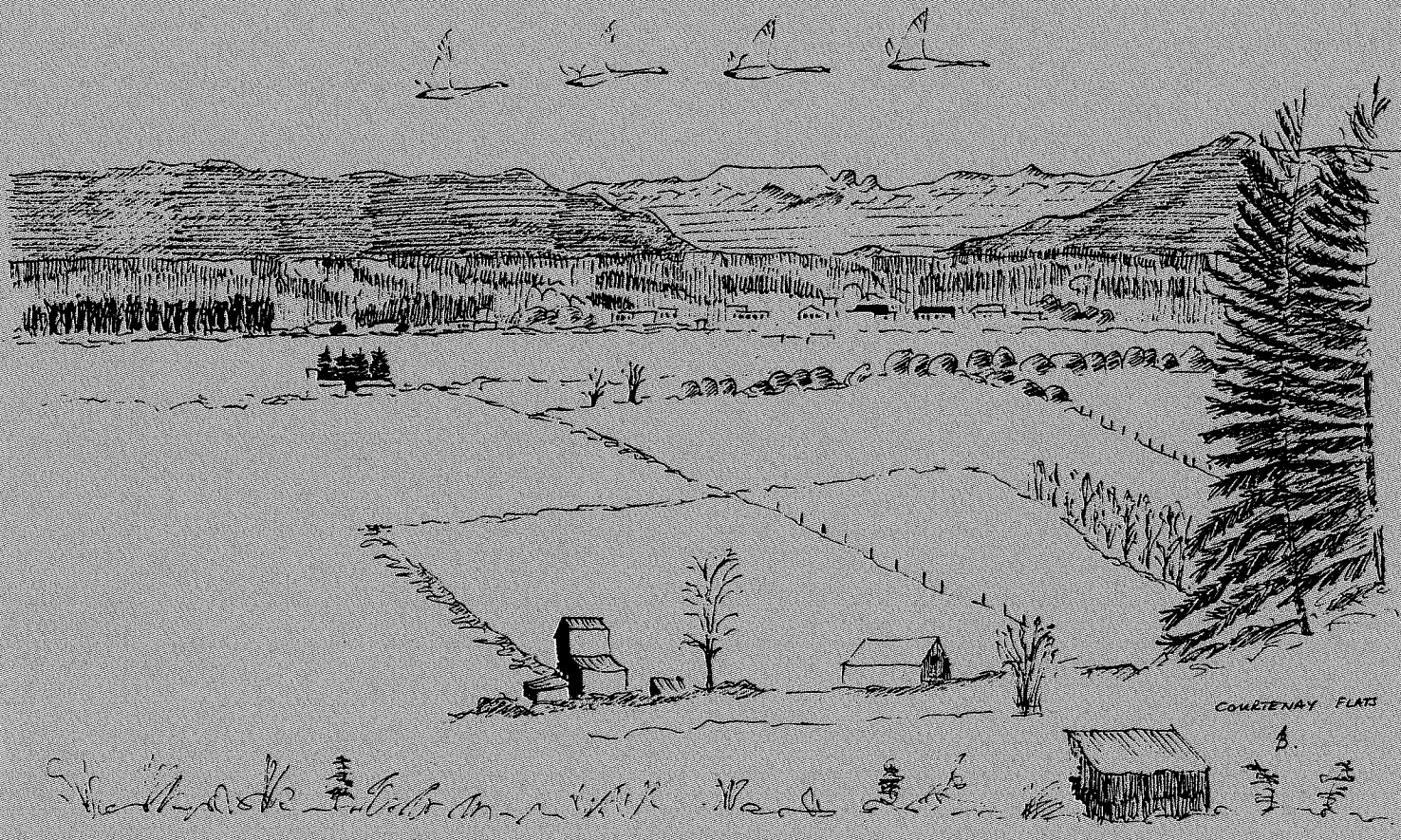
PROCEEDINGS AND PAPERS OF THE FOURTEENTH TRUMPETER SWAN SOCIETY CONFERENCE

Trumpeter Swans -- An Asset or a Liability?



3-6 February 1993
Courtenay, British Columbia

Donna C. Compton
Madeleine H. Linck
Harvey K. Nelson
and
Janissa R. Balcomb

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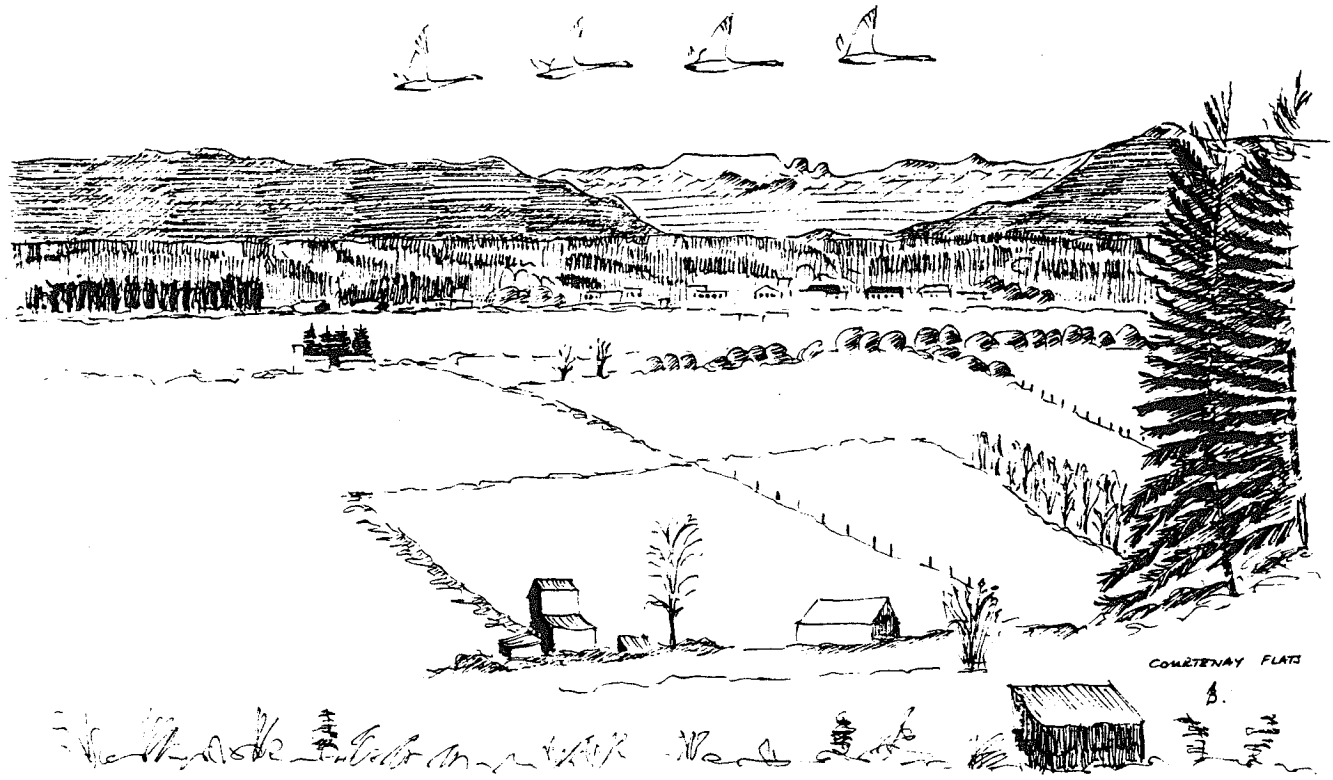

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Conference Sponsors

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PREFACE

It was a great pleasure to meet in the Comox Valley on Vancouver Island in British Columbia, one of the world's most glorious places and we are greatly indebted to the Comox Strathcona Natural History Society for inviting us there.

As many of you know, I have spent hundreds of hours in the air during the past 35 years, tracking the remarkable increase of the Alaska nesting Trumpeter Swan population as it grew from near 1,000 to over 13,000 birds. I have looked at every lake from Juneau north to the Brooks Range and from the Canadian border west to the tree line at the edge of the Tundra Swan habitat, not once, but many times. This area is largely unbroken wilderness, much of it not even bothered by the ice sheets that covered so much of North America in the past. For a long time we remained mystified as to what had released these Trumpeters after World War II, allowing for such rapid increase. We are now convinced that it was learning to winter on the lush farm lands of southwest British Columbia and western Washington that so improved the productivity of the Alaskan swans. So it was particularly fitting that we met in the heart of the best Trumpeter Swan wintering habitat.

The Comox Valley, on Vancouver Island in British Columbia, is the winter home for more than 1,000 Trumpeter Swans. The birds have an impact on the people living in the valley, as both an asset and a liability. Having adapted to feeding in the winter agricultural fields, the swans cause some crop depredation. However, Vancouver Island is an attractive residential, retirement, and winter tourist center, and the birds provide an important attraction.

Balancing the needs of humans with the needs of wildlife is a challenge of today's world that we cannot ignore. How can Trumpeter habitat be adequately protected as human populations double and swan populations increase as well? Can swan managers find ways to promote this species which will be compatible with other land uses? What can be done to balance the crop losses suffered by farmers because of swans with revenue received by the rest of the community, also because of the swans? How important are Trumpeters to the region?

This sort of meeting is a credit to the progress of our civilization where we, a dominant species, are debating how to make a place for another species which we do not intend to eat, within our habitat, and keep it wild and free, a benefit to everyone and a burden to none. I am confident that the ideas and concepts developed at the conference will benefit not only the Trumpeters, but our own and future generations of North Americans.

Jim King
President

ACKNOWLEDGEMENTS

As Program Chair, I would like to thank all those who put so much effort into the organization and delivery of the Conference. The Conference would not have happened without the dedication of the Comox-Strathcona Natural History Society and Ducks Unlimited. Special thanks go to those I worked with directly from the Natural History Society, Barbara and Don Sedgwick, Marian and Doug Innes, and Margaret Clayton, and to Graeme Fowler from Ducks Unlimited. Special thanks also to the farmers who took time from their busy schedules to explain their concerns to the Conference participants.

Richard W. McKelvey
Program Chair

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On behalf of the Comox-Strathcona Natural History Society, I should like to thank all the people who worked so hard and with so much enthusiasm to make the 14th Trumpeter Swan Society Conference a success. In particular, the members of my committee:

Advertising and press	Margaret Clayton
Coast Westerly	Marian Innes
Treasurer and registration	Fran Johnson and Helen Robinson
Schools and displays	Jean Hudson and Pat Smith
Banners, pins and t-shirts	Betty Lunam
City Hall and general liaison	Don Woodcock
Ducks Unlimited-Canada	Graeme Fowler

Special thanks are due also to the two Pats; Pat Gould and Pat Levitt manned the sales table and dealt successfully with mixed and matched currency! Pat Gould merits an extra plaudit as the emcee for the banquet.

