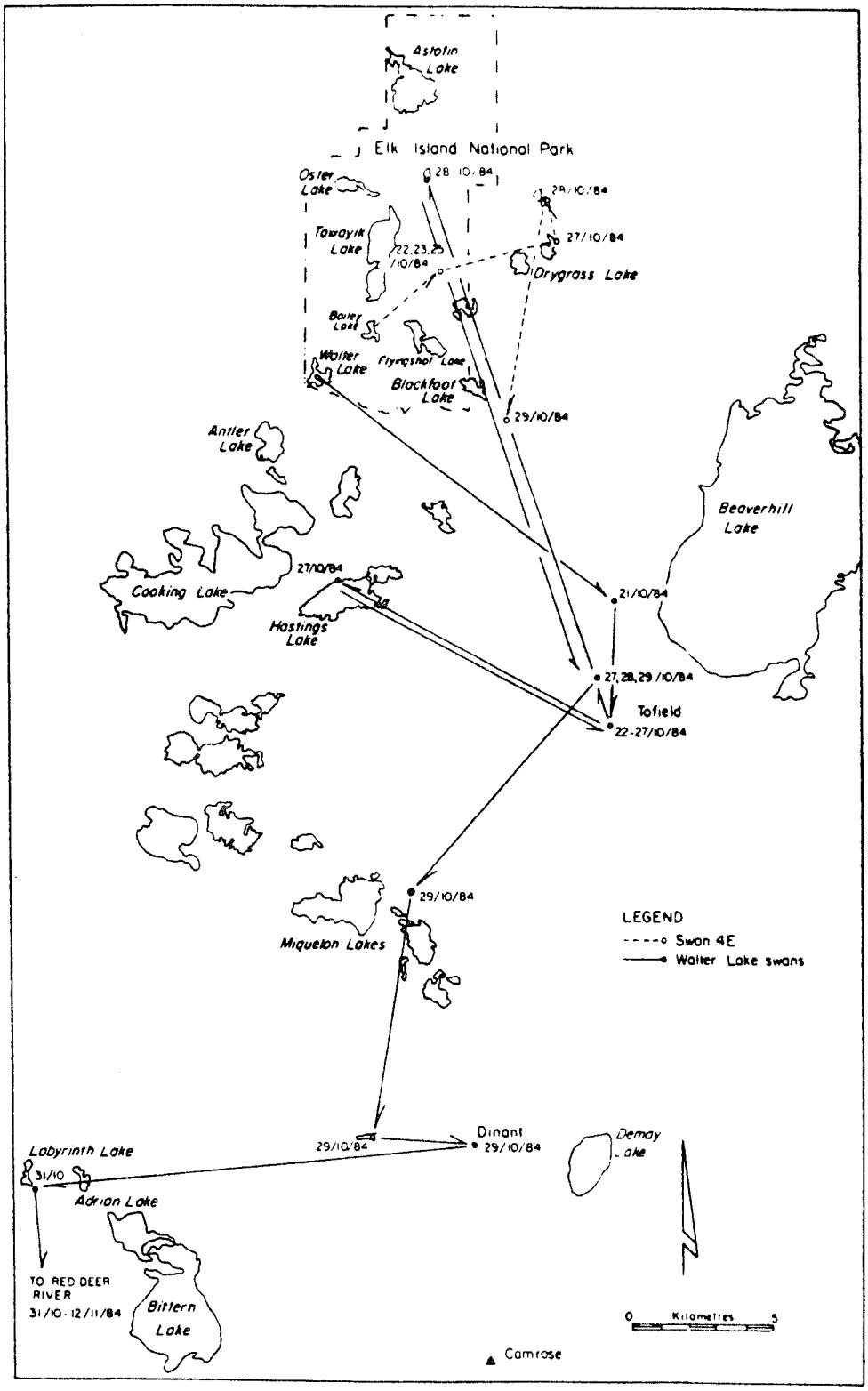

Figure 2. Movements of transplanted Trumpeter Swans from Elk Island National Park, Alberta, 1984.

To verify the possible new location of the Walter Lake group, another aerial survey was conducted on 27 October. At 0853h, the aerial survey located the swans on Hastings Lake, 19 km west-northwest of the Tofield site (Figure 2). At 1035h, the ground crew reported that the swans were moving southeast of Hastings Lake. The aircraft was notified of this movement and returned to the vicinity of Hastings Lake. Using radio telemetry, they located the Walter Lake group on the Tofield site. Here the family group was joined by Tundra Swans (C. columbianus), an adult and a cygnet. While returning to Edmonton, the aircrew observed the 4E adult 7 km east-northeast of the Ross Creek site. The bird was initially observed sleeping on the ice of a mostly frozen pond, and, later, it was seen in the open water.

The ground crew found the adult and four cygnet Trumpeters plus the adult Tundra Swan and cygnet at the Tofield site at 1120h. All of the swans were observed sleeping on the ice of the totally frozen reservoir. At 1228h, the Tundra Swans initiated calling, head bobbing, and took flight. The Trumpeters seemed to be totally indifferent to this activity and continued to sleep on the ice-covered reservoir. At about 1300h, the Trumpeter family flew off the reservoir to a pond on the south side of the Tofield sewage lagoon. This pond is located about 1.5 km northwest of Tofield (Figure 2). A portion of this pond was still ice-free due to muskrat activity, and the Trumpeters were observed spending a considerable period of time feeding on pondweeds (Potamogeton spp. and Myriophyllum sp.).

On 28 October, the ground crew again located the swan family group on the pond south of the Tofield sewage lagoon at 0730h. The air temperature was -18°C, and most of the open water from the night before had frozen over except for two small patches. Swans were observed to feed and sleep alternately, usually one or two birds fed while the others slept. At 1535h, the family group began head bobbing and wing stretching, and, at 1540 h, the family flew west with the adult in the lead. Because the ground crew was not able to follow the birds for any distance, P. Goossen was contacted and asked to initiate an aircraft search. At 1635h, he observed six swans in flight immediately north of Tawayik Lake in EINP. At 1649h, the group of swans was observed from the aircraft in a narrow stretch of open water on Island Lake in EINP (Figure 2). A beaver lodge was observed at the south end of the open water. This probably accounted for the lake not being totally frozen. Before returning to Edmonton, the air crew observed adult 4E 2 km north-northwest of the 27 October sighting on the ice of a partially frozen pond.

On 29 October, the ground crew initiated monitoring of swans on Island Lake in EINP at 0630h. Six swans were observed sleeping on the ice at the south end of the lake. The extra swan was probably a Tundra cygnet, as it was noticeably smaller than the Trumpeter cygnets. At approximately 1100h, the swans left the lake and flew south. After being contacted, the air crew left Edmonton at 1114h, searched the EINP area, located swan 4E sleeping on a frozen lake 13 km south of the 28 October site, and proceeded to the Tofield area (Figure 2). There, at 1155h, they located the six swans on the same pond, now frozen, adjacent to the Tofield sewage lagoon. Shortly after the ground crew caught up with the swans at Tofield, the swans departed again. The aircraft returned and radio-tracked them to a small frozen lake 1 km east of the largest Miquelon Lake at 1320h (Figure 2). The ground crew again caught up with the birds at this site at 1400h. At this time, all six birds were observed to be sleeping and resting on a frozen pond. At 1455h, the swans took flight to the southwest in a "V" formation, with a cygnet in the lead. The air crew was contacted again and, by 1538h, found the six swans on a frozen pond, 14 km north-northwest of Camrose and 15 km south of the Miquelon Lakes site (Figure 2). After guiding the ground crew to the new location, the aircraft landed at Camrose and left for Edmonton at 1710h. The ground crew observed six swans resting on the ice of a small pond on this site. At sunset, a coyote was observed hunting around the periphery of this pond. At 1845h, the ground crew, using radio signals, determined that the swans left this pond in the dark. The tracking aircraft was contacted in Edmonton and returned to the Camrose site. At 2009h, it located the swans by radio signal only 6 km east of their last location. The aircraft returned to Edmonton after guiding the ground crew to this new site (Figure 2).

The swans remained and were monitored on this site until 1145 h on 30 October, when they flew west with the adult in the lead. At this time, only four cygnets were observed. One cygnet may have been predated upon by a coyote (Canis latrans) the night before. Unfortunately, the cygnet which was lost did not have a radio collar. Because of a snow storm, the aircraft was unable to fly, and the ground crew could not locate the birds after an extensive ground search.

On 31 October, at 0730h, the tracking aircraft was in the air and searching the Tofield, Miquelon Lakes, Camrose, Driedmeat Lake, Buffalo Lake, and Red Deer Lake areas. At 0902h, a radio signal was detected at the north end of Bittern Lake. At 0921h, the swans were observed from the aircraft on a frozen pond 26 km north-northwest of Camrose and 26 km west of their last known location (Figure 2). Once the ground crew was guided to the site, the aircraft returned to Edmonton via EINP. At EINP, the the air crew observed the adult Trumpeter (4E) on the same frozen wetland it was observed on 28 October. At 1030h, the ground crew initiated monitoring of the swans. At 1200h, the cygnets initiated wing stretching and head bobbing, while the adult exhibited no movement. At 1212h, the three largest cygnets took flight, circled and flew south. The adult swan and the fourth and smallest cygnet made a weak attempt to become airborne, but quickly settled back to sleep on the ice. The cygnets were followed by a tracking vehicle for approximately 15 km and were, subsequently, lost. The tracking aircraft was contacted, and the air crew located the three cygnets in flight at 1252h, about 150 m above ground level and 51 km east of Red Deer. By 1310h, the aircraft located the Trumpeter Swan cygnets on an open stretch of the Red Deer River, about 4 km south-southwest of the first visual sighting and 1 km west of the Nevis Bridge. The air crew guided the ground crew to the site before leaving for Red Deer, where the aircraft remained overnight.

The three cygnets remained on the Red Deer River on 1 November. The ground crew, with the assistance of Ducks Unlimited (Canada) personnel, was able to capture the adult (4F) in a field adjacent to the wetland northwest of Bittern Lake, and it was taken to the Valley Zoo. After attempting to assist in the location of the missing fourth cygnet in the same area, the aircraft returned to Edmonton via EINP and Wabumum Lake. At EINP, a signal was received from 4E on the same lake it was observed earlier, although the bird was not observed from the air. Later, on 1 November, CWS biologists and EINP wardens found the bird dead, adjacent to the lake on which it had last been seen. An autopsy on the 4E bird was performed by Alberta Poultry veterinary staff, and it was concluded that the bird died from exposure and starvation.

The cygnets 4R, 4T, and 4U remained on the Red Deer River until 10 November when it was decided, due to failing condition of these birds, to capture and move them to the Valley Zoo in Edmonton. While on the Red Deer River, the cygnets were joined by several migrating flocks of Tundra Swans but showed no indication or desire to leave the river.

Flight movements

The majority of results discussed in this section are derived from Goossen (1986). Walter Lake swans flew a total minimum distance of 197 km after departing from the Lake, while the lone adult (4E) only flew a minimum of 28 km after leaving Bailey Lake. An additional 89 km were flown by three cygnets from the Walter Lake group. The mean flight distance for the Walter Lake birds (excluding the evening flight on 29 October which may have been precipated by a predator and the three cygnets' flight on 31 October) was 19.1 km/flight (N=10, range 3-32 km), while in contrast the mean flight distance for the lone adult (4E) was only 7.0 km/flight (N=4, range 2-13 km) (Figure 3). The longest flight of all the swans was made by the three cygnets from the Walter Lake group which flew 88 km from the Camrose area to the Red Deer River on 31 October. Most flight angles (60 percent) were oriented between east-southeast and west (Figure 3).

Aircraft surveys of Wabamun Lake and vicinity

Five flights were made to survey the Wabamun Lake area in order to locate collared Trumpeter Swans. On 22 October, four groups of swans (4-15 birds) were seen on Wabamun Lake. However, Goossen observed no collars. On 25 October, he monitored 1983 radio frequencies of radio-collared swans but failed to detect any signals between Edmonton and Wabamun Lake. Wabamun Lake was frozen except near the Wabamun Plant by 1 November. During a flight on that day, Goossen observed an adult and three cygnets (no collars seen) in the open water near Wabamun and one collared (yellow) adult on the open lake near the Keephills Plant. This was later confirmed as 3K, an adult guide bird from the 1983 release. No 1983 signals were heard between Spruce Grove and Lac St. Anne.

On 6 November, three adults and three cygnets were observed on the southwest corner of the Sundance Plant Cooling Pond, while a single adult was seen on the Keephills Plant Cooling Pone. Goossen could not confirm collars on these birds, and no 1983 radio signals were heard. Three adults and three young (probably the same birds seen on 6 November) were found on the Sundance Plant Pond (west end) on 8 November, while an adult swan with a yellow collar and an accompanying cygnet were seen on the Keephills Pond. No swans were seen in the open water near Wabamun on 6 and 8 November. The identity of the swans at Wabamun Lake and area are left as unknown in this report because of the difficulty in positive differentiation of the two species (Tundra and Trumpeter) in the field.

DISCUSSION AND RECOMMENDATIONS

Techniques and methods were developed and tested to rear, release, and monitor artificial family groups of Trumpeter Swans in Alberta. Efforts to establish a breeding population of Trumpeter Swans at EINP which would migrate to an alternate wintering site had success. This pilot project did result in the development and testing of successful methodologies and techniques in many major aspects of the project. A summary of all swans released and their known final status is given in Tables 2 and 3.

Eggs were successfully taken from several Grande Prairie flock nest sites with minimal impact on breeding pairs or flock production, and artificially incubated and propagated. Techniques have been developed or tested which were successful in capturing, handling, and preconditioning adult guide birds to accept cygnets and form artificial family groups. Cygnets were successfully reared and bonded. Techniques for radio-collaring and tracking were adapted and tested using ground and aerial equipment. Methodologies were adapted and successfully tested for the reintroduction of swan family groups onto wetlands in the wild. Trumpeter Swans adapted well to the wetland habitats of EINP. No abnormal behavior or conditions were observed or noted by wardens monitoring swans on the various Park lakes. The unusually rapid onset of winter conditions in October of 1984 resulted in an abnormal loss of swans to coyote predation and cold weather stress. Some monitoring of swan movements of one adult guide (4E) and a family group made up of four cygnets (4U, 4R, 4T, & 4J) and their guide (4F) was conducted.

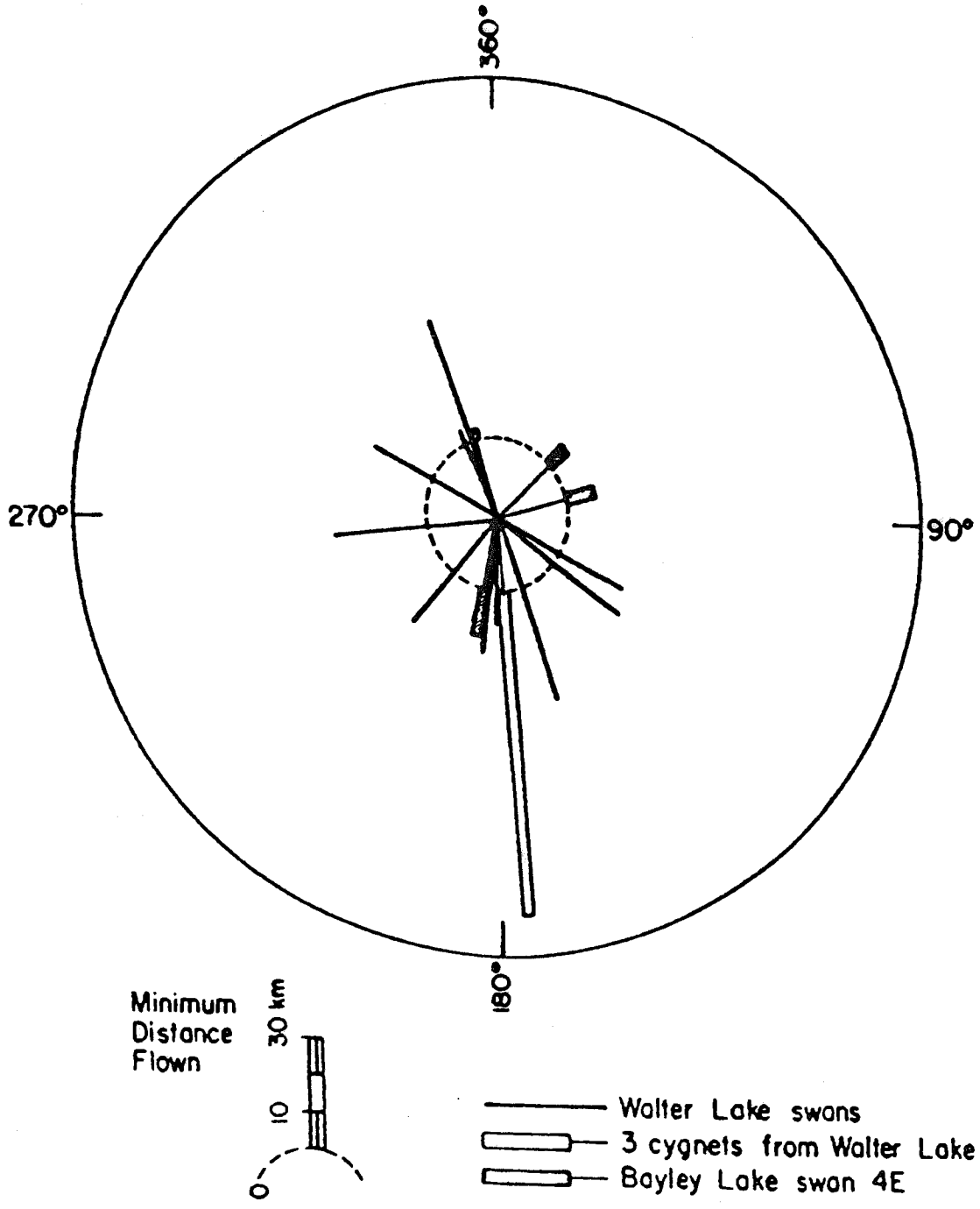

Figure 3. Flight angles of released Trumpeter Swans, Elk Island National Park, Alberta, 1984.

Table 2. EINP transplant 13 Trumpeter Swans (3 adults - 10 cygnets) released 28 August - 13 September 1984.

Swan	Collar	Sex	Date released	Last signal	Last visual	Comments
Adult	4F	F	28 Aug	1 Nov	1 Nov	Captured in field near Labyrinth Lake, being held at Camrose.
Cygnet	4U	F	28 Aug	10 Sep	11 Nov	Captured on the Red Deer River, being held at Camrose.
Cygnet	4R	M	28 Aug	12 Nov	12 Nov	Captured on the Red Deer River, being held at Camrose.
Cygnet	4T	M	28 Aug	10 Nov	10 Nov	Captured on the Red Deer River, being held at Camrose.
Cygnet	4J	F	18 Aug	11 Sep	29 Oct	Probable coyote kill, N.E. of Camrose.
Adult	4W	F	13 Sep	23 Oct	10 Oct	Slipped collar, backpack located underwater in Bailey Lake, recovered 13 November 1984.
Cygnet	4C	M	13 Sep	23 Oct	21 Oct	Status unknown.
Cygnet	4K	F	13 Sep	23 Oct	6 Oct	Status unknown.
Cygnet	4S	M	13 Sep	23 Oct	10 Oct	Probable coyote kill on Bailey Lake, collar recovered 2 November 1984.
Adult	4E	F	13 Sep	1 Nov	1 Nov	Picked up dead on lake, near Blackfoot Lake.
Cygnet	4A	F	13 Sep	23 Oct	6 Oct	Collar underwater, Bailey Lake as of 13 November 1984.
Cygnet	4H	F	13 Sep	23 Oct	10 Oct	Probable coyote kill, collar recovered Bailey Lake 2 November 1984.
Cygnet	4P	M	13 Sep	23 Oct	6 Oct	Probable coyote kill, collar recovered Bailey Lake 2 November 1984.

Note: All collars were yellow with black alphanumeric markings and leg bands were numbered 589-00051 through 589-00063.

Significant observations of swan migration behavior were made during this study. The adult guide bird (4E), unhampered by cygnets, remained in the general vicinity of EINP and showed no inclination to migrate, even though all the wetlands eventually iced over. The other guide bird (4F) and its cygnets exhibited a lot of back-and-forth movement around the Tofield area, with only minor inclinations to migrate south or west. The most southerly migration was carried out by the cygnets after they abandoned the guide bird. During the early stages of movement, the guide bird always led the family group during flight. Approximately 3 days before the cygnets abandoned the guide, it was observed that a cygnet led the family group during flights. During the winter of 1983-84, two adult 1983 guide birds wintered on the Keephills Cooling Pond 75 km west of Edmonton. One of these same birds (3K) wintered on this cooling pond again in 1984-85 and was last sighted during the spring of 1985, near Whitehorse, Yukon.

The status of several birds from these transplants is still unknown. Two unconfirmed reports of yellow-collared swans from two areas in Idaho provide a shred of evidence that some of the transplant birds may have migrated south. No collared Trumpeters have been observed near EINP during subsequent springs, although an uncollared Trumpeter Swan was observed on an abandoned water reservoir at Vegreville, Alberta, during the summer of 1985. This location is only 40 km east of EINP.

These limited observations indicate that guide birds either lacked the drive to migrate or were totally disoriented. More effort and research is required if such a project is to succeed in the future.

Table 3. EINP transplants 20 Trumpeter Swans (4 adults - 16 cygnets) released 24 August - 7 September 1983.

Swan	Collar	Sex	Date released	Last signal	Last visual	Comments
Adult	3A	F	24 Aug	30 Aug	6 Oct	Wintered on Keephills Cooling Pond in 1983-84.
Cygnet	3F	F	24 Aug	28 Oct	8 Sep	Was missing from group. Signal picked up separate from adult in October.
Cygnet	3C	M	24 Aug	3 Sep	24 Aug	Not in group upon aerial survey 8 September or 6 October - may be dead.
Cygnet	3E	F	24 Aug	8 Sep	8 Sep	Not in group 6 October -- may be dead.
Cygnet	3J	F	24 Aug	8 Sep	8 Sep	Not in group 6 October -- may be dead.
Cygnet	3H	F	24 Aug	22 Sep	6 Oct	The only one left with adult.
Adult	3K	F	31 Aug	26 Sep	14 Nov	Wintered on Keephills Cooling Pond in 1983-84 & 1984-85, observed spring 1985 near Whitehorse.
Cygnet	3M	F	31 Aug	3 Nov	3 Nov	Weak signal, may have broken antenna.
Cygnet	3S	M	31 Aug	3 Nov	3 Nov	Weak signal, may have broken antenna.
Cygnet	3R	M	31 Aug	10 Sept	3 Nov	May have broken antenna.
Cygnet	3P	M	31 Aug	28 Oct	8 Sept	May be missing (dead).
Cygnet	3O	F	31 Aug	3 Nov	3 Nov	Good signal.
Cygnet	3L	F	31 Aug	3 Nov	3 Nov	Weak signal, may have broken antenna.
Adult	3U	F	7 Sept	-	16 Nov	Has broken antenna.
Cygnet	3V	M	7 Sept	10 Sept	16 Nov	No collar - bird lost it.
Cygnet	3W	M	7 Sept	8 Nov	16 Nov	Bird is dead.
Cygnet	3T	M	7 Sept	10 Sept	16 Nov	Broken antenna.
Cygnet	3X	F	7 Sept	10 Sept	16 Nov	No collar - bird lost it.
Cygnet	3Y	F	7 Sept	8 Sept	16 Nov	No collar - bird lost it.
Adult	3Z	F	7 Sept	31 Oct	14 Nov	Has backpack transmitter. Released alone, good signal.

Note: All collars were yellow with black alphanumeric markings and leg bands were numbered 589-00001 through 589-0020.

As a result of observations made during the pilot project, some specific recommendations for future transplants are suggested:

1. Prior to the collection of Trumpeter Swan eggs for transport or aviculturist purposes, there is a need to inform the public in the area of the collections, and on the need, rationale, and impact of these egg collections.

2. Nests on lakes having a history of limited, or no, success in fledging young should be favored as egg collection sites. A maximum of one-half of the total clutch should be removed from any incubating nest.

3. To improve the efficiency of nest location and egg collection, there is a need to fly a breeding pair survey to locate active nests.

4. Trumpeter Swan eggs should not be collected until clutches have reached the last half of their incubation period (16+ days). This will ensure better survival and hatchability of eggs. During "normal" years, this usually necessitates egg collecting during the last week in May.

5. Specially designed transport cases should be used to move and store eggs; this will ensure maintenance of tolerable temperatures and reduce damage to shells and embryos during transport.

6. To improve the acceptance of artificially incubated cygnets by guide birds, the guides should be totally isolated from other birds for a period of at least 30 days prior to introducing the cygnets.

7. Before the artificial family groups are released onto transplant wetlands, they should be preconditioned to natural foods. It is recommended that birds for transplant be provided aquatic vegetation free-choice while decreasing the amount of available commercial feed. This preconditioning period should last at least 3-4 weeks before release. This will ensure that released birds will be able to utilize natural aquatic vegetation more readily than if they were not preconditioned.

8. Radio collars placed on swans must be fitted precisely to ensure that they will not slip off. Efforts should be made to develop and test alternate sites for radio-tagging of swans. Frequencies of radios placed on family groups should be adequately spaced in order that each radio in a family group is on a separate channel. This will prevent overlap and confusion when monitoring several individual swans from the same family group.

9. Although radio collars provided satisfactory performance during this study, efforts to improve range and longevity of transmitters, especially during ground-to-ground monitoring, should be pursued.

10. The results of this pilot project, coupled with the recommendation of Burgess and Burgess (1986), provide the justification to initiate the Elk Island Trumpeter Swan restoration project in 1987, provided funding can be arranged.

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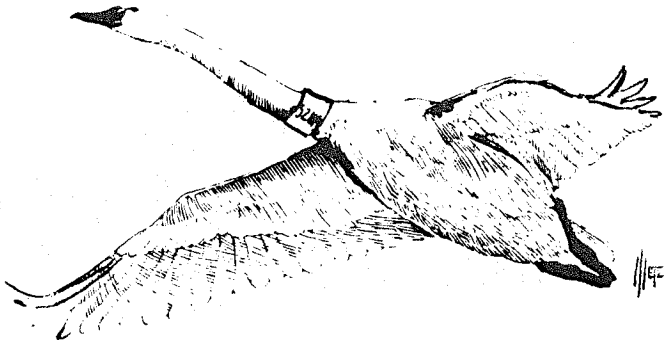

ELK ISLAND NATIONAL PARK TRUMPETER SWAN RESTORATION EXPERIMENTAL PROJECT

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In February 1986, we received inquiries from the Canadian Wildlife Service (CWS), Edmonton, and the Elk Island National Park (EINP), West Region, as to whether we would be interested in evaluating Elk Island National Park's wetlands for Trumpeter Swan (Cygnus buccinator) restoration. We arrived at EINP on 9 June and began discussions with Jack Willman, Dave Gilbride, and other members of the Park warden service. Since rain kept us from field work, we studied the Park's file on Trumpeter Swans.

It became evident that the warden staff had done excellent pre-restoration wildlife and plant surveys of those lakes picked for reintroduction and controls.

It was also clear that few EINP people knew the reasons for selecting their area for using British Columbia guide birds as foster parents, or why the wildlife specialists wanted the restored Trumpeters to migrate to the Canadian Pacific Coast. They had no knowledge of Alberta's earlier pioneering work on Canada Geese (Branta canadensis) where the use of adult Canada Goose guidebirds captured at the desired wintering area determined the chosen wintering area of artificially-reared goslings. It seemed strange that there were no listings of those studies, other routine Canada Goose restorations, or historical Trumpeter Swan occurrences in the "Literature Search File." (Perhaps too much emphasis was given to the negative impact of introducing wildlife species on plant communities and indigenous avifauna to obtain a balanced literature search.)

For the above reasons, we decided to survey the release lakes and one control lake for quality and quantity of aquatic wildlife and plants and to evaluate the entire pilot project according to our expertise and experiences. During later discussions with Leonard Shandruk, we were given his comprehensive final report, "Elk Island National Park Trumpeter Swan Transplant Pilot Project" March 1986. Much of the following section is paraphrased from Mr. Shandruk's excellent abstract or is taken from the EINP files.

A pilot Trumpeter Swan transplant project was initiated at Elk Island National Park (EINP), Alberta, in 1983. Its purposes were to test and evaluate techniques and methods for establishing a new Trumpeter Swan breeding flock in Alberta that would winter on the Canadian Pacific Coast. The reason for wanting this flock to winter on the uncrowded West Coast was that the current Alberta-Northwest Territories flocks were wintering in the overcrowded Tristate Region of Idaho, Montana, and Wyoming and may be subject to catastrophic "die-offs." The major objectives of this project were to test and develop transplant-migration techniques.

Eggs were collected in Alberta and adult female Trumpeters were obtained from the British Columbia coast to form artificial families. Hatching and bonding of cygnets to adults were done at the Brooks (Alberta) Wildlife Centre.

In 1983, 17 eggs were collected and hatched. Three artificial family groups of five cygnets each and their guide foster parents were subsequently released on Walter, Bailey, and Flyingshot Lakes in the EINP's Wood Bison Isolation Area. In 1984, 16 eggs were collected and 11 eggs hatched. One group of four and the foster parent were released on Walter Lake, and two groups of three cygnets each with their guidebirds were released on Bailey Lake.

In 1983, all of the released swans were marked with U. S. Fish and Wildlife Service (USFWS) stainless steel legband series 589-00001-20 and yellow plastic collars with a black 3, followed by series of letters (e.g., 3A3A). Letters not used were B, D, G, I, N, Q, or R because they might be confused with other letters or numbers. A solar-powered transmitter 25mm x 35mm was affixed to the collar with a 25 cm antenna around the swan's neck.

In 1984, the swans were legbanded with the series 589-00051-63. The yellow collars were inscribed with a black 4 and a series of letters occurring twice (e.g., 4A4A). The radio collar was redesigned. The whip antenna was replaced with a loop. The loop and the transmitter were bonded to the collar with dental acrylic rather than silicon. The solar batteries were replaced with lithium batteries, ensuring that they would function under all conditions. In addition, backpack transmitters were placed on two of the three adult guide birds.

Due mainly to transmitter failures, very little monitoring information on Trumpeter movement was collected in 1983. It was later determined that two guide birds had wintered at the Keephills Cooling Pond, near Wabamun, Alberta. One of these swans wintered on this same site in both 1983 and 1984 and was last seen near Whitehorse, Yukon Territory, during the spring of 1985.

Trumpeter families in each lake were monitored by EINP wardens every third day in 1983 and every second day in 1984. In 1984, aerial monitoring by CWS began when the wardens were unable to account for all swans during the early freeze-up in October. The unusually early and rapid freeze-up resulted in excessive losses of swans to cold weather stress and coyote predation. Only the Walter Lake family group survived. The adult guide bird Trumpeter was captured near Bittern Lake on 1 November. Three cygnets were captured 11 November on the Red Deer River, about 100 miles south of their release site.

It seems from these studies that most of the adult British Columbia Trumpeters were disoriented and that those that did fly west were unable to ascend the frigid Rocky Mountains at the time weather pushed them out of the lower elevated rearing grounds.

WILDLIFE SURVEYS

We have previously used bird counts as indicators of habitat conditions where extreme diversity of species indicated extreme diversity of habitats, and large numbers of individual species indicated abundant habitat desired by those few species. For example, large numbers of grebes (Podilymbus podiceps, Podiceps spp.), scaup (Aythya affirms), and Gadwall (Anas strepera) indicate a good supply of invertebrate and other animal prey species, while the presence of American Wigeon (Anas americana), Redhead (Aythya americana), and American Coot (Fulica americana)indicate an adequate supply of plant food for those species, as well as for Trumpeter Swans.

In 1983, Park wardens made a pre-Trumpeter restoration waterfowl survey* of Walter, Bailey, Flyingshot, Goose, and Blackfoot Lakes by canoe and by helicopter (Graham 1983). It was obvious from these surveys that all five lakes in the Isolation Area were very productive waterfowl habitats. They were particularly important to Eared Grebe (Poliçeps nigriçollis), Mallard (Anas platyrhynchos), Blue-winged Teal (A. discors), Lesser Scaup, American Coot, Ruddy Duck (Oxyura jamaicensis), and Redhead.

Some commonly observed species during the canoe surveys almost completely disappeared during the helicopter survey. In dollar terms, the helicopter was twice as expensive for half the results. Thus, it was decided that a canoe instead of a helicopter would be used for further monitoring (Graham 1983).

Walter Lake

We surveyed Walter Lake for wildlife 17 and 19 July 1986 and found 36 bird species and 1937 individual birds using that Lake (Table 1). The large number of Lesser Scaup indicates an abundant invertebrate food supply. Eight elk (Cervus canadensis), four white-tailed deer (Odocoileus virginianus), and two wood bison (Bison bison athabascae) were on the shores. Muskrat (Ondatra zibethica) and beaver (Castor canadensis) sign were common. There were eight active and two inactive beaver lodges on Walter Lake. The central cattail-sedge island appeared to be an excellent potential Trumpeter nesting site. In addition to several abandoned beaver lodges as potential sites, the emergent vegetation margin had sufficient locations for nesting swans. The 240-acre lake appeared to be a typical aspen parkland lake with excessive high waters (due to beaver activity) flooding the woodlands.

Due to different seasons, people, and methods, our data cannot be compared directly with the June 1983 waterbird survey data. However, it is interesting to note that only 14 waterfowl species and 185 individuals were seen in June 1983, compared to 17 waterfowl species and 1762 individuals in mid-July 1986.

* In these surveys, waterfowl consisted of grebes, geese, ducks, and coot.

Table 1. Bird survey, Walter Lake, Elk Island National Park, Alberta, 17-18 July 1986.

Species			
Common name*	Scientific name*	Number of broods	Total birds
Horned Grebe	Podiceps auritus		2
Red-necked Grebe	Podiceps grisegana	10	24
Eared Grebe	Podiceps nigricollis		2
Canada Goose	Branta canadensis	1	4
Green-winged Teal	Anas crecca	1	12
Mallard	Anas platyrhynchos	2	46
Blue-winged Teal	Anas discors	4	57
Northern Shoveler	Anas clypeata		5
Gadwall	Anas strepera		212
American Wigeon	Anas americana	4	32
Canvasback	Aythya valisineria		10
Redhead	Aythya americana		22
Ring-necked Duck	Aythya collaris		11
Lesser Scaup	Aythya affinis		1016
Common Goldeneye	Bucephala clangula		4
Bufflehead	Bucephala albeola	1	18
Ruddy Duck	Oxyura jamaicensis		21
Diving ducks sp.			250
Red-tailed Hawk	Buteo jamaicensis		1
Sora	Porzana carolina		2
American Coot	Fulica americana		2
Killdeer	Charadrius vociferus		2
Lesser Yellowlegs	Tringa flavipes		2
Spotted Sandpiper	Actitis macularia		13
Common Snipe	Gallinago gallinago		6
Ring-billed Gull	Larus delawarensis		4
Franklin's Gull	Larus pipixcan		38
Bonaparte's Gull	Larus philadelphia		2
Black Tern	Chlidonias niger		2
Northern Flicker	Colaptes auratus		1
Eastern Kingbird	Tyrannus tyrannus		3
House Wren	Troglodytes aedon		2
Cedar Waxwing	Bombycilla cedrorum		25
Yellow Warbler	Dendroica petechia		1
Red-winged Blackbird	Agelaius phoeniceus		59
Common Grackle	Quiscalus quiscula		16
Brown-headed Cowbird	Molothrus ater		8
Totals	36 species	23 broods	1937

Taxonomic order and common and scientific names in accordance with Check-list of North American Birds (Am. Ornith. Union. 1983. 6th ed.).

Bailey Lake

Bailey Lake is a relatively isolated aspen parkland lake with poor drainage, 80 acres in size. It was surveyed for wildlife on 25 July 1986. We found 20 bird species and 415 birds (Table 2). The cattail-sedge emergent margin is sufficiently wide for Trumpeter nesting. It had one inactive and four active beaver lodges. Signs of muskrat were commonly observed. It is interesting to note that we saw only 10 waterfowl species and 371 individuals compared to 12 waterfowl species and 307 individuals in June 1983. We saw 22 waterfowl broods on Bailey Lake in 1986. The relatively large number of American Wigeon and American Coot indicate adequate plant food supply. The low Lesser Scaup numbers indicate a lesser quantity of invertebrate food.

Table 2. Bird survey, Bailey Lake, Elk Island National Park, Alberta, 25 July 1986.

Species			
Common name	Scientific name	Number of broods	Total birds
Pied-billed Grebe	Podilymbus podiceps		1
Red-necked Grebe	Podiceps grisegana	8	43
Mallard	Anas platyrhynchos	3	51
Blue-winged Teal	Anas discors	3	32
Gadwall	Anas strepera	1	58
American Wigeon	Anas americana	5	121
Redhead	Aythya americana	1	7
Lesser Scaup	Aythya affinis		10
Bufflehead	Bucephala albeola	1	15
Red-tailed Hawk	Buteo jamaicensis		2
American Coot	Fulica americana	1	20
Black Tern	Chlidonias niger		6
Eastern Kingbird	Tyrannus tyrannus		6
Tree Swallow	Tachycineta bicolor		2
Marsh Wren	Cistothorus palustris		6
Common Yellowthroat	Geothlypis trichas		4
Song Sparrow	Melospiza melodia		4
Dark-eyed Junco	Junco hyemalis		2
Red-winged Blackbird	Agelaius phoeniceus		24
Brewer's Blackbird	Euphagus cyanocephalus		1
Totals	20 species	23 broods	415

Flyingshot Lake

Flyingshot Lake is a rather large, open, shallow lake of 410 acres. It was surveyed for wildlife on 12 August 1986. We found 26 bird species and 4747 birds (Table 3). The Lake had seven active and two inactive beaver lodges. In addition to potential swan nesting sites on beaver lodges, the cattail-sedge emergent margin was sufficiently wide at several locations for nesting Trumpeters. Three cygnets were lost here in 1983 from transfer stress, diseases, or predation. The cause(s) may be identified and rectified. Muskrat sign was common, and we saw two muskrats. We recorded 17 waterfowl species and 4524 individuals, compared to 21 waterfowl species and 887 individuals in June 1983. The large number of waterfowl seen in August 1986 consisted of 31 broods, a large number of molters, and a large number of ducks staging for the autumn migration. The large numbers of Gadwall, American Wigeon, Blue-winged Teal, and Bufflehead indicated a good supply of both animal and plant food for Trumpeter Swans.

Table 3. Bird survey, Flyingshot Lake, Elk Island National Park, Alberta, 12 August 1986.

Species			
Common name	Scientific name	Number of broods	Total birds
Pied-billed Grebe	Podilymbus podiceps		2
Red-necked Grebe	Podiceps grisegana	1	8
Eared Grebe	Podiceps nigricollis		2
Great Blue Heron	Ardea herodias		8
Black-crowned Night-Heron	Nycticorax nycticorax		2
Green-winged Teal	Anas crecca		72
Mallard	Anas platyrhynchos	5	165
Northern Pintail	Anas acuta		20
Blue-winged Teal	Anas discors	?	645
Northern Shoveler	Anas clypeata		20
Gadwall	Anas strepera	?	2350
American Wigeon	Anas americana	7	722
Canvasback	Aythya valisineria	1	16
Redhead	Aythya americana	2	18
Lesser Scaup	Aythya affinis	2	60
Bufflehead	Bucephala albeola	2	220
Hooded Merganser	Lophodytes cucullatus		2
Ruddy Duck	Oxyura jamaicensis	1	16
Red-tailed Hawk	Buteo jamaicensis		5
American Coot	Fulica americana	10	186
Solitary Sandpiper	Tringa solitaria		8
Spotted Sandpiper	Actitis macularia		2
Bonaparte's Gull	Larus philadelphia		175
Black Tern	Chlidonias niger		20
Warbler sp.?			1
Swamp Sparrow	Melospiza georgiana		1
Red-winged Blackbird	Agelaius phoeniceus		1
Totals	26 species	31 broods	4747

Goose Lake

Goose Lake is a fluctuating lake of about 143 acres that doubles in size during flood stage. The water was high during our wildlife survey of 26 July 1986. We found 31 bird species and 1386 birds (Table 4). We saw few signs of muskrat and beaver. There was one active and one inactive beaver lodge. We saw 17 waterfowl species and 856 individuals on 26 July 1986, compared to 14 species and 542 individuals in June 1983. There were 32 broods in the 1986 survey. The relatively large numbers of Gadwall and Lesser Scaup and broods indicated a good supply of invertebrate food. (This predator-prey base seemed to have been diluted by excessive flood waters at the time of our plant and invertebrate survey of 13 August 1986.) Goose Lake lies adjacent to the Alberta Provincial reconstructed Ukrainian Village Site, and the public activities on the boundary may have an impact on this natural area.

Table 4. Bird survey, Goose Lake, Elk Island National Park, Alberta, 26 July 1986.

Species			
Common name	Scientific name	Number of broods	Total birds
Pied-billed Grebe	Podilymbus podiceps		2
Eared Grebe	Podiceps nigricollis	4	34
Canada Goose	Branta canadensis	1	7
Green-winged Teal	Anas crecca		6
Mallard	Anas platyrhynchos	3	96
Blue-winged Teal	Anas discors	2	32
Northern Shoveler	Anas cylpeata	2	52
Gadwall	Anas strepera	2	265
American Wigeon	Anas americana	2	29
Canvasback	Aythya valisineria		9
Redhead	Aythya americana	1	12
Ring-necked Duck	Aythya collaris		10
Lesser Scaup	Aythya affinis	8	220
Common Goldeneye	Bucephala clangula	1	6
Bufflehead	Bucephala albeola	2	18
Ruddy Duck	Oxyura jamaicensis	2	36
Red-tailed Hawk	Buteo jamaicensis		2
Sora	Porzana carolina		4
American Coot	Fulica americana	2	22
Black Tern	Chlidonias niger		130
Eastern Phoebe	Sayornis phoebe		2
Eastern Kingbird	Tyrannus tyrannus		2
Tree Swallow	Tachycineta bicolor		2
Bank Swallow	Riparia riparia		300
Cliff Swallow	Hirundo pyrrhonota		2
White-breasted Nuthatch	Sitta carolinensis		2
Marsh Wren	Cistothorus palustris		6
Song Sparrow	Melospiza melodia		6
Red-winged Blackbird	Agelaius phoeniceus		40
Yellow-headed Blackbird	Xanthocephalus xanthocephalus		30
American Goldfinch	Carduelis tristis		2
Totals	31 species	32 broods	1386

AQUATIC SURVEYS

EINP wardens used a modified Clark Webster survey (Jessen and Lound 1962; Graham 1983) in June 1983 to identify and record occurrences and percentages of submerged plants in Walter, Bailey, Flyingshot, Goose, and Blackfoot Lakes. In the modification, one or more line transects were run across typical sections of each lake. Random samples were then taken with a garden rake from these lines, raking in about 1 m from the cardinal points to a common center. A great amount of aquatic vegetation was examined, identified, and recorded according to species, density, and percent of total sample. Coontail (Ceratophyllum demersum) was the most common. Star or ivy duckweed (Lemna trisulca) was found in all lakes and was the dominant plant on two. Flyingshot Lake had the most diversity with six significant plant species. Flyingshot also had the greatest submerged plant density. Goose Lake had the poorest density and recorded only three aquatic plant species.

Because Park staff's pre-restoration survey methods and data seemed adequate and because the Trumpeter Swan restoration had not yet occurred, there was no need to duplicate their earlier efforts. Instead, we attempted to quantify the lakes' aquatic plant and animal food production. We deleted Blackfoot Lake from our studies because only a small portion is within EINP, it is being subjected to increasing disturbances, and it was the least accessible during our assignment.

Attempts to supplement and quantify 1983 data

In July-August 1986, we attempted to supplement and quantify the 1983 basic aquatic plant survey data on four Wood Bison Area lakes by taking 10 one-square-foot samples of submerged vegetation with a Red Rock Lakes (RRL) plant sampler, one Eckman dredge bottom sample, and top samples of invertebrates and other animal foods with a 10-inch diameter sweep net.

The Red Rock Lakes plant sampler was designed to sample Trumpeter Swan plant food. It consists of two metal, mesh baskets mounted on long-handled tongs in such a way as to sample one square foot of lake bottom vegetation. The catch is identified and weighed in pounds and multiplied by 43,560 to calculate "ballpark" estimates of plant production per acre of marsh or lake. The Eckman dredge was used as a supplementary tool to explore the bottom for possible foods that might be dug up by swans in relatively shallow waters (maximum 30-inch water depth).

The 10-inch sweep net with 1-mm mesh was used in 1-m sweeps at the water surface and at 20 inches below the surface to supplement EINP data and to allow comparison with Holton's work in the Grande Prairie area (Holton 1982).

Walter Lake

We attempted to quantify the 1983 Walter Lake aquatic plant data by taking 10 RRL samples from transect line B. The water here was quite deep, ranging from 2.0 to 5.9 feet and averaging 4.7 feet. In retrospect, transect A or C may have been more shallow and more typical of Trumpeter Swan feeding areas. Again, only three significant aquatic plants, star duckweed, coontail, and water milfoil (Myriophyllum exalbescens) were found with a trace of cattail (Typha latifolia).

Plant species	Average ounces/ square foot	Pounds/ acre	Pounds/240-acre Walter Lake
Star duckweed (Lemna trisulca)	2.6	7079	1,698,840
Coontail (Ceratophyllum demersum)	.8	2178	522,720
Water milfoil (Myriophyllum exalbescens)	3.4	9257	2,221,560

The total aquatic plant biomass averaged 6.8 ounces per square foot, or 18,513 pounds per acre and 4,443,120 pounds for the 250-acre Walter Lake. This would provide 100 Trumpeter Swans 2,221 days of aquatic food at 20 pounds per day!

We took one bottom sample with the Eckman dredge at 3.8 feet (Table 5b). This produced 17 ounces of aquatic plant and 100 mg of invertebrate biomass. We believe that this was too deep for Trumpeters to scratch and pump cygnet food to the surface. We have had no experience in quantifying Eckman dredge data and did not attempt it.

We took two 10-in diameter, 1-m surface sweeps with a 1-mm mesh sweep net at each station and accumulated the collection for a 485 mg total and a 48.5 mg average (Table 5a). To standardize this data to compare with Holton's, we divided by 2 and multiplied by 5. The average then for 10 stations with one sweep was 24.5 mg and 122.5 mg for five sweeps. In comparison, Holton's small mesh net picked up an average of 54 mg of invertebrates in the Anderson Lake area with five sweeps; 26 mg in the Flying Shot Lake (Grande Prairie area); and 34 mg in the Updike area. It seems that Walter Lake is blessed with an abundance of invertebrates for cygnet food.

Table 5a. Aquatic invertebrates - Walter Lake, Elk Island National Park, Alberta, 22 July 1986 (sweeps 1 m long made with 10-in diameter net, 20 samples at surface.)

Order	Common name	Number	Mg
Hirudinidae	Leeches	6	120
Amphipoda	Freshwater shrimp	680	810
Odonata	Damselfly larvae	1	10
Hemiptera	Backswimmers, waterboatmen	27	40
	Misc. animal bodies	8	30
Total		722	1010
Average for sample		72	101
Average for 1 sweep		36	50.5

Table 5b. Aquatic invertebrates - Walter Lake, Elk Island National Park, Alberta, 22 July 1986 (1 sample 9-in x 9-in Eckman dredge).

Order	Common name	Number	Mg
Hirudinidae	Leeches	6	120
Amphipoda	Scuds	14	50
Diptera	Aquatic flies	8	20
	Misc. animal bodies	8	10
Total		36	200

Bailey Lake

We attempted to quantify the Bailey Lake aquatic data by taking 10 RRL samples from transect line A. The water was deep, ranging from 4.0 to 4.8 feet and averaged 4.5 feet. There were five plant species in significant quantities and only traces of sedge (Carex sp.) and common duckweed (Lemna minor).

Plant species	Average ounces/ square foot	Pounds/ acre	Pounds/80-acre Bailey Lake
Coontail (Ceratophyllum demersum)	9.2	25,047	2,003,760
Star duckweed (Lemna trisulca)	5.8	15,790	1,263,240
Flat-stalked pondweed (Potamogeton friesii)	2.4	6,534	522,720
Clasping-leaf pondweed (Potamogeton richardsonii)	0.3	817	65,340
Sago pondweed (Potamogeton pectinatus)	0.2	545	43,560

The Eckman dredge malfunctioned and was not used to sample this Lake.

We took two 10-in diameter, 1-m sweeps with the 1-mm mesh sweep net at each station and accumulated the invertebrate collection for a 70-mg total and a 7.0-mg average (Table 6a). We divided by 2 and multiplied by 5 to obtain 17.5 g for comparison with Holton's work. It seems as if Bailey Lake may be a little short on invertebrates for early cygnet growth as compared to Holton's figures for the Grande Prairie area.

Table 6a. Aquatic invertebrates - Bailey Lake, Elk Island National Park, Alberta, 25 July 1986 (Sweeps 1 m long made with 10-in diameter net, 20 samples at surface.)

Order	Common name	Number	Mg
Amphipoda	Freshwater shrimp	2	10
Hemiptera	Backswimmers, waterboatmen	18	30
Gastropoda	Snails	8	20
Odonata	Damselfly larvae	1	10
	Unidentified animal egg	1	Tr.
Total		30	70
Average for sample		3	7
Average for 1-m sweep		1.5	3.5

Flyingshot Lake

We attempted to quantify the Flyingshot Lake aquatic data by taking 10 RRL samples on transect line A. The water was shallow, ranging from 1.5 to 3.5 feet and averaging 2.6 feet. Six plant types were significant.

Plant species	Average ounces/ square foot	Pounds/ acre	Pounds/410-acre Flyingshot Lake
Coontail (*Ceratophyllum demersum*)	7.4	20,147	8,260,065
Water milfoil (*Myriophyllum exalbescens*)	2.6	7,079	2,902,185
Filamentous algae	2.4	6,534	2,678,940
Star duckweed (*Lemna trisulca*)	1.8	4,901	2,009,205
Green algae	1.5	4,084	1,674,338
Sago pondweed (*Potamogeton pectinatus*)	0.7	1,905	781,358

The total aquatic plant biomass averaged 16.4 ounces per square foot, or 44,649 pounds per acre and 18,306,090 pounds for the 410-acre EINP Flyingshot Lake. This would feed 100 adult swans at 20 pounds a day for 9153 days!

We took one sweep with the 10-in diameter, 1 mm-mesh sweep net for about a meter at the surface and another about 25 cm below the surface (Tables 7a and b). To compare with Holton's work in the Grande Prairie area, we must use our small-mesh surface data. We found an average of 23 mg of invertebrates and sticklebacks in one sweep or 115 mg in five sweeps compared to Holton's 54 g at Grande Prairie Flying Shot and 34 g at Updike Lake area. Similar to Holton's work, we found a great increase of animal life below the surface, 112 mg for one sweep or 560 for five sweeps. There appears to be an abundant supply of animal food for young cygnets at Elk Island National Park's Flyingshot Lake.

The bottom was sampled with the Eckman dredge at 2.0-foot depth and yielded 5 ounces of plant material and 85 mg of animal material (see Table 7c).

Table 7a. Aquatic invertebrates and sticklebacks-Flyingshot Lake, Elk Island National Park, Alberta, 5 August 1986 (sweeps 1 m long made with 10-in diameter net, 10 samples at surface.)

Order	Common name	Number	Mg
Pisces	Stickleback	8	100
Hemiptera	Backswimmers, waterboatmen	6	40
Odonata	Damselfly larvae	5	30
Amphipoda	Freshwater shrimp	75	40
Gastropoda	Snails	28	10
Diptera	Aquatic flies	7	10
Total		129	230

Table 7b. Aquatic invertebrates and sticklebacks - Flyingshot Lake, Elk Island National Park, Alberta, 5 August 1986 (sweeps 1 m long made with 10-in diameter net, 10 samples at 25 cm below surface.)

Order	Common name	Number	Mg
Pisces	Stickleback	26	710
Hirudinidae	Leeches	2	Tr.
Hemiptera	Waterboatmen, backswimmers	74	150
Amphipoda	Freshwater shrimp	340	190
Odonata	Damselfly larvae	4	5
Diptera	Aquatic flies	16	5
Gastropoda	Snails	143	160
Total		605	1220

Table 7c. Aquatic invertebrates and sticklebacks - Flyingshot Lake, Elk Island National Park, Alberta, 5 August 1986 (one sample 9-in x 9-in Eckman dredge).

Order	Common name	Number	Mg
Pisces	Stickleback	1	Tr.
Gastropoda	Snails	21	60
Amphipoda	Freshwater shrimp	60	15
Diptera	Aquatic flies	10	5
Odonata	Damselfly larvae	1	Tr.
Misc. animal bodies		2	5
Total		95	85

Goose Lake

We attempted to quantify the Goose Lake aquatic data by taking 10 RRL samples on transect line A. The lake flows slowly toward the northwest. It is a deep lake, ranging from 2.9 to 6.0 feet and averaging 5.0 feet. The aquatic vegetation was thinly scattered with five species, averaging 0.1 ounce or more per square foot.

Plant species	Average ounces/ square foot	Pounds/ acre	Pounds/143-acre Goose Lake
Coontail (*Ceratophyllum demersum*)	1.9	5,173	739,703
Star duckweed (*Lemna trisulca*)	1.4	3,812	545,045
Sago pondweed (*Potamogeton pectinatus*)	0.1	272	38,932
Green algae	0.1	272	38,932

The total aquatic plant biomass averaged 3.6 ounces per square foot or 9801 pounds per acre and 1,401,543 pounds for the 143-acre Goose Lake. This amount could produce sufficient aquatic plant food for 100 adult swans for 7000 days at 20 pounds per day, but it is so scattered that we expect few swans could use this lake for any length of time.

The bottom was sampled with the Eckman dredge at 2.9 feet and yielded 8 ounces of live plant material and 130 mg of animal matter, mostly bloodworms (Table 8c).

We took one sweep with the 10-in diameter, 1-mm-mesh sweep net for about a meter at the surface (Table 8a). We found an average of 1.5 mg of invertebrates at the surface, and an average of 10.5 mg 25 cm below the surface, or 7.5 mg with five sweeps at the surface and 52.5 g with five sweeps below the surface. Thus, Goose Lake compares quite unfavorably with the productive cygnet rearing areas in the Grande Prairie area and with the target lakes in EINP Wood Bison Area for cygnet production.

Table 8a. Aquatic invertebrates - Goose Lake, Elk Island National Park, Alberta, 13 August 1986 (one sample 9-in x 9-in Eckman dredge).

Order	Common name	Number	Mg
Annelida	Bloodworms	124	130
Gastropoda	Snails	1	Tr.
	Pondweed seeds	22	30
Total		147	160

Table 8b. Aquatic invertebrates - Goose Lake, Elk Island National Park, Alberta, 13 August 1986 (sweeps 1 m long made with 10-in diameter net, 10 samples at surface.)

Order	Common name	Number	Mg
Amphipoda	Freshwater shrimp	5	8
Gastropoda	Snails	4	Tr.
Cladocera	Daphnia	14	7
Total		23	15

Table 8c. Aquatic survey - Goose Lake, Elk Island National Park, Alberta, 13 August 1986 (sweeps 1 m long made with 10-inch diameter net, 10 samples at surface.)

Order	Common name	Number	Mg
Amphipoda	Freshwater shrimp	9	15
Gastropoda	Snails	3	Tr.
Cladocera	Daphnia	175	90
Total		187	105

SUMMARY

Elk Island National Park has made excellent pre-Trumpeter Swan restoration aquatic wildlife and plant surveys. These have been supplemented further with qualitative and quantitative surveys. The resulting observations and data indicate that there are adequate undisturbed aquatic habitats for several pairs of breeding Trumpeter Swans and their cygnets in the 12,000-acre Wood Bison Area south of Highway 16. Further, there are adequate habitats in the remaining 36,000 park acres and the many miles of adjacent outside areas for an expanding Trumpeter Swan flock.

RECOMMENDATIONS

It is time to continue the EINP restoration project by using similar methods and techniques as before, but replacing the British Columbia guide birds with Lacreek, South Dakota/Nebraska flock guide birds (Brechtel 1982). Perhaps this will result in guide birds and cygnets with close enough migration instincts that they will stay together and migrate south.

It is true that most of the Lacreek flock winters at Lacreek National Wildlife Refuge where natural foods must be supplemented with artificially-supplied grains when winter closes in. But Trumpeters prefer aquatic foods and forage out to sandhill springs and other open waters whenever those habitats are available. About 30 percent of this Lacreek flock of 300 swans migrate. We believe that the Refuge resident swans form the nucleus of those birds that remain, with a migration occurring among those birds that range off the Refuge. It is, therefore, likely that Trumpeters migrating to Lacreek from Alberta would be the most apt to continue on south.

Should the Lacreek part of the pilot project not succeed in restoring Trumpeter Swans, we urge that Elk Island National Park's desire to restore Trumpeter Swans be considered further by clipping the wings of two breeding pairs and placing one pair on Flyingshot Lake and the other pair on Walter Lake to nest and rear free-flying cygnets. Or, consider providing EINP with two pairs of pinioned, breeding swans to be released on a satisfactory lake or pond each summer to produce resident free-flying cygnets.

ACKNOWLEDGEMENTS

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PROGRESS REPORT ON IMPACT OF COLLECTING TRUMPETER SWAN (Cygnus buccinator) EGGS IN MINTO FLATS, ALASKA - 1986

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INTRODUCTION

Increasing interest in Trumpeter Swan (Cygnus buccinator) restoration and the continued population increase throughout Alaska prompted the Pacific Flyway Study Committee to prepare "Guidelines for Transplanting Trumpeter Swans from the Pacific Coast Population." The guidelines allow for an experimental program for removal of eggs from Alaska to provide a limited source of birds for restoration and other uses.

A Trumpeter Swan Draft Environmental Assessment was prepared for public comment and, subsequently, a Work Study Plan for monitoring the impact of collecting Trumpeter Swan eggs for transplants. The Minnesota Department of Natural Resources was issued a permit to take 50 Trumpeter Swan eggs in 1986. This report summarizes the first year results of collecting activities.

Fifty eggs will be removed from nests in 1987 and 1988 also, after which the program will be evaluated by the Pacific Flyway Study Committee, and a decision will be made as to how to proceed.

OBJECTIVES

1. To assess the impact of collecting Trumpeter Swan eggs on local productivity in succeeding years.
2. To determine the impact of disturbance from collection on individual nest success and cygnet survival.
3. To develop recommendations and quotas for future egg collections.

All procedural and monitoring activity descriptions are documented in the Work Study Plan for monitoring egg collection activities.

PROCEDURES

Study area

Collection activities were to be allowed only in the highest nest densities in Alaska. Those areas include the Copper River Delta, Nelchina Basin, and Minto Flats (Figure 1). The area selected for collection and study was Minto Flats. Selection criteria for Minto Flats included: 1) proximity to the Migratory Bird Management Office in Fairbanks for logistical and personnel support; 2) land status of collection area is State ownership; 3) accessibility of nests by float plane; and, 4) high density of swans.

Minto Flats is located approximately 40 miles (64 km) west of Fairbanks in the Tanana River Valley (Figure 1). That area selected for the study area included 735 square miles of habitat on four USGS 1:63,630 scale quadrangle maps (Figure 2). Two maps each were considered the egg collection area and the control or non-collected area. Total Trumpeter Swan habitat in the Minto Flats is approximately 1400 square miles, and the population averages 1031 swans annually (Table 1).

Table 1. Swan observations in Minto Flats, Alaska, 1981-84, prior to egg collection study.

Quadrangle - no.		Average number of: Broods	Pairs	Singles	Flocked birds	Young	Total swans
Fairbanks	C-5	6.5	12.8	3.4	16.0	22.0	67.0
	C-6	1.8	7.2	2.0	14.0	5.8	36.2
	D-4*	12.2	31.2	4.1	20.5	47.8	134.8
	D-5*	31.0	76.0	9.8	61.8	114.2	337.8
	D-6	8.8	24.7	3.9	7.5	22.2	83.0
Livengood	A-4**	10.5	27.5	5.2	79.5	40.8	180.5
	A-5**	10.5	32.8	3.2	49.8	43.2	161.8
	B-4	3.5	7.8	0.9	1.5	11.5	29.5
Total Minto Flats		84.8	220.0	32.5	250.6	307.5	1030.6

Average brood size = 3.63
Percent pairs with brood = 38
Percent young in population = 30

* Egg collection maps (429 square miles)
** Control area maps (305 square miles)

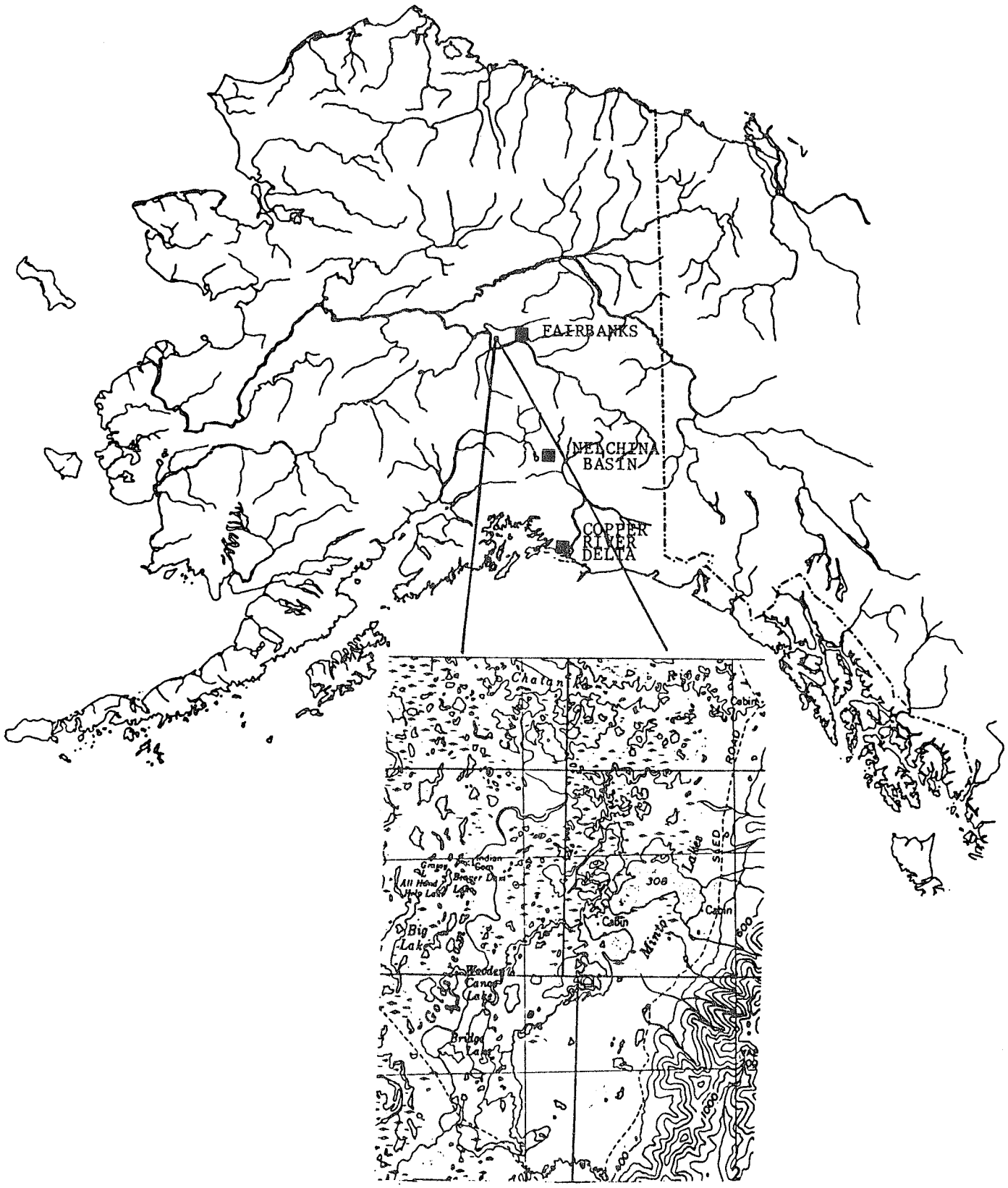

Figure 1. Location of Minto Flats study area in Alaska.

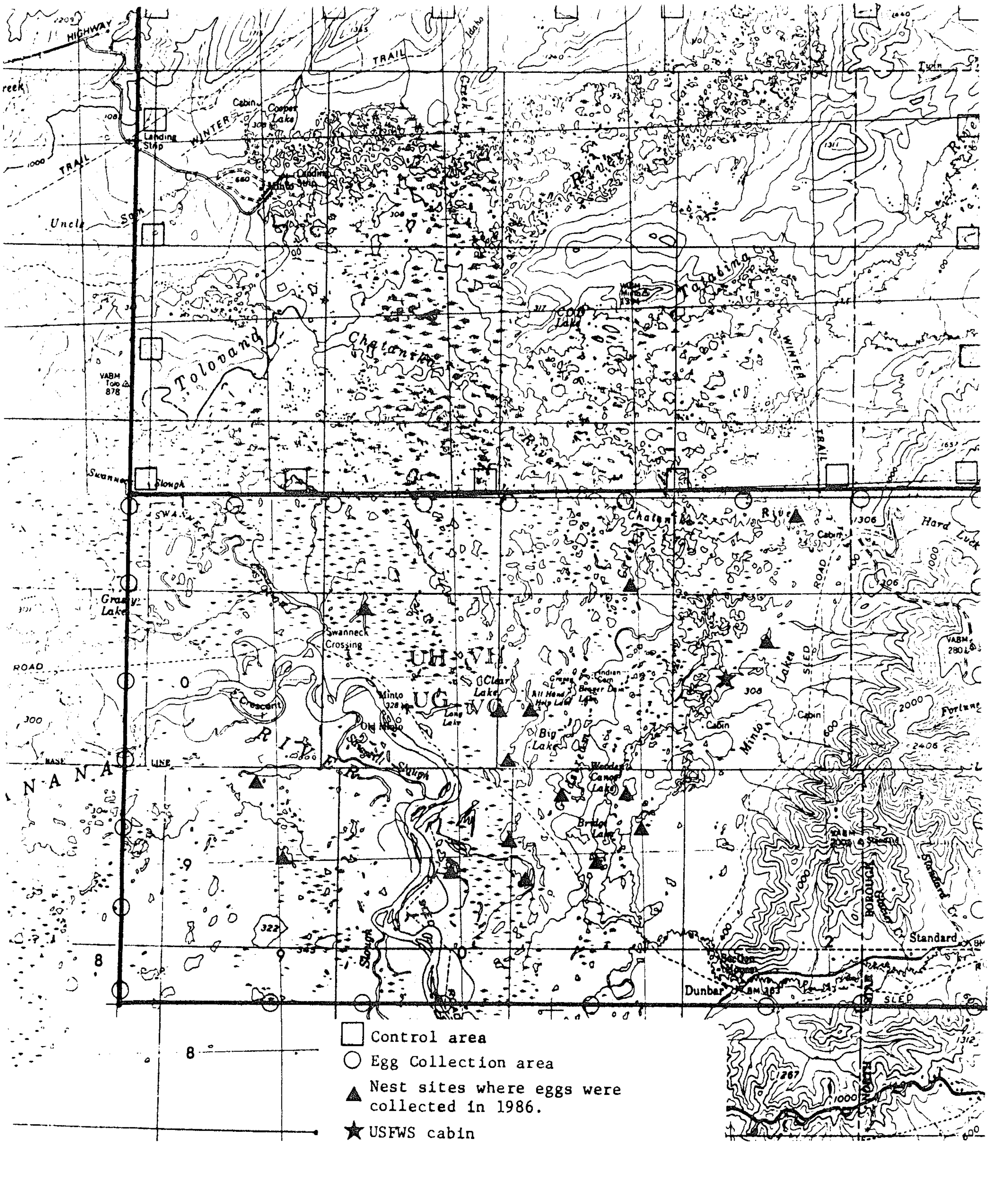

Figure 2. Study area for Trumpeter Swan egg removal impacts, Minto Flats, Alaska - 1986.

The study area is the core area of Trumpeter Swan habitat in Minto Flats. Total numbers of swans in the study area have averaged 814 during 1981-84, or 79 percent of the average swan population in Minto Flats. Table 2 compares swan numbers and densities between the collection and control areas. During 1986, above-average success for swans was noted throughout the Minto Flats. In the study area, there were 33 percent more pairs, 44 percent more broods, and 20 percent more young than the 1981-84 average (Table 2).

Table 2. Study area swan observation, Minto Flats, Alaska, 1981-84 (prior to egg collection) and 1986 observations (first year of egg collection).

1981-84	Pairs*	Sq. mi./pair	Broods	Sq. mi./brood	Young	Sq. mi./young
Collection area	107	4.0	43	9.9	162	3.0
Control area	60	5.0	21	4.5	84	3.6
1986						
Collection area	136	3.1	62	6.9	193**	2.2
Control area	86	3.5	30	10.2	102	3.0

* Includes singles with nest and/or brood.
** Includes the possible young from the 50 eggs removed.

Data collection

To facilitate the hatching success of eggs and the most efficient egg collection during the critical period, substantial "collecting criteria" were developed. The following guidelines for egg collection and subsequent follow-up were established:

1. Two nest survey flights were flown over the collection area to determine lake occupancy by nesting swans and timing of incubation. It was determined before the flights that an adult swan or pair of swans was to be on or near a nest site during both surveys for the nest to be considered active.

2. An aerial survey was flown over the complete study area during the second week of incubation to determine nest occupancy. Nests in the collection area were randomly selected for collection sites from those lakes accessible by float plane.

3. Eggs were collected within 10-15 days of hatching to enable optimum survival of the embryo during transit to Minnesota. At each nest, at least two fertile eggs were to be left.

4. An aerial survey was flown within the week after egg collection to determine desertion or occupation of nests following collecting activities.

5. Aerial surveys of the complete study area were continued into late fall to allow comparisons of productivity and cygnet mortality between the control and egg collection areas.

RESULTS

Collection activities

Reconnaissance flights during early May and subsequent complete surveys during 18-19 May and 5-6 June established initiation of incubation date of 17 May (± 3 days) for 1986. Trumpeter Swan incubation is estimated at 35 days (Banko 1960, Hansen et al. 1971) and has been verified for Interior Alaska during time-budget studies on breeding swans in Minto Flats (Bollinger 1983). Collecting eggs 10-15 days before hatching required nest visits between 5-10 June.

To select a nest site for egg collection, the following criteria were applied: 1) An adult swan or pair of swans must be at or near the nest site during both nest surveys; and 2) the lake must be accessible for a take-off water run of approximately 2,000 feet (depending on conditions on the day of collections) to accommodate a Cessna 185 on amphibious floats with pilot and one passenger on board.

During the nest searches of May and June, it was determined that 90 nests existed in the collection area, and, of those, approximately 30 nest/lake sites appeared accessible by float plane (Table 3).