Club members helped as gophers, drivers, artists and field trip leaders. They put up and manned mall displays and gave generously of their time and expertise.

The Conference was a success not only because of the efforts of the Natural History Society, but because of the contributions, help and participation of many local individuals, businesses, and governments, both local and Provincial. Our thanks to Mr. Ron Bannerman, Schools Coordinator; Mr. Dan Bowen, Ministry of Transportation and Highways; Dr. Alan Burr, Canadian Wildlife Service; Jennifer Hilt, Bruce Scheltgen and staff, Coast Westerly Hotel; Mayor Webber and Council of the City of Courtenay; Comox Centre Mall; Comox Valley Chamber of Commerce; Comox Valley Farmer's Institute; Courtenay Youth Music Camp; Driftwood Mall; Ducks Unlimited-Canada; Federation of British Columbia Naturalists; Franklin Electric; Hi-Lo Transportation; Mr. Dan Patrick and class, Highland School; Mr. Bud Jacobs, British Columbia Hydro; Mr. Stan Jensen, City of Courtenay; Mr. Bruce Thompson, Superintendent School District 71; Gordon and Darlene Weir; Marianne Muir, Wilsden Galleries; Ms Heather Thomas, Mr. Charles Western and classes, Vanier High School; Video Wave Productions; all participating elementary school students and, finally, the Comox District Free Press, The Record, The North Island News and Comox Valley Cablenet, for their coverage of the event.

Barbara Sedgwick
Conference Coordinator for Comox-Strathcona Natural History Society

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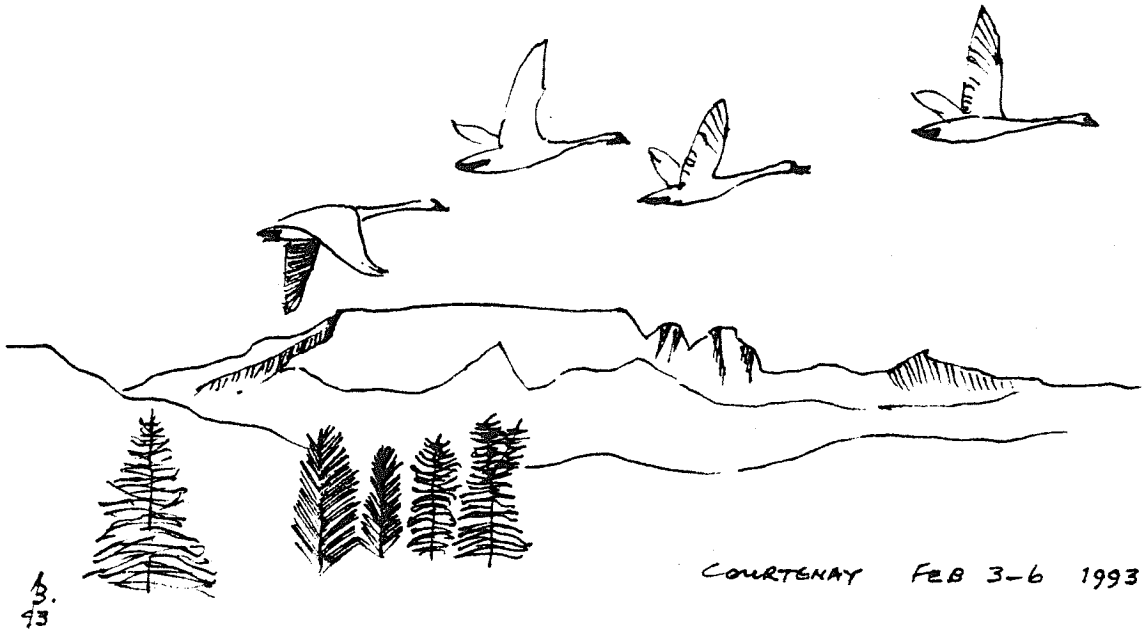

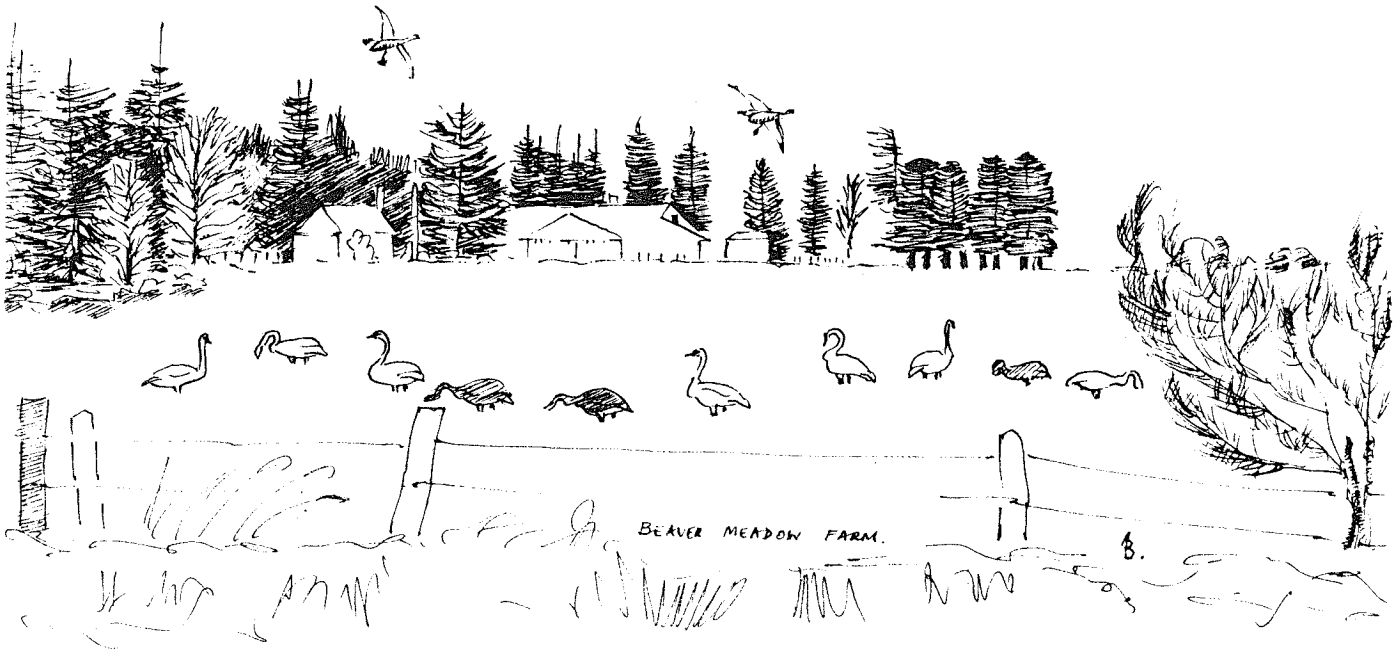
BEAVER MEADOW FARM.
B.

PACIFIC COAST TRUMPETER SWANS IN THE 21ST CENTURY

James G. King, 1700 Branta Road, Juneau, Alaska 99801

ABSTRACT

The Alaska/Yukon nesting Trumpeter Swans have roughly doubled in each of the last three decades from 1124 in 1959 to 13,459 in 1990. Continued three more decades there could be more than 100 thousand. In response to this potential, we should: 1) inventory potential agricultural and estuarine wintering habitats, 2) zone habitat for where wintering swans would be desirable and where not, 3) plan for appropriate Trumpeter use of farmland, 4) enhance "protection" zones, 5) apply harassment in other zones as needed, 6) create observatories where swans can feed undisturbed near concealed crowds, 7) develop appropriate education programs around observatories and 8) encourage associated businesses so Trumpeters can become a financial asset rather than a burden.

The Alaska/Yukon nesting Trumpeter Swan population has roughly doubled in each of the last three decades from 1124 reported in 1959 (Hansen et al. 1971) to 13,459 in 1990 (Bortner 1993). This increase has coincided with the swans adapting to winter feeding on the farmlands of western Washington and British Columbia. Nourished on waste corn, potatoes, carrots, also winter cover crops and pasture grasses (Wareham 1992) they return to the northern nesting regions in peak condition, which leads to peak production. Should the trend continue for the next three decades there would be more than 100 thousand birds in this population. This is not a prediction, but it is a mathematical possibility. And what of the three decades after that? There is still plenty of vacant nesting habitat. Realistically, we can expect that the population will level at some point and perhaps even decline.

What we can predict is that as swans increase, farmland conflicts will build. If we fail to plan now, we can foresee endless meetings, news media frolics, emergency actions, unbudgeted expenses, perhaps lawsuits and so forth. The false economy of no action will shift to the high cost of crash programs.

Trumpeter management in the Northwest will be more than a local issue, for these great white birds are part of the wilderness fauna of two national forests, four national parks, six national wildlife refuges and eight state wildlife refuges in Alaska as well as one national park in Canada. Canadians and Americans across the continent will be watching.

The problems of northwest Trumpeter management for the 21st century are not nearly as complex as for most species. Much of the nesting habitat is well protected. The Alaska Trumpeters are in essence telling us what they need in winter. An ideal solution is possible because the swans are primarily interested in otherwise productive farmland, much of which lies idle during the 4 months they want to be there. Recent experiments in Canada have shown that swans can be discouraged from using areas where they are not wanted.

Eight steps we could take now are:

1. Inventory the agricultural and estuarine habitats suitable for wintering Trumpeters in the Northwest.

2. Zone the habitat for where swans could be safe and welcome, and where not, thus creating a system of "protection" and "harassment" zones.

3. Make swans an economic asset for farmers by helping them plant crops that are enhanced by swan use or by helping them plan swan related visitor facilities for which people would want to pay.

4. Enhance the protection zones by discouraging disturbance and providing

appropriate crops and water. Sanctuaries could be developed and either publicly or privately managed under a variety of concepts.

5. Apply harassment as needed. With adequate protected space available, minimal harassment should take care of any conflicts.

6. Develop observatories where wild swans can feed undisturbed within a few feet of crowds of people concealed in good buildings as has been done so successfully by The Wildfowl Trust in England.

7. Develop appropriate educational programs around the swan viewing installations.

8. Encourage associated businesses so Trumpeters can become a financial asset rather than a burden to society.

The people of North America decided some decades past that they want to sàve Trumpeter Swans. Some progress has been made, but the job is not done yet. This is a challenge for those in the field of wildlife management and a test of the commitment of the public at large. Can 250 million North Americans make a place for a hundred thousand odd Trumpeter Swans, wild and free?

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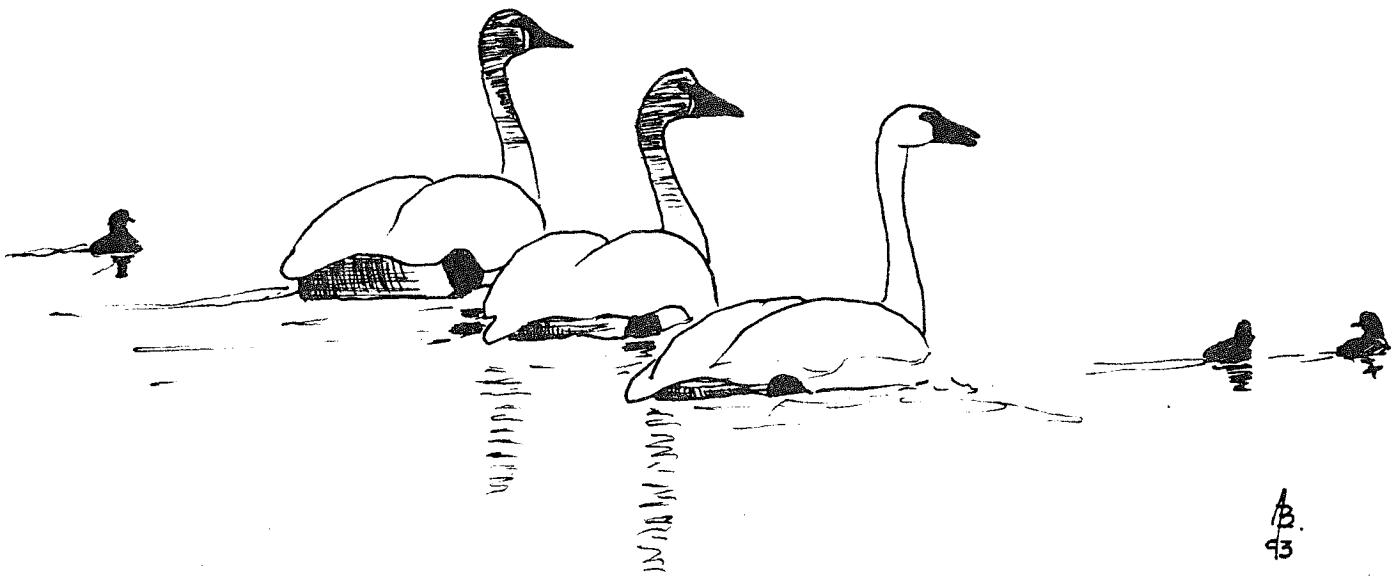

A POTENTIAL SUMMER POPULATION OF TRUMPETER SWANS (CYGNUS BUCCCINATOR) FOR ALASKA

Bruce Conant, John I. Hodges, Deborah J. Groves and James G. King, U. S. Fish and Wildlife Service, Migratory Bird Management, 3000 Vintage Blvd. #240, Juneau, AK 99801

ABSTRACT

Alaska continues to accommodate a rapidly expanding summer population of Trumpeter Swans (Cygnus buccinator). This population has grown from 2,847 in 1968 to 13,337 in 1990 and is expected to continue to increase. Two methods were used to estimate how much more growth might be expected. Figure 1 shows the result of fitting the numbers of white swans from the past five censuses in Alaska to a logistic growth curve. It suggests a leveling off of this component of the population at 34,000 by the year 2050. In the second method, each 1:63,360 scale U. S. Geological Survey census map together with a graph of paired swans from past censuses were perused for the potential for paired swans, considering current habitat utilization and availability. Figure 2 shows an expected 19,000 paired swans by the middle of the next century with this method. The historical percentage of white swans from the census populations recorded in the paired condition [.68 (range .62-.72)] was then applied to each respective population component. A juvenile factor of .30 was added to yield a possible total summer population of 49,000 by the curve method and 40,000 with the map method (Table 1). With 45,000 mi^2 (117,000 km^2) of habitat available and the absence of other limiting factors, we might expect the 2050 census to find one Trumpeter Swan per mi^2 summering in Alaska.

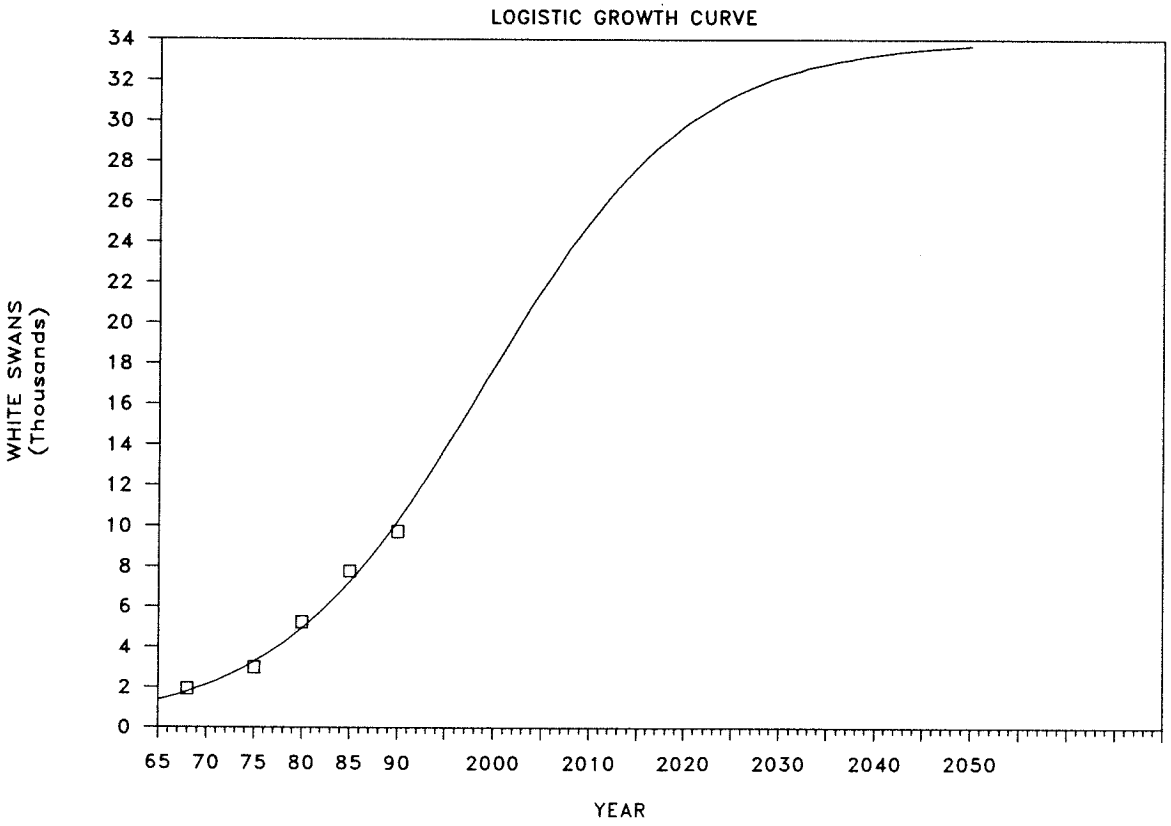

Figure 1. Potential white phase Trumpeter Swans summering in Alaska from past census data fitted to a logistic growth curve.

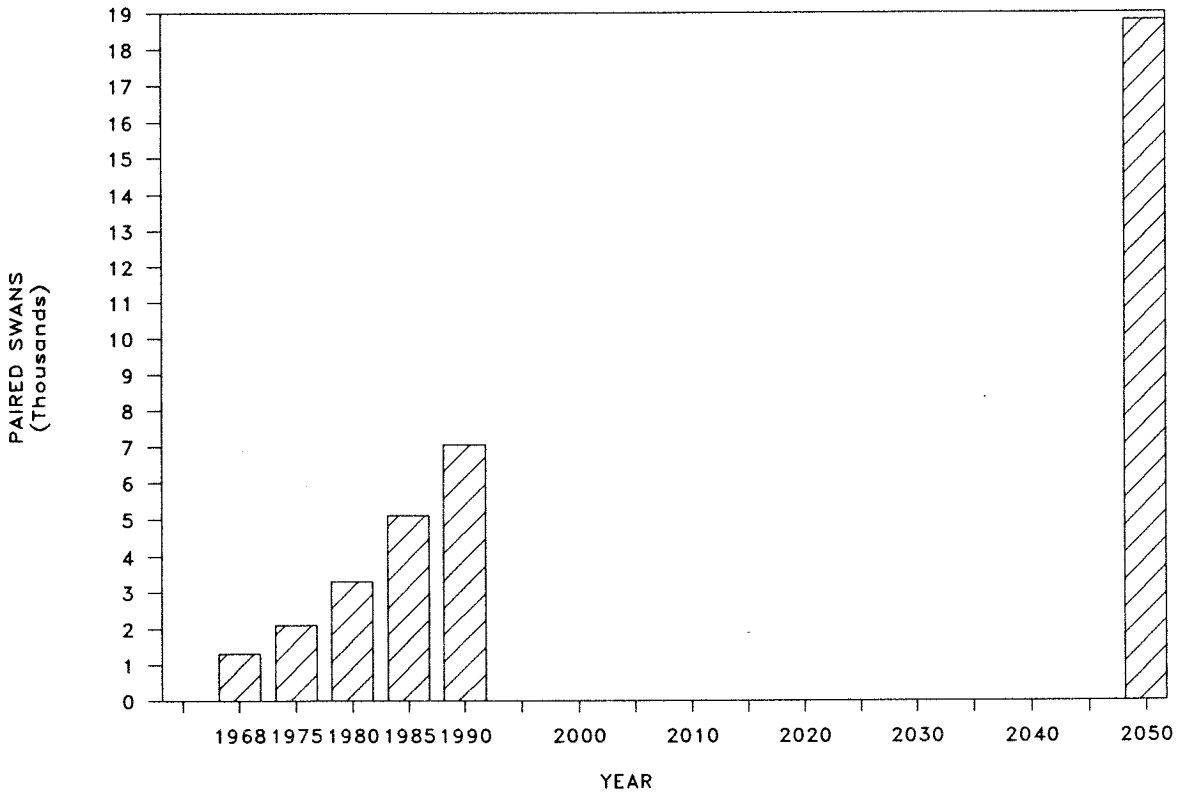

Figure 2. Potential paired white phase Trumpeter Swans summering in Alaska from past census data and using the map method of analysis.

Table 1. Comparison of potential populations of Trumpeter Swans summering in Alaska from logistic growth curve and map methods of analysis (in thousands).