On 10 June, egg collection activities began at 10:15 a.m. and continued until 7:45 p.m. with our return to Fairbanks. In addition to myself, Carrol Henderson of the Minnesota DNR Nongame Program (MNDNR) and his assistant, David Ahlgren, participated in the egg collecting activities. A total of 16 nest sites were visited to collect 50 eggs. At least two fertile eggs were left in each nest (Table 4). Average clutch size of these nests was 5.2 eggs (n = 16).

Table 3. Survey results of Minto Flats, Alaska, study area - 1986.

Area (map no.)	Dates surveyed	Total nests	Broods	Pairs	Singles w/nests or (brood)	Young	Percent prs. & singles w/nest or (brood)	Percent nest w/ young	Average brood size
Collection*	18-19 May 1986	50 / 8/**	--	126	8	--	37	--	--
Control**	20 May, 2 June 1986	45 / 9/	--	84	9	--	48	--	--
Collection	5-6 June 1986	90 /10/	--	139	10	--	60	--	--
Control	17-19 June 1986	41 /14/	--	69	14	--	49	--	--
Collection	15-16 August 1986	--	62 /2/	134	(2)	193	(46)	68	3.11
Control	19 August 1986	--	30 /1/	85	(1)	102	(35)	73	3.40

* Collection area maps are Fairbanks D-4 and D-5.

** / / Number of single adults on nest in total.

*** Control area maps are Livengood A-4 and A-5.

Collection activities included landing the aircraft on the lake, taxiing up to the nest site, measuring and candling each egg, placing each egg collected in a heated incubator, and departing from the lake. These activities averaged 20 minutes per nest site. Three trips were made to the U. S. Fish and Wildlife Service cabin on Minto Lake (Figure 1) where water was heated to keep incubation/transport cases warm, and collected eggs were left with the assistant. Weather during the day ranged from cloudy with intermittent light rain and 40°F in the morning to partly cloudy and 45°F in the afternoon. Winds were generally out of the west at 10-15 knots. The eggs and MNDNR personnel were on their way back to Minneapolis by midnight on the same day of collections, and the eggs were placed in permanent incubators in Minnesota by 10:00 a.m., 11 June.

Follow-up surveys

All collection nest sites were rechecked for occupancy by adults on 12, 17, and 22 June and for cygnet survival on 16 August (Table 4).

During the three subsequent nest checks, only one pair (43-50 A) was never observed back on the nest or with cygnets (Table 4). At six nest sites (37 percent), an adult swan was observed on the nest at least once, but no cygnets were ever observed. A ground check of five of the nests where no cygnets were ever observed on 18 August revealed that at one nest (27-29 G) no evidence of eggs was found; at one nest (8-4 M) both eggs hatched; and, at three nests (32-32 I, 18-16 D, 0-44 L), at least one egg hatched (Table 4).

Table 4. Trumpeter Swan nest site observations in the collection area, Minto Flats, Alaska, 1986.

Nest I.D. number	No. eggs in clutch	No. eggs collected	No. fertile eggs left	Position of female relative to nest during aerial survey: 12 June off	12 June on	17 June off	17 June on	22 June off	22 June on	16 August adults & no. cygnets
43- 50(A)	6	4	2	x		x		x		Pr + 0
95-109(B)	5	3	2		x		x		x	Pr + 2
96-113(C)	4	2	2		x		x		x	Pr + 0
32- 32(I)	6	4	2		x	x		x		No birds in area
19- 13(H)	6	3 (one addled)	2		x		x		x	Pr + 0
18- 16(D)	7	5	2		x		x		x	Pr + 1
14- 19(O)	3	1	2		x		x		x	Pr + 1
24- 28(N)	5	3	2	x			x		x	Pr + 2
8- 4(M)	5	3	2	x			x		x	Pr + 0
2- 4(K)	6	4	2		x		x		x	Pr + 2
0- 44(L)	7	5	2	x			x		x	Pr + 1
3- 5(J)	5	3	2		x		x		x	Pr + 2
44- 36(E)	4	2	2		x		x		x	Pr + 2
14- 14(F)	6	4	2	x			x		x	Pr + 2
27- 29(G)	5	3	2		x		x	x		Pr + 0
0- 24(P)	4	1	3	x		x		x		Pr + 3
Total	84*	50	33							18

* Average clutch size 5.25 eggs.

Data Analysis

1. Nest success of collection area vs. control area nests.

   A nest was considered successful if at least one cygnet was observed. Of the 16 nest sites where eggs were collected, 10 sites (62 percent) had at least one cygnet. In the control area, 30 nest sites (73 percent) of 41 had at least one cygnet.

   The null hypothesis (H_0) of: the probability that nest success is independent of visiting the nest by float plane was tested by using a Chi-square test with a 2 x 2 contingency table. Using the above data, a X^2 at 0.05 and 1 degree of freedom = 3.841 and $0.1 < P < 0.25$. The calculated $X^2 = 0.62$, and we must accept the H_0. Therefore, during 1986, there was no significant difference of nest success between the collection area and control area.

2. Cygnet survival of collection area vs. control area pairs.

   Thirty-three young were possible at the 16 nest collection sites. On 16 August, 18 young (54 percent) were still alive. To analyze cygnet mortality in the control area, average clutch size of 5.25 (n = 16) from the egg collection sites was assumed to be average throughout the study area. In the control area, there were 41 nests with a possible 215 young (41 x 5.25). On 16 August, there were 102 young alive (47 percent).

   The H_0 of: the probability that cygnet survival is independent of visiting the nest with a float plane was tested using a Chi-square test again with the 2 x 2 contingency table. The above data suggests a X^2 at 0.05 and 1 degree of freedom = 3.841 and $0.1 < P < 0.25$. The calculated $X^2 = 0.58$; therefore, we must accept the H_0. Therefore, during 1986, there was no significant difference of cygnet mortality between the collection area and the control area.

Discussion

There appeared to be no significant impact on nest success or cygnet mortality on Trumpeter Swan nests disturbed by egg collection activities in 1986. Cygnet survival was slightly higher at the nest collection sites (54 percent) than in the control area (47 percent), although nest success was slightly lower at nest collection sites (62 percent) compared to the control area (73 percent). Interpretation of the 1986 data concludes that the egg collection activities had some negative effect on the adults' inclination to return to the nest after the disturbance. Adult swan reactions to the float plane on the nest site lake ranged from distant departure of the nest mound and flying from the lake, to standing on the nest mound defending the nest with wings spread and constant swimming back and forth near the nest during egg collection. Remaining cygnet survival may have been enhanced by the removal of eggs and subsequent sibling competition and possibly resulted in increased adult attention given to the remaining cygnets.

During 1987 and 1988, nest success and cygnet survival will be compared using an empirical estimate of the standard error. This will enable us to determine errors between survey collection areas.

The 1986 breeding season recorded a substantially higher number of broods (92) in the study area than the 1981-84 study area average (64). If, in the succeeding years, there are continued increases in the number of nests, those nests selected for egg collections will be different from those selected in 1986. Individual monitoring data of all egg collection sites will be analyzed each year. The number of years a nest site is selected for egg collection will also be taken into consideration. Ideally, no nest site should have eggs collected from it more than once during the study.

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STATUS REPORT OF THE LACREEK TRUMPETER SWAN FLOCK MANAGEMENT PLAN, AUGUST 1986

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ABSTRACT

A total of 187 Trumpeter Swans (Cygnus buccinator) returned to Lacreek National Wildlife Refuge following the 1985 breeding season, including 43 cygnets. This compares unfavorably to the all-time peak of 263 Trumpeter Swans, including 57 cygnets, that returned in 1983. Severe winter weather may have caused an influx in early December 1983, followed by a rapid decrease of over 100 swans during the next few weeks. Unbanded Trumpeter Swans were reported in Arkansas and Oklahoma in late December 1983 and early January 1984, with subsequent sightings in Kansas and Oklahoma in the following years. A winter migration pattern may be developing. An attempt was made to band and collar Trumpeter Swans on the southern edge of the sandhills to provide positive identification of any migrating birds. The marking effort was fraught with problems, and only one swan was marked in 1986. The sandhills/high plains flock continues to produce more cygnets to flight stage every year. Lacreek Refuge Trumpeter Swan production continues to improve, with 19 cygnets brought to flight stage in 1986. Seven subadult Trumpeter Swans were captured and transferred to Mingo National Wildlife Refuge in Missouri in 1986 -- four died in the first month. Landowners where swans were captured for the transplant are concerned about the mortality at Mingo Refuge in Missouri. Additional work on this needs to be done.

Population Report

A total of 187 Trumpeter Swans (Cygnus buccinator) returned to Lacreek National Wildlife Refuge following the 1985 breeding season, including 43 cygnets. This compares unfavorably to 237 Trumpeters, including 47 cygnets in 1984, and the all-time peak of 263 Trumpeter Swans, including 57 cygnets in 1983 (Table 1). The cause of the decline is not known, but it is speculated that, in 1983, severe winter weather brought birds into Lacreek that had been wintering elsewhere. With the continued severe cold, however, approximately 100 Trumpeter Swans left the Refuge during December and were not seen again. If these birds migrated south, and survived, they may have established a minor winter migration, resulting in fewer birds wintering at Lacreek in subsequent years.

Table 1. Breeding season peak population and production data for Trumpeter Swans wintering on Lacreek National Wildlife Refuge, Martin, South Dakota.

Breeding season	Adults/ subadults	Cygnets	Total
1985	144	43	187
1984	190	47	237
1983	206	57	263
1982	167	48	215
1981	172	58	230
1980	140	56	196
1979	119	65	184
1978	138	36	174
1977	126	65	191
1976	146	41	187

This theory is supported by Trumpeter Swan sightings in Oklahoma, Kansas, and Arkansas, beginning in December 1983 and, again, during the winter of 1985-86. The 1983 population peak occurred on 7 December 1983 and declined rapidly toward the end of the month. On 20 December 1983, six adult Trumpeters and five cygnets were sighted near Dumas, Arkansas. The sighting was unconfirmed, and one of the swans was reported as wearing a brown collar. According to the Bird Banding Lab, no one was using brown collars, but it may have been a stained yellow collar. On 28 December 1983, eight adult Trumpeters and five cygnets were sighted 8 miles north of Ada, Oklahoma, on the South Fork of the Canadian River. Another adult was seen on Sooner Lake near Perry, Oklahoma, on 6 January 1984, during a waterfowl survey by the Oklahoma Department of Wildlife Conservation. No reports of sightings were received for the 1984-85 winter, but two sightings were made in Kansas in late 1985. A single bird was observed on Cedar Bluff Reservoir, 25 miles west of Hays on 26 November 1985, and a sick subadult was picked up 3 miles northwest of Emporia on the Neosho River on 12 December 1985. Another report was received from Dana L. Base, Nongame Biologist for the Oklahoma Department of Wildlife Conservation, confirming five adult Trumpeters and one cygnet 9 miles southwest of Mangum, Oklahoma, between 8 February 1986 and 11 March 1986.

Although there have been sightings of collared Trumpeters from Minnesota in Kansas and Oklahoma over the past few years, none of the birds above were marked. There is a good chance that some of them were Lacreek birds.

An attempt was made this year to band and collar adult Trumpeters on the southern part of the breeding range in the Nebraska Sandhills. The nesting pairs were located during the aerial breeding population survey, and the banding attempt was made on 29 July 1986. The first pair was located on Dolly Warden Lake (T28N, R41W) on the Pat Vinton ranch in Sheridan County, Nebraska. Dolly Warden Lake was not accessable to our airboat due to heavy cattail growth around the edges. We then traveled to Gem Lake (T28N, R40W) on the Joe Westover ranch in Cherry County, Nebraska. The lake was accessible, but both adult swans were flying. The last location was Three Mile Lake (T19N, R36W) on the Whitewater Ranch, Arthur County, Nebraska. Again, the lake was not accessible to the airboat due to a dense, wide, cattail margin. As a result, only one swan was banded.

An aerial survey of the sandhill/high plains breeding flock was conducted in July and August of 1986. The survey recorded 103 adults, including 41 nesting pairs, 21 nesting pairs with broods, and a total of 74 cygnets. Compared to previous years, the breeding performance of this flock seems to be improving. Since the first comprehensive aerial surveys began in 1980, the number of adults has remained relatively stable. The number of nesting pairs and pairs with broods increased from 1980 to 1984 and has since stabilized, but the number of cygnets brought to flight stage has steadily increased from 44 in 1980 to 74 in 1986 (Table 2).

Table 2. Breeding performance of southern Nebraska Trumpeter Swans.

Year	No. adults/ subadults	No. pairs	No. broods	No. cygnets
1986	103	41	21	74
1985	95	40	22	63
1984	116	42	28	65
1983		No Data		
1982		No Data		
1981	104	30	16	54
1980	120	28	18	44

Nesting on the Refuge in 1986 produced 19 cygnets to flight stage (Table 3) from six broods. Trumpeter Swans nested on Pools 2, 6, 8, 9, and 11. Though the cygnets were not actually flighted at the time of this writing, flight stage is assumed for this report because losses of cygnets after the middle of August to actual flight in early September has been minimal. The pair that hatched two in Pool 2 in 1985, and lost them, raised two cygnets to flight in 1986. The two pairs that nested in the north and south ends of Pool 6 in 1986 raised two and three cygnets, respectively, to flight. The brood on the south end included a leucistic (white) cygnet. Both of the pairs on Pool 6 were successful for the first time in 1986. The pair that nested on Pool 8 this year was an old established pair that had nested previously on Pool 7. They brought six cygnets to flight. The pair on Pool 9 was also experienced and brought four cygnets to flight. The nesting pair on Pool 11 was experienced, but they only brought two cygnets off in 1986. They were the exception, as nesting experience seems to be a major factor in nesting success, both in terms of the number of young produced and the number surviving to flight stage.

Table 3. Production data for Trumpeter Swans on Lacreek National Wildlife Refuge, Martin, South Dakota.

Year	Nesting pairs	Broods	Hatched	Fledged
1986	6	6		19
1985	6	5	18	13
1984	5	5	15	7
1983	5	4	17	9
1982*	7	3	9	4
1981	5	3	12	6
1980	6	4	11	6
1979	5	5	14	5
1978	6	5	17	12
1977	5	4	15	14
1976	5	5	11	6

* Includes one pair with three fledged cygnets transferred to Missouri and the removal of eight eggs for Minnesota.

Missouri Transplants

Seven subadult Trumpeter Swans were captured and transferred to the State of Missouri in 1986. We encountered a number of problems while attempting to capture swans this year. In 1985, all the subadult Trumpeter Swans in the Lacreek area gathered into two groups on two widely separated sandhill lakes. The swans stayed together on the lakes for about a week prior to the molt, allowing us to watch them and wait for molted flight feathers to appear on the loafing sites. All of the birds molted at about the same time, permitting all five swans on Scotchman Lake, 6 miles southeast of the Refuge, to be captured 3 days after the first molted feathers were discovered. This year, the subadult Trumpeters gathered into groups of only two, three, or four birds and kept moving every day or two between a number of lakes in the Scotchman Lake area. Since the literature cited a molt period for subadults between 20 June and 10 July, and we had captured the 1985 swans on 27 June, we began to worry when the end of June was approaching, and the birds were not settling down into one location for molting. We were afraid we might miss them as we had in 1984, when we were too late and the birds had already regained flight. When a group of six finally settled onto Scotchman Lake for 4 days between 25-29 June, and the white remiges were seen on the loaf sites, we got anxious and made a capture run on 30 June. We caught three swans, and the other three flew away. Since the last bird captured that day was losing feathers as we chased it, we assumed that the molt was just starting and we could come back and capture the rest of the birds in a few days. We did not want to keep the swans in our holding pen at the Refuge any longer than necessary for stress reasons. We decided to release the collared swans back onto Scotchman Lake and recapture them later when we came back for the others. Wrong! When the Refuge Manager flew the area the next day, the flightless, collared swans were gone. They were located "on foot" 1-1/2 miles southeast of Scotchman Lake, walking towards Winslow Lake. We assumed that the capture stress forced them to leave Scotchman but that they would stay on Winslow Lake. Wrong again! The next aerial check was on 6 July, and they were gone again.

During the aerial surveys that were made the following 2 weeks to find additional swans for capture, a special effort was made to search for the missing swans. We even assumed that the walking swans could have fallen prey to predators and searched thousands of acres of sandhill uplands. The Refuge Manager found almost every cow skull and empty clorox jug in the surrounding 10 miles but no sign of the 3 collared birds. At least we will know if they return during the winter (collar numbers 19FA, 26FA, 27FA).

Trumpeter Swans for the Missouri project were captured from non-nesting pairs and small groups moving around the area. One pair (28FA and 29FA) was captured on Phantom Lake (5 miles SSE of the Refuge) on 10 July. Out of six swans available on Clubhouse Lake (8 miles SSE of the Refuge), five were captured and banded/collared on 11 July. The pair that attempted to nest on Clubhouse Lake (21RA and 22RA) in 1986 was separated out and left on the Lake at the landowner's request. Out of the four nonbreeders on Clubhouse Lake with the nesting pair, we captured three -- the fourth one was still flying. These three nonbreeders (17RA, 18RA, and 19RA) were held for transfer. Another pair of nonbreeders on Winslow Lake (20RA and 23RA) were captured for transfer on 14 July 1986. An unsuccessful nesting pair was also observed throughout the spring on Winslow Lake, but they confined themselves to the dense marsh on the south end of the Lake and were not disturbed during the capture activities.

The transfer was made on 14 July 1986, during the night, with the release on Mingo National Wildlife Refuge, near Puxico, Missouri, early in the morning on 15 July 1986. Three of the birds died of stress-related problems within a few days. Another died of injuries suffered in a flying accident in early August. Two of the swans transferred this year (19RA and 28FA) were alive and well at the time of this writing and appear to have formed a pair bond. Another bird (20RA) is missing.

The first pair of Trumpeter Swans to be transferred to Missouri in 1982 (82TY and 98TY) nested this year and hatched two cygnets. Unfortunately, the cygnets did not survive. This was an old established pair at Lacreek which had successfully produced large broods on Lacreek Refuge for many years prior to their transfer to Mingo. Apparently, starting over is hard work.

Mingo National Wildlife Refuge has a traditional marsh management policy of draining their units every other year. Because Trumpeter Swans need stable marsh conditions for nesting, this practice may be detrimental to swan nesting success. The current status of all of the swans transferred to Missouri is displayed in Table 4.

From the above observations, one must conclude that Trumpeter Swans are very susceptible to disturbance and will go to great lengths to avoid repeated disturbance, even striking out on foot, when flightless, for parts unknown, probably to their own detriment. This phenomenon was also observed in 1983, when one adult left her mate on South Twin Lake in western Cherry County, Nebraska, with two of their three cygnets. What stress prompted her to leave the nesting area on foot while flightless is unknown, but she was found 6 miles east of the nesting area in an open pasture. The two cygnets that had left with her were not found and were assumed lost to predation. There is concern that this propensity for solitude and undisturbed nesting habitat may be a factor in the mortality and lack of reproductive success at the release site in Missouri. The mortality in Missouri is a problem of grave concern. Landowners in the South Dakota/Nebraska areas are very protective of "their" Trumpeter Swans and have expressed concern over the mortality suffered by transferred birds. Additional work on this problem needs to be done.

Table 4. Status of Trumpeter Swans tranferred to Missouri from South Dakota and Nebraska as of August 1986.

Transfer year	Collar code*	Age/sex**	Transmitter	Fate
1982	82TY	Ad/F	No	Alive
1982	98TY	Ad/M	No	Alive
1982	7FA	Cy/M	No	Found dead 12/82
1982	8FA	Cy/M	Yes	Found dead 8/84
1982	9FA	Cy/F	Yes	Missing 1/83
1983	10FA	Ad/F	No	Alive--moved out of area
1983	11FA	Ad/M	Yes	Killed by predator 10/83
1983	17FA	Cy/M	Yes	Killed by predator 11/83
1983	18FA	Cy/M	Yes	Killed by predator 10/83
1983	12FA	Ad/M	Yes	Killed by predator 9/83
1983	13FA	Ad/F	No	Killed by predator 10/83
1983	16FA	Cy/F	No	Missing as of 10/83
1984	No transfer			
1985	16RA	SA/F	Yes	Found dead 10/85
1985	20FA	SA/F	Yes	Found bird/weak--died 11/85
1985	21FA	SA/F	Yes	Killed by bobcat 9/85
1985	22FA	SA/M	Yes	Found dead 1/86
1985	23FA	SA/M	Yes	Missing 10/86
1985	24FA	SA/F	Yes	Found dead 9/85
1986	17RA	SA/F	No	Died--stress 7/86
1986	18RA	SA/M	No	Died--stress 7/86
1986	19RA	SA/M	No	Alive
1986	20RA	SA/F	No	Missing 8/86
1986	23RA	SA/M	No	Died--flying accident 8/86
1986	28RA	SA/F	No	Alive
1986	29RA	SA/F	No	Died--stress 7/86

* FA & TY suffix = South Dakota capture; RA suffix = Nebraska capture
** Ad = Adult, Cy = Cygnet, and SA = Subadult when transferred

STATUS OF MISSOURI'S EXPERIMENTAL TRUMPETER SWAN RESTORATION PROGRAM

John W. Smith, Wildlife Research Biologist, Missouri Department of Conservation

ABSTRACT

A combined total of 25 Trumpeter Swans (Cygnus buccinator) was transferred to Missouri during the period 1982-86. Fifteen (60 percent) of those birds are known to have died, and another three (12 percent) are known or suspected to have left the study area. Although predation was implicated in eight (53 percent) of the known mortalities, it is believed that stress related to the transfers was the primary factor leading to death by predation in most of the mortalities experienced during this ongoing experimental program.

INTRODUCTION

The Missouri Department of Conservation, in cooperation with the U. S. Fish and Wildlife Service (USFWS), initiated an experimental Trumpeter Swan (Cygnus buccinator)restoration program in 1982 (Smith and Wilson 1983). That program, which is still underway, has the following objectives:

1. To determine the efficacy of Trumpeter Swan reintroductions as a technique for reestablishing migratory behavior and recolonization of historical winter range.

2. To determine the habitat use and food habits of Trumpeter Swans reintroduced to Missouri.

The program was designed to complement the objectives set forth in the Management Plan for Lacreek Trumpeter Swans (USFWS 1982), which provides for at least 300 Trumpeter Swans that migrate and winter south of Lacreek National Wildlife Refuge (NWR). It was hoped that the objective could be met, in part, by encouraging birds from the Lacreek flock to winter in Missouri. The potential for establishing a migration between Lacreek and Missouri was demonstrated when a family group of Trumpeter Swans was observed at Thomas Hill Reservoir in north-central Missouri in December 1978. The adult female of that family had been banded as a local cygnet on Lacreek NWR in 1974.

STUDY AREA

The area selected for the initial restoration attempt was Mingo NWR in southeast Missouri. Mingo was selected primarily because of its location which is far enough south that the area does not usually experience a prolonged winter freeze-up. That fact, combined with repeated observations of migrant swans wintering on the Refuge, indicated that Mingo NWR had the potential to overwinter swans on natural foods, thus avoiding the problems associated with artificial feeding that have plagued previous restoration efforts. The area also afforded the benefits of a permanent assigned staff which facilitated animal monitoring and provided the capability for selective habitat management in support of the restoration effort.

The Mingo Refuge encompasses an area of approximately 8745 ha (Figure 1). Situated in an ancient channel of the Mississippi River, the Refuge includes over 5000 ha of seasonally flooded bottomland hardwood forest and remnant cypress swamp. An additional 1820 ha is managed as marsh habitat, including 225 ha in 11 impoundments intensively managed for moist-soil production of waterfowl foods (Fredrickson and Taylor 1982). As a result of unsuccessful efforts to drain the swamp for conversion to farmland during the early 1900's, the Refuge is crossed with north-south ditches 6 to 9 m wide and 1 to 2 m deep along nearly every section line (Figure 1). Several of the ditch banks are now the main framework of Refuge roads on the area.

METHODS

Trumpeter Swans were obtained for restoration through cooperation with the manager and staff of Lacreek NWR, South Dakota. Transfers were authorized under special permit, granted by Region 6 of the USFWS. Early emphasis was placed on acquiring Trumpeter family groups, to test the hypothesis that the adults of displaced family units would lead their cygnets northward in the spring after overwintering on Mingo NWR. However, following the transfers of 1982 (one family group = two adults + three cygnets) and 1983 (two family groups = four adults + three cygnets), it was decided to shift to the acquisition of subadults or nonbreeders in the hope that larger numbers of birds would be available for transfer. Consequently, the transfers conducted in 1985 and 1986 consisted of subadults or nonbreeders captured while flightless (six birds in 1985 and seven in 1986). Swans were not available for transfer in 1984.

Swans were captured by Lacreek Refuge personnel using an airboat. The birds were held in an aquatic holding pen for several days pending transfer to Missouri. Each bird was sexed, banded with a standard USFWS metal bird band (size 9C), and marked with a yellow collar and leg band bearing a unique two-number, two-letter identification code. Selected individuals were equipped with radio transmitter packages to facilitate monitoring post-release movements and habitat use.

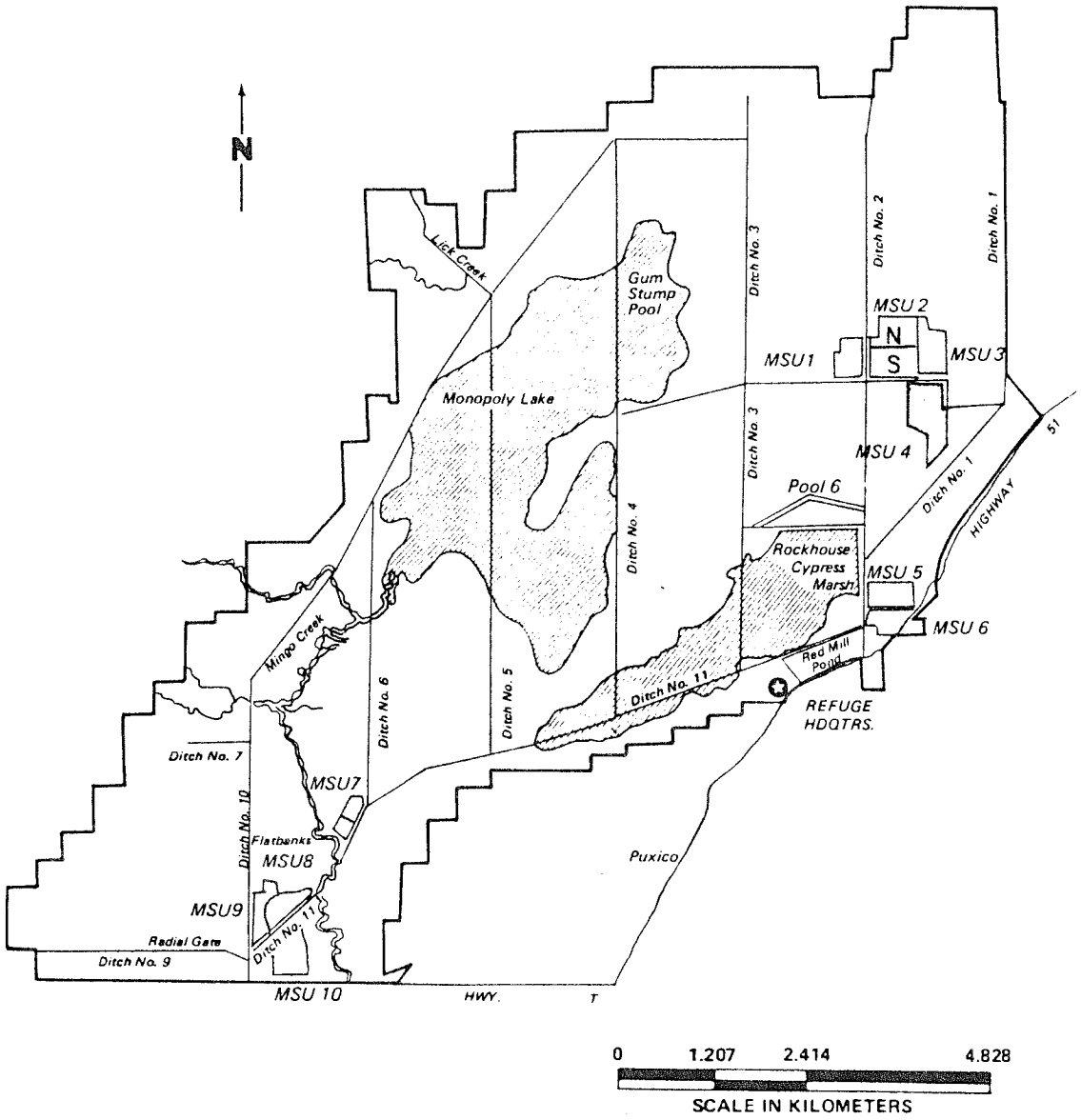

Figure 1. Mingo National Wildlife Refuge, Missouri, showing locations of moist soil units (MSU).

In 1982, birds were processed for shipment to Missouri by restraining them with burlap sacks. The method proved unsatisfactory, because the heavy burlap caused undue heat stress to the birds. In subsequent transfers, the birds were restrained in nylon mesh bags developed by the Tennessee Valley Authority (Don Hammer, pers. comm.). The feet of each bird were secured with vinyl electrical tape prior to placement in the bag. The swans were transported to Missouri using Missouri Department of Conservation fixed-wing aircraft.

Releases were conducted in Rockhouse Cypress Marsh and the Monopoly Wilderness Area of Mingo NWR (Figure 1). A major objective during releases was the maintenance of family units or group integrity. In 1982, a single family group of five birds was held in captivity for 2 days in an aquatic holding pen constructed on Rockhouse Cypress Marsh by Mingo NWR staff. The birds were allowed to swim to freedom together when the gate was opened on the third day. Due to a drawdown of Rockhouse Marsh in 1983 and 1985, releases were made directly into the Monopoly Wilderness Area during those years, without pre-release confinement. Releases were made as soon after daylight as practicable to take advantage of cooler temperatures and to allow as much time as possible prior to nightfall for the birds to become familiar with their new surroundings.

RESULTS AND DISCUSSION

To date, a combined total of 25 Trumpeter Swans has been transferred to Missouri during the experimental restoration program (Table 1). Although the project is still underway, an interim analysis of project status is highly appropriate. Indeed, this Conference is well timed to provide opportunities to discuss the present status of Missouri's project and the future direction of our restoration efforts. Analysis of habitat use and food habits continues.

The number of family groups available for transfer in 1982 and 1983 was insufficient to test the hypothesis that adults of displaced family units would lead their cygnets northward in the spring after overwintering on Mingo Refuge. Although the post-release survival of the original 1982 family group was very good (one cygnet died of shock in early December from injuries sustained either during a flying accident or an unsuccessful predation attempt), the family unit dissolved, and the remaining cygnets dispersed in late December 1982 after nearly 4 months on the study area. None of the cygnets involved in the subsequent 1983 transfer are known to have survived, and none of the surviving adults from either transfer attempted to migrate during the spring following release, although the single survivor from the 1983 release left the study area during her second winter at Mingo. That bird, an adult female bearing collar number 10FA, disappeared by the spring of 1985 and is unaccounted for.

Of 18 Trumpeters released at Mingo NWR prior to 1986, 12 (67 percent) are known to have died from various causes, four (22 percent) are presumed dead, and three others (one adult, one subadult, and one cygnet) are known or believed to have left the study area (Table 1). At least four birds are known to have survived for 1 year following release.

Table 1. Status of Trumpeter Swans transplanted to Mingo National Wildlife Refuge, Missouri (1982-86).

Year	No. released	No. mortalities	No. surviving 1 year (%)*	No. remaining on Refuge*	Status undetermined
1982	5	2	3 (60)	2	1
1983	7	5	1 (14)	0	2
1985	6	5	0 (0)	0	1
1986	7	3	N/A**	2	2
Total	25	15 (60%)	4 (22%)	4 (16%)	6 (24%)

* Minimum figures
** Released 15 July 1986

Only two of the 18 birds released prior to 1986 are known to be alive and present on the study area. Those birds, the mated pair from the original 1982 release, continue to thrive on Mingo Refuge. They attempted unsuccessfully to nest in 1985, failing due to a drawdown of Rockhouse Cypress Marsh in June of that year. However, the pair nested successfully in 1986. Repeated attempts to locate the nest failed, so clutch size and original brood size data are not available. The pair was first observed with two cygnets in late June; the estimated date of hatching was 15 June. Although their cygnets disappeared without a trace in mid-July, the successful nesting of the pair in 1986 was a highly significant event and represented the first documented nesting of wild Trumpeter Swans in Missouri since the turn of the century.

The incidence and causes of mortality experienced during this study can be grouped in five categories: predation (eight birds), stress (two birds), disease (one bird), accident (one bird), and unknown (three birds, probably stress related as discussed below). The above totals to 15 known mortalities, or 60 percent, of all birds released (Table 1). Predators included bobcat (*Lynx rufus*), raccoon (*Procyon lotor*), and a possible Great Horned Owl (*Bubo virginianus*). The "diseased" bird went blind in both eyes and died after being found emaciated in November 1985. A necropsy, performed by the University of Missouri Veterinary Diagnostic Laboratory, did not reveal the cause of the bird's blindness; death resulted from starvation, presumably caused by an inability to see, to feed properly.

Of 15 Trumpeters known to have died during the program, 80 percent (12 birds) died within 3 months of release. Seven (58 percent) of the mortalities occurring within 3 months of release were known or suspected to have been caused by predation. Four others (33 percent), including two birds that died within 1 week following release in July 1986, were attributed to stress associated with the transfer. Although every attempt was made to minimize stress to the birds prior to and during release, the long-term effects of stress must be considered a major factor impacting Trumpeter Swan survival.

Effects of stress on wildlife are poorly studied, but it is possible that some of the Trumpeter mortalities attributed to predation during this study may indeed have been facilitated, albeit indirectly, by earlier periods of stress experienced during the capture and transfer process. It may well be that stress, manifested as increased susceptibility to disease or predation, can result in reduced survivability even months following the stressful event. Obviously, the stress factors involved in Trumpeter Swan restoration efforts deserve careful evaluation.

Although the 60 percent mortality observed thus far during Missouri's experimental restoration program is indeed high, it must be viewed in light of similar mortality experienced during Trumpeter Swan restoration efforts elsewhere. The restoration effort that started the Lacreek flock in the early 1960's began with 57 young Trumpeter Swans (Monnie 1966). Of 36 birds that survived to release age, only 12 (33 percent) remained on the Lacreek Refuge during the third summer. The potential for eventual success with Missouri's experimental Trumpeter Swan restoration program is considered very good, and future efforts will endeavor to control the problems with stress-related mortality that have been experienced, to date.

ACKNOWLEDGMENTS

The assistance and continuing cooperation of Refuge Managers Rolf Kraft (and the staff of Lacreek NWR, South Dakota) and Gerald Clawson (and the staff of Mingo NWR, Missouri) is gratefully acknowledged.