Swans	Curve method	Map method
White	34	28
Paired (.68)	23	19
Juvenile (.30)	15	12
Total	49	40

EXPANSION OF TRUMPETER SWANS IN THE UPPER TANANA VALLEY, ALASKA

Terry J. Doyle, U. S. Fish and Wildlife Service, Tetlin National Wildlife Refuge, P.O. Box 779, Tok, AK 99780

ABSTRACT

The history and demographics of Trumpeter Swan expansion in the Upper Tanana Valley (UTV) was studied from 1982-92. Data on population trends and nest/brood survival was obtained by conducting aerial surveys of all wetland habitat within a 4,662 km^2 area. Banding of flightless swans was conducted in 1983-84 and 1989-92 to identify wintering areas and territory fidelity on the breeding ground. The first breeding record of Trumpeter Swans in the UTV was in 1982. Since that time the population has increased an average of 25 percent each year making it the fastest growing population in Alaska. Annual establishment of new breeding territories and a large proportion of nonbreeding pairs indicate a potential for further expansion. To date, 107 Trumpeter Swans have been neck banded. Twenty-seven individuals have been resighted a total of 101 times including: 19 individuals on the wintering grounds of Vancouver Island, the Skagit Valley and south coastal Washington, eight on the breeding ground, and two during migration. This population should continue to expand contingent upon favorable weather conditions and suitable winter habitat.

INTRODUCTION

The Upper Tanana Valley (UTV) is recognized as an important migration route for Trumpeter and Tundra Swans migrating into and out of Alaska to and from the Yukon Territory (Cooper et al. 1991). It is only recently that Trumpeter Swans have nested in the UTV. In the late 1950's and early 1960's there were reports of flightless Tundra Swans near Tetlin Village during the summer, but not Trumpeter Swans (Yocom 1963, Jim King, pers. comm.) In 1980, the nearest breeding Trumpeter Swans were located in the upper Copper River basin, 51 km southwest of the study area. The closest other breeding records were 100 km southeast in the Yukon Territory and 142 km northwest in the lower Tanana Valley. The first documented breeding record of Trumpeter Swans in the UTV was in 1982. Annual surveys have been conducted since 1982, providing a unique opportunity to document the expansion of this population from its inception.

The objectives of this study are to describe the history of Trumpeter Swan expansion in the UTV; quantify demographic aspects of the population, including the composition of the population, territory establishment and success, and egg and brood survival; and summarize the results of our banding activities.

STUDY AREA

The UTV is located in east central Alaska at the head of the Tanana River (Figure 1). The study area includes all wetland areas of the Tanana River basin upstream of the Robertson River confluence. This area includes approximately 4,662 km^2 of wetland habitat bordered to the northeast by the rolling hills of the Tanana-Yukon Highlands dissected by the Forty Mile River, to the west by the Mentasta Mountains of the Alaska Range, to the south by the Nutzotin Mountains of the Wrangell Mountains and to the east by the Yukon Territory.

The vegetation is typical of much of interior Alaska. Upland vegetation is boreal forest consisting primarily of black and white spruce (Picea mariana and P. glauca) with trembling aspen (Populus tremuloides) and birch (Betula papyrifera) in burned areas and balsam poplar (P. balsamifera) along water courses. Within the study area, are thousands of waterbodies ranging from <1 ha to several square kilometers in size. Elevation of wetland habitat ranges from 460 m, in the lower end of the valley to 809 m in the upper end.

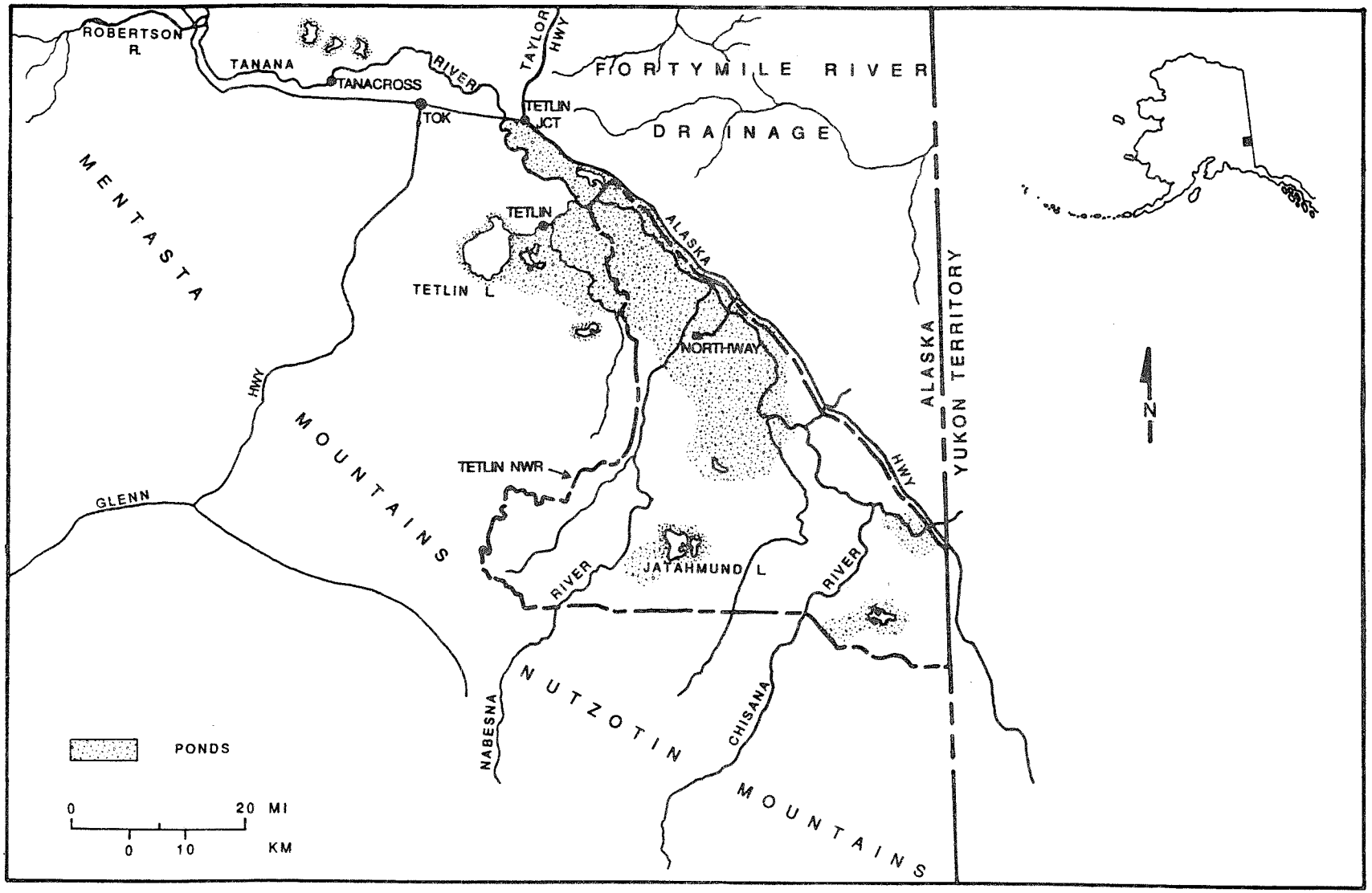

Figure 1. Location of Trumpeter Swan study area in the Upper Tanana Valley, Alaska.

METHODS

Data on population trends and nest/brood survival were obtained by conducting aerial surveys in a PA-18 Super Cub or Cessna 172 with at least one observer (King 1973). All swan locations were recorded according to a standardized protocol (Anonymous 1991).

Nest surveys were conducted from 1988-92 in late May or early June during incubation. Only active territories (historical brood or nest locations) from previous years were searched during the nest survey, although new active territories were sometimes found while in transit between historical territories. Clutch sizes were determined in 1990-92 by making a low pass over a subset of active nests.

Early brood surveys were conducted from 1990-92 soon after all nests had hatched. Only active territories located during the nest survey were searched for early broods, although broods were sometimes found in between previously found active nests.

A comprehensive survey of all waterbodies in the study area was conducted in late summer (late August/early September) of 1980, 1982, and 1985-92; with partial surveys conducted in 1983 and 1984. The late summer survey was used to make annual population comparisons.

Nest success and egg survival were determined by comparing the nest survey to the early brood survey for each active territory. Early brood survival was determined by comparing the early brood survey to the late summer survey for each territory. Late brood survival was determined by comparing the late summer survey to cygnet observations during banding activities in September. In all cases, a subset of active territories was used in the survival calculations.

Trumpeter Swans have been neck banded in the UTV as far back as 1983. The primary objective of the banding effort has been to document the wintering ground of this population. Secondary objectives have been to document site fidelity of adults to breeding territories, site fidelity of subadults to the natal ground, age and location of breeding territory establishment and to collect blood for genetic analysis. Flightless swans were captured using a long handled dip net from the float of a PA-18 Super Cub or Cessna 185. We attempt to capture all cygnets from a given brood.

RESULTS

The number of Trumpeter Swans in the UTV expanded an average of 25 percent each year from 56 in 1982 to 427 in 1991 (Figure 2, Table 1) making it the fastest growing population in Alaska (Conant et al. 1992). The mean exponential rate of increase from 1982 to 1991 was r=.23. The rate of increase in 1991 was 10 percent and the population decreased slightly in 1992. A closer look at the number and proportion of swans in various reproductive classes further describes the population trend.

Cygnet production has increased from 12 in 1982 to 184 in 1990 (Table 1, Figure 3). The smaller population increase in 1991 and slight decrease in 1992 can be attributed to a decline in cygnet production during those years.

Cygnets have made up the largest percentage of the population in 5 of the 9 years that complete surveys have been conducted; cygnets ranged from 21 percent of the population in 1982 to 47 percent of the population in 1990 (Figure 4). Cygnets did not make up the highest percentage of the population in 1982, 1987, 1991 and 1992.

The number of swans in pairs without young is the second largest grouping (Table 1, Figure 3). The percentage of swans in pairs without young tends to mirror the percentage of cygnets in the population (Figure 4). The percentage of swans in pairs without young varied greatly in the early 1980's with the highest percentage in 1982 when percentage of cygnets in the population was lowest. There was a steady decrease in the percentage of swans in pairs without young from 1987-90 coinciding with the rapid expansion phase of the population. The percentage has increased in 1991 and 1992 as the number and percentage of cygnets decreased.