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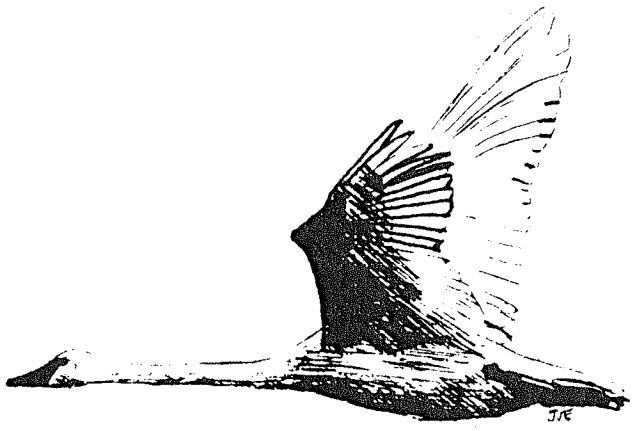

STATUS REPORT FOR THE HENNEPIN PARKS' TRUMPETER SWAN RESTORATION PROJECT

Laurence N. Gillette, Wildlife Manager, Hennepin Parks

Hennepin Parks (formerly Hennepin County Park Reserve District) operates a system of 1,000- to 5,000-acre park reserves in the western half of Hennepin County, Minnesota. Hennepin Parks is engaged in a Trumpeter Swan restoration project which is intended to establish a flock of 100 free-flying, migratory Trumpeter Swans, with at least 15 nesting pairs in south-central Minnesota.

Englund (1982) reported on Hennepin Parks' swan program through 1982, and Gillette (1986) summarized events between 1980 and 1984. This update discusses the following topics:

1. Population changes and cygnet recruitment from 1980 to 1986.
2. Migration of released Trumpeters in 1984 and 1985.
3. Causes of mortality for free-flying swans in Minnesota and attempts that are being made to reduce this mortality.

Table 1 shows the population changes that have occurred since 1980 in the total population and the free-flying swans. (Although Hennepin Parks has been raising swans for release since 1973, the first birds were not let go until 1979.) It also shows the number of cygnets fledged each fall. As predicted at the last conference (Gillette 1986), the rapid increase in the free-flying populations through 1984 was not sustained during the following 2 years despite high cygnet recruitment. Mortality of adult and subadult birds severely limited the rate of growth.

Table 1. Trumpeter Swan population 1980-86*, Hennepin Parks, Minnesota.

Year	1980	1981	1982	1983	1984**	1985**	1986
Total population (including captive birds)	31	37	55	72	84	81+	80-90
Cygnets to flight (but not necessarily released)	9	8	17	27	25	19	29
Free-flying swans (includes cygnets that were allowed to fly free)	8	13	22	21	44	47+	50-60

* Numbers for the total population and free-flying swans are for 31 December of each year.

** Trumpeter Swans migrated south in between these population estimates.

Mortality increased, in part, because the numbers of free-flying swans increased and, in part, because swans began spending more time outside the security of the park reserves. This was especially true in 1985. A third factor contributing to increased mortality was the commencement of migration for some of the free-flying swans in December of 1984. Twenty-nine swans left, but only 18 returned the following spring. Although it was costly in terms of swans that were lost, this one event probably did more to remove obstacles for Trumpeter restoration in the Midwest than anything else by proving that Trumpeters from Red Rock Lakes had not lost the genetic ability to migrate.

Ten swans left Carver Park Reserve on 12 December 1984, and 19 left Lake Rebecca Park Reserve on 28 December (Figure 1). The Carver birds traveled together to central Iowa before they split up into smaller groups. The Lake Rebecca flock apparently fragmented shortly after leaving the park. The birds were observed in the south as pairs, sibling groups, and family units of two to four swans.

Sixteen of the 29 swans were seen in Kansas, Oklahoma, and Missouri during the winter (Figure 2), and two others that were not reported at all during the winter returned in the spring. The observed swans used a wildlife management area, an open water area below a dam, a power plant discharge lake, a river, and a sewage treatment lagoon as winter habitat while in the south. One swan was found dead beneath a powerline in Iowa on the trip south, and one was found under similar circumstances in Oklahoma on the trip north. All other birds that disappeared apparently did so on the trip south. They were never observed again after leaving Lake Rebecca or central Iowa. This high mortality is expected for birds learning a migration route by trial and error.

Many of the returning migrants were not seen in the spring at the sites from which they migrated in the fall. They appeared to go directly to the vicinity of the wetlands they had used during previous summers. Fortunately, a good observer network provided sightings of these swans.

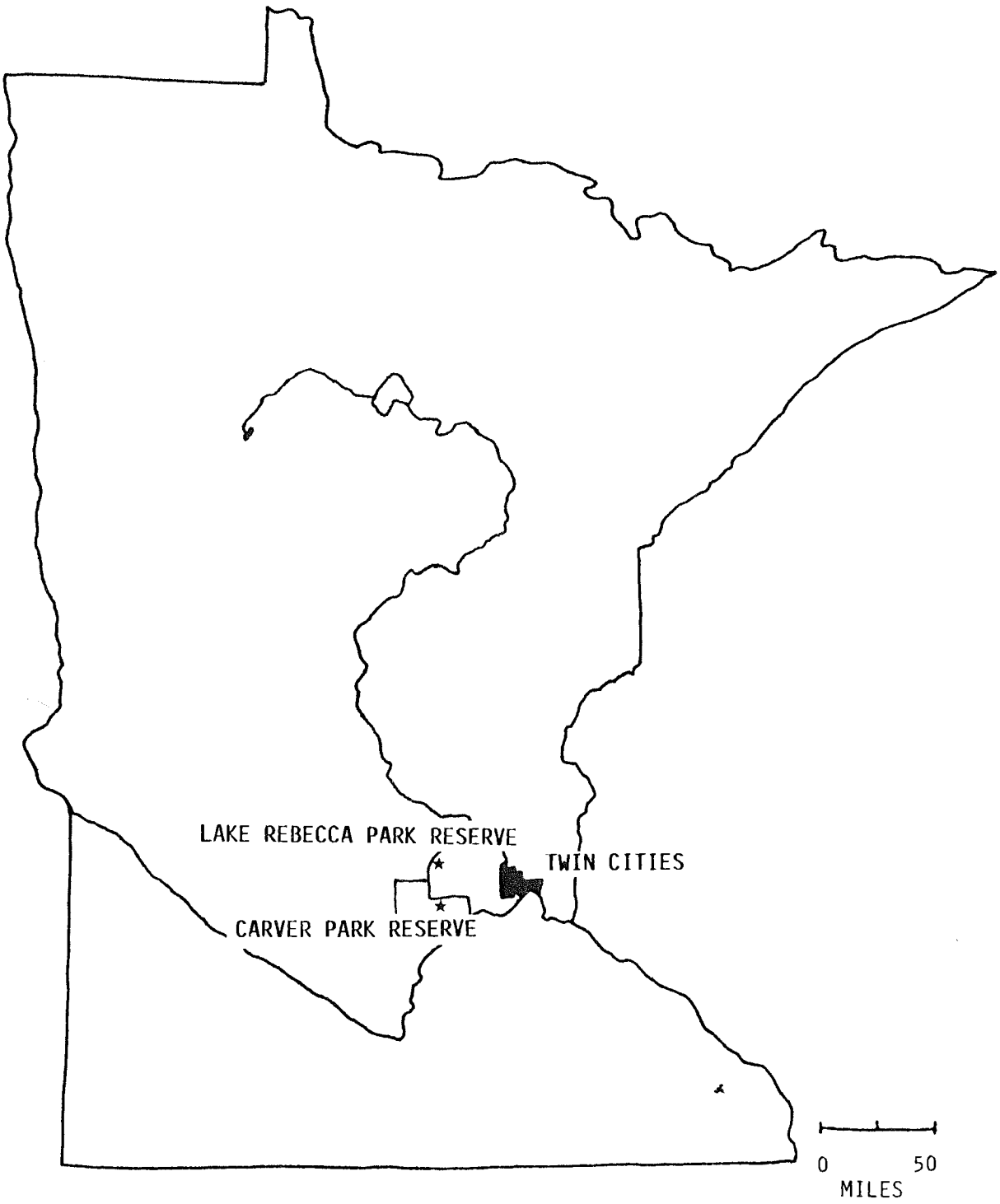

Figure 1. Hennepin Parks' locations from which Trumpeter Swans migrated in 1984.

Figure 2. Confirmed sightings of Hennepin Parks' Trumpeters during the migration.

Only six swans migrated during the winter of 1985-86. Two returned to almost the exact site in Oklahoma that they used the previous winter. The others were not located or could not be identified due to a lack of collars. Four of the six returned to Minnesota.

Two of the migrant swans, one male and one female, lost their mates during the hunting season and during migration, respectively. Both swans returned alone to their summer marshes where they remained alone during the nesting season. Neither swan made an attempt to locate a mate elsewhere, yet the male readily accepted a female released in his wetland the following July.

As indicated previously, increased mortality rather than decreased recruitment or dispersal is considered to be the primary factor limiting the growth of Hennepin Parks' flock. Table 2 shows the causes of mortality as far as can be determined. Shooting remains the most important and probably the only controllable factor.

Table 2. Fates of Trumpeter Swans released by Hennepin Parks 1980-September 1986.

Causes of mortality for released or wild-reared Trumpeter Swans	Time period				
	1980-83	1984	1985	9/1/86	Total
Shot during hunting season	10	1	5		16
Hit power lines	6	2	1		9
Lead poisoning	2			2	4
Aspergillus flavis				2	2
Leg infection				1	1
Severe trauma				1	1
Prolonged undetermined illness				1	1
Unknown (carcass recovered)	2	3	1		6
Disappeared (spring-fall)	9	3	3+*	?**	15+
Disappeared during migration	—	1	8	2	11
Total	29	10	18+	9+	66+

* Numerous swans are unmarked. It is impossible to determined exactly when or if they disappeared.

** Swans that disappear in spring, summer, and fall are not determined until swans return to refuges in October and November.

Shooting is of greater significance than the numbers indicate, because it eliminates a disproportionate number of adult birds. Adult behavior is somewhat different from that of subadults. If they nest, they generally remain in one marsh from mid-April until October. Usually, their movement patterns are fairly well established. If they have been able to avoid hazards such as lead poisoning and collisions with power lines, chances are good they will continue to do so. Hunters represent a new factor, since they bring the potential for death to an otherwise satisfactory wetland. Four out of five swans shot in 1985 were 2 years old or older. All four were shot on the wetlands they had used all summer and fall.

There is very little evidence to suggest that swans shot in Minnesota were misidentified as other species of waterfowl. Closing the season on the Snow (*Chen caerulescens*) or Canada Goose (*Branta canadensis*) would do very little to protect the Trumpeter. Educating hunters about the Trumpeter Swan and the restoration program is essential, but it still does not reach the source of the problem.

It seems that the only way to curb these intentional and senseless shootings is to increase the chances of apprehension and the penalties for those who are convicted. A well-advertised reward system is essential to increasing the perception that anyone shooting a swan will be arrested, although, in actuality, it may not lead to more arrests. Penalties can be increased only if the courts view swan shootings more seriously than a simple misdemeanor.

This approach is being taken by Hennepin Parks, with cooperation from Minnesota Department of Natural Resources Section of Nongame, the Minnesota Waterfowl Association, and The Trumpeter Swan Society. A reward of $500 is offered for information leading to the arrest and conviction of anyone shooting a swan. Combinations of fines, restitution, and confiscation of property have increased the penalties to nearly $2,000 per shooting. It is amazing how fast news of these penalties travels through the hunting community.

This may appear to be drastic action to some, but it also appears to be necessary if the Trumpeter Swan is to be restored to the Midwest. It is being undertaken in cooperation with other agencies in the hope that it will have a positive impact on both hunting and the restoration effort.

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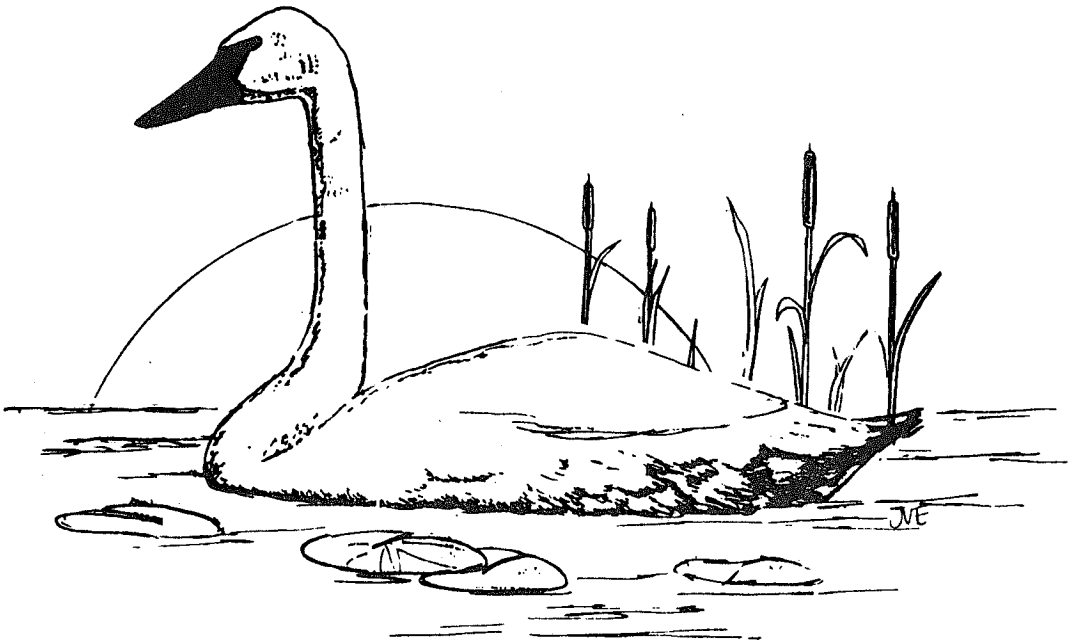

MINNESOTA DEPARTMENT OF NATURAL RESOURCES TRUMPETER SWAN PROJECT SUMMARY - 1986

Carrol Henderson, Nongame Wildlife Supervisor, Minnesota Department of Natural Resources

The Minnesota Department of Natural Resources (MNDNR) took a giant step forward in 1986 with its Trumpeter Swan (Cygnus buccinator) restoration project by obtaining 50 Trumpeter Swan eggs from Alaska for hatching, rearing, and eventual release.

This was the first time that the U. S. Fish and Wildlife Service had approved the removal of 50 Alaskan Trumpeter Swan eggs for restoration purposes. The permit to collect Alaskan eggs was subject to approval of the Pacific Flyway Council, the Alaska Department of Game and Fish, and the U. S. Fish and Wildlife Service. The Minnesota Trumpeter Swan plan was also approved by the Mississippi Flyway Council. The eggs had to be collected according to procedures established by the Pacific Flyway Council.

Fifty Trumpeter Swan eggs were collected on 10 June 1986 by a team consisting of Carrol Henderson, (MNDNR Nongame Wildlife Supervisor), Rod King (Pilot-Biologist for U. S. Fish and Wildlife Service), and Dave Ahlgren (volunteer and Northwest Airlines pilot). King had located 91 Trumpeter Swan nests in the Minto Flats near Fairbanks, Alaska, prior to the 10 June collection date. The 50 eggs were collected from a total of 16 Trumpeter Swan nests. Two live eggs were left in each nest.

Each nest was approached by landing on the lake in a Cessna 185 float plane and taxiing up to the nest. Each nest was then approached on foot, using chest waders. All eggs were candled and measured with calipers. The eggs removed from each nest had visible air sacs and larger diameters than those left in the nest. All eggs collected were individually marked; the 50 cygnets could subsequently be identified as to their lake of origin. Eggs were immediately placed in insulated suitcases with individual egg compartments, ventilation, and hot water bottle heat.

Egg collections began at 10:46 a.m. (Alaska time) and concluded at 7:05 p.m. the same day. The egg collection team then flew back to Fairbanks. Henderson and Ahlgren took a midnight flight to Anchorage and returned to Minneapolis via Seattle. They arrived in Minneapolis at approximately 9:30 a.m. (Alaska time) on 11 June -- less than 24 hours after the first eggs were removed from their nest.

Of the 50 eggs, 43 hatched and 35 cygnets survived to 1 September 1986. Two eggs failed to hatch; the embryos were seriously deformed. Four other embryos failed to hatch but appeared normal, and one egg was either infertile or the embryo died at an early stage of development. All six embryos were sent to the Patuxent Wildlife Research Center for heavy metal analysis.

In addition to the Alaskan cygnets, seven cygnets were also received from the Minnesota Zoo and the Brookfield Zoo in Chicago, for a total of 42 cygnets produced in 1986.

Egg collection will continue in Alaska for at least 2 more years, with a goal of producing 40 cygnets per year in 1987 and 1988. Cygnets raised will be released in northwest Minnesota in the vicinity of Detroit Lakes. It is the goal of this project to establish a free-flying migratory population of at least 15 pairs of Trumpeter Swans in northwest Minnesota.

This population is intended to complement the current population of Trumpeter Swans established by Hennepin Parks in the vicinity of Hennepin County, Minnesota.

The project is funded by donations to the Nongame Wildlife Checkoff on Minnesota tax forms and by donations from the Dellwood Wildlife Foundation, the Minnesota River Valley Audubon Club, and Northwest Airlines.

RESTORATION OF TRUMPETER SWANS IN ONTARIO

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The Trumpeter Swan (Cygnus buccinator) disappeared as a breeding bird in Ontario 150-200 years ago. The decision to reestablish the species was made in 1982 when experimental work began. By 1985, the techniques for raising Trumpeters under Mute Swan (C. olor) foster parents had been developed. The purpose of this paper is to record our experiences in Ontario and describe the methods which we think should lead to success.

TECHNIQUES FOR ESTABLISHING TRUMPETER SWANS

A number of techniques have been used to establish populations of migratory birds. Some are suitable for use with Trumpeter Swans and some are not.

Stocking

A technique widely used for many species of game birds consists of hatching eggs in incubators and raising the young in brooders. Doty and Kruse (1972) reported the success of this technique with Wood Ducks (Aix sponsa) at the Arrowwood National Wildlife Refuge (NWR). However, with species which have a more elaborate social structure and develop strong family bonds, such as Canada Geese (Branta canadensis), this technique does not work as well. They often make poor parents and lose most of their goslings (Lumsden, pers. observ.), perhaps because they did not themselves experience normal brood care by their natural parents. We did not know if Trumpeter Swans raised in this way would behave in a similar manner. We released two Trumpeters on the Toronto waterfront which were hatched in an incubator and raised in a brooder, at Kortright Park, Guelph, Ontario. As yearlings they were placed in a pen at Ontario Place on 11 May 1983. They were fed the pelleted ration to which they were accustomed. They did not feed on submerged aquatic weeds for a month. When they were joined by a Trumpeter, foster-raised by Mute Swans in 1982 at Ontario Place, they quickly learned to eat pondweeds by tipping. On 21 August, the female was found with a broken wing and was recaptured for treatment. The male was released and ranged along the Toronto waterfront with his companion. They wintered successfully at Humber Park, feeding on algae (Cladophora sp.) and handouts of bread and grain from the public. In spring, the released male began attacking children and had to be retrapped and returned to Kortright Park.

All the Trumpeters raised at Kortright Park in incubators and brooders turned out to be exceptionally aggressive toward humans and would probably not be suitable subjects for release. There may be ways of adjusting the technique used at Kortright Park to produce less aggressive birds. More isolation from humans during raising may be necessary. Trumpeters raised in this way at Hennepin Parks were not unusually aggressive and adapted well to release (Weaver, pers. comm.).

Release of breeding stock

Captive Trumpeters raised by their own parents, or wild-caught birds which have been pinioned or wing-clipped, can be released into suitable range where adequate nesting and brood habitat exists. Their progeny can be allowed to fly free. Artificial feeding should not be done in summer. The birds should preferably be wintered on the same area, with the installation of an aerator or bubbler to provide open water, if necessary. They may need pelleted food and grain to sustain them through hard winter weather. Security from predators should also be provided.

The free-flying cygnets can be expected to pioneer into nearby marshes and eventually nest. This technique may provide the best quality birds for restoration. Unfortunately, shortage of adult stock precludes this approach, at this time, in Ontario.

Transplanting adult Trumpeters

Trapping, shipping, and release of wild Trumpeters is a possible restoration technique; however, migratory birds present problems not encountered with resident species.

We do not really know how adult Trumpeter Swans will behave if they are transplanted and released. Conventional wisdom suggests that they would try to return to their original home. However, this did not happen when three families of Trumpeters were moved from Lacreek NWR in South Dakota to Mingo NWR Missouri; survivors of these broods remained at Mingo and did not return to Lacreek, as hoped. A transplant on an experimental basis to find out if this is a usable restoration technique is needed.

Fostering under Mute Swans

We have a feral population of about 110-120 Mute Swans in Ontario. We want to remove them eventually and replace them with Trumpeters. Since 1982, we have been preventing recruitment by removing their eggs. The fostering technique involves placing Trumpeter eggs in Mute Swan nests for hatching and raising of the cygnets. It has advantages in that the cygnets grow up in a natural environment, learning to eat natural

foods and presumably learning how to cope with natural hazards. The quality of bird resulting from this approach is far superior to stocked, captive-raised birds, although perhaps not as high quality as cygnets raised by their natural parents.

There is one problem to which we have no answer, as yet. Will Trumpeters raised by Mute foster parents become sexually imprinted on Mute Swans and seek them as mates when they mature? Sexual imprinting takes place over a fairly long period of time during the brood period. It is stronger among siblings than it is with foster parents of a different species. Ideally, a fostered Trumpeter should be raised with siblings of its own species. However, this can not always be assured.

We have one Trumpeter male fostered by Mute Swans and raised with a Trumpeter sibling which is now 4 years old (spring 1986). Although there are many potential mates among Mute Swans on the waterfront, this bird shows no sign of courting them. This bird seems to dominate all the Mute Swans it encounters. Many more observations are needed before we can determine if sexual imprinting is a potential problem.

Breeder-loan arrangements

For success, the fostering approach will depend on an adequate supply of Trumpeter eggs. From 1984 to 1986, three aviculturists provided 26 eggs to the Ontario program. Others have promised eggs in the future. It may be possible to increase the number of eggs by placing captive pairs on a breeder-loan basis in zoos, parks, and with private breeders. Mature pairs can be placed with cooperators on condition that all or most of the eggs laid are donated for restoration. We are exploring this approach to production of Trumpeter eggs, and we have two cooperators willing to participate.

Egg collection from wild Trumpeters

Waterfowl eggs travel well if picked up in the last half of incubation. It may be difficult to judge the state of incubation of Trumpeter Swan eggs if the nests were not under adequate observation at the time of laying. Goose and duck eggs float in water about midway through incubation. Swan eggs do not behave in this way (Shandruk, pers. comm.).

To develop criteria for judging the state of incubation of swan eggs, we tested the buoyancy of 54 naturally incubated Mute Swan eggs in 10 clutches for which the dates of laying were known. The data are given in the following table with the number of eggs tested in parentheses.

Table 1. Buoyancy of Mute Swan eggs in water.

State of incubation	Behaviour of eggs
Day 8-18	All lie on the bottom with the air cell end tilted up (16)
Day 20-27	All sink, stand on point and tilt to one side (32)
Day 28-29	All sink and stand vertically on point (19)
Day 30-34	Stand vertically on point (4); float, diameter of meniscus 2-4 cm (22)
Day 35-36	Sink very slowly (1); float, tilt to one side, diameter of meniscus 3-4 cm (5)

The variation in the buoyancy of eggs after 30+ days of incubation may be due to variation in state of development of the embryos. Eggs within a Mute Swan clutch may hatch over a 24-48 hour period (Scott et al. 1972). Embryo development in some of the clutches examined here suggests that the hatching span may sometimes be as long as 60 hours. Developmental stage of embryos within a clutch was not correlated with order of laying.

Rotten eggs due to infertility or early embryonic death were usually not distinguishable from those containing live embryos by these buoyancy tests. They were, however, often detected by their smell and the ringing sound they emit when tapped with a pencil.

Tests with seven Trumpeter eggs in two clutches gave the following results:

Table 2. Buoyancy of Trumpeter Swan eggs in water.

State of incubation	Behaviour of eggs
Day 30	Float, tilt to one side, diameter of meniscus 4-6 cm (3)*
Day 31	Hatch (3)
Day 32	All sink, stand on point
Day 33	Sink (2); float, diameter of meniscus 0.0-0.5 (2)
Day 35	Hatch (4)

* Number of eggs tested in parentheses.

It therefore appears that, with allowance for a slightly shorter incubation period, Trumpeter Swan eggs have similar buoyancy characteristics to those of Mute Swans.

To ensure that Trumpeter eggs collected for restoration are picked up in the second half of incubation, they should be placed in a container of water and tested for buoyancy. If they stand on their points with little tilt, or float, they should contain embryos well enough developed to withstand shipment.

Two days before hatch, the embryos click, and, just before and during pipping, they utter a harsh squawking call which can be heard clearly when the egg is held to the ear. If the eggs are to be used for fostering under Mute Swans, it may be too late to pick them up if calling is heard (see section on family bonding). Pipped eggs may hatch during shipment and are best left in the nest.

All eggs picked up for shipment should be marked with a wick pen to identify those belonging to the same clutch. When placing eggs for fostering, it is important to ensure as synchronized a hatch as possible. If eggs from different clutches are placed together, the gap between hatching may cause premature desertion of late eggs by the female.

Shipment of Trumpeter eggs

Waterfowl eggs picked up in the last half of incubation do not need supplemental heat during shipment. Indeed, the embryos generate so much heat that, if many eggs are packed together, the centre ones may overheat and die. It is important to provide good ventilation, not only to carry away excess heat, but, also, to satisfy the great oxygen demands of the embryos' high metabolic rate.

A cheap styrofoam cooler, with slits cut in the sides, protected with a plywood or wooden frame, has served well in the past for shipments from Grande Prairie to Ontario.

It is very important that the eggs be packed point-end-down/air-cell-up for shipment. When packed lying flat the air cells may become detached or rupture as happened to the shipment we received in 1982.

Late embryonic death

Among the eggs shipped from Grande Prairie in 1982, we had one embryo which died at the pipping stage. When the egg was opened, the embryo was found to have resorbed the yolk sac completely and had scraped the membrane off part of the shell with the egg tooth. It apparently did not have the strength to pip the shell and hatch normally. At Kortright Park over the years, many Trumpeter, Tundra (C. columbianus), Mute, and other swan species have been hatched in incubators. This problem had not been previously encountered. There is a possibility that the cooling period during shipment of the Grande Prairie Trumpeter eggs, coming at a critical time of development of the hatching muscle, may have caused this problem.

Such cygnets may be saved with timely action. The air cell close to hatching is asymmetrical and extends slightly down one side of the egg. Candling can reveal its shape, and the outline can be drawn on the shell with a pencil. Close to pipping, the tip of the beak is located at the base of this air cell extention and slightly to the left.

In the field, where candling is not practical, the location of the air cell extention can be located, when the embryo is at the calling stage, by floating the egg in water. It will tilt slightly to one side. The beak of the embryo is located about one-quarter of the way down the length of the egg on that side.

Since 1982, we have star-cracked or made a small hole in two Trumpeter eggs when we suspected that the embryo was having trouble. In each case, the cygnet hatched a very short time later.

Synchronization of breeding cycle

Trumpeter Swans at Grande Prairie breed about 3 weeks later than Mute Swans in southern Ontario. In Ontario, we may see our first Mute eggs as early as 1 April and, in a late year, 11 April. To accommodate the late nesting date of Trumpeters, it may be necessary to extend the incubation of Mute Swans by giving them dummy eggs. We have records of incubation lasting 67 and 68 days on dummies before the bird finally deserted.

It is not desirable to prolong incubation much beyond the normal 36 days, although Trumpeter cygnets were successfully raised after 45 and 58 days of incubation. Females lose condition steadily throughout incubation and may not have the vigour to care for cygnets properly if the period is prolonged too much. Removing the first clutch and relying on the swans to renest and then using the second cycle for fostering is one way to synchronize breeding cycles with Trumpeters. If Mute Swan eggs are not picked up on the day the clutch is completed (day 1 of incubation), there is an average of 12 days plus 1 day delay to renesting for every 3.6 days of incubation. However, some years the birds seem to take longer to start their second clutch as Table 3 shows.

Table 3. Variation among years in interval to start of second clutch in Mute Swans.

Year	Sample size	Mean no. days of incubation	Interval (days) to beginning of second clutch
1983	5	8.0 (range 3-12)	15.4 range 12-19)
1984	10	7.5 (range 1-11)	17.7 (range 12-21)
1985	9	4.3 (range 1-9)	16.3 (range 15-19)
1986	7	3.4 (range 1-7)	17.6 (range 14-25)

There seems to be few data available on the delay to starting the second clutch from the date of collection of the first clutch for Trumpeter Swans. When the eggs of the first clutch were picked up after 2 days of incubation, one captive pair laid the first egg of the second clutch 16 days later.

Twelve days is the shortest interval we have seen in wild Mute Swans. It is unlikely ever to be much shorter than 12 days because it takes a Mute Swan 10-11 days to mature a yolk in the ovary, and the egg develops over at least 1 and probably 2 days in the oviduct before laying. When the first clutch is collected, the bird starts again building new yolks from the resting stage follicles and does not carry on with the extra enlarged follicles which may remain from the first clutch.

The ability or willingness of a pair of swans to lay a second clutch is hard to predict. Of 69 nestings of Mute Swans, from which the first clutch was removed within 12 days of completion, 67 percent laid a second clutch (range 58 percent in 1983 - 74 percent in 1985). These data may give us some idea what to expect when double clutching Trumpeters.

Incubation by Mute Swans does not have to run 36 days to evoke proper brood care. They provided normal brood care to Trumpeters after only 16, 17, 24, and 28 days of incubation.

We have used dummy eggs for a variety of experiments with Mute Swans. We make these by cutting a hole in the side of the egg, extracting the contents, and filling it with a mixture of styrofoam pellets and cement. Mute Swans will desert pure cement dummy eggs, probably because they are too heavy.

Family bonding

Clicking and calling by embryos just before hatch functions to establish family bonds. When an embryo calls, the incubating female answers with a call similar to that she will use later which we can name the "follow me" call. Thus, the female is prepared for the appearance of the cygnets, and the cygnet may even learn to recognize "mother" before it hatches. At this stage of the hatch process, some males stand on the nest beside the female and may also be influenced by the calling embryo.

The pre-hatching call of a Trumpeter embryo differs from that of a Mute embryo. Trumpeters utter a long, drawn-out squawk, while Mute embryos give a "vee vee vee" call, similar to that uttered by Canada Geese. We could not detect that this difference in call had any effect on Mute foster mothers.

When we placed pipping Trumpeter eggs, a few hours before hatch, in Mute Swan nests, we saw very weak family bonds when they left the nest. The cygnets were overly independent, often feeding 100 m or more away from the female. Sometimes they followed swans which were not their foster parents. When the full "conditioning period," from clicking to hatch, was spent under a foster parent, we saw tight family bonds and behaviour which did not differ from that which we saw in normal Mute Swan broods.

There is a temptation to incubate Trumpeter eggs in an incubator where they are safe, rather than expose them to the full incubation period under a Mute Swan with the hazards of the natural environment. There is much to be said for this approach. We lost one clutch of valuable Trumpeter eggs to a predator which we might have avoided by artificial incubation. It is, however, important that all of the final phase of incubation and hatching, at least 3 days, be spent under the foster parents.

Brooding behaviour

Mute, Black-necked (C. melanocoryphus), and Australian Black Swans (C. atratus) are reported to brood their cygnets on their backs (Scott et al. 1972). The parent gives the cygnet a leg up by extending the tarsus. Trumpeters very rarely brood their cygnets on their backs. At the Wildfowl Trust in England, fostering Trumpeters on Australian Black Swans failed because the cygnets chilled and died when the foster parents failed to take them ashore to brood (Mathews, pers. comm.). The Mute foster parents in Ontario have always taken their Trumpeter cygnets ashore to brood them. Only one female Mute was seen with a Trumpeter cygnet on her back for three brief periods.

Reciprocal experiments, fostering Mute cygnets on a pair of Trumpeters, were tried in 1985 and 1986. The Mute cygnets sometimes tried to climb onto their foster mother's back but were unable to do so because of lack of cooperation from the female Trumpeter.

There may be variation in the behaviour of different stocks of Mute Swans. Some may be more prone than others to brood their cygnets on their backs. Chilling of cygnets because the fostering Mutes failed to take them ashore, however, was not a problem in Ontario.

Colour of cygnets

We have adequate observations on four broods of Trumpeters fostered under Mute Swans between 1982 and 1984. In each case, we saw aggression by the male directed at the cygnets when they first left the nest. In two cases, the foster father pecked at the cygnets without actually touching them. In the other two cases, the attacks were serious and resulted in roughing up of the cygnets.

Mute Swans have two colour phases. The "Royal" hatches as a pale brown cygnet and as an adult has black legs and feet. The "Polish" phase, a sex-linked recessive (Munro et al. 1968), is almost white at hatching with a faint cinnamon tinge on its dorsal surface. As an adult, it has dusty pink feet.

Male Mute Swans have been recorded killing their own "Polish" phase cygnets and have even attacked their own mates on their territories when they failed to recognize them. Norman (1978) tested territorial Mute Swans with brown and white dummies and confirmed that territorial Mute Swans reacted much more aggressively toward the white dummies. Trumpeter cygnets are almost white when they hatch, and their colour may have evoked the aggression we witnessed.

In 1985, we dyed three cygnets brown before they left the nest. The foster father showed no aggression toward them when they left the nest. In 1986, all but one of 10 cygnets were dyed brown before they left the nest. We have adequate observations on two of three broods and saw no evidence of aggression. Dyeing cygnets before they leave the nest seems to solve the problem of aggression by the foster father.

We use diluted Nyanzol D dye and paint it with a brush on the dorsal surface of the cygnet. It is available from J. Belmar Inc., P. O. Box 145, 200 Sutton Street, North Andover, Mass. 01845 (617/683-8726).

Marking swans

Any restoration program must have an adequate marking system to follow movements of swans. Because of icing problems and objections from the public to collars, we have chosen to mark our Trumpeter and Mute Swans with patagial tags. These are large cattle ear tags with a two-digit system, black numerals on yellow. It is important to have the digits marked on both sides of the tag. Experience over a 3-year period suggests that the ink used tends to wear off. It must be applied heavily when the tag is prepared for use.

These tags are not as conspicious as collars; however, they seem to do the job. When two of our Trumpeters migrated to Chesapeake Bay, the tags were noted and reported.

Predation

We have no Bald Eagles (Haliaeetus leucocephalus) near Cranberry Marsh and have no evidence of avian predation on Trumpeter cygnets.

We lost one clutch of three Trumpeter Swan eggs to a predator, possibly a raccoon (Procyon lotor). This is surprising because we have had about 25 wild Mute Swan nests under observation annually since 1983 and have no records of loss of this kind, although we suspect theft of eggs by humans in a few cases. The fostering Mute pair in this case were good parents and successfully hatched and raised Trumpeters in 1983 and 1984. Normally, Mute Swan nests are very well guarded. When the female leaves for a feeding recess, the male often stands or sits on the nest until she returns.

We suspect that snapping turtles (Chelydra serpentina) are serious predators of Trumpeter cygnets. In Cranberry Marsh, we have successfully fledged four cygnets but have lost 10. Two of these we know were taken by snapping turtles, two more were found being eaten by turtles. The rest disappeared without a trace. In 1985, we removed 27 snapping turtles from Cranberry Marsh. In 1986, 59 were trapped and released elsewhere.

In 1986, seven Trumpeter cygnets left the nest in three broods. To date, we have lost only two. These disappeared without a trace and also may have been taken by turtles. However, one cygnet was deserted by its foster parents at 4 weeks of age and disappeared at about 7 weeks of age. This desertion may have contributed to its death.

Snapping turtles prey on Mute cygnets in Rhode Island and may be the most important predator there (Willey 1968). Four Mute Swan pairs successfully raised 15 cygnets and lost at least nine in Cranberry and nearby marshes in 1983-86. These data are too few to determine whether Trumpeter cygnets are more vulnerable to turtle attack than Mute cygnets.

Time and effort for successful restoration

It is becoming increasingly clear that the quotas on eggs taken from wild populations of Trumpeter Swans will limit the extent of restoration efforts. Demand is high. Three states and two provinces are planning, or have started, restoration programs. The costs of restoration are high, and it is hard to justify the expense if only 10-20 eggs are available annually for a project.

Due to relatively low survival rates (Page 1976) and slow maturation of Trumpeters, large numbers of eggs are needed if a program is to be completed in less than 20 years. It is clear that eggs from captive Trumpeters will be needed if the demand is to be satisfied.

Turner (1981) developed a model for the Grande Prairie population of Trumpeters. He used 86 percent for hatching success, 60 percent survival of cygnets to flight stage, 43 percent survival to 1 year old, 71 percent survival to 2 years old, and 82 percent annual survival thereafter (see Table 4 for Ontario statistics).

Table 4. Trumpeter Swan restoration program in Ontario.

	1982	1983	1984	1985	1986	Total
Eggs used	2	6	12	7	17	44
Eggs failed to hatch	0	0	2	1	5	8
Eggs preyed on	0	0	0	3	0	3
Eggs hatched	2	6	10	3	12	33
Cygnets died on the nest	0	0	2	0	5	7
Cygnets disappeared	0	4	6	3	2	15
Cygnets fledged	2	2	2	0	5	11

At a rate of 50 eggs per year, these survival rates suggest that there might be an average 11 Trumpeters still alive at the beginning of year 2. At year 5, there might be 30 swans present, of which five birds could be of breeding age (4 years old). By year 10, there could be 46 Trumpeters, of which 21 could be breeders.

To reach a target of 15 wild-breeding pairs for a self-sustaining population, 12 years of effort and 600 eggs might be needed.

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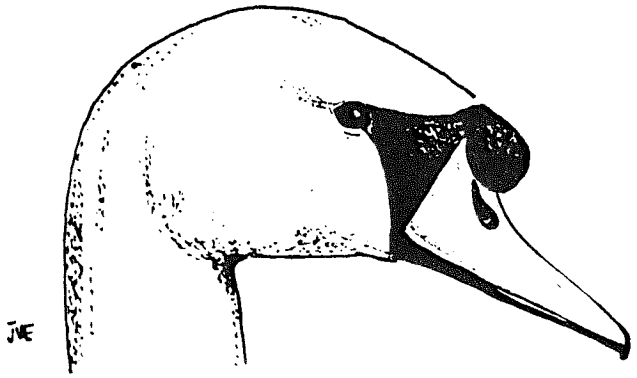
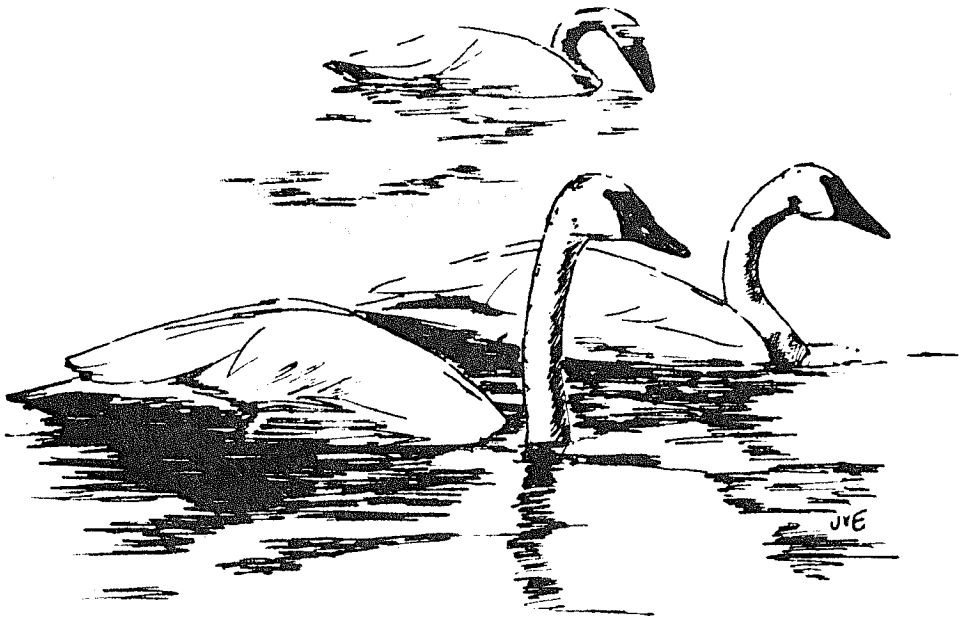


Mute Swan
(Cygnus olor)

1985 SURVEY OF TRUMPETER SWANS



NEW GOALS FOR THE SECOND HALF CENTURY OF TRUMPETER SWAN RESTORATION

James G. King, Retired Pilot-Biologist, U. S. Fish and Wildlife Service

(The paper as read at the 10th Trumpeter Swan Society Conference is presented here. Ideas and comments generated subsequently are inserted in parentheses.)

Reports of the remarkable recovery of the Trumpeter Swan (Cygnus buccinator) are grossly exaggerated. Trumpeters are still extinct in five Canadian provinces and 33 states where once they were part of the avifauna. Except for Alaska and British Columbia, they survive only as remnants or as struggling introductions. It is time now to reexamine our goals and our conservation methods to see if, in fact, we can help the Trumpeter recover its former abundance.

Wildlife managers still have not demonstrated that they have any substantial control over how wild swan populations increase or decline. A much larger population is needed to ensure safety of the species and provide maximum benefits to man. With that in mind, the following objectives and tasks are presented for your own review.

(A good deal more thought and debate is needed before agreement on long-range goals is achieved. This document can be considered a continuing exercise for the presentation and testing of ideas. An update can be expected at the 11th Conference, so if you have pet items you want considered, let me know.)

RANGEWIDE

Objective 1: To manage Trumpeter Swans so that the species never again becomes either threatened or endangered.

Objective 2: To restore a free-flying population of wild Trumpeters in every state and province of their former range.

Objective 3: To develop methods for relocating or removing eggs, cygnets, subadults, or pairs in such a way that the productivity of the collecting area is not reduced.

Objective 4: To increase the size of the population to the point that it can provide hunting recreations. (The idea of hunting Trumpeters is uniformly offensive to Society members, in spite of the surprising number who confessed to having eaten swan when queried by Beth Sheehan. Perhaps a more acceptable goal would be having sufficient Trumpeters so that the fear of accidentally shooting some can no longer be used by hunters as an excuse for objecting to restoration projects.)

Objective 5: To encourage the use of natural food sources by the swans except where hand feeding can be used to develop showcase sites near big cities. (There is an inherent distaste for encouraging wild swans to become dependent on handouts. We must, however, consider that if we want Trumpeters to regain substantial numbers, occupying valuable land and consuming valuable resources in a people-glutted world, they must provide something in return. High visibility, flying shows, social interaction, family activity, and photographic opportunities may be some of those benefits. In England and Japan, nationwide attention has been focused on wild swans by winter feeding at appropriate public viewing sites. Proper screening can provide separation of people and birds and prevent loss of wildness.)

Objective 6: To learn to create Trumpeter habitat. (If we can not find suitable winter habitat in the "sunbelt" states, we should create it.)

Objective 7: To educate the public to the needs of swans.

Objective 8: (To lay the taxonomy question to rest through use of mitochondrial DNA or other new tests. There is a strong feeling that natural races should not be mixed accidentally or inadvertently before we understand what we are doing. Hank Hansen put it this way, "The many races of Canada Geese have frequently been so bastardized, but seldom to their benefit and never to man's credit. Let's not make the same mistake with Trumpeters."

Task A: Establish an international, scientific review committee to evaluate projects dealing with Trumpeter population manipulations. (We already have such a committee. The waterfowl Flyway Councils have been given authority to evaluate and set priorities for Trumpeter reintroductions. The Trumpeter Swan Society (TTSS) has members on the Technical Committees of the Councils. An arrangement should be made so that the TSS committee gets proposals in time to advise the Councils of their views.)

Task B: Write a status report on Trumpeter Swans for each state and province to include:
1) An historical review of museum and literature records;
2) An inventory of possible wintering habitat;
3) An inventory of possible nesting habitat; and
4) A review of the potential for restoration.

This report to be the basis for local management plans and restoration projects. (King and McKelvey have begun working on a mailed questionnaire, as well as other plans to accomplish this.)

Task C: Establish a Trumpeter Swan research laboratory with field stations as appropriate to determine:
1) Factors causing population increases and declines;
2) Ways to protect swans from accidents at power lines and other structures;
3) Requirements for nesting habitat and methods for creating it;
4) Requirements for winter habitat and methods for creating it; and
5) Methods for raising Trumpeters to be placed in big city parks to replace Mute Swans (C. olor).

(Rolf Kraft and others feel that making park birds out of Trumpeters would be degrading.) (A Trumpeter Swan research institute at an appropriate university was suggested. Minnesota? British Columbia? Alaska? Ontario? Washington? Alberta? South Dakota? Yukon? Missouri? NWT? Anybody out there interested?) (Intense behavioral studies are needed to ensure that in our restoration efforts we never expect swans to do things that they cannot do and that we take full advantage of the things they are inclined to do.)

Task D: Restore wild, nesting, or wintering Trumpeter flocks near population centers throughout their historic range for the benefit of a maximum number of people.

Task E: Build wintering refuges in desired wintering areas. (The use of grasslands and grains as well as aquatics needs to be evaluated.)

Task F: Develop interpretive and educational materials to help people better understand the value of having swans as part of our native fauna and the needs of the swans.

Task G: Develop interpretive, educational, and observation facilities at refuges and parks where swans can be seen under seminatural conditions.

Task H: Establish wintering Trumpeters in areas where Mute Swans now occupy traditional Trumpeter habitat.

Task I: Use proper scientific design and proper scientific reporting for any manipulation or moving of Trumpeters. Existing populations from which swans are removed should be as carefully monitored as the transplanted populations. Scientific reporting for unsuccessful projects should not be neglected. (There is a possibility that techniques can be perfected that will allow removal of some eggs or young without significantly reducing productivity of the donor stock.)

Task J: (Promote a treaty among Canada, United States, and Mexico, establishing the Trumpeter Swan as the Official North American Bird, symbol of our ideals of purity, strength, beauty, family fidelity, and our dedication to conservation of the wildlife resources we share.)

Task K: (Establish a propagation center where production of eggs for reintroductions can be maximized, using techniques outlined by Harry Lumsden. This might be part of the research institute mentioned earlier.)

Task L: (Maintain a computerized Trumpeter Swan bibliography, always current and available to researchers.)

Task M: (Complete various Trumpeter Swan books such as the scientific monograph and a popular work. A fascinating story has been unfolded by 20 years of TTSS newsletters and meeting proceedings that could be summarized and illustrated with photos donated by the membership to make a valuable publication.)

Task N: (Conant and Hodges suggest perfecting a continent-wide survey system with a computerized data bank that can be used to coordinate complete censuses every 5th year, with intermittent sampling as appropriate. The system would document the restoration of Trumpeters during the next 50 years and make progress reporting easy and graphic.)

Task O: (SCREAM BLOODY MURDER ABOUT THE USE OF LEAD SHOT ANYWHERE THAT SWANS MIGHT GET IT.)

PACIFIC COAST POPULATION (PCP)

Objective 1: To encourage the population to reach a minimum of 50,000 birds and not allow it to decline below that figure. (This could be achieved in about 20 years if the recent increase rate can be sustained.)

Task A: Complete and implement a management plan for Alaska that will ensure that Trumpeters remain a viable part of the avifauna of each major valley where they now nest, no matter how high the human population goes.

Task B: Continue to census the Alaska summer population at least once every 5 years and maintain computerized records.

Task C: Write a winter management plan for British Columbia, Washington, and Oregon.

Task D: Access the habitat available for wintering swans in the northwest, looking for areas near cities that could be acquired or developed for wintering swans.

Task E: (Develop accessible viewing places for swans along Alaska's road system.)

ROCKY MOUNTAIN POPULATION (RMP)

Objective 1: To develop a population of at least 10,000 birds.

Objective 2: To maintain the Montana/Wyoming/Idaho summer population at or above the 1985 level of about 1000.

Task A: Locate or build new wintering areas in the southern Rockies and establish migration to them from the Tristate area.

Task B: Encourage southern wintering birds to pioneer new nesting areas in the Rocky Mountain valleys.

Task C: Develop new wintering traditions for the Peace River subpopulation to either the southern Rockies or the Pacific coast.

INTERIOR POPULATION (IP)

Objective 1: To reach and maintain a population of at least 100,000 wild Trumpeters east of the Rockies. (Burgess and Weaver find this objective unrealistically high. Lumsden (1984) likes it because it fits with his conservative estimate of the former population of 130,000 Trumpeters east of the Rockies in Canada.)

Task A: Establish a number of wintering Trumpeter flocks in the lower Mississippi and Gulf states.

Task B: Establish high visibility flocks near big cities.

Task C: Create suitable winter habitat in appropriate places where none exists today.

ATLANTIC COAST POPULATION (ACP)

Objective 1: To establish a nesting population of 10,000 birds in the Maritime Provinces and New England States to winter on the Atlantic coast.

Task A: Replace existing Mute Swan populations with Trumpeters.

If we can espouse these objectives and address these tasks, the second 50 years of Trumpeter Swan restoration will be an unqualified success.

Thanks to those who took the time to give me their thoughts on some of these matters. I look forward to receiving more.

LITERATURE CITED

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ALASKA TRUMPETER SWAN STATUS REPORT - 1985

Bruce Conant, Pilot-Biologist, U. S. Fish and Wildlife Service
John I. Hodges, Wildlife Biologist, U. S. Fish and Wildlife Service
James G. King, Retired Pilot-Biologist, U. S. Fish and Wildlife Service
Steve L. Cain, Biolgical Technician, U. S. Fish and Wildlife Service

ABSTRACT

The fourth complete census of Trumpeter Swans (Cygnus buccinator) on their Alaska summering grounds was completed in 1985. This year 375 hours of flight time was expended by three survey crews to fly 32,306 statute miles of survey tracks over all the potential swan habitat depicted on 425 USGS, 1:63,360 scale maps. Compared to 1980, the population was comprised of: paired birds 5120 (+54 percent); singles 449 (+166 percent); flocked birds 2204 (+25 percent); total white swans 7773 (+48 percent); cygnets 1686 (-31 percent); and total swans 9459 (+23 percent). Cygnets accounted for 18 percent of the population (32 percent in 1980), and 588 broods (-14 percent) were found with an average brood size of 2.9 (3.6 in 1980). Although Trumpeters summering in Alaska continue to increase at an exponential rate, a comprehensive Alaska Trumpeter Swan Management Plan is needed to ensure they remain an integral part of each geographical unit of their present distribution. A combined program of complete censuses every 5 years and random sampling for interim years is recommended for the proper management of this magnificent international resource.

INTRODUCTION

Complete censuses of Trumpeter Swan (Cygnus buccinator) summer populations in Alaska were conducted by the U. S. Fish and Wildlife Service (USFWS) in 1968, 1975, and 1980 (Hansen et al. 1971, King 1976, King and Conant 1981). Because of the continued increase in the summer population, three survey crews and aircraft were needed to complete the 1985 census. A total of 375 hours of flight time was expended to fly 32,306 statute miles of survey tracks over all the potential swan habitat. The survey was initiated on 31 July and terminated on 9 September. The primary survey aircraft used were a specially modified turbine powered DeHavilland Beaver, a Cessna 185, and a Cessna 206, all on amphibious floats. An integrated computer system was developed to enter all attribute data, digitize the latitude and longitude of each observation, and store all information for easy retrieval. Various map overlays and summaries of all Trumpeter survey data are available upon request from the Alaska Regional Office of the USFWS in Anchorage, Alaska.

ACKNOWLEDGEMENTS

Five USFWS pilot-biologists did almost all the flying and shared some of the observer duties. These were Bruce Conant, John I. Hodges, James G. King, William I. Butler, and Rodney J. King. Steven L. Cain served as primary observer on one crew and did all of the digitizing of map data. Hodges and Cain developed the necessary computer software. Additional survey help was provided in the Tetlin area by Dave Stearns, Steve Bresser, and Dave Sowards of the Tetlin National Wildlife Refuge. James L. Baker, Richard S. Pospahala, Mary Hogan, Dave Stearns, Phil Feiger, Mike Nunn (USFWS), and Keith Giezentanner (U. S. Forest Service) provided logistical support. Hogan also participated as an observer. William Brooks supervises the USFWS Information Resources Management Division, the primary swan data bank.

SURVEY AREAS

A total of 425 USGS quadrangle maps were censused in 11 delineated Trumpeter Swan nesting areas in Alaska (Figure 1). Most of these 11 units were separated on the basis of significant geographical features such as drainages and mountain ranges. All of the Tanana River drainage was formally included in the Fairbanks Unit (Unit 6). However, because of recent expansion of the upper drainage population, this year all swan data from this drainage was divided into two units, the Upper Tanana (Unit 11) and the Lower Tanana (Unit 6).

METHODS

The aerial survey technique used was described by King (1973). Small aircraft were used to put observers over all known or suspected Trumpeter Swan summer habitat. Observations were made and recorded on 1:63,360 scale (1 inch = 1 mile) USGS maps. Generally, a system of parallel tracks were flown within each quadrangle map at an altitude of 500-600 feet above ground. Pilot-biologists were responsible for navigation, ensuring that all habitat was adequately surveyed, and finding all swans. Consideration was given to factors such as sun glare and observer experience. The primary observer was responsible for tracking the flight path on the maps, making swan observations, and recording them by type, number, and precise location. Secondary observers, when available, were used to increase the "eye power" from the moving platform.

As the survey progressed, swan attribute data from completed maps were entered directly into portable Epson HX-20 computers in the field. The exact latitude and longitude of each sighting was determined later from original survey maps with a Tektronix digitizing system in Juneau. These coordinates were then merged with the attribute data from the Epson computers. The combined data was stored in the Tektronix system and later transferred to a Data General MV 8000 computer in Anchorage, which serves as the primary data storage bank for all Trumpeter census data for Alaska. Transparent map overlays, points on computer-generated maps of any scale (Figure 1), tabular summaries, and computer-drawn graphs are examples of products that can be easily produced.

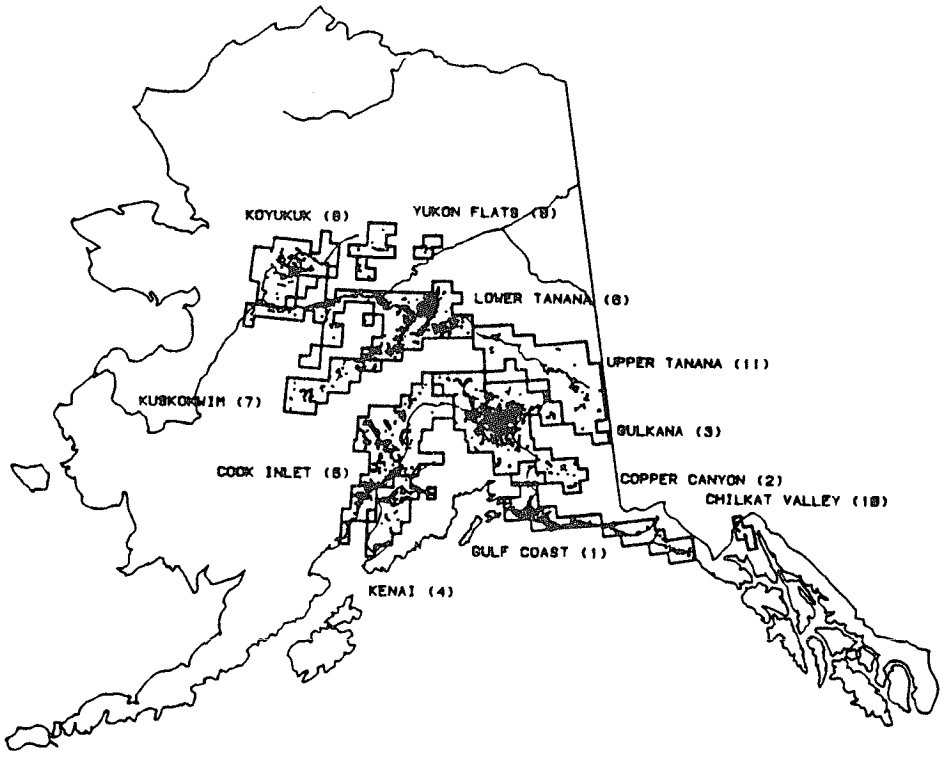

Figure 1. Trumpeter Swan summering areas in Alaska and USGS maps censused in 1985 (each dot represents an actual swan observation).

RESULTS

The 4 years of complete Statewide Trumpeter surveys show how the population has increased (Figure 2, Table 1). The subtotal for white swans (birds more than 1 year old) best measures this growth.

Expansion of range into the peripheral habitat (Units 7 through 11) is shown in Table 1. The annual production for 1985 was proportionally lower than for the other 3 years as indicated by percent juvenile (Table 1), average brood size, and percent of pairs with broods (Table 2).

Trumpeter Swan production summarized for the 4 years, as measured in late summer, also shows the drop in production for 1985 (Table 2). The number of cygnets (Table 1) and broods (Table 2) were both reduced from 1980.

The trend in numbers of white swans recorded for the four Statewide counts varies by unit (Figure 3). Expansion of swan range into peripheral habitat is shown by the increase in maps surveyed for units 3, 5, 8, and 11. Increases in swan density since 1975 is demonstrated by the increase in white swans recorded for units 1, 3, 5, and 6.

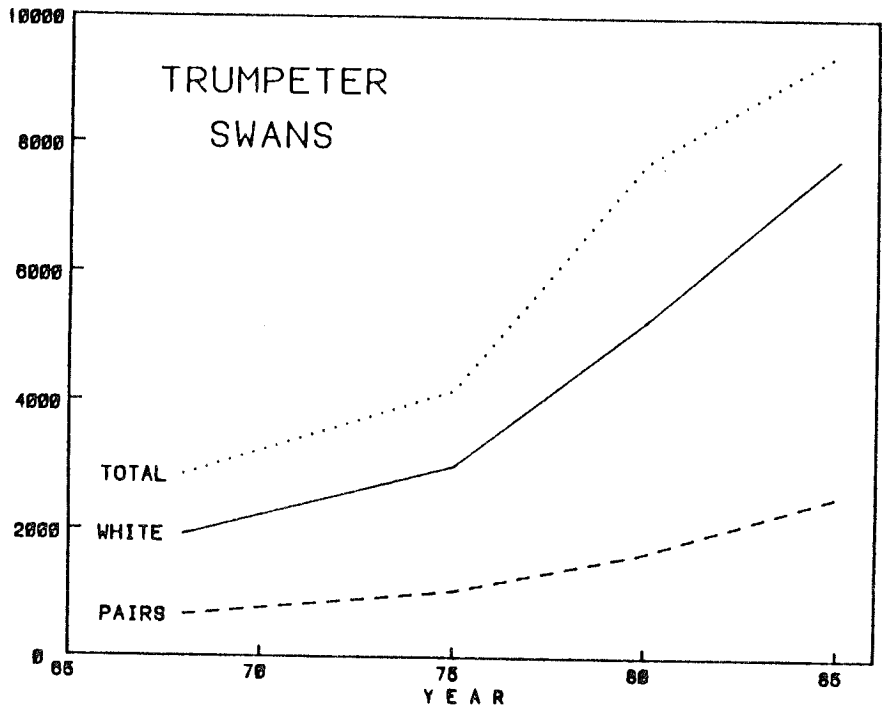

Figure 2. Trumpeter Swans recorded on Alaska Statewide summer censuses for 1968, 1975, 1980, and 1985.

DISCUSSION

The Alaska summer population of Trumpeter Swans continues to increase at an exponential rate. This is best reflected by the increase in white swans recorded since 1968 (Figure 4). This was anticipated from results of sample surveys flown 1981-84 (Conant et al. 1984). Production was significantly reduced in 1985, primarily because of the late spring and retarded phenology (Conant and Hodges 1985). That factor accounts for total swans not following the same rate of increase as white swans.

Obviously, this rate of increase cannot be sustained indefinitely, but it is not now apparent when the total summer population will begin to level off. For the Copper Canyon (Unit 2) and Kenai (Unit 4) areas, the habitat appears to be saturated. For others, variable rates of increase have occurred (Figure 3). There appears to be a large (10,000 square miles) amount of summer habitat available in the Yukon Flats (Unit 9) which is nearly devoid of swans. The density of swan use in the apparent best habitat is increasing. Additional higher altitude, peripheral habitat is being pioneered noticeably in the Gulkana (Unit 3) and Upper Tanana (Unit 11) areas. If the earth (and particularly Alaska) is indeed warming as some suggest, more habitat may become available, and the increase may be sustained for some unknown period of time. Past or future limiting factors are not readily apparent. Planned additional analyses of these data for adequacy of each survey coverage and population modeling for survival rates may increase our understanding.

A factor which could slow or ultimately reverse the present trend is the exclusion of swans from good habitat by human appropriation and disturbance. This obviously has happened to some of the swan habitat in the Cook Inlet (Unit 5) area. Swans are being displaced from good lake and pond habitat because of recreational use (Timm and Wajeck 1978). However, they are continuing to increase due to their ability to utilize beaver ponds and marshy areas not yet selected by people. As the human population in Alaska also increases and becomes more mobile, this type of swan habitat loss will accelerate. A comprehensive Trumpeter Swan Management Plan is needed now for Alaska. Trumpeters should be allowed to flourish and remain an integral part of the avifauna of each geographical unit of their present distribution.

Although the amount of area surveyed within the Trumpeter summer habitat continues to increase (number of maps surveyed: 1968 - 177; 1975 - 278; 1980 - 306; 1985 - 425), that factor is not the primary reason for the increase in swan numbers recorded. Personnel conducting Statewide swan surveys have, over the years, been involved with other detailed waterfowl surveys and, hence, aware of any significant expansion of the summer swan population. The main factors responsible for the increase were the increase in density on the previously surveyed high-quality habitat, and the expansion of swan range into peripheral habitat. Although the rate of increase was surprising, the pattern of expansion of habitat use was expected. It resulted from a rapidly increasing population (Figures 2 & 4), the consequence of a number of recent years of good production.

Table 1. Summary of Alaska summer Trumpeter Swan observations for 1968, 1975, 1980, and 1985.

Unit	Year	Number of obs.	Adults and subadults: in pairs	as singles	in flocks	subtotal	Cygnets	Percent juvenile	Total swans
1 Gulf Coast	68	264	442	29	191	662	363	35	1025
	75	276	442	32	190	664	193	23	857
	80	387	586	52	266	904	351	28	1255
	85	520	778	76	440	1294	164	11	1458
2 Copper River	68	35	56	5	53	114	44	28	158
	75	32	56	2	72	130	49	27	179
	80	43	70	4	33	107	33	24	140
	85	54	74	8	108	190	11	5	201
3 Gulkana	68	198	288	31	81	400	190	32	590
	75	355	556	43	155	754	284	27	1038
	80	622	1026	42	632	1700	660	28	2360
	85	1111	1736	143	595	2474	533	18	3007
4 Kenai	68	53	86	3	27	116	65	36	181
	75	50	72	5	29	106	39	27	145
	80	59	90	12	8	110	65	37	175
	85	59	92	5	40	137	51	27	188
5 Cook Inlet	68	143	224	19	50	293	124	30	417
	75	220	340	36	60	436	181	29	617
	80	373	608	38	186	832	369	31	1201
	85	524	800	66	454	1320	241	15	1561
6 Lower Tanana (Fairbanks)	68	146	224	21	94	339	137	29	476
	75	317	518	21	185	724	388	35	1112
	80	444	746	16	585	1347	773	36	2120
	85	770	1202	113	426	1741	503	22	2244
7 Kuskokwim (McGrath)	68								
	75	17	20	6	4	30	7	19	37
	80	35	60	0	22	82	63	43	145
	85	73	122	0	62	184	55	23	239
8 Koyukuk	68								
	75	60	94	6	45	145	35	19	180
	80	70	124	4	27	155	104	40	259
	85	132	206	23	29	258	45	15	303
9 Yukon Flats (Ft. Yukon)	68								
	75	1	2	0	0	2	1	33	3
	80	1	2	0	0	2	4	67	6
	85	5	10	0	0	10	3	23	13
10 Chilkat Valley (Haines)	68								
	75	1	2	0	0	2	0	–	2
	80	4	6	0	3	9	11	55	20
	85	11	16	1	7	24	16	40	40
11 Upper Tanana (Fairbanks)	68								
	75								
	80	5	6	1	4	11	4	27	15
	85	68	84	14	43	141	64	31	205
Totals	68	839	1320	108	496	1924	923	32	2847
	75	1329	2102	151	740	2993	1177	28	4170
	80	2043	3324	169	1766	5259	2437	32	7696
	85	3327	5120	449	2204	7773	1686	18	9459

Table 2. Summary of Alaska summer Trumpeter Swan production for 1968, 1975, 1980, and 1985.

Unit	Year	Number of adults and subadults in pairs with broods	Number of adults and subadults in pairs without broods	Number of adults and subadults as singles with broods	Number of adults and subadults as singles without broods	Number of broods	Average brood size	Percent pairs with broods
1 Gulf Coast	68	182	260	0	29	93*	3.9	41
	75	122	320	0	32	61	3.2	27
	80	194	392	2	50	99	3.6	33
	85	112	666	1	75	57	2.9	14
2 Copper River	68	22	34	2	3	13	3.4	39
	75	32	24	0	2	16	3.1	57
	80	20	50	0	4	10	3.3	29
	85	6	68	0	8	3	3.7	8
3 Gulkana	68	104	184	0	31	52	3.7	36
	75	182	374	2	41	93	3.1	33
	80	376	650	5	37	194**	3.4	36
	85	382	1354	0	143	191	2.8	22
4 Kenai	68	42	44	0	3	21	3.1	49
	75	30	42	0	5	15	2.6	42
	80	38	52	0	12	19	3.4	42
	85	32	60	0	5	16	3.2	35
5 Cook Inlet	68	66	158	3	16	36	3.4	29
	75	120	220	1	35	61	3.0	36
	80	204	404	1	37	103	3.6	34
	85	166	634	1	65	85**	2.8	21
6 Lower Tanana (Fairbanks)	68	74	150	5	16	42	3.3	33
	75	220	298	1	20	112**	3.5	42
	80	402	344	0	16	202**	3.8	54
	85	350	852	4	109	179	2.8	29
7 Kuskokwim (McGrath)	68							
	75	6	14	0	6	3	2.3	30
	80	32	28	0	0	16	3.9	53
	85	36	86	0	0	18	3.1	30
8 Koyukuk	68							
	75	32	62	0	6	16	2.2	34
	80	68	56	2	2	36	2.9	55
	85	26	180	3	20	16	2.8	13
9 Yukon Flats (Ft. Yukon)	68							
	75	2	0	0	0	1	1.0	100
	80	2	0	0	0	1	4.0	100
	85	2	8	0	0	1	0	20
10 Chilkat Valley (Haines)	68							
	75	0	2	0	0	0	–	–
	80	4	2	0	0	2	5.5	67
	85	6	10	0	1	3	5.3	38
11 Upper Tanana (Fairbanks)	68							
	75							
	80	2	4	0	1	1	4.0	33
	85	38	46	0	14	19	3.4	45
Totals	68	490	830	10	98	257	3.6	37
	75	746	1356	4	147	378	3.1	35
	80	1342	1982	10	159	683	3.6	40
	85	1156	3964	9	440	588	2.9	23
4-year average							3.3	34

* Two broods without adults present
** One brood without adults present

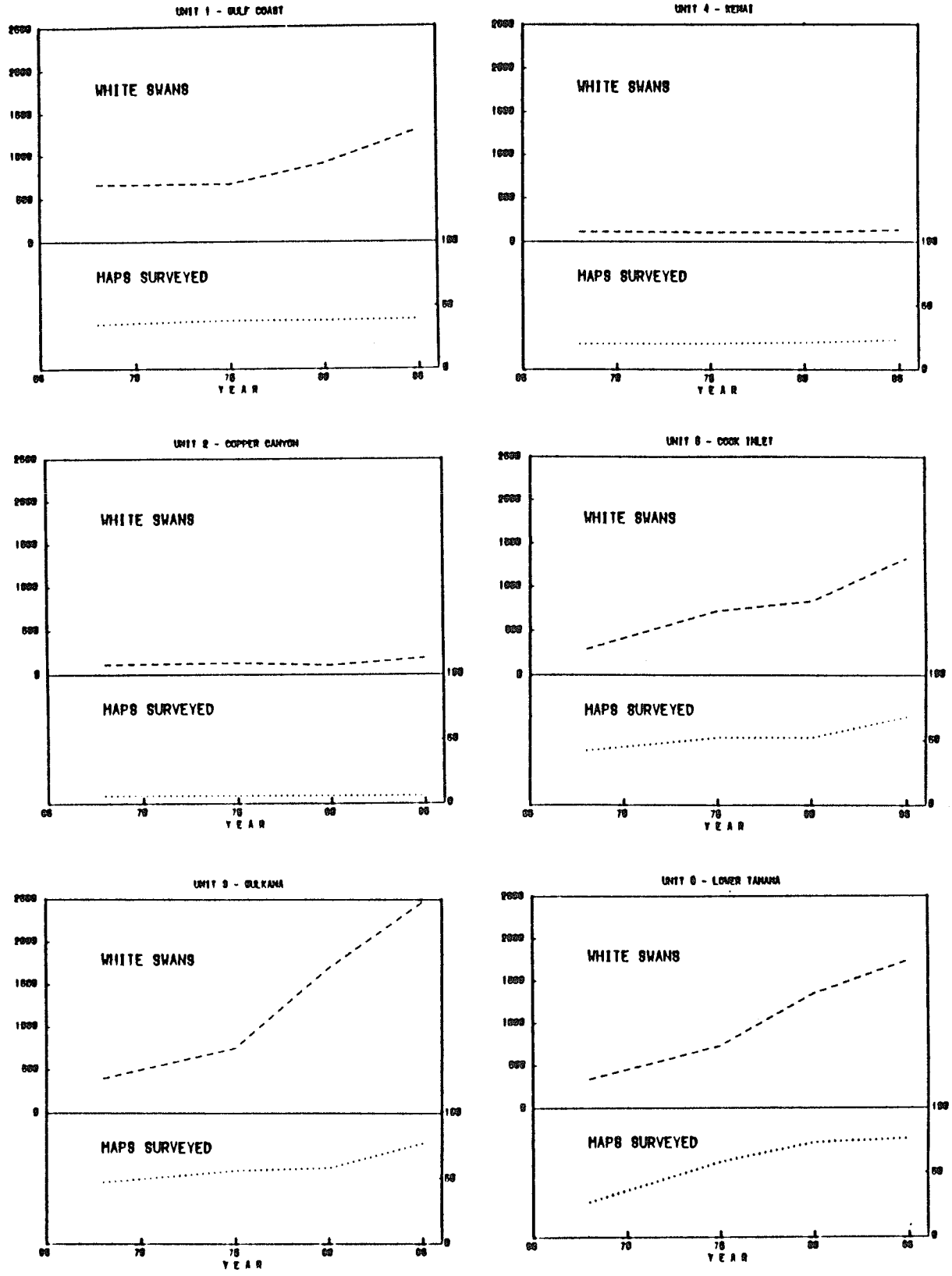

Figure 3. Numbers of white swans recorded on Alaskan Statewide summer censuses compared to the number of maps surveyed by unit for 1968, 1975, 1980, and 1985.