The number of flocked swans was the third largest grouping (Table 1, Figure 3). The

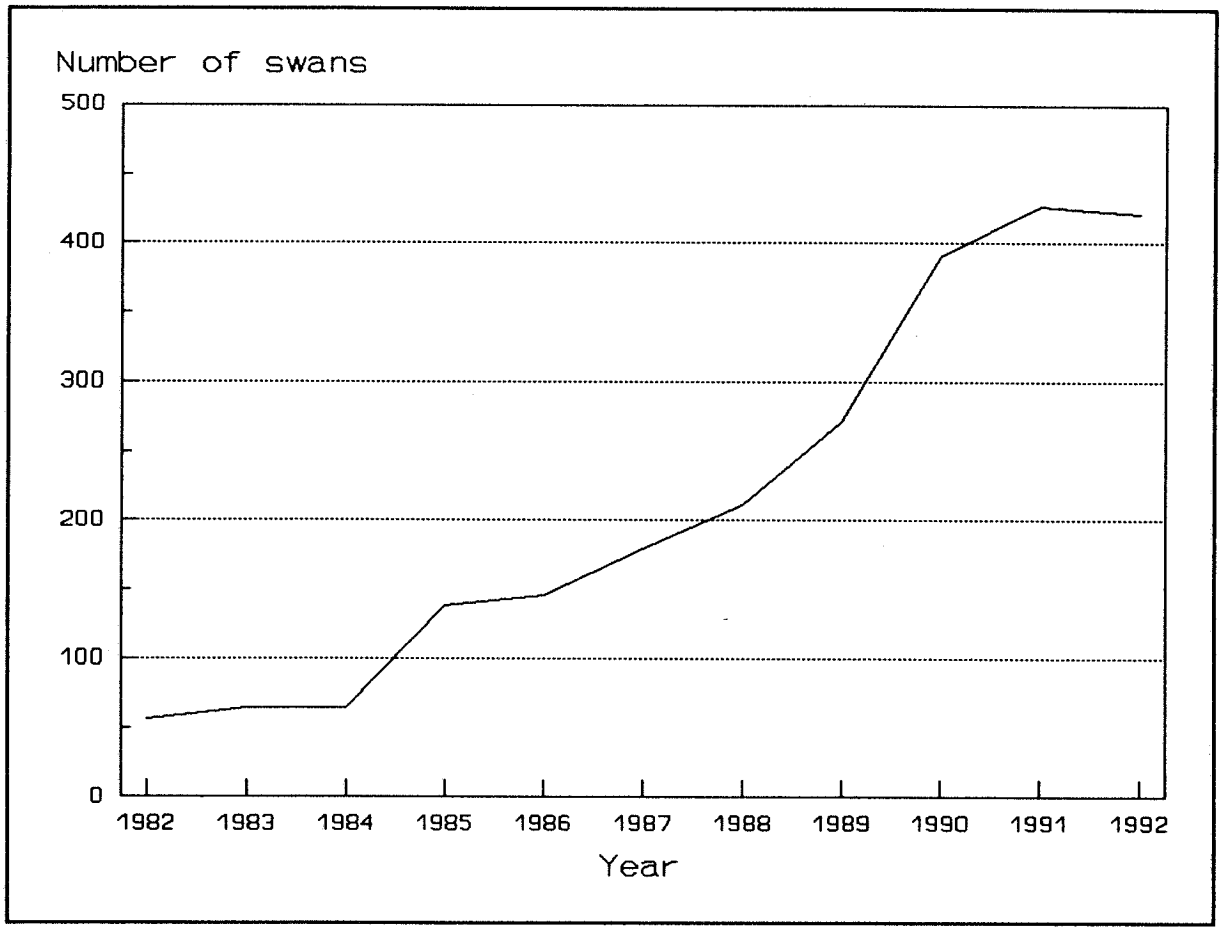

Figure 2. Total number of Trumpeter Swans recorded during the late summer census in the Upper Tanana Valley, Alaska, 1982-1992.

percentage of flocked swans gradually decreased from 1982 to 1990 jumping up to 30 percent in 1991 making up the highest proportion of the population (Figure 4). The 1991 increase in flocked swans probably reflects the large number of cygnets produced the previous year.

The number of swans in pairs with young made up the smallest percentage of the population next to singles (Table 1, Figures 3 and 4). The only year in which pairs with cygnets out numbered pairs without was in 1990, the year of greatest cygnet production.

Territory establishment, activity and success

Territory establishment and success help explain why cygnet production decreased in 1991 and 1992. To date, 68 distinct territories have been identified where either a nest or brood have been observed (Table 2). The number of territories has increased steadily since the first three were established in 1982. Eight new territories were identified in 1992 even though the overall swan population did not increase. This would seem to indicate that there is still vacant breeding habitat and some other factor accounted for the drop in cygnet production in 1991 and 1992.

Table 1. Number of Trumpeter Swans recorded during the late summer census in the Upper Tanana Valley, Alaska, 1982-92.

Grouping	Year										
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Individuals in pairs without cygnets	24	22	6	26	36	66	52	72	74	96	132
Individuals in pairs with cygnets	6	12	18	24	24	24	38	50	84	68	68
Flocked birds	11	3	3	34	29	38	28	45	35	128	90
Single birds	3	0	3	11	9	7	17	15	13	17	26
Cygnets	12	27	34	43	48	44	76	90	184	118	105
Total swans	56	64	64	138	146	179	211	272	390	427	421
Average brood size	4.0	4.5	3.8	3.6	4.0	3.7	4.0	3.6	4.4	3.5	3.1

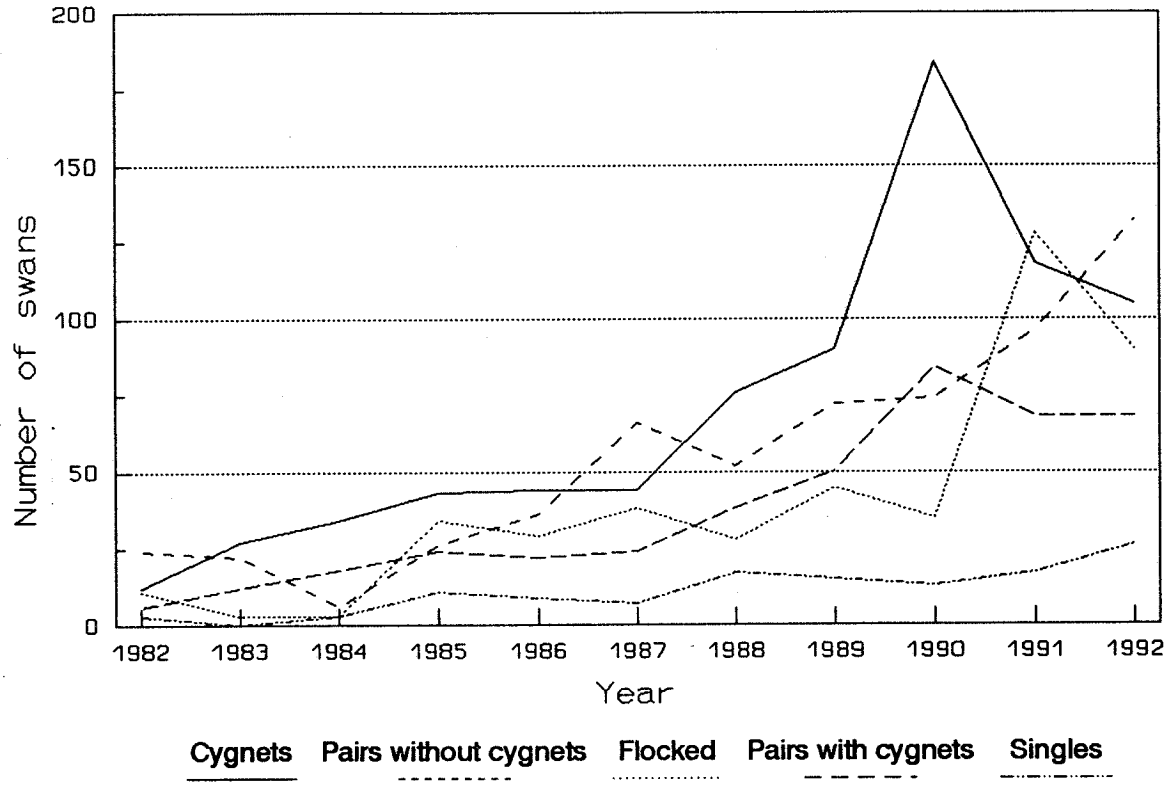

Figure 3. Number of Trumpeter Swans recorded during the late summer census in the Upper Tanana Valley, Alaska, 1982-92.

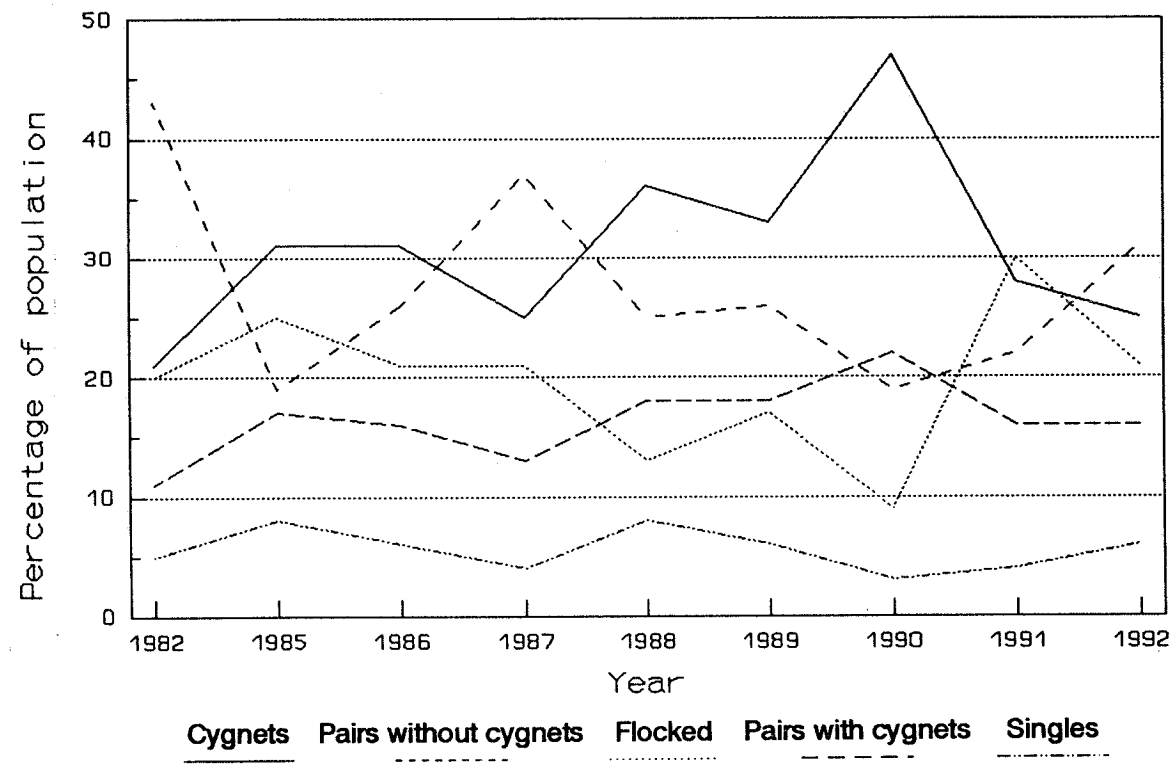

Figure 4. Percentage of swans in various classes during the late summer census in the Upper Tanana Valley, Alaska, 1982 and 1985-92.