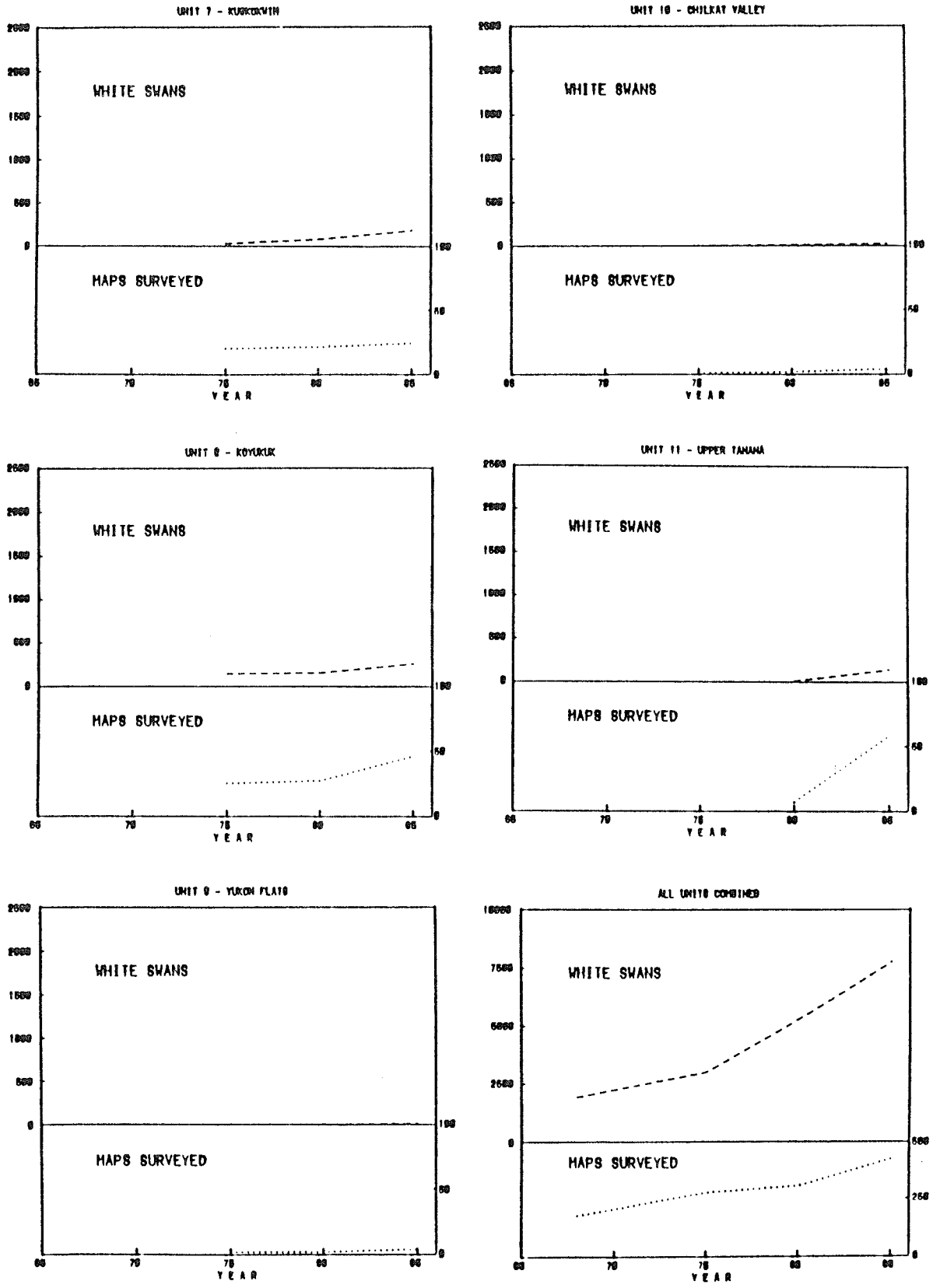

Figure 3. (continued)

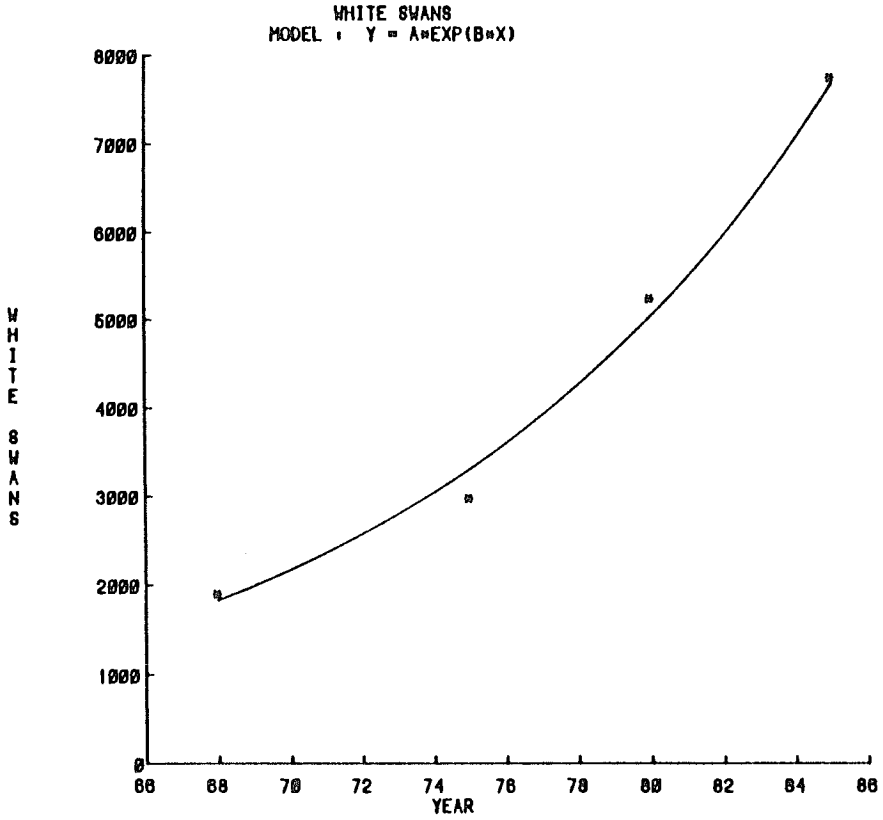

Figure 4. Exponential growth of number of white Trumpeter Swans recorded on Alaska Statewide summer censuses 1968, 1975, 1980, and 1985.

Alaska hosts nesting populations of both Trumpeter and Tundra Swans (C. columbianus) during the summer. The Trumpeter Swan census is based on type of habitat. All swans sighted on the survey are plotted. Species are not differentiated from the air. Generally, Trumpeters summer in the coastal and interior taiga habitat and Tundras summer on the coastal tundra. There is some overlap of these habitats and of each species' range. There are an unknown number of Trumpeters outside the Trumpeter survey area and some Tundras within it. With both populations growing, the amount of overlap is probably increasing. The habitat covered on this survey probably does not miss many Trumpeters, but does include some Tundras. Limited ground observations suggest that only the Koyukuk (Unit 8) contains substantial numbers of Tundra Swans during the survey periods. More ground study is needed to determine the percent of Tundras included and Trumpeters omitted in this and other units.

Swans are highly visible from the air. The census is an exhaustive attempt to find and plot all swans present, but we do miss an unknown proportion. The Tetlin National Wildlife Refuge detected the omission of two observations (68 observations were recorded) in the Upper Tanana (Unit 11). Poor light, pilot and observer fatigue, poor weather conditions, heavy cover, and other factors can cause swans to be missed. It is believed that the proportion missed is less than 10 percent of the total present. Repetitive air surveys, perhaps using a helicopter and/or ground study, could shed more light on the number of swans missed on a single fixed-wing air survey.

It is practical to monitor Alaska Trumpeter Swan populations accurately with this census method. An integrated computer system for data entry, storage, and retrieval is in place. All swan data contributed on USGS maps in the prescribed format can be quickly and accurately produced to meet planning and other swan data needs. Data manipulation and analysis is greatly facilitated with this system.

A plan to alter the interim (between 5-year total count) sampling procedure (Conant et al. 1984) is planned for 1986. A stratified random sampling scheme will be developed and employed to better monitor the total Trumpeter population on Alaskan breeding grounds. We hope those wishing to continue or start collecting standardized Trumpeter population data will contribute to the computer-based storage system. A data collecting protocol has been developed and is available upon request. A complete census every 5 years is recommended to maintain the continuity of this impressive data set for better management of this magnificent international resource.

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ALASKA TRUMPETER SWAN 1986 SAMPLE, AND RECOMMENDATIONS FOR A CONTINENT-WIDE SAMPLING SCHEME

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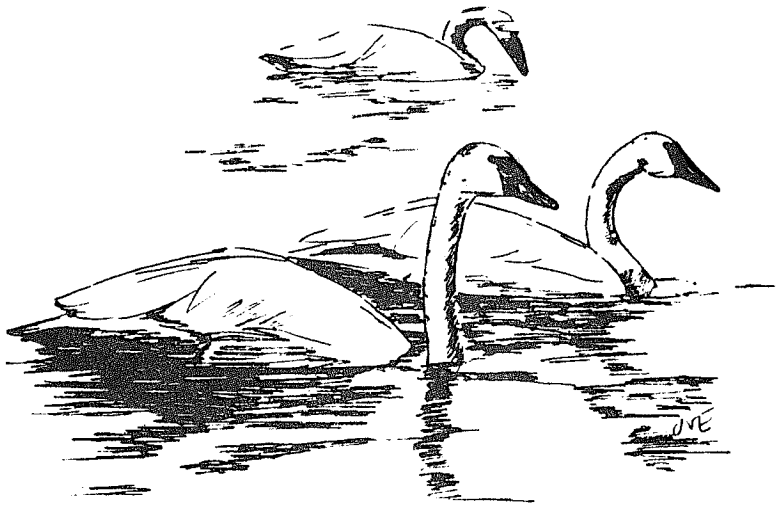
Bruce Conant, Wildlife Pilot-Biologist, U. S. Fish and Wildlife Service
Steven L. Cain, Biological Technician, U. S. Fish and Wildlife Service

ABSTRACT

The complete census of Trumpeter Swans (Cygnus buccinator) in Alaska in 1985 allowed us to design a precise sampling scheme for 1986. All sample units (1:63,360 maps) were stratified using single and paired swans recorded in 1985. The expected variance and average cost per map in each stratum was known for 1985 and used to optimally allocate effort in the 1986 sample. A sample of 80 maps from the 425 total maps flown in 1985 was selected to assure 95-percent confidence limits within ± 10 percent of the estimated number of single and paired swans present in Alaska. The estimates in 1986 were 6153 ± 448 for single and paired swans, 7145 ± 660 for white swans, and 3034 ± 535 for cygnets. Singles declined by 16 percent from 1985 and flocked swans declined by 55 percent. Pairs increased by 13 percent and cygnets increased by 80 percent. Poor recruitment in 1985 was suspected as the major cause of the decline in single and flocked swans in 1986.

We suggest a continent-wide aerial sample be used to monitor the inevitable expansion of the Trumpeter Swan population. The sample could be surveyed over a 5-year period. Within each sample unit, the presence or the absence of swans would be documented. In addition, the actual habitat and its quality for swan use could be measured and expanded for the entire continent. This survey would provide a point of reference to which future researchers and managers could document the repopulation of Trumpeter Swans. One would expect them to be at least as grateful as managers would be now for such a reference point 200 years ago.



A SURVEY OF TRUMPETER SWAN BREEDING HABITATS IN ALBERTA, SASKATCHEWAN AND NORTHEASTERN BRITISH COLUMBIA

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ABSTRACT

Trumpeter swan breeding habitat surveys were conducted in Alberta, southwestern Saskatchewan, and northeastern British Columbia between August 29 and September 20, 1985. The objectives of these surveys were: to determine distribution and location of breeding habitat, to record all wetlands used by trumpeter swans, and to determine total population size of flocks surveyed.

Surveys were flown with Cessna 182 and 185 aircraft at an approximate altitude of 250 m above ground level and an average speed of 200 kph. The survey crew consisted of a pilot, an observer-navigator and whenever feasible a second observer.

This study accounted for 75 pairs of trumpeter swans, 92 flocked or single birds and 130 cygnets for a total of 372 birds within the areas surveyed. The Grande Prairie flock accounted for 321 (86 percent) of the total count.

In order to monitor the population status of the Interior Canada Subpopulation, an annual fall survey of the Grande Prairie flock is recommended. In addition, a need to document the total Canadian breeding range and the wintering grounds of these breeders in order to formulate long-term population and habitat strategies is recommended.

ACKNOWLEDGEMENTS

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Kevin McCormick, Canadian Wildlife Service, Kirby Smith and Leo Dube, Alberta Fish and Wildlife Division who assisted me during the aerial surveys; Gordon Holton, Alberta Fish and Wildlife Division, and Bruce Turner, Canadian Wildlife Service provided advice and logistical support; the pilots and staff of Red Fox Aviation, Wapiti Aviation, Sundance Aviation and Northern Air Charters who all provided excellent service; Kevin McCormick, Bruce Turner, and Hal Reynolds provided valuable comments and criticisms; Susan Popowich drafted the figures and Heather Breen typed the manuscript.

1.0 INTRODUCTION

The trumpeter swan is one of few conservation success stories. Near the brink of extinction in the early 1900s, its population has made a dramatic comeback. Although still one of the rarest migratory birds breeding in Canada, to date, minimal efforts to document its total population status and complete breeding range have been initiated.

Since the proportion of trumpeter swans known to breed in Canada is small (4.5%) relative to the total North American population, it is classified as a rare migratory bird by COSEWIC. The Migratory Birds Convention Act provides and encourages management activities to ensure maintenance and preservation of trumpeter swan habitat. This would involve the complete documentation and protection of breeding habitats in Canada and cooperative efforts with the U. S. to improve and enlarge the wintering habitats in North America.

Traditionally, it was thought that breeding habitat limited the Interior Canada Subpopulation. Recent increases in the number of pioneering flocks in Canada, continuous growth of the Grande Prairie flock and winter die-offs in the Tri-state provide strong evidence that wintering habitat may be the critical factor limiting population growth. Nevertheless, as part of a management strategy, currently occupied and potentially suitable habitats in Canada need to be thoroughly delineated and assessed for carrying capacity.

The North American Management Plan for Trumpeter Swans (1984), and the Canadian Wildlife Service, draft Habitat Strategy for Trumpeter Swans (1985), both recognize as a management priority the urgent need to document the habitat use and habitat potential for trumpeter swans in the interior of Canada. Currently there is a large discrepancy between the winter population estimates for the Interior Canada Subpopulation and the total number of birds accounted for on the Canadian breeding areas. Approximately 500 trumpeter swans (33%) using Tri-state wintering habitats are currently unaccounted for by breeding ground population surveys. These birds are believed to originate from breeding habitat in Canada.

Population and habitat surveys coincided with similar efforts in Alaska, the Yukon, Northwest Territories, and northern British Columbia, enabling the updating of habitat use and population estimates for both the Rocky Mountain and Pacific Coast Populations of trumpeter swans. The Alaska portion of this extensive survey has been conducted every five years and Canadian efforts during 1985 coincided with the Alaska survey to improve knowledge on habitat use and population of trumpeter swans in North America. These extensive detailed surveys provide a continental perspective on the status of the trumpeter swan population and its habitat.

1.1 Objectives

1. To determine the location, distribution, and use of trumpeter swan breeding habitat in Alberta, Saskatchewan and northeastern British Columbia.

2. To document all wetlands used for trumpeter swan breeding habitat and to determine total population size.

3. To provide information on habitat use and population status to provincial and local land management authorities.

2.0 METHODS

Prior to conducting surveys, a comprehensive review of existing literature, unpublished reports, previous surveys and discussions with personnel from various government agencies was undertaken. Staff from Alberta Fish and Wildlife Division, Alberta Forest Service, Saskatchewan Department of Natural Resources, British Columbia Ministry of Environment, and Canadian Wildlife Service were contacted to determine key areas of trumpeter swan breeding habitat in Alberta, Saskatchewan, and northeast British Columbia. It was determined that six separate areas of habitat had breeding trumpeter swans (Fig. 1).

Survey routes, covering as much of the known and/or suspected breeding areas, were outlined on 1:250,000 maps. Areas surveyed and dates of surveys were:

1.	Cardston/Pincher Creek	August 29, 1985
2.	Edson/Whitecourt	September 6, 1985
3.	Grande Prairie District/Alberta	September 10,11, 1985
4.	Grande Prairie District/B.C.	September 11, 1985
5.	Otter/Russell Lakes	September 17, 1985
6.	Chinchaga River	September 20, 1985

Survey routes that covered as many of the known or suspected breeding wetlands within the above areas were outlined and followed (Appendix I). The Cypress Hills were not surveyed, as it was determined (M. Killaby, pers. comm.) that only one breeding pair and three subadult trumpeter swans occurred in this area in 1984 and that ground surveys were being conducted in 1985.

All censuses were conducted using Cessna 182 or 185 fixed-wing aircraft. During each survey the aircraft was flown along a designated route at an approximate altitude of 250 m above ground level and an average speed of 200 kph. The survey crew consisted of a pilot, an observer-navigator, and a second observer. Both observers had maps outlining the survey route and both plotted the location and number of trumpeter swans seen. When swans were observed on a wetland, the pilot was asked to circle the wetland at a reduced speed and altitude in order to determine the exact number of swans present and flock composition. Surveys were usually flown during the early morning or late afternoon.

3.0 RESULTS AND DISCUSSION

Survey results were summarized according to the major breeding areas surveyed and tabulated in Table 1. When a single adult with a cygnet(s) was observed, this observation was documented as a breeding pair. Appendix I provides the best indication of all the wetlands surveyed within each area. In addition, all those specific wetlands on which swans were observed, their specific location and other related information appear in Appendix II. Limitations in time and assistance precluded the collection of any quantitative habitat information.

3.1 Grande Prairie Flock

Survey coverage was increased in 1985 to include more wetlands to the south of Wapiti River along both sides of the Smoky River. Also an area to the southwest of the traditional wetlands surveyed in B.C., which included the Stoney Lake area, was added to the survey (Appendix I). Within the Grande Prairie survey area, approximately 192 different wetland areas were surveyed.

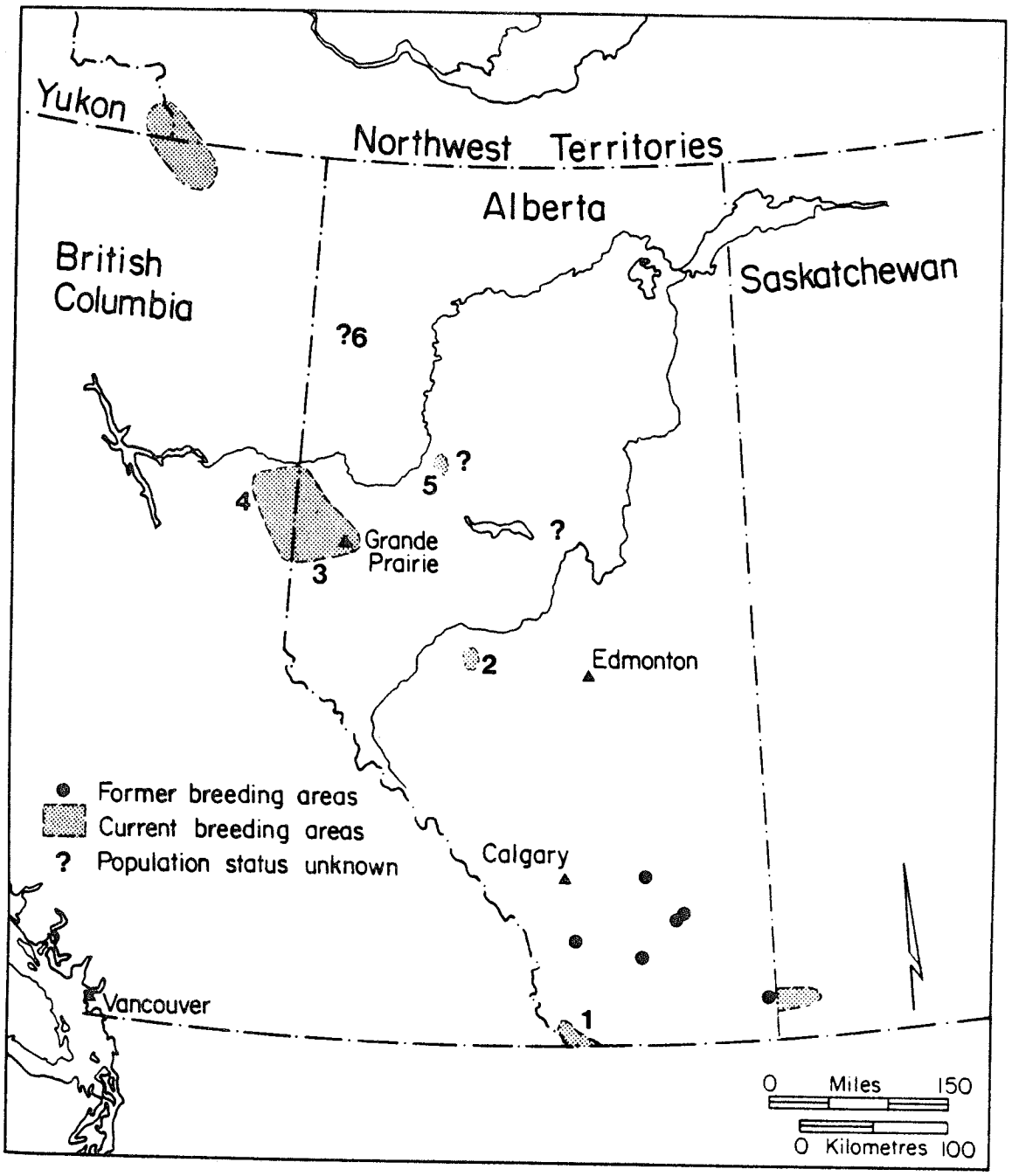

Figure 1. Location of Trumpeter Swan survey areas, 1985.

Table 1. A summary of Trumpeter Swan observations, fall 1985.

Survey site	Trumpeter Swans Observed				
	Paired	Cygnets	Singles	Flocked	Total
Cardston/Pincher Creek	6	-	-	-	6
Edson/Whitecourt	14	8	1	-	23
Grande Prairie-Alberta	102	98	3	82	285
Grande Prairie-B.C.	20	16	-	-	36
Otter/Russell Lake	4	3	-	4	11
Chinchaga River	2	3	-	-	5
Total	148	128	4	86	366

Sixty-one pairs of trumpeter swans were observed during the survey of the Grande Prairie flock (Table 1). Thirty broods totalling 114 cygnets were also censused, in addition to 85 adults and subadults in groups or as singles. A total of 321 trumpeter swans were censused. Although not directly comparable to the 1984 data, since in 1984 the B.C. segment of the survey was not completed, almost all segments of the population were lower in 1985 than in 1984 (Table 2). These lower population levels plus the 1984 death rate of 0.44 (Table 2) supports the observations of a significant trumpeter swan die-off in the Tri-state wintering area. Within the last ten years, the only time the death rate exceeded 0.33 was in 1978, when a significant die-off was recorded on the wintering grounds (Fig. 2). This 1984 die-off may have resulted in a more mature or experienced breeding flock which had excellent production in 1985. A cygnet to adult ratio of 0.55 and a mean brood size of 3.8, indicates a productive population which may still continue to increase in the future (Fig. 3).

Within the Alberta portion of the Grande Prairie survey, a total of 51 pairs, 26 broods (98 cygnets) and 85 flocked or singles were recorded. A total of 283 trumpeter swans were observed. Although more wetlands (65) were surveyed during 1985 than in 1984, this larger sample of wetlands only accounted for an additional two pairs and one cygnet. These observations indicate a significant decrease in the 1985 Alberta population from 1984.

Table 2. Size and components of the Grande Prairie flock, 1976-1985.

Year	Total # lakes survey.	Pairs with cygs.	Pairs without cygs.	Total pairs	Single + flocked	Total adults + subadults	Total cygs.	Total popul.	Cygnets to adults	Death rate**	Birth rate***
1976	103	14	22	36	8	80	41	121	0.51	0.27	0.34
1977	113	25	6	31	26	88	80	168	0.91	0.17	0.48
1978	153	20	19	39	61	139	72	211	0.52	0.50	0.34
1979	136	18	27	45	15	105	61	166	0.58	0.17	0.37
1980	120	23	16	39	60	138	72	210	0.52	0.20	0.34
1981	124	23	19	42	84	168	84	252	0.50	0.31	0.33
1982	131	21	17	38	97	173	67	240	0.39	0.30	0.28
1983	162	25	40	65	38	168	81	249	0.48	0.10	0.33
1984*	157	37	26	63	99	225	118	343	0.52	0.40	0.34
1985	192	30	31	61	85	207	113	320	0.55		0.35
Means	139	24	22	46	57	149	79	228	0.55		

* B.C. component of this flock was not surveyed in 1984.
** Death rate = [total population T - adult population (T + 1)]/total population T.
*** Birth rate = cygnets/total population T.

[Editor's note: T is the year being considered.]

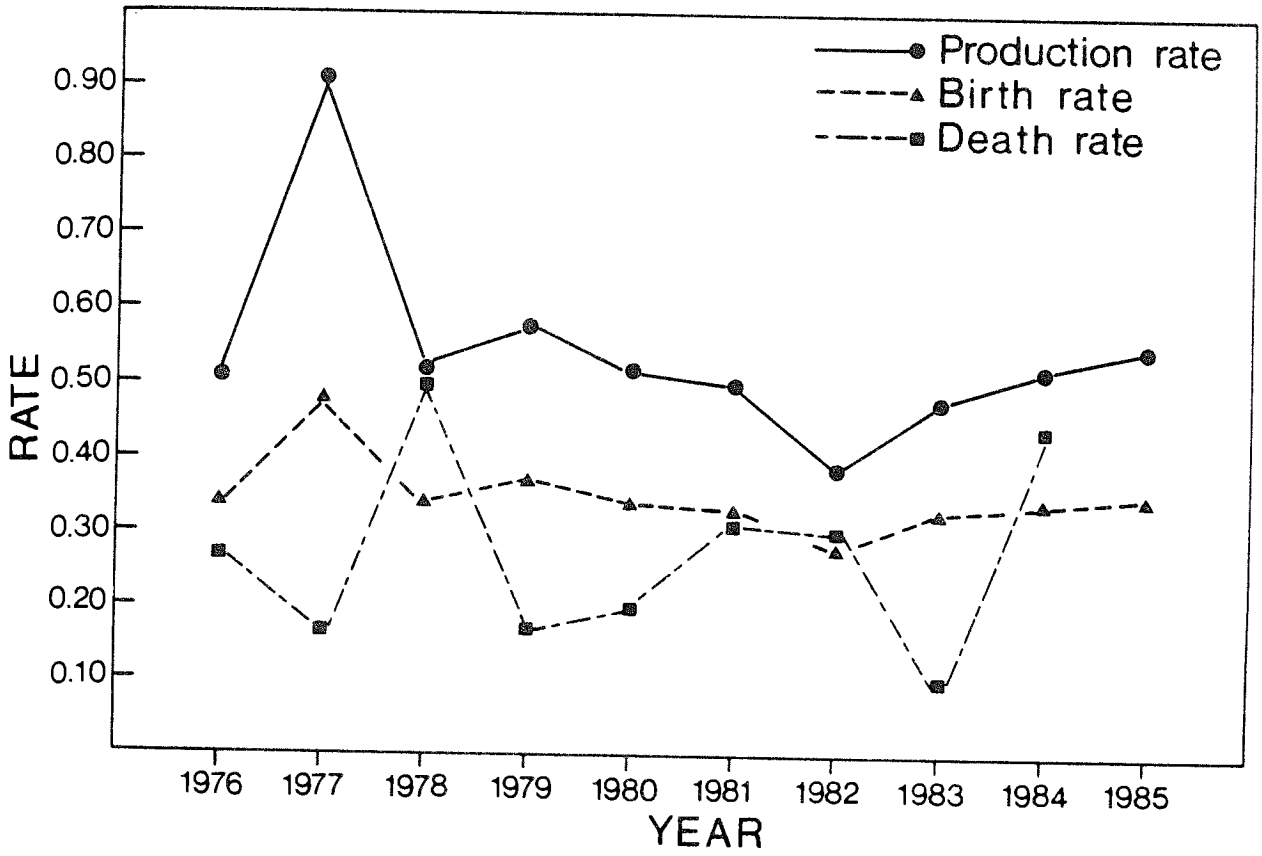

Figure 2. Birth, death, and production rate -- Grande Prairie Trumpeter Swan flock.

3.2 Alberta Pioneer Flocks

3.2.1 Otter/Russell Lakes - Chinchaga River

Two pairs with one and two cygnets respectively were observed on September 17 in the Otter Lakes area. In addition, a group of four adult swans were seen at Golden Lake (Appendix I). Specific locations of these observations and survey routes are found in Appendix I and II. These observations do not differ from September 21, 1982 when CWS biologists observed two pairs with six and four cygnets each in this same general area. In addition to a fairly extensive survey in this area, a site to the east known as the Panny Tower area was surveyed. A pair of swans were observed in this general area during the summer (G. Holton, pers. comm.), but no swans were observed during this survey. General impressions of the habitat in this area indicate that the quality of wetlands is variable. Sufficient amount of good quality wetlands are lacking and thereby may be a factor limiting expansion of this flock.

On September 20, 1985 a survey of the Chinchaga River area was conducted (Appendix I). One pair with three cygnets was observed on S.E. Osland Lake, no other swans were seen during this survey. The number of swans in this area was much lower than expected, because 13 adults and eight cygnets were observed here during 1984 (G. Holton, pers. comm.).

3.2.2 Edson/Whitecourt

Six pairs of trumpeter swans were observed with two pairs having broods of two and four cygnets, respectively, during this survey. The route followed was the traditional route flown by the Alberta Fish and Wildlife and Canadian Wildlife Service (Appendix I). In addition, an area north of the town of Whitecourt was searched and a pair with two cygnets and a single white bird were observed. The results of the Edson portion of this survey do not differ significantly from results obtained by Taggert and Smith in 1984 or the CWS fall survey in 1983 when 12 and eight adult swans, respectively, were observed. A lack of quality wetlands may limit the expansion of the flock in this area.

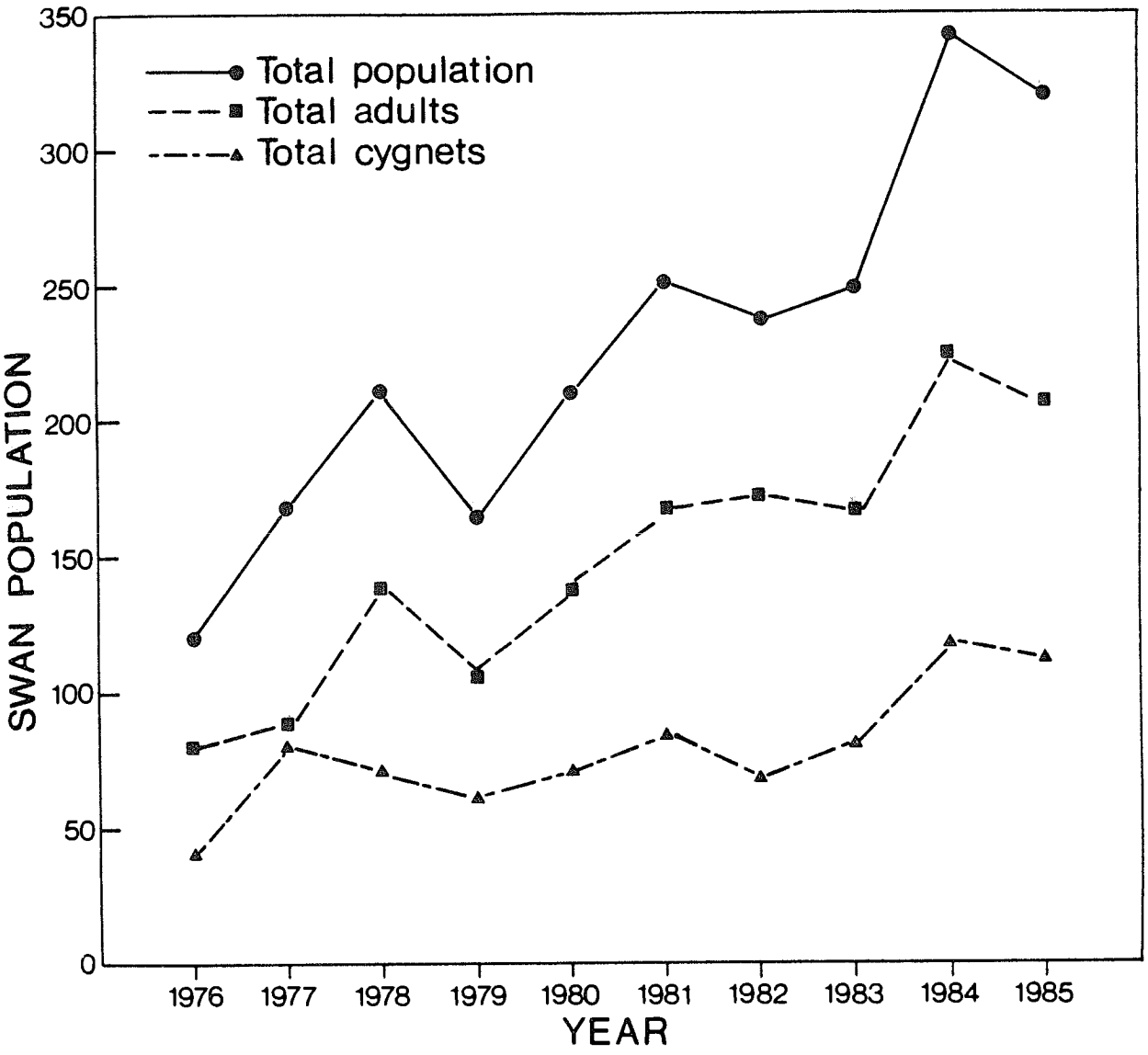

Figure 3. Temporal changes in Grande Prairie Trumpeter Swan flock.

3.2.3 Pincher Creek/Cardston and Cypress Hills, Saskatchewan

Three pairs of trumpeters were observed within Waterton Lake National Park during the August 29, 1985 survey. No cygnets were observed, although production of broods has been recorded in this area during previous years (J. Stelfox, pers. comm.). The survey route followed during this survey can be found in Appendix I. The quality of the trumpeter swan habitat was variable in this area.

The Cypress Hills area in Saskatchewan was not surveyed since it was determined that Saskatchewan Natural Resource personnel had conducted extensive ground surveys of the area. M. Killaby (pers. comm. 1985) indicated that one breeding pair which produced two cygnets and two single white birds were observed in this area in 1985 (Appendix I).

3.3 1985 Survey Area Population Estimate

The 1985 fall survey of the Grande Prairie flock and several pioneer flocks of trumpeter swans in Alberta-Saskatchewan has resulted in the documentation of 75 pairs, 92 grouped or singles and 130 cygnets. This accounted for 242 total adult and subadult birds and a population estimate of 372 trumpeter swans within the area surveyed.

4.0 RECOMMENDATIONS

Considering the results of these surveys and management priorities for trumpeter swans, it is recommended that:

1) annual surveys to monitor status of the Grande Prairie flock, including the B. C. component be continued.

2) mid-summer surveys be initiated to better document breeding habitat use and carrying capacity for trumpeter swans within the current Canadian breeding range.