Table 2. Status of Trumpeter Swan territories in the Upper Tanana Valley, Alaska, 1982-92.

Territory status[1]	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
# territories	3	6	9	21	23	28	40	41	53	59	68
# occupied				20	20	24	36	40	50	55	64
% occupied				95.2	86.9	85.7	90.0	97.5	94.3	93.2	94.1
# active				20	12	12	29	32	48	41	48
% active				95.2	52.1	42.8	72.5	78.0	90.5	69.4	70.5
# successful				12	12	12	19	25	42	34	34
% successful				60.0	100.0	100.0	65.5	78.1	87.5	82.9	70.8
# unsuccessful				8			10	7	6	7	14
Nest failure							3	3	3	3	11
Brood failure							5	0	1	4	3
Nest/brood failure				8			2	4	2	0	0

[1]A territory is an exclusive area where breeding activity in the form of a nest or a brood has been observed. Occupied territories are those with a pair present. Active territories are those with a nest or a brood present. Successful territories are those that have at least one cygnet present during the late summer survey. Percent successful territories is the number of successful territories divided by the number of active territories.

From 1988 to 1992 an average of 76 percent of the territories in a given year have been active, having a nest or brood present (Table 2). The percentage of active territories declined to 70 percent in 1991 and 1992 compared to 78 percent in 1989 and 90 percent in 1990. This would account for some of the decline in cygnet production in 1991 and 1992. It is unknown why territory activity declined. It is likely some nesting pairs fail before we conduct our nest survey.

From 1988-92 an average of 77 percent of the active territories were successful in raising at least one cygnet to the late summer survey (Table 2). Nearly 90 percent of the active territories in 1990 were successful, accounting for the large number of cygnets produced. In contrast, the 70 percent territory success in 1992 helps explain why cygnet production declined from 1991 even though the percentage of active territories was similar. There were twice as many unsuccessful territories in 1992 compared to 1991, 80 percent of which were due to nest failure.

Average brood size decreased in 1991 and 1992 accounting for some of the decrease in cygnet production those years (Table 1). Average clutch size decreased each year between 1990 and 1992. However, the differences were not significant.

Egg and cygnet survival have both declined since 1990 (Table 3). Much of the decline in egg survival from 1992 was total clutch loss. Survival of cygnets between the early and late brood surveys was slightly higher in 1992 than 1991. However, in 1992 cygnet survival decreased after the late summer survey.

Banding and collaring

To date, we have neck banded 107 Trumpeter Swans consisting of 89 cygnets, 10 subadults and eight adults. Most neck bands are dark blue with four white codes ending in AK. To date, 27 individuals have been resighted 101 times (Table 4).

Over 80 percent of the resightings have been on the wintering ground. Fourteen individuals have been observed on Vancouver Island as far back as the winter of 1983-84. Most (58) resightings on Vancouver Island have come from the Comox and Courtenay areas. An additional six resightings occurred near Woss, British Columbia. There were single resightings from Qualicum Beach and Nanaimo. The first resighting of UTV Trumpeter Swans in Washington's Skagit Valley occurred during the winter of 1990-91. Since that time, five individuals have been observed there a total of 17 times. The first observation outside of the Puget Sound area occurred at Willapa Bay on the southern coast of Washington in December 1992. Individuals do not always return to the same wintering area. Swan 13AK was in the Skagit Valley during the winter of 1990-91 and was on Vancouver Island during the winter of 1991-92.

There have been 15 resightings on the breeding grounds of seven individuals and an additional eight resightings of unidentified neck banded birds. Some highlights include a male that established a breeding territory as a 4-year-old, 21 miles from where it was banded as a cygnet. This individual has returned to the same breeding territory for the last 5 years. A female established a breeding territory 13 miles from where it was banded as a cygnet and has successfully bred there the last 2 years. An adult breeding female returned to the same territory to breed the year after banding. Four individuals banded as cygnets have been observed 1 to 2 years later, 6 to 25 miles from where they were banded.

Only two resightings have been made during migration. Two individuals were observed approximately 483 km southeast of the breeding ground near Whitehorse, Yukon Territory, on 15 April 1992.

DISCUSSION

An increasing statewide population coupled with favorable weather conditions may be ultimately responsible for the expansion of Trumpeter Swans in the Upper Tanana Valley. Various hypotheses ranging from global warming (Conant et al. 1992) to improved winter habitat have been proposed to explain the increase in the Pacific Coast Population of Trumpeter Swans. These hypotheses have yet to be tested.

Table 3: Egg, early brood, and late brood survival of Trumpeter Swans in the Upper Tanana Valley, Alaska, 1990-92. Different territories were used for egg, early brood and late brood survival estimates depending on the number of nests and broods available for comparison.

Parameter	Year		
	1990	1991	1992
Egg survival			
# nests	16	25	27
# eggs	89	134	123
# young cygnets	72	85	59
% hatch	81	63	48
Early brood survival			
# broods	21	29	28
# young cygnets	99	116	101
# old cygnets	91	95	88
% survival	92	82	87
Late brood survival			
# broods	1	27	6
# old cygnets	4	96	20
# oldest cygnets	4	90	16
% survival	100	94	80

Table 4: Resightings of Trumpeter Swans neck banded in the Upper Tanana Valley (UTV), Alaska from 1984-93.

Neck band code	Wintering ground			Breeding ground	Migration
	Vancouver Island	Skagit Valley	South coast Washington	UTV	Whitehorse Yukon
24EA	1				
25EA	1				
26EA	1				
27EA	1				
29EA	1				
34EA				5	
35EA	1				
74EA	1				
75EA	1				
76EA				4	
11AK		7			
13AK	8	5			
14AK		3			
25AK				1	
35AK		1			
37AK				2	
40AK					1
51AK	16				
52AK	8				
54AK	12				
55AK	12				
57AK	2				
64AK				1	
77AK		1			
81AK					1
89AK				1	
94AK			1	1	
Total	66	17	1	15	2

The ice free period in the UTV is such that Trumpeter Swans have enough time to nest and raise young under favorable weather conditions. A series of unfavorable weather years, such as observed in 1992, could possibly reverse the trend seen in the last decade. In 1992, an extremely late spring, followed by a wet summer and extremely early winter resulted in relatively high nest failure and low average brood size and consequently the first decline observed in this population. Actual cygnet survival from 1992 was probably even lower due to the early freeze up catching flightless cygnets.

The reason for a drop in cygnet production between 1990 and 1991 remains a mystery. Warm dry conditions during incubation and brood rearing probably made 1990 an exceptional year for swan production. (Conditions were so dry in 1990 that fires burned through several swan territories, yet cygnet production on those territories were some of the highest recorded.) However, weather conditions during nesting and early brood rearing in 1991 did not appear to be much different than in 1990.

When conditions are right peripheral breeding habitats are capable of supporting rapid population expansions on the order of a 25 percent annual increase. Time will tell if and for how long the expansion in the UTV will continue. For the foreseeable future, there appears to be no shortage of breeding habitat in which to expand and no shortage of swans to fuel the expansion as long as weather conditions remain favorable.

This may not be the case on the wintering grounds. As Trumpeter Swan populations expand on the breeding ground, the wintering ground may become the limiting factor. With increased pressures for development on the wintering ground, sustained population increases may depend on the swans finding or adapting to other suitable habitats. Preliminary banding returns suggest that Trumpeter Swans may be expanding their winter range as well as their breeding range.

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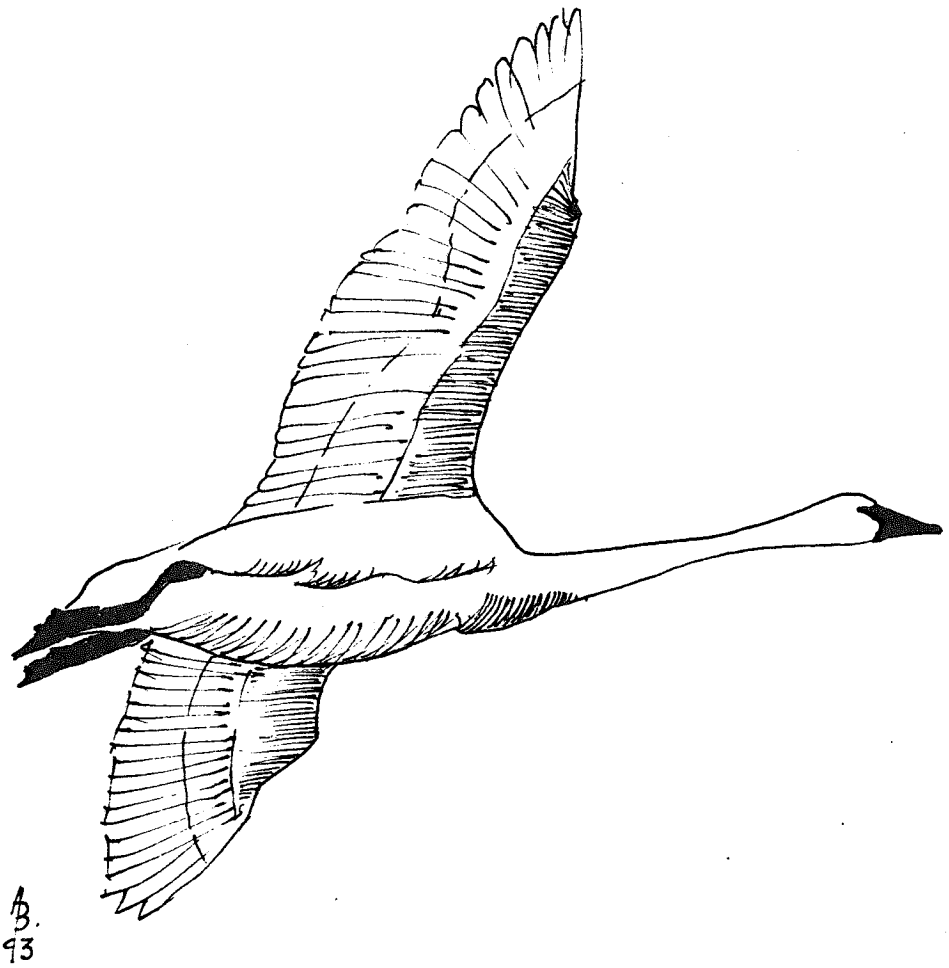

TRUMPETER SWAN MOVEMENTS FROM MINTO FLATS, ALASKA: 1982-92

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ABSTRACT

Trumpeter Swans have been neck banded in the Minto Flats, 50 km west of Fairbanks, Alaska, since 1982. Only resightings of neck banded swans outside of Alaska are summarized. A total of 238 Trumpeter Swans have been neck banded in Minto Flats, of which 70 unique neck bands (29%) have been resighted. Of those 70 individual swans resighted, there have been 109 total observations. Distribution of those 109 resightings have been in Yukon Territory 10 (9%), British Columbia 56 (51%), and Washington State 43 (40%).