3) information on annual population status and habitat use be provided to local land management authorities to ensure continued protection of trumpeter swan habitat throughout the region; and

4) there is an immediate need to undertake a marking project, especially on pioneering swans, to improve our knowledge of wintering habitat use by Canadian breeding trumpeter swans.

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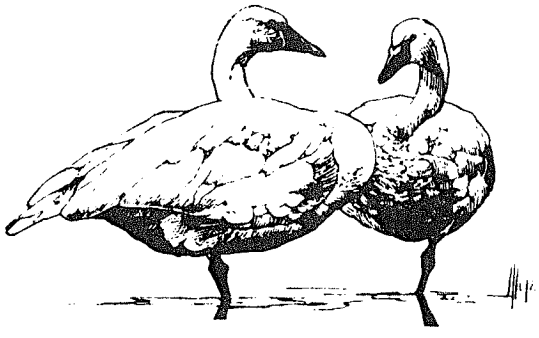
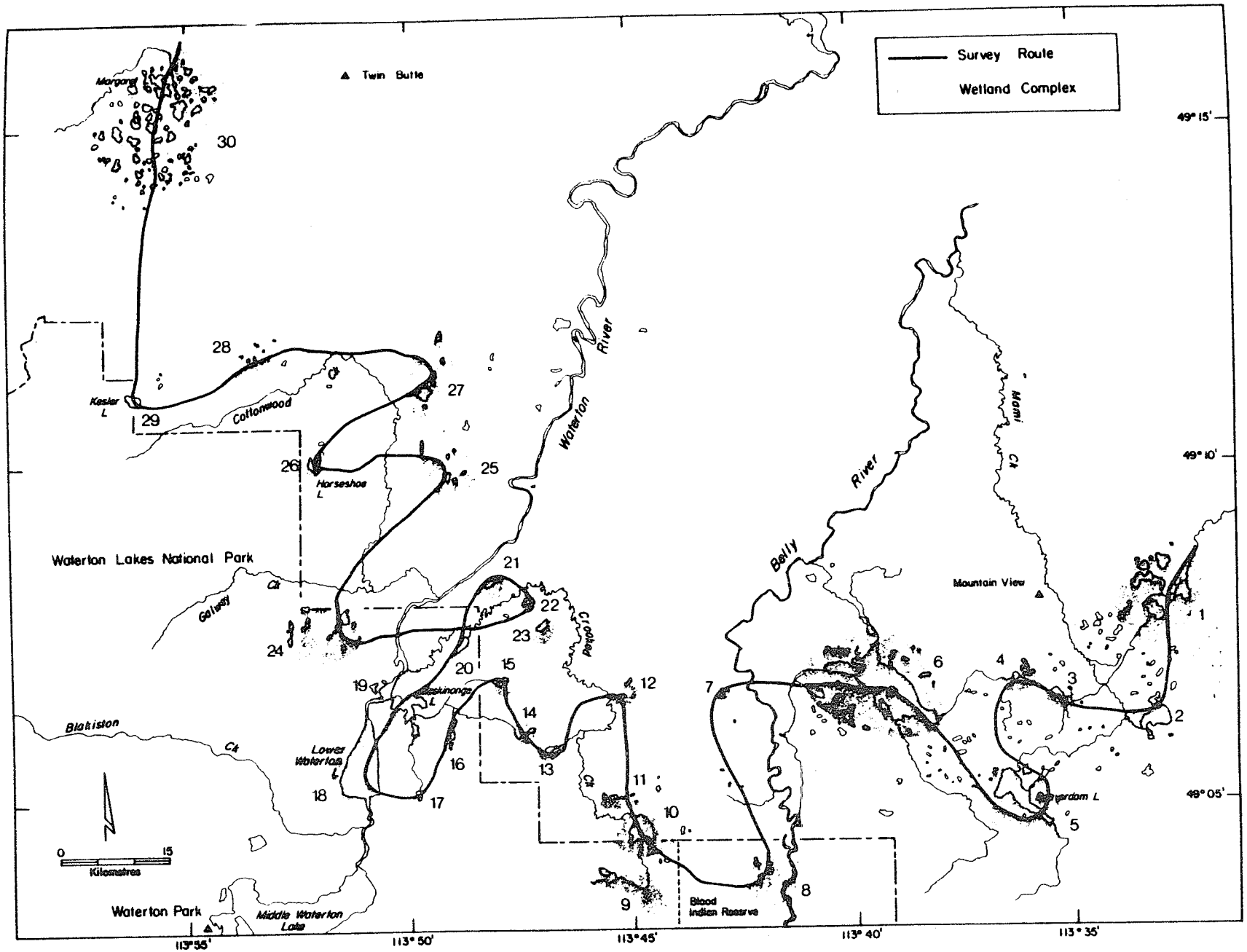
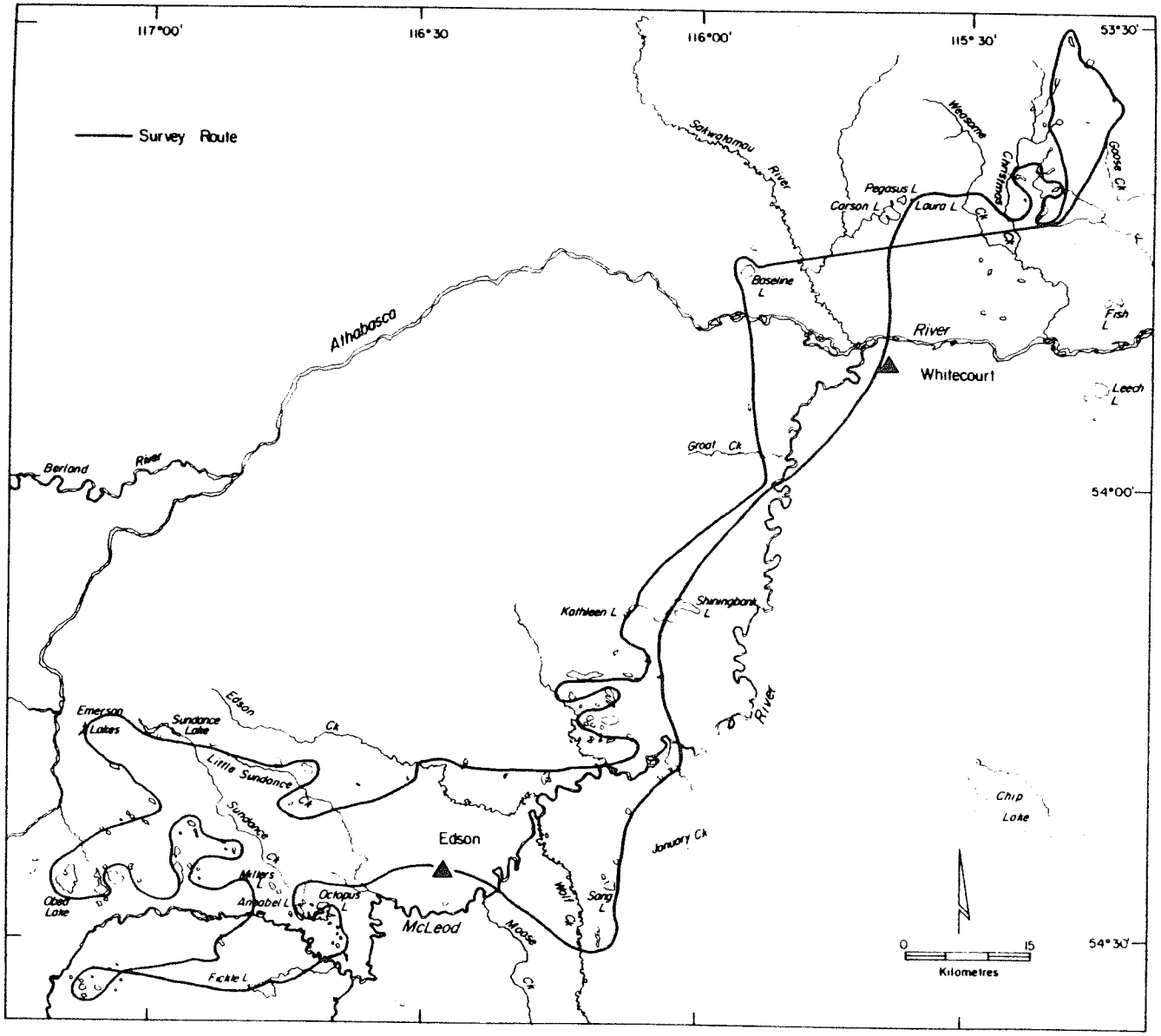
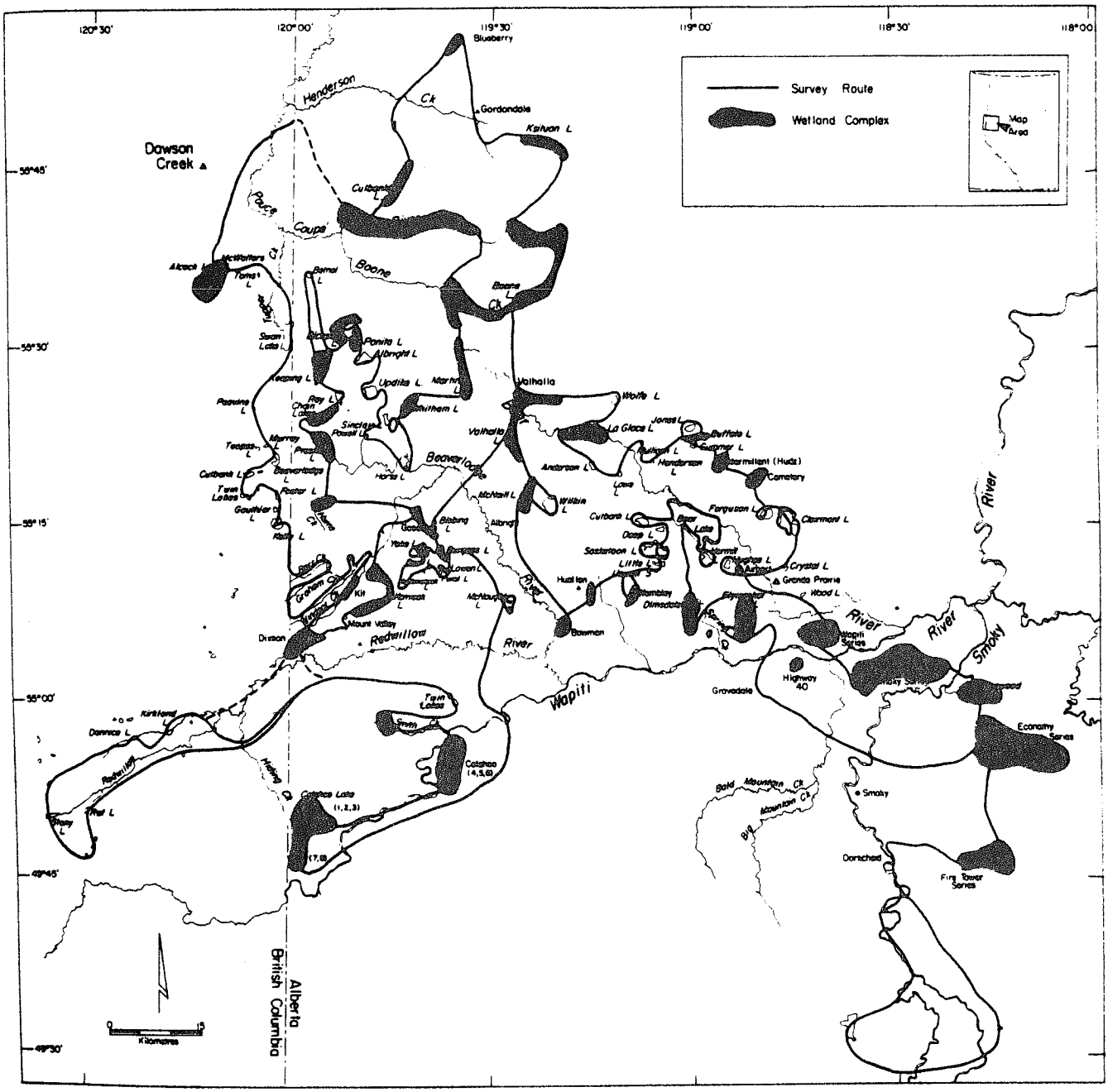




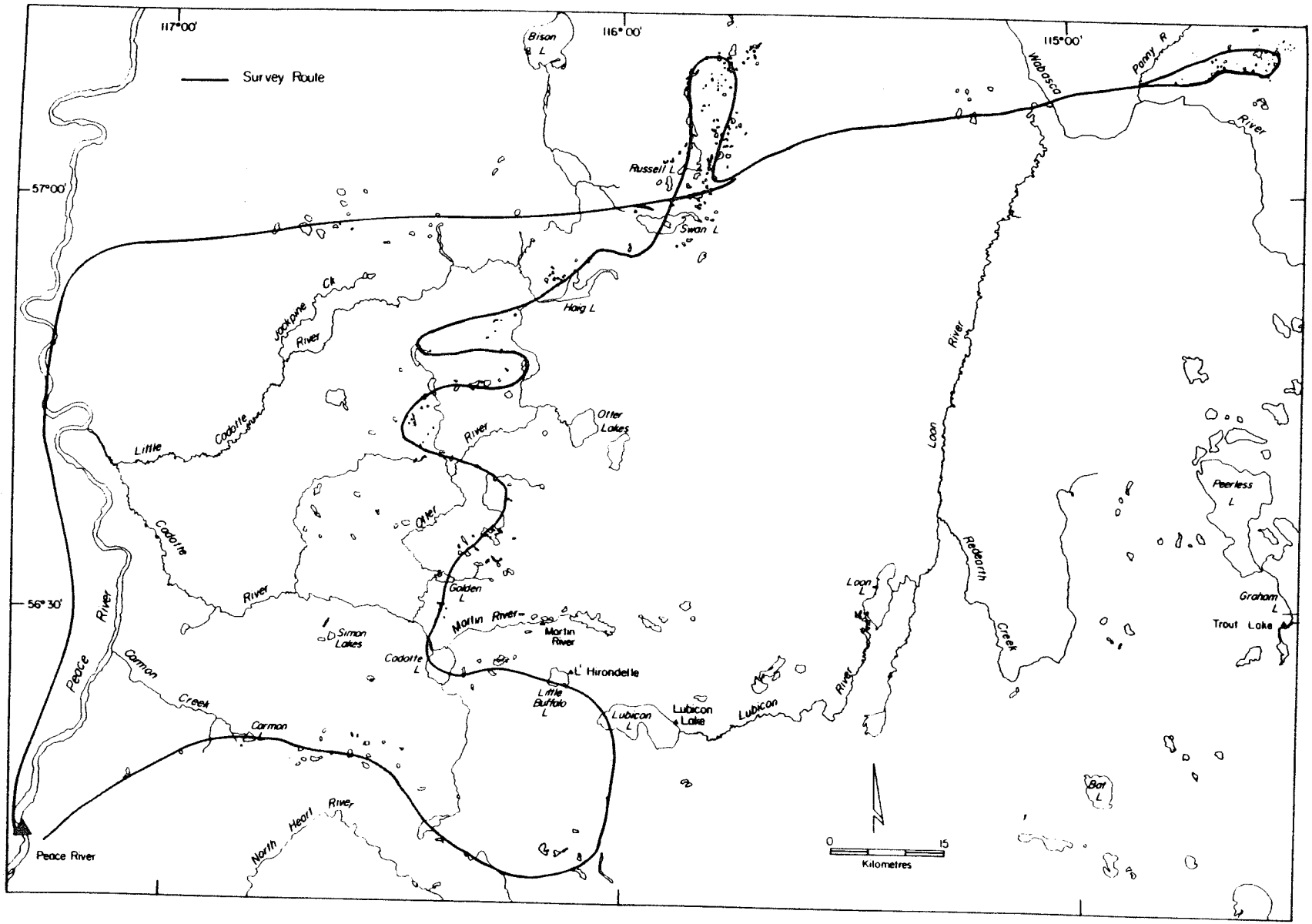
Appendix I. Cardston/Pincher Creek Trumpeter Swan 1985 survey route.



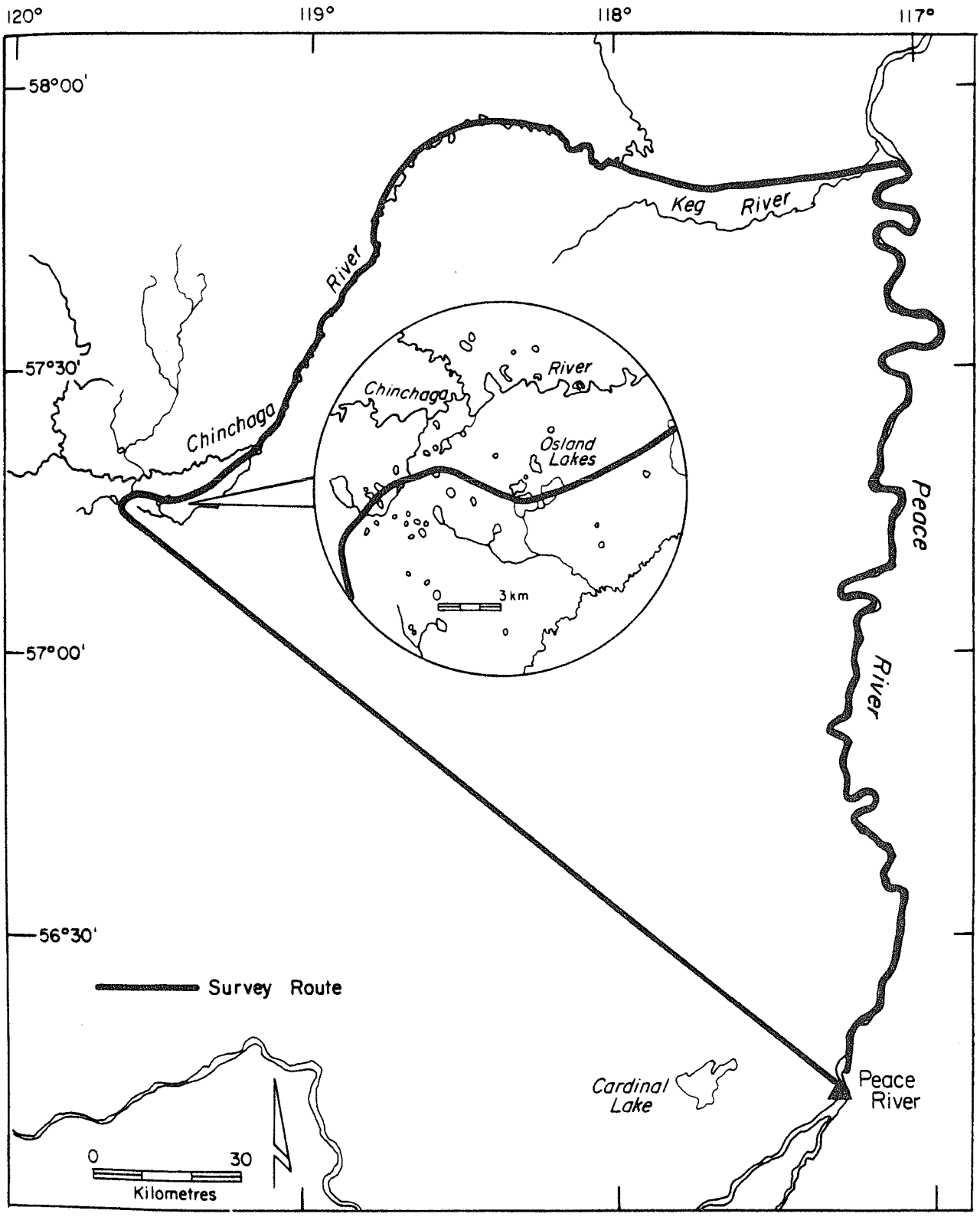
Appendix I. Edson/Whitecourt Trumpeter Swan 1985 survey route.



Appendix I. Grande Prairie trumpeter swan 1985 survey route.



Appendix I. Otter/Russell Lakes Trumpeter Swan 1985 survey route.



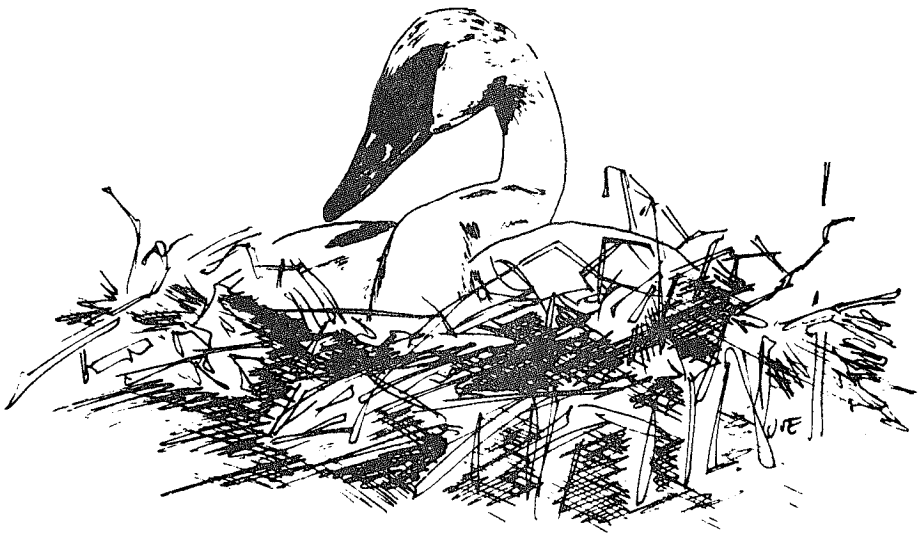
Appendix I. Chinchaga River trumpeter swan 1985 survey route.

Appendix II. Trumpeter swan aerial survey results, Alberta/British Columbia, fall 1985.

Wetland	UTM Grid	Map #	Pairs	Cygnets	Single	Group	Total
Unnamed, Waterton 1	TK 933 407	82H	1				2
Unnamed, Waterton 2	TK 933 405	82H	1				2
Unnamed, Waterton 3	TK 926 433	82H	1				2
Kathleen Lake	NK 558 668	83F	1				2
Unnamed, Edson 1	NK 562 661	83F	1	2			4
Unnamed, Edson 2	NK 554 654	83F	1				2
Unnamed, Edson 3	NK 518 643	83F	1				2
Unnamed, Edson 4	NK 516 633	83F	1				2
Sucker Lake	NK 504 634	83F	1	4			6
Unnamed, Whitecourt 1	PL 607 623	83K	1	2			4
Unnamed, Whitecourt 2	PL 606 618	83K			1		1
Osland Lake NW	LP 352 649	84E	1	3			5
Golden Lake	NN 538 667	84C				1	4
Unnamed, Otter Lake 1	NN 535 692	83C	1	2			4
Unnamed, Otter Lake 2	NN 536 694	84C	1	1			3
Albright	LM 323 649	83M	1				2
Anderson	LM 358 634	83M	1	5			7
Bear	LM 375 625	83M				4	39
Boone	LM 347 662	83M	1	4			6
Boone Creek (2)	LM 339 649	83M	1	4			6
N. Boone	LM 354 671	83M	1	3			5
E. Boone	LM 351 663	83M	1	6			8
W. Boone Creek	LM 336 661	83M	1		1		3
Burgess	LM 333 621	83M	1				2
SW Chain	LM 313 643	83M	1	5			7
Cutbank 2	LM 328 678	83M	1	3			5
Deep	LM 368 624	83M	1				2
Dickson	LM 319 656	83M	1	2			4
Dimsdale	LM 372 613	83M	1				2
Ellenwood	ML 419 607	83M		5	1		6
Ellenwood Creek	ML 417 607	83M	1	5			7
Flyingshot	LM 382 613	83M	1	2			4
Dixson-2	LM 314 612	83M	1				2
SE Goodfare	LM 334 622	83M	1				2
Henderson	LM 367 635	83M	1	6			8
Horse	LM 328 634	83M	1	7			9
Horse	LM 328 635	83M	1				2
Hume Creek	LM 314 629	83M	1	5			7
Intermittent (Hudz)	LM 378 635	83M	1	5			7
Kamisak	LM 324 615	83M	1				2
E. Kamisak	LM 326 616	83M	1	2			4
Keeping	LM 314 650	83M	1				2
N. Keeping	LM 314 653	83M	1				2
LaGlace	LM 358 640	83M			1	1	4
Little	LM 367 618	83M	1	4			6
Martin	LM 338 647	83M	1				2
N. McNaught's	LM 344 613	83M	1	4			6
McNeill	LM 347 629	83M				1	10
Mt. Valley	LM 318 612	83M	1	3			5
Ponita	LM 321 655	83M	1				2
N. Ponita	LM 321 657	83M	1				2
Pouce Coupe	LM 319 675	83M	1				2
Powell	LM 323 641	83M	1				2
Preston	LM 315 640	83M	1				2
Preston	LM 315 638	83M	1				2
Sinclair	LM 325 643	83M				1	27
S. Twin	LL 334 608	83M	1	5			7
Updike	LM 323 648	83M	1	4			6
Valhalla	LM 345 638	83M	1				2
Wilkin	LM 351 628	83M	1				2
Wolfe	LM 362 646	83M				1	3
Wood	LM 390 613	83M	1	3			5
Yoke	LM 330 623	83M	1	3			5

Appendix II. Continued

Wetland	UTM Grid	Map #	Pairs	Cygnets	Single	Group	Total
SE Yoke	LM 332 622	83M	1				2
Calahoo Creek 2	LL 312 682	83L	1				2
Economy Creek 3	ML 422 689	83L	1	1			3
Dorscheid	ML 403 671	83L		1	1		2
Smoky River	LL 398 682	83L	1				2
Beaver lodge BC	FS 687 136	93P	1	5			7
Cutbank E BC	FS 687 132	94P	1				2
Foster BC	FS 687 132	93P	1				2
Gauthier BC	FS 687 129	93P	1				2
Swan BC	FS 689 155	93P	1				2
Teepee BC	FS 687 138	93P	1	4			6
Twin W BC	FS 683 131	93P	1	3			5
Kirkland BC	FR 673 673	93I	1	4			6
Stony Lake BC	FR 655 678	93I	1				2
Stony Marsh BC	FR 653 675	93I	1				2
Calahoo Creek 8	LL 308 674	83M	1				2
Kit 2	LM 319 618	83M		1	1		2
Smith 2	LL 324 695	83L	1				2
Smoky 7	MM 401 602	83M	1				2
Smoky 8	LM 699 601	83M	1				2
Smoky 14	MM 412 602	83M	1				2
Highway 40	LM 389 603	83M			1		1



THE 1985 SURVEY OF TRUMPETER SWANS IN BRITISH COLUMBIA AND YUKON

Richard McKelvey, Wildlife Biologist, Canadian Wildlife Service

Between late July and early September 1985, a survey of wild Trumpeter Swans (Cygnus buccinator) was conducted by the Canadian Wildlife Service in western Canada, in conjunction with the 5-year-interval study in Alaska. This was the first time that a comprehensive survey of Trumpeter Swans was conducted throughout their known breeding range in North America. This paper summarizes the results of that survey in British Columbia and Yukon. More complete details can be found in McKelvey (1986).

PREVIOUS SURVEYS

Surveys have been conducted in British Columbia and Yukon in the recent past, but the data base is small. Surveys conducted in southeastern Yukon between 1978 and 1981 were reported by McKelvey et al. (1983). Observations of swans elsewhere in Yukon have accumulated since then, but the major breeding areas in southeastern Yukon have not been revisited systematically.

Swan surveys were conducted in the Ft. Nelson area and the Ft. St. John area of British Columbia in 1981, but they were only partly documented (McKelvey 1981) and have not been repeated. Surveys carried out near Dawson Creek, in conjunction with surveys of the Grande Prairie swans, have been somewhat more regular. Dawson Creek surveys are not dealt with in this report because those data have been included in reports from Grande Prairie in these Proceedings.

1985 SURVEY

Standard aerial survey methods were used in the 1985 survey. Details, including flight lines, can be found in McKelvey (1986).

In Yukon, 38 pairs with nine broods (22 cygnets) and 43 adult-plumaged birds, singly or in flocks, were seen, for a total of 141 swans. In British Columbia, excluding the Dawson Creek area, 10 pairs and five broods (14 cygnets) were seen, for a total of 34 swans.

The number of swans seen in Yukon was less than expected. In southeastern Yukon, numbers were similar to those seen previously in the centre of that area but were lower on the range peripheries. Numbers seen elsewhere in Yukon were also generally lower. However, the data base in those areas is not as extensive as in southeastern Yukon, and direct comparisons are difficult.

Numbers of adult-plumaged birds seen in the Ft. Nelson area were slightly less than those seen previously, but productivity was higher. In 1981, no cygnets were seen, while, in 1985, four were seen. The Ft. St. John area swans showed a similar trend; fewer pairs were seen (2 as compared to 3), but productivity was much higher (10 as compared to 0).

Productivity seems to have increased in British Columbia and remained the same in Yukon, while the total population has declined throughout. It has been suggested that winter mortality is limiting the Canadian Trumpeter Swan population. Perhaps, the results of this survey reflect that limitation.

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1985 CAPTIVE TRUMPETER SWAN SURVEY RESULTS

Donna Compton, Administrative Assistant, The Trumpeter Swan Society

The 1984 North American Management Plan for Trumpeter Swans calls for assessment of the continental Trumpeter Swan (Cygnus buccinator) population at 5-year intervals. In 1985, the first complete survey (within a single year) was to include captive as well as wild populations.

The Trumpeter Swan Society was asked by the U. S. Fish and Wildlife Service (USFWS) to conduct the captive Trumpeter Swan survey, with its financial assistance. The Society had conducted a similar survey in 1979, 1981, and 1983.

Initially, Trumpeter Swan propagators from the 1983 survey list were mailed a survey form. The form requested basic information on the number, sexes, ages, and pairings of Trumpeters in their possession and the names and addresses of waterfowl propagators to whom they had sold or traded Trumpeters since 1983. The survey letter included a list of names and addresses of known propagators and requested names and addresses of unlisted propagators.

Next, each USFWS Regional Enforcement Office, Permits Section, generated a list of licensed propagators involved with sale or trade of Trumpeters. (Note: not all swan owners have waterfowl breeder permits because a permit is not needed if the propagator is not selling or trading birds.)

Due to strict privacy laws in Canada, it was impossible to obtain a similar list of Canadian-licensed propagators. The Ontario Canadian Wildlife Service office was willing to cross-check the 1983-generated list against their information and contact those not listed within their region. However, by the time this agreement was finally reached, there was not time to contact all of the other provinces individually to try to make similar arrangements.

Finally, a list of newly discovered propagators was generated from the returned surveys and the permitting office lists, and all of these additional propagators were sent the original survey. Those who did not respond to the initial survey were sent a second questionnaire. If there was still no response, they were called, using the USFWS - FTS lines.

The results of the past surveys are compared with 1985's in Table 1.

Table 1. Captive Trumpeter Swan survey results, 1974-85.

	Year				
	1974 (Lohmeyer 1974)	1979	1981	1983	1985
Number of captive Trumpeters	157	252	286	419	611
Number of Trumpeter owners	59	61	77	88	150

The number of propagators nearly doubled between 1983 and 1985. The thoroughness of the 1985 survey, as compared to that of 1983, may account for some of the increase. However, most of the increases in numbers of propagators and numbers of Trumpeter Swans in captivity are due to the increasing success of some owners in propagating Trumpeters and the steadily increasing number Trumpeters Swans available (Figure 1).

Figure 1 illustrates the age structure of the captive population in 1985. One hundred and fifty cygnets were produced, a significant contribution to Trumpeter numbers. Most of the captive offspring were pinioned, a standard waterfowl propagation practice, usually rendering the birds permanently flightless. With the increasing number of states involved in Trumpeter restorations, the private breeders could provide a steady, reliable source of cygnets if they were willing to sell and if they could be persuaded to clip rather than pinion the cygnets.

The total of 611 Trumpeters in captivity in 1985 in North America is probably quite close to the actual number. A few Canadian breeders may have been missed because of privacy law restrictions. Other sources of error were transactions (sale or trade of birds) made during the survey period and breeder-loan arrangements. These were difficult to track, and some duplication may have occurred. Finally, there may be a few swan owners who are not licensed and are not in close contact with any other swan breeders.

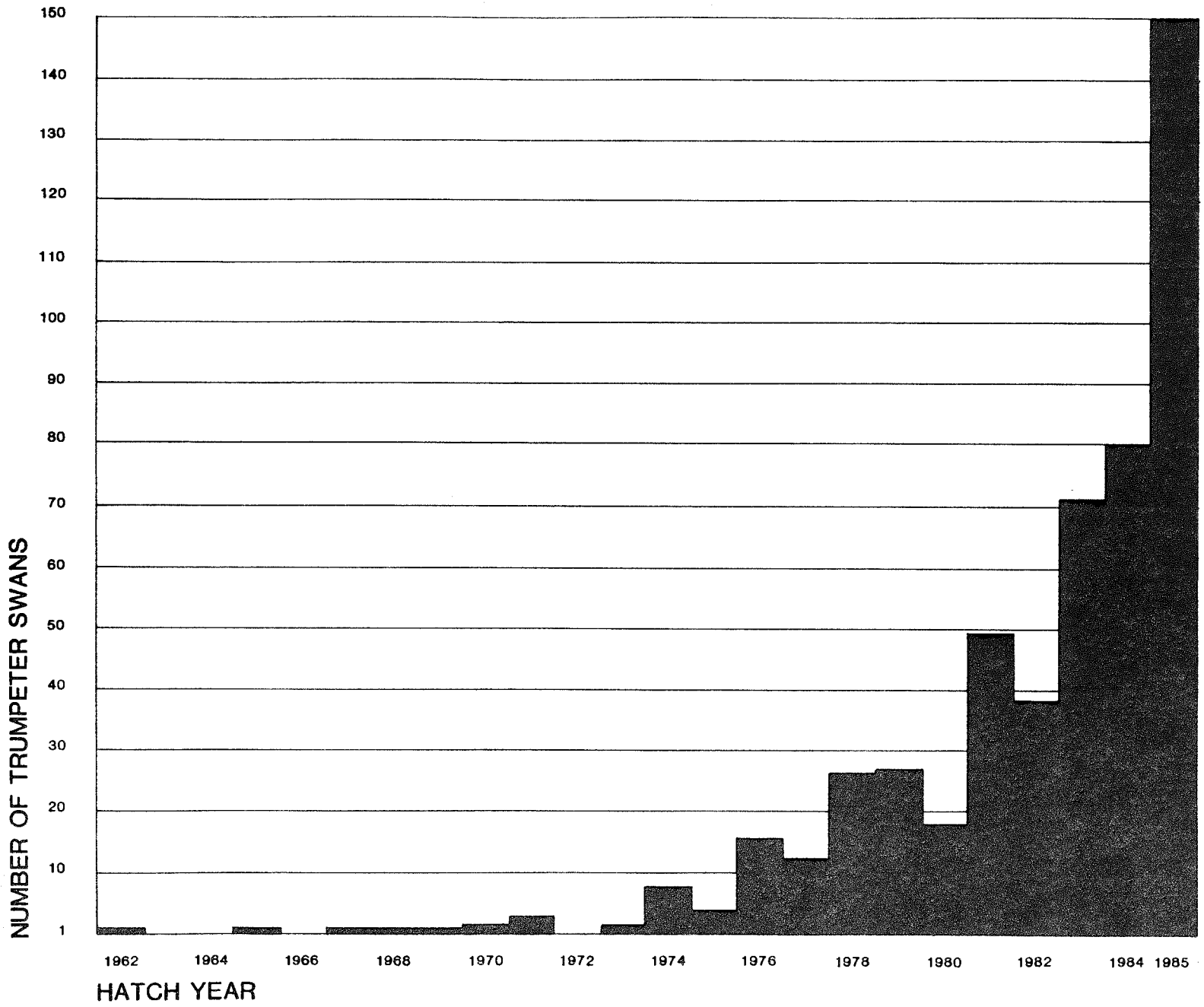

Figure 1. Age distribution of captive Trumpeter Swans in North America in 1985.