INTRODUCTION

The boreal forest of Alaska is home for more than 85 percent of the world's population of Trumpeter Swans. Approximately 30 percent of the more than 13,000 Trumpeter Swans in Alaska in 1990 were found in the Lower Tanana Valley Unit (Conant et al. 1991). The majority of these Lower Tanana Valley swans breed in the Minto Flats located 40 km west of Fairbanks, Alaska (Figure 1).

To delineate the migration and wintering areas of these Minto Flats swans a marking program began in 1982 and continued through 1992. Trumpeter Swans were neck banded as time and funds allowed during each year of the period, except 1989 and 1990. With the invaluable efforts of volunteers throughout the Pacific Northwest and with limited funding by the U. S. Fish and Wildlife Service (USFWS) main migration routes and wintering areas have been identified.

Thirty-five battery powered transmitters were placed on Trumpeter Swans intermittently from 1982-88. Various means were used to attach transmitters to swans including backpack, gluing to feathers of the back and neck bands. Of the 35 transmitters placed on swans 14 (30%) were relocated outside of Alaska. In 1984, transmitter-bearing swans were tracked on their fall migration route using USFWS aircraft.

Paid observers, volunteers and the general public, who enjoy watching Trumpeter Swans, reported the resightings presented here.

I wish to thank all those who have endeavored to read neck bands and contact me directly. Special appreciation goes to the personnel of the USFWS Bird Banding Laboratory, Laurel, Maryland, for their expeditious efforts in referring neck band observations to the Migratory Bird Management Office in Fairbanks, Alaska.

METHODS

During 1982-88 and 1991-92, 238 Trumpeter Swans were fitted with blue plastic neck bands marked with white codes. Birds were captured by the use of float-equipped, fixed-wing aircraft taxiing on the water. Adult swans were captured during the mid-summer molt and cygnets were caught prior to fledging. These birds were captured using a large net with a four meter long handle. The bail of the net was approximately one meter in diameter.

To capture flightless swans the aircraft is slow taxied on the water while the "catcher" (person holding the net) stands on the left float of a Cessna 185 or on the right float of a Piper Supercub, immediately behind the wing strut. Placing the "catcher" behind the wing strut enables that person to safely remain behind the aircraft prop while swans are dipped from the water as the aircraft approaches within approximately one to two meters of the fleeing bird. Once the swan is captured in the net, the aircraft engine is turned off, the pilot exits the aircraft, walks to the back of the float, retrieves the net bail and swan to the float, subdues the swan and places it in the aircraft. Before a captured bird is placed in the aircraft

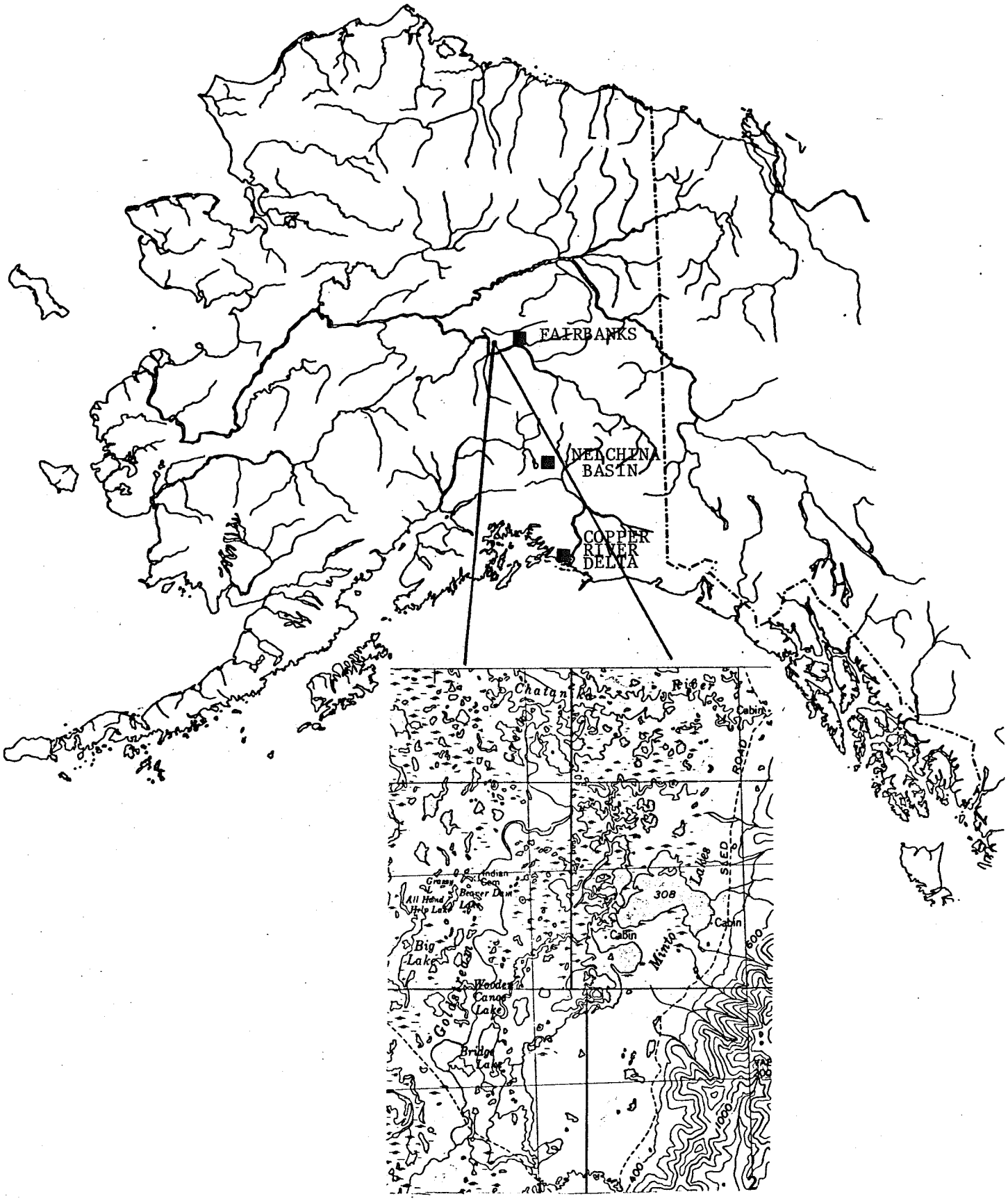

Figure 1. Location of Minto Flats study area in Alaska.

cabin its legs are crossed over the tail and taped at the junction of the tarsal and foot. The bird is then placed on the floor behind the front seat(s) of the aircraft.

If other swans are on the lake, the procedure is repeated until all birds possible are captured. After the capture, the aircraft is usually taxied to shore and the birds are processed. If we were capturing cygnets, all siblings in the brood were captured (if possible), leg banded, neck banded and then released together as a brood. When capturing molting adult birds, as many birds as comfortably fit in the aircraft were captured, marked in the above method and usually released individually as they were banded.

For analysis purposes, the neck band observation periods have been divided into four seasons. Season periods were selected from grouped dates and locations of observation data. They include: Fall, 1 October - 30 November, after which birds were close to or on the wintering grounds; Winter, 1 December - 15 March, after which the majority of swans were migrating north of wintering grounds; Spring observations included 15 March - 30 April, after which all observations were made in Alaska; Summer, 1 May - 30 September, after which all cygnets would normally be fledged and migrating or at least staging for migration. Several individual swans were observed more than once in the same time period in the same area. In this report, these "grouped" sightings are treated as one unique resighting for that time period.

RESULTS AND DISCUSSION

Age and sex distribution of the 238 neck banded individuals is 21 (9%) adult females, 15 (6%) adult males, 90 (38%) local females (flightless cygnets) and 112 (47%) local males (flightless cygnets).

Seventy unique neck bands (29%) of the 238 total neck banded have been resighted outside of Alaska since winter 1982-83 through winter 1991-92. A resighting record is comprised of reporting a valid neck band code with date and location. Neck band codes were numeric-numeric-alpha-alpha, such as 28EA. Resighting rates were 50 percent for all adults and 24 percent for all banded cygnets. Female cygnets had the lowest resighting rate at 18 percent.

Distribution

During the period 1983-92, 109 separate observations were made of 79 unique neck bands. The largest number of times these neck bands were observed was in British Columbia with 56 times (51%), Washington State with 43 observations (40%) and Yukon Territory with 10 observations (9%), (Figure 2).

Distribution and time of year the observations were made are illustrated in Figure 3. All Yukon Territory observations were made near Whitehorse in spring. British Columbia neck bands were observed fall through early spring and were distributed throughout the length of the Province.
Washington observations were made only during winter in areas near Bellingham and south to approximately 15 km east of Seattle.

The list of all neck bands observed with the last digit of the year in which they were observed as well as the approximate location is illustrated for Yukon Territory, British Columbia and Washington State in Figures 4, 5 and 6 respectively.

The maximum number of years resightings could occurred in any one area was 10. Observations were categorized here for area and individual neck band. There were 10 unique neck band observations in 3 different years in Whitehorse, Yukon Territory, 43 different neck bands observed in 8 different years throughout British Columbia and 26 different neck band observations in 9 different years in northwest Washington. No area reported a neck band resighting in every year of the study.