The Trumpeter Swan Society will continue to assist the USFWS in the North American Swan Survey every 5 years. An additional survey of private propagators will be conducted midway between the 5-year surveys to help maintain contact with and current addresses for swan owners.

The survey not only keeps track of the number of captive Trumpeters, it provides a list of swans available for sale or trade, enhances communication between breeders, and increases the accessibility of swans and cygnets for restorations.

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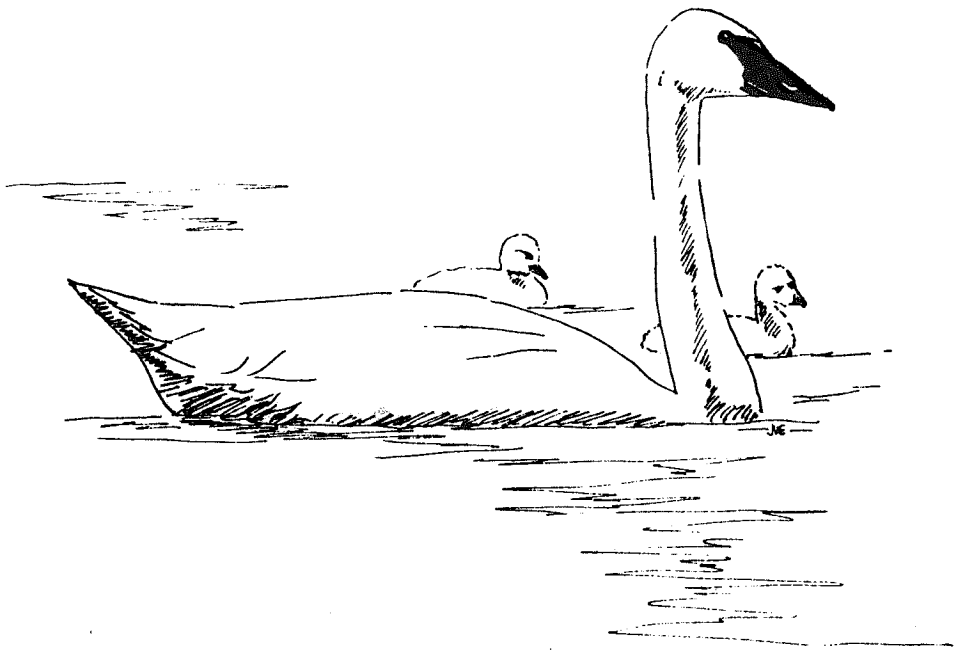

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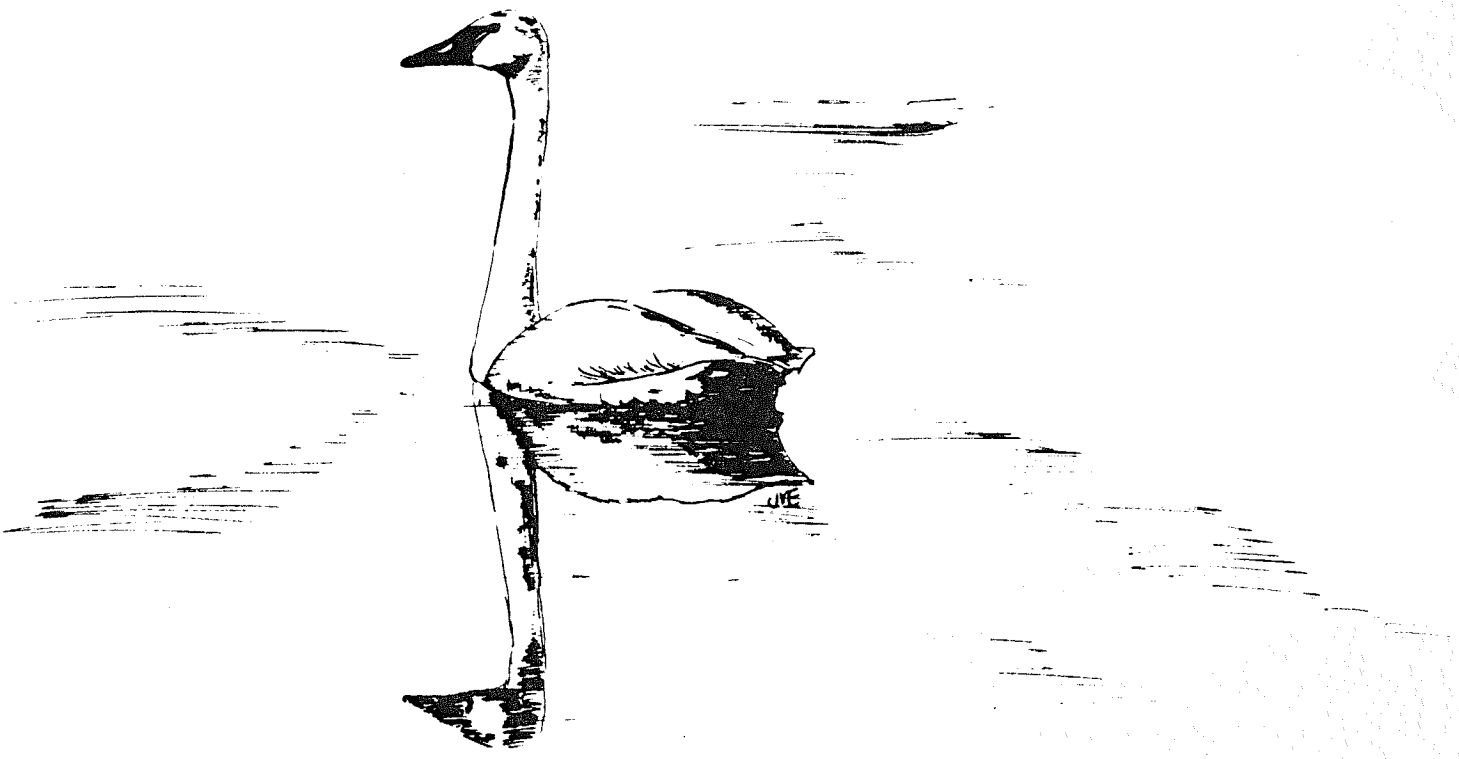

PRODUCTIVITY OF TRUMPETER SWANS IN RELATION TO CONDITION

Harry G. Lumsden, Research Scientist, Ontario Ministry of Natural Resources

There is an acute shortage of Trumpeter Swan (Cygnus buccinator) eggs for restoration purposes. Anything we can do to increase production will be of great benefit. We do not know enough about the breeding biology of Trumpeter Swans to be certain about their breeding strategies. The purpose of this paper is to discuss the breeding strategies of waterfowl, in general, and see how they might apply to swans. It appears that there may be some techniques which can be used to increase productivity and satisfy some of the demands of restoration programs.

Clutch size in wild Trumpeters varies from 1-9 eggs. In Alaska, 213 clutches averaged 5.2 eggs (data from Hansen et al. 1971). At Grande Prairie, Alberta, 14 clutches averaged 5.6 eggs (Holton 1981) and in the Tristate area, 249 clutches averaged 4.8 eggs (Banko 1960; Page 1976; and others).

A large sample of individual clutch sizes, by year, was available only from Alaska. The difference between the highest year, 1965, on the Kenai Peninsula (mean 5.7 eggs) and the lowest year, 1964, (mean 4.4 eggs) is significant (Kolmogorov-Smirnov (K-S) test X^2 = 12.72, d.f. 2, P<0.01). There is, then, significant variation from year to year in clutch size in wild Alaskan birds. Trumpeters, like other waterfowl species which nest in the north, probably lay smaller clutches in years with late ice breakup.

Eight years of data from two study areas in Alaska should be representative of the egg-laying capacity of wild Alaskan swans. The addition of 4 or 5 years of additional data will probably not greatly alter the clutch-size distributions. I have combined these 8 years for comparison with the egg-laying performance of of captive Trumpeters.

Many members of The Trumpeter Swan Society and aviculturists kindly sent me their data on the performance of their captive Trumpeter pairs in response to a questionnaire which I circulated. The results of the survey were as follows:

Thirty-nine breeders replied with data on 41 females, not all of known age, and 104 clutches for years ranging from 1973-86.

Table 1. Mean clutch size of captive Trumpeter Swan females by age.

3-year-old birds	5.0 (N=4)
4-year-old birds	5.3 (N=15)
5-year-old birds	5.7 (N=20)
6-8-year-old birds	5.9 (N=35)
9-14-year-old birds	6.9 (N=19)

Clutch size varied from 3-11 with unusual clutches of 8, 10, 12, and 17, which are not included in Table 1 (see discussion below).

Only 17 percent of the females, for which age at first breeding was given, laid eggs at 3 years of age. The mean clutch was 4.5 among first-time breeders 3-7 years old and was significantly smaller than the mean of 6.3 for second-time breeders (K-S test X^2 = 17.06, d.f. 2, P<0.001).

How do captives compare with wild Alaskan Trumpeters in their production of eggs?

I used 93 clutches from captives to compare with the 213 clutches from Alaska. We can conclude that captive Trumpeters are significantly more productive of eggs than Alaskan wild birds (K-S test X^2 = 16.18, d.f. 2, P<0.001).

In the Tristate area, the overall mean clutch size is 4.8 eggs. In view of the large sample size of 249 clutches, it is possible that these swans are even less productive than the Alaskan Trumpeters and much less so than captives.

Why do captive Trumpeters produce more eggs than wild birds?

A reliable and nutritious diet would surely have some influence. Also, the remnant wild populations of Trumpeter Swans are breeding at high altitudes and latitudes where late springs can be expected to reduce mean clutch size. Most captives are held at lower latitudes and in areas with a much milder climate. It is possible that the original stocks of Trumpeters breeding across the low prairies and in the Great Lakes region may have had clutch sizes comparable to our captive birds.

What breeding strategies do Trumpeter Swans follow, and how do they compare with other species of waterfowl?

Drent and Daan (1980) classified some birds as "income" breeders. These rely on the daily intake of food to build their clutch of eggs. Most swallows, sparrows, and thrushes would be in this category. They classified others as "capital" breeders which do not feed at all during the development of yolks and the egg-laying period. They build their clutch entirely on deposits of fat, protein, and other materials stored in their bodies. Examples would be arctic-breeding Canada Geese (Branta canadensis), the Ross' Goose (Chen rossii), and the Lesser Snow Goose (C. caerulescens caerulescens). Owen and Reinecke (1979) further refined these categories by describing four strategies used by waterfowl which relate time and place to proportions of "income" and "capital" resources used for building a clutch.

Although not yet studied in detail, the Tundra Swan (C. columbianus) is probably a "capital" breeder. Being unable to feed upon arrival on its arctic breeding range, its produces its clutch entirely on energy stored in its body prior to reaching its nesting area. It follows that, having once used this energy, it has no resources left for renesting should the first clutch be lost.

Our studies of Mute Swans (C. olor) suggest that they use both "capital" and "income" energy for reproduction. For the purposes of this paper, I shall call them "combination" breeders. On the loss of their first clutch, many are able to feed heavily, restore their body reserves, and lay a second clutch.

It is likely that the original Trumpeter Swan stocks on the prairies and in the east were "combination" breeders. Captives certainly are, since they can produce replacement clutches on removal of the first. We need more data before we can classify the Alaskan stocks. Renesting of Trumpeters on the Minto Flats in 1985 may have taken place after the loss of the first clutch through flooding (Rod King, pers. comm.). More details are needed before we can rule out the possibility that the new nests contained continuation clutches.

Some Trumpeters winter on open water very close to their breeding grounds and arrive in their breeding range very early in spring. Arrivals at the Copper River Delta on 20 March, the Gulkana Basin on 15 April, and mid-April on the Kenai Peninsula (Hansen et al. 1971) suggest that body reserves are being accumulated very close to, or on the breeding grounds. If the birds are able to feed throughout the yolk development and laying stage of the breeding cycle, they can be considered to be "combination" breeders.

We must be careful not to classify a species dogmatically into one of these three categories. Most arctic breeding Canada Geese are clearly "capital" breeders, but the Giant Canada Geese (B. c. maxima), nesting in southern Ontario, are "combination" breeders (Mainguy and Thomas 1985). It is possible that various populations of Trumpeters belong to different categories.

What limits clutch size in Trumpeter Swans?

It is clearly maladaptive for a wild bird to lay more eggs than can be incubated. Waterfowl are probably indeterminate egg layers and are influenced in their subsequent production by the number of eggs already in the nest, among other factors. The first field test of this hypothesis, of which I am aware, was that of Andersson and Ericksson (1982). They found that if they put four eggs into wild, Common Goldeneye (Bucephala clangula) nests shortly after the clutch was started, the female laid significantly fewer subsequent eggs than a control group of females whose clutches were not manipulated. The experimental females adjusted their final clutch size to a given total number of eggs.

We carried out experiments in 1983-85 to see if Mute Swans would do the same. We placed four dummy eggs in Mute Swan nests before laying began. The pairs were randomly selected on the Toronto waterfront. We compared clutch size with a control group of Mutes which were left alone to complete their clutch normally.

The experiment was not a complete success because more than half the experimental pairs deserted their nests when the dummy eggs were added, and built a new nest close by. We then had to put dummies in the new nests, but, by then, often the females had begun to lay. The mean clutch sizes, ± one standard deviation, are given in Table 2.

Table 2. Mean clutch size in Mute Swans with four eggs added compared with normal clutches.

		Normal clutches	Experimental clutches
1985	First clutch	6.5±1.02 (N=15)	6.1±1.17 (N=8)
1983 & 1984	Second clutch	5.8±0.98 (N=10)	5.3±1.53 (N=12)

The differences are not significant (K-S test X^2=0.013, d.f. 0.33, P>0.05 and X^2=1.18, d.f. 0.33 P>0.05). The sample sizes are very small, however, and the trends are in the direction of the predicted smaller clutches in the experimental group.

What happens if the eggs are removed as they are laid so that accumulation of eggs has no influence on the total number laid?

In 1984, we tested the Mute Swans again with a randomly selected experimental group; the remainder formed the control group. In the experimental group, we left one dummy egg in the nest at all times to reduce the chance of desertion. The experimental pairs averaged 7.3±1.6 eggs (N=6), and the controls 6.25±0.83 (N=12) (K-S test X^2=0.05, d.f. 2.77, P>0.05). Again, the difference in the means in this experiment are not significant, but the trend of the experimental birds having larger clutches is compatible with the prediction.

There is anecdotal evidence in the avicultural survey of captives that Trumpeter Swans may lay more eggs than normal when their eggs are removed during laying. At the Delta Waterfowl and Wetlands Research Station, a 4-year-old Trumpeter, laying for the first time, produced eight eggs in 1986. The first two eggs were destroyed by a skunk (Mephitis mephitis). The female continued to lay in the same nest. Of the 15 4-year-old swans reported in the avicultural survey, and of the 22 first-time breeders, none laid eight eggs. It is possible that the loss of the first two eggs influenced the final clutch size.

The Kansas City Zoo took the first five eggs laid from their breeding pair of Trumpeters in 1984 and, again, in 1985. The female was left to continue laying and incubate the remainder of the clutch. She laid a total of 12, and 10 eggs, respectively, in these clutches. Of the 93 clutches recorded in the questionnaire, only one other pair produced 10 eggs. However, I had correspondence with Colby Wood about his pair which laid two clutches of 11 eggs each, in 1982. He apparently did not remove the eggs as they were laid.

Larry Gillette (pers. comm.), at Hennepin Parks, reported on a 15-year-old Trumpeter which laid 17 eggs in about 43 days in 1985. Intermittently, eggs were taken and replaced, so that at any one time she had seven eggs in the nest. The time span for these 17 eggs was 7 days longer than the 36 days it might take at the normal deposition rate of one egg per 2 days. The normal gap between clutches is probably at least 14 days. These 17 eggs can be regarded as a single clutch.

What is the potential clutch size for a swan?

To determine potential clutch size of a bird, one must examine the ovaries on completion of laying. One can then see, in the ovary, postovulatory follicles which have ruptured and given up their yolks to the oviduct. The number should equal the clutch size. One may also find resorbing follicles. These can be almost as large as a mature yolk. They are bluish-purple in colour instead of clear yellow as in an enlarging follicle and are soft and flaccid instead of firm.

Canada Geese on the Toronto waterfront averaged 1.4 resorbing follicles (N=28) (Thomas, pers. comm.). The arctic-breeding Lesser Snow Geese at La Perouse Bay averaged 0.35 to 0.06 resorbing follicles (Hamann et al. 1986).

Swans are strikingly different from these geese. The specimens, of which I have record, developed many more follicles than eggs they actually laid. We have examined two wild Mute Swans which were killed 5 and 8 days after they had completed, and we had removed, their first clutches. They had laid seven eggs each. One was resorbing five and the other four surplus follicles. Thus, they had the potential to lay 11 and 12 eggs. Each was enlarging seven new follicles for the second clutch. A captive Trumpeter died at Kortright Park after laying two eggs. She had 14 resorbing follicles and, therefore, had the potential for laying 16 eggs. David Thompson (in Tyrrell 1916) mentioned in his narrative of explorations in western America (1784-1812), finding 12 and 13 "eggs" "to the size of a walnut" in female Trumpeters he shot in spring. He comments, "but nine is the greatest number (of eggs) I have found in a nest."

This is evidence, although not as extensive as I would like, that swans may have a potential clutch size very much larger than the clutch they normally lay.

Why do swans lay fewer eggs than they appear to be capable of?

Incubation in most species of waterfowl, including Trumpeter and Mute Swans, is by the female alone. Daily recesses for feeding are usually few in number and are brief. As a result, females lose a large amount of weight during incubation. No matter whether she is a "capital" or "combination" breeder, a breeding female partitions her body reserves into a quantity for eggs and a sufficient allotment to tide her over the incubation period.

Hamann et al. (1986) examined body reserves in Lesser Snow Geese on completion of laying. They found that among females which had laid clutches of five eggs, some had resorbed follicles, and some had not. Of the birds which had resorbed follicles, carcass analysis showed that they had as high or, in most cases, higher body reserves than those that had not resorbed follicles. Had they gone on to lay another egg, however, their body reserves would have been severely depleted. Female Snow Geese, like many arctic-breeding species, cannot feed until close to the time when the eggs hatch. If a female has depleted body reserves, she is faced with a choice: she can continue incubation and, when she reaches the point of starvation, she can either desert and lose her production for the year, or she can risk dying on her nest. Harvey (1971) has shown that in some years with particularly bad weather during the incubation period, many Snow Geese do die of starvation on their nests. Presumably, environmental factors caused these birds to use up their reserves faster than normal.

Here we come to the second factor which limits clutch size in many waterfowl, including swans. They lay until they reach the threshold of body reserves which they must retain to see them through incubation. This factor may operate to limit the clutch before the first factor I discussed - the accumulation of eggs in the nest - cuts off further production. The loss of energy through enlarging more follicles than needed, and then resorbing them, is very small. The material from a resorbed follicle is recycled in the body and is used again. It is not wasted.

The Mute Swans on the Toronto waterfront, whose eggs were removed as they were laid, did not increase their clutch size to a significant extent, because they were probably near the threshold of body reserves required for incubation.

How did the Hennepin Parks Trumpeter manage to lay 17 eggs?

It seems likely that she was so well nourished that she took proportionately less of her body reserves for each, and was able to build her clutch largely out of her daily intake of food.

There is one other factor which may limit clutch size in waterfowl. A bird cannot put shells on a clutch of eggs out of the daily intake of food (Hazelwood in Farner and King 1972). This is because of the relatively low rate of absorption of calcium from food and the remarkably high rate of deposition in the shell. It seems that many species overcome this problem by storing calcium in the form of medullary bone during the yolk development phase of the breeding cycle. The Trumpeter Swan which died at Kortright Park had large deposits of calcium granules embedded in the marrow of her long bones. Not only are such calcium deposits used up during shell formation, but females may also withdraw calcium from their skeletons to provide the necessary materials. It is possible that a Trumpeter could be limited in the number of eggs she can lay by the amount of calcium available to cover them. It is, therefore, important to ensure that enough calcium in the form of oyster shell or lime-rich soil is provided.

How can we manage captive Trumpeters for maximum production of eggs?

There are two approaches which may be effective. The first has been tried by a number of breeders and seems to work, and the second needs testing.

1. We can double clutch the pairs by removing the first clutch as soon as it is complete. The ability of Trumpeters to renest may be influenced by the initiation and completion dates for the first clutch. It is possible that if the first clutch is not started until May, a second will not be produced. We need tests to determine the latest date that a second clutch can be started. The avicultural survey provided data on only seven pairs of Trumpeters which had been double clutched. The females were 4(1), 5(3), 6(1), and 8(2) years old (parens = no. females). Mean size for the first clutch was 7.0 eggs, and the second was 5.3 eggs.

2. We can remove eggs as they are laid, leaving one dummy or one egg in the nest at all times to reduce the chances of desertion. I want to stress that this technique has not been tested. There are some anecdotal indications that it may work. We need trials with many pairs over a period of years before we can be sure that it is a practical technique for increasing the productivity of Trumpeter Swans.

No matter what technique is used, care must be taken to ensure that the body reserves of the female are at a peak before laying and that the pair is given a first-class diet throughout the spring. The object should be to feed the bird so well that she can build a clutch largely out of daily intake of food, using a minimum of her body reserves for each egg.

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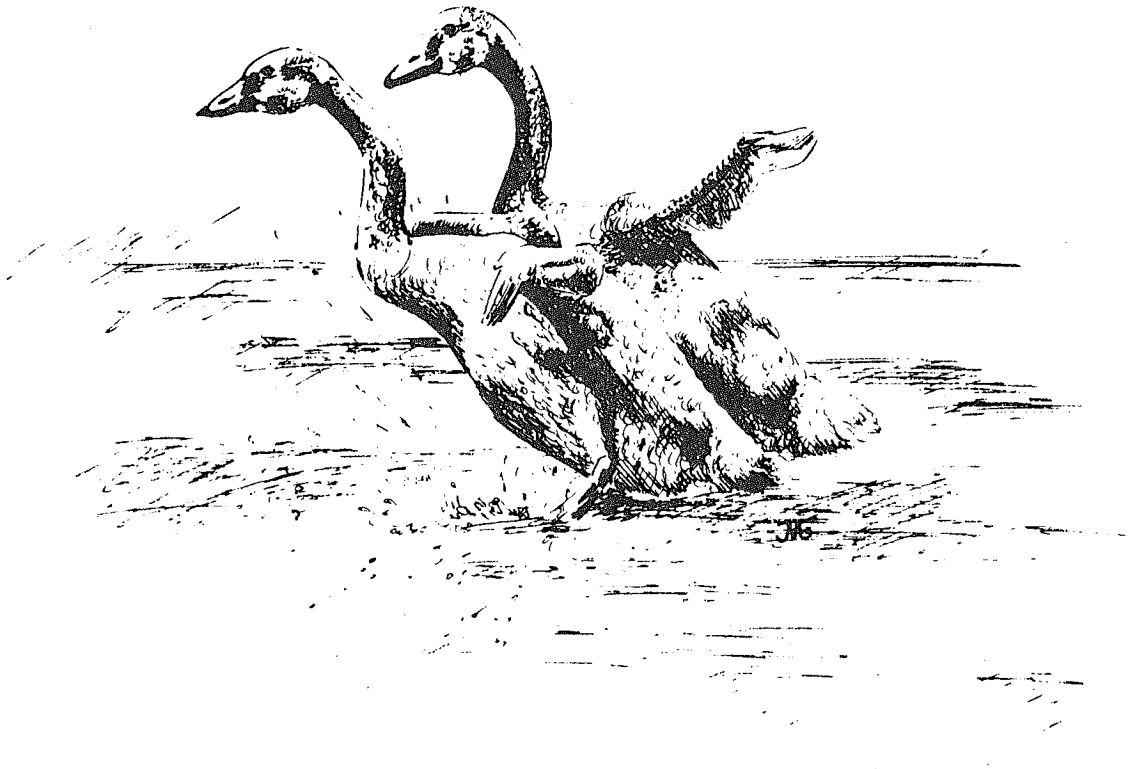

THE FOOD OF TRUMPETER SWAN CYGNETS IN ONTARIO

Harry G. Lumsden, Research Scientist, Ontario Ministry of Natural Resources

Cranberry Marsh

Most of our fostering work with Trumpeter Swans (Cygnus buccinator) in Ontario has been done in Cranberry Marsh, a 23-ha (57-acre) marsh near Whitby. This marsh is an ancient bay of Lake Ontario, cut off from the Lake by a barrier beach. There is no creek flowing in and no permanent outlet to the Lake. Drainage is by seepage through the gravel. Water depth depends on the levels in Lake Ontario which are currently in an all-time record height. When the Lake is low, the Marsh may almost dry up, and cattle grazed on its bed in the 1960's. Water levels are at a peak in spring and drop throughout the summer, the extent depending on rainfall.

It is an exceptional marsh in that, having no outlet, carp have never managed to enter it. The only fish present are bullheads and minnows. The absence of a creek means that there is no siltation and little pollution. There is some runoff of agricultural fertilizer and chemicals from adjacent farmland. Compared with adjacent marshes, the water is relatively clear, with little turbidity, and it has a relatively high pH, 7.4 to 8.8 recorded in 1977. It has an overwhelming abundance of macro-invertebrates (Lemay 1980). The absence of carp has resulted in luxuriant growth of submerged aquatic plants not seen in adjacent marshes where carp are present.

Cranberry Marsh has changed greatly over the years. In 1980, the dominant submerged aquatic was coontail (Ceratophyllum demersum), (Lemay 1980). In 1983-86, coontail was very scarce, and the Marsh was dominated by sago pondweed (Potamogeton pectinatus), and the pondweed P. pusillus. The curly-leafed pondweed (P. crispus), was present in small patches. In 1977, the Marsh was only sparsely covered by duckweed (Lemna sp.), in July, but it covered almost the whole marsh in fall. In recent years, duckweed has been abundant only round the edges in late summer and fall.

We have seen substantial change in the productivity of Cranberry Marsh between 1983 and 1986. In 1983, the pondweeds remained dense all summer and flowered profusely. The swans and about 35 duck broods fed heavily on the blossoms. There were about 15 Black Tern (Chlidonias niger) nests, a brood of Pied-billed Grebes (Podilymbus podiceps), and up to 42 Mute Swans (C. olor) which summered and molted in the marsh. In 1984, there were only about 15 duck broods and no Black Terns or grebes. The pondweeds did not flower, died down in midsummer, and no Mute Swans moved in to molt. In 1985, there was recovery with 15-20 duck broods and two pairs of Black Terns. The pondweeds flowered sparingly, but died down in midsummer. 1986 saw substantial recovery to the 1983 levels of duck broods and terns. The pondweeds flowered well but died down again in midsummer; consequently, no swans moved in to molt. With these changes in productivity the food habits of the swans changed.

In 1983, the broods of Trumpeters fed predominantly on the rich beds of pondweeds occasionally moving to the shore to feed on emergent species. In 1984-86, when the pondweeds died down in midsummer, they moved to the edges of the marsh to feed on duckweed, the alga (Spirogyra sp.), arrowhead (Sagittaria latifolia), and occasionally bur reed (Sparganium americanum). They also used beggartick (Bidens cernua), growing on the mud near the center of the Marsh.

METHODS

The diet of Trumpeter cygnets at Cranberry Marsh was determined by observation through binoculars or a telescope. This technique gives a tally of only the most visible and commonly eaten species. In 1983 and 1984, collections of food plants were made at many locations round the Marsh and particularly within the home range of Trumpeter broods. They were combined to give mean values. In 1985 and 1986, collections were made at six stations arranged systematically round the Marsh. Emergent species and duckweed were collected at adjacent points on the shore.

Having no money for analysis, we have had to restrict our collections and have depended on the generosity of the Tree Improvement and Forest Biomass Institute Laboratory at Maple. We here express our gratitude. Analyses were done for 10 elements by atomic absorption. Nitrogen levels were measured using the Kjeldahl method and converted to percent crude protein with the factor 6.25.

RESULTS

The results of the analyses are presented in Table 1.

Table 1. Percent crude protein in swan foods in Cranberry Marsh, Ontario.

Species	1983 29 June	1983 26 July	1984 16 August	1985 11-12 June	1985 29 July	1986 15 July
Potamogeton pectinatus	28.8	21.5	19.6	18.2±3.2	20.2±4.9	20.1±3.5
Potamogeton pusillus	--	--	--	--	--	18.9±5.0
Potamogeton crispus	19.5	--	19.0	20.2±4.0	--	15.9±0.7
Potamogeton sp. flowers	--	--	--	23.2	--	--
Sparganium americanum	--	--	43.2	--	--	--
Sagittaria latifolia	--	--	--	36.5±2.6	33.5±4.4	33.5±1.4
Bidens cernua	--	--	33.75	--	--	--
Lemna sp.	13.2*		15.2	25.3±47.7	17.0±2.5	17.8±5.1
Spirogyra sp.	--	--	22.7	14.8±3.9	15.9±2.7	18.5±12.4
Cladophora sp.	--	--	--	17.4(Feb.)		--

* Insufficient sample in June, combined with July sample.

DISCUSSION

Crude protein content of most of these swan foods is high and is at, or well above, the recommended levels in artificial foods. The fiber content of aquatic plants is low, so that most of the crude protein is digestible. Most herbivorous birds do not feed at random on the plants available to them - they select the best. Experiments with Canada Geese (Branta canadensis) showed that they discriminated among fertilized plots of grass, feeding very heavily on those containing the highest levels of protein (Lumsden unpublished). Table 1 gives the standard deviations of the means for each species for 1985 and 1986. These indicate that variance is relatively high. If the swans are feeding like the geese, and taking the best available, their diet, as far as protein intake is concerned, is probably excellent. In 1985, when collections were made about the time the Trumpeter cygnets hatched on 11-12 June and, again, on 29 July, there was no change in protein content of most of the foods checked. However, the protein content of duckweed did drop significantly in July.

Protein in Spirogyra is generally rather high, but variable. This may be because many invertebrates are trapped in the filamentous mass. They are eaten by the swans with the algae and, therefore, have been analysed together. Only in 1984 were they removed.

The winter diet is composed mostly of the alga Cladophora sp., and some swans accept handouts of bread and grain from the public. The Cladophora grows most abundantly on the rocks and breakwaters near sewage outfalls. Perhaps that accounts for the high protein content.

Ontario Place

Sometimes, cygnets can get into trouble with imbalances in their diet. In 1982, we chose to foster two Trumpeter cygnets on a pair of Mute Swans in a park at Ontario Place. There they were under surveillance at all times. We thought that for our first trial we would use the opportunity to detect incompatibilities between the species. The brood left the nest area 2 days after hatch and would not return for the crumble ration put out for them.

Ontario Place had an aquatic weed problem in their channels and ponds. Thus, we were not particularly concerned about food availability because of this abundance of natural food. However, the cygnets grew more slowly than captives at Kortright Park and wild Alaska cygnets (Hansen et al. 1971). On 21 August, at 57 days of age, one cygnet was found to be unable to stand or walk. She was taken to the Veterinary College at the University of Guelph and treated at Kortright Park. She was diagnosed as suffering from rickets. By 30 August, she was responding to treatment and was returned in late September to the brood which was then ranging widely on the Lake Ontario shore.

We sampled the most abundant aquatic plants at two sites most frequented by the swans in Ontario Place. Crude protein levels in sago and curly-leafed pondweed, waterweed (Elodea canadensis), milfoil (Myriophyllum sp.), and coontail, were generally within the range or slightly below the levels at Cranberry Marsh. Most striking, however, was the gross imbalance between calcium and phosphorus. Research on poultry feeds suggests that there should be a ratio of calcium:phosphorus of 1.67:1 total phosphorus or 2.2:1 based on available phosphorus (Schaible 1970). The ratios for total phosphorus in aquatic weeds are given in Table 2.

Table 2. Calcium:phosphorus ratios at Ontario Place and Cranberry Marsh, Ontario.

Species	Ontario Place		Cranberry Marsh
	Site 1	Site 2	
Myriophyllum sp.	120.2:1	89.3:1	2.6:1
Ceratophyllum demersum	4.6:1	-	-
Elodea canadensis	21.8:1	9.3:1	-
Potamogeton sp.	31.8:1	-	5.8:1
Potamogeton crispus	9.9:1	10.6:1	11.2:1
Sagittaria latifolia	-	-	1.6:1
Lemna sp.	-	-	5.1:1
Spirogyra sp.	-	-	4.4:1

There is a striking difference in the ratios between Ontario Place and Cranberry Marsh. Ontario Place is a landfill site composed of cement, bricks, mortar, and subsoil. It has little or no water circulation from phosphorus-rich Lake Ontario. The male sibling of the female suffering from rickets was apparently unaffected by the imbalance in his diet. He weighed 9.2 kg (20.2 pounds) on 19 April 1983 and 11.6 kg (25.6 pounds) on 24 August 1984. While the ratios in Cranberry Marsh are generally higher than those recommended for poultry, the Trumpeter cygnets there grow well and show no signs of a dietary imbalance.

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BIONERGETICS OF WINTERING TUNDRA SWANS IN THE MATTAMUSKEET REGION OF NORTH CAROLINA

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ABSTRACT

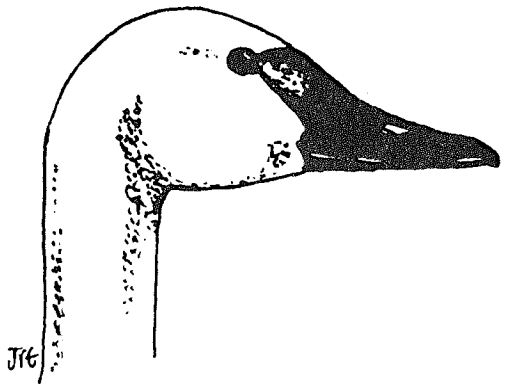
Energetics of Tundra Swans (Cygnus columbianus columbianus) wintering in the Mattamuskeet region of North Carolina were evaluated by studying the dynamics of body weights, carcass composition, time-activity budgets, and food habits during the winter of 1983-84.

Swans lost weight throughout the winter. Most internal organs did not decrease in weight when considered as a proportion of body weight. Significant decreases in weight were primarily due to loss of lipid reserves. Nevertheless, swans primarily existed on energy derived from foods and not stored reserves during the winter.

Time-activity budgets were affected by habitat type, wind speed, time of day, and season. Feeding activity did not vary during the season, but was different between habitats. Levels of feed activity were probably different due to the lower energy content of foods in the marsh habitat. There did not appear to be a shortage of food, so food availability did not cause the weight loss.

Use of lipids over protein reserves appears to be an adaptation to the unpredictable nature of winter weather. Weight loss over the winter is probably an adaptation to decrease tissue maintenance costs and to decrease wing-loading during spring migration. Since swans leave the wintering areas at low weight and with few reserves, their reproductive success may be dependent on nutrients accumulated at intermediate latitude, staging areas.

If this pattern of weight loss is shared by Trumpeter Swans (C. buccinator), then the swans nesting at Red Rock Lakes National Wildlife Refuge may be severely limited by the lack of late winter-early spring habitats that provide adequate food supplies. The swans, therefore, could not accumulate the energy reserves necessary for egg formation and completion of incubation.



Tundra Swan
(Cygnus columbianus)

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