Individual observations

Individual neck band observations have followed several unique patterns as illustrated by the following examples. Adult female 23HC, banded in 1985, was observed in the Skagit Valley for four consecutive winters (1986-89, Figure 7). She was observed with her mate 24HC (also banded in 1985) for only

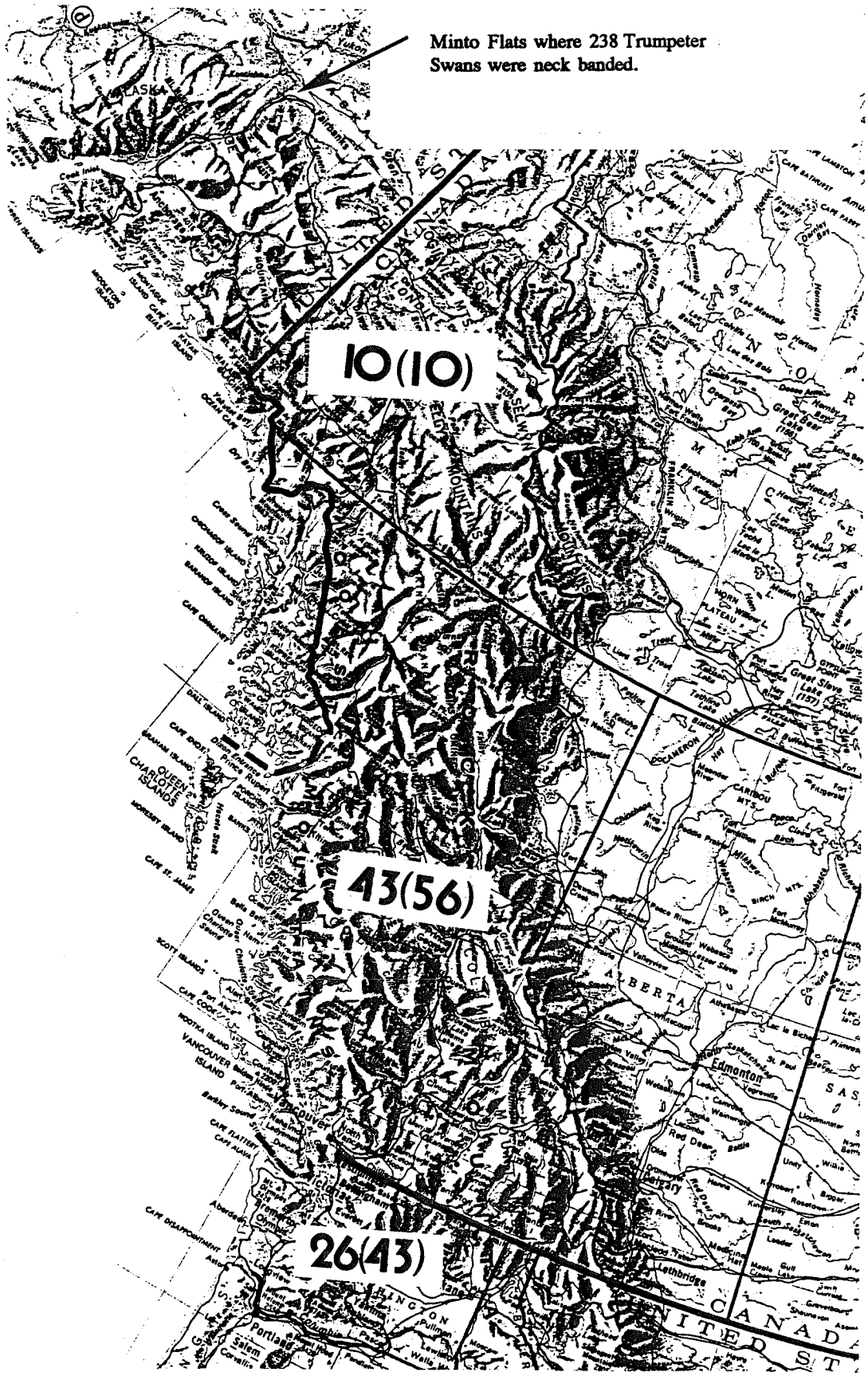

Figure 2. Number of individual neck band records with total observations in parentheses.

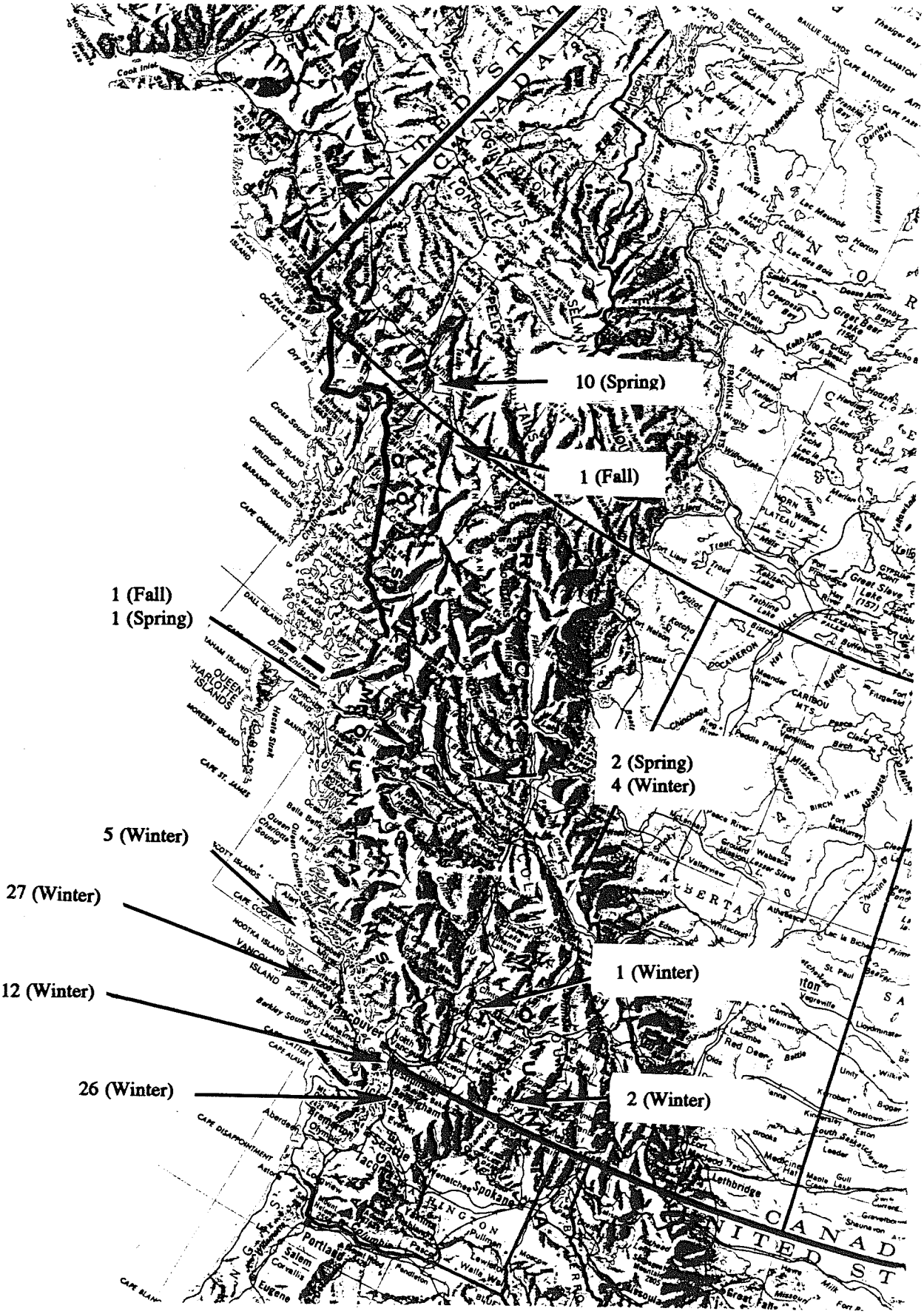

Figure 3. Distribution of neck band observations and time of year.

Figure 4. Yukon Territory Trumpeter Swan neck band observations.

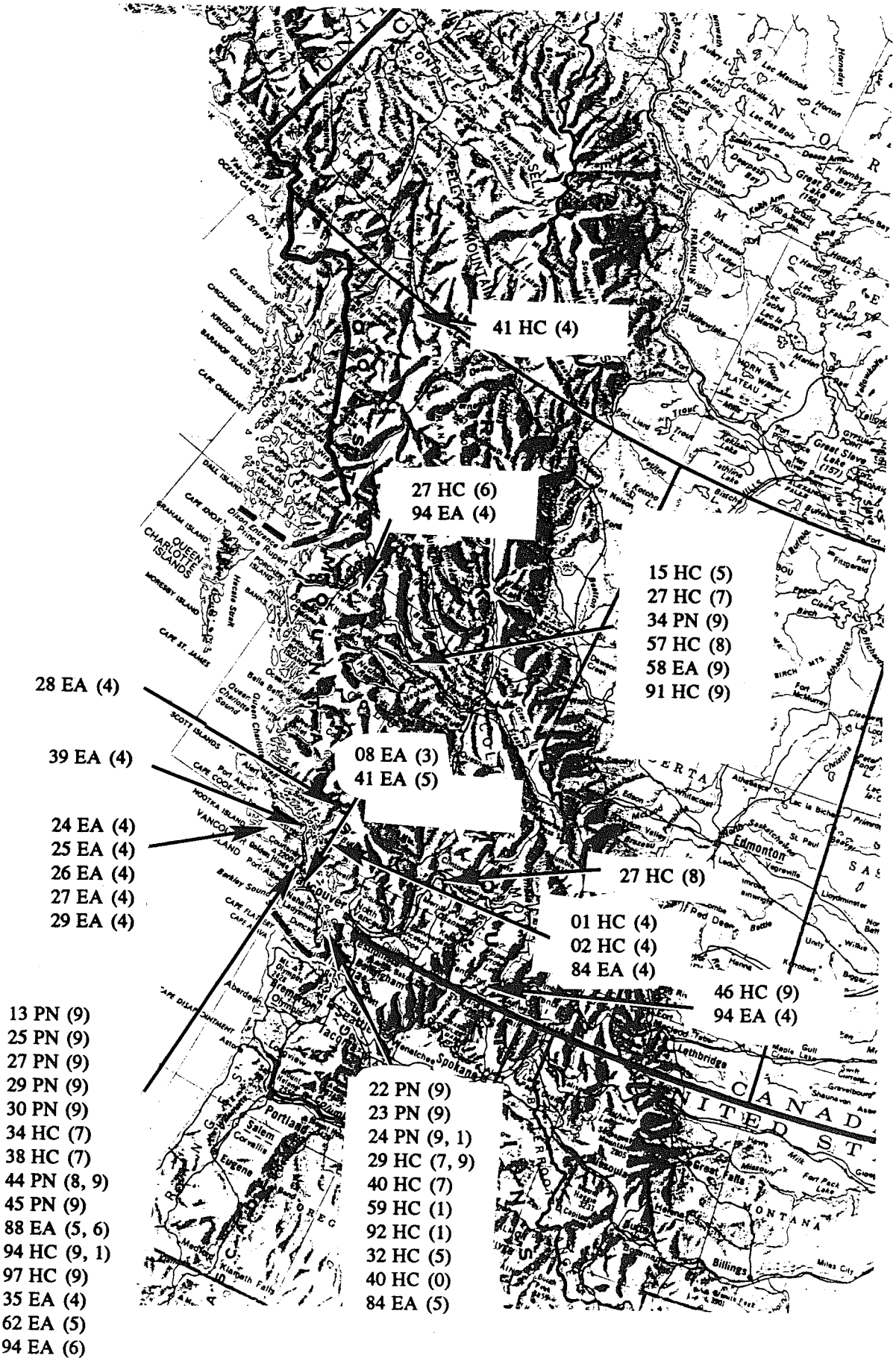

Figure 5. British Columbia Trumpeter Swan neck band observations.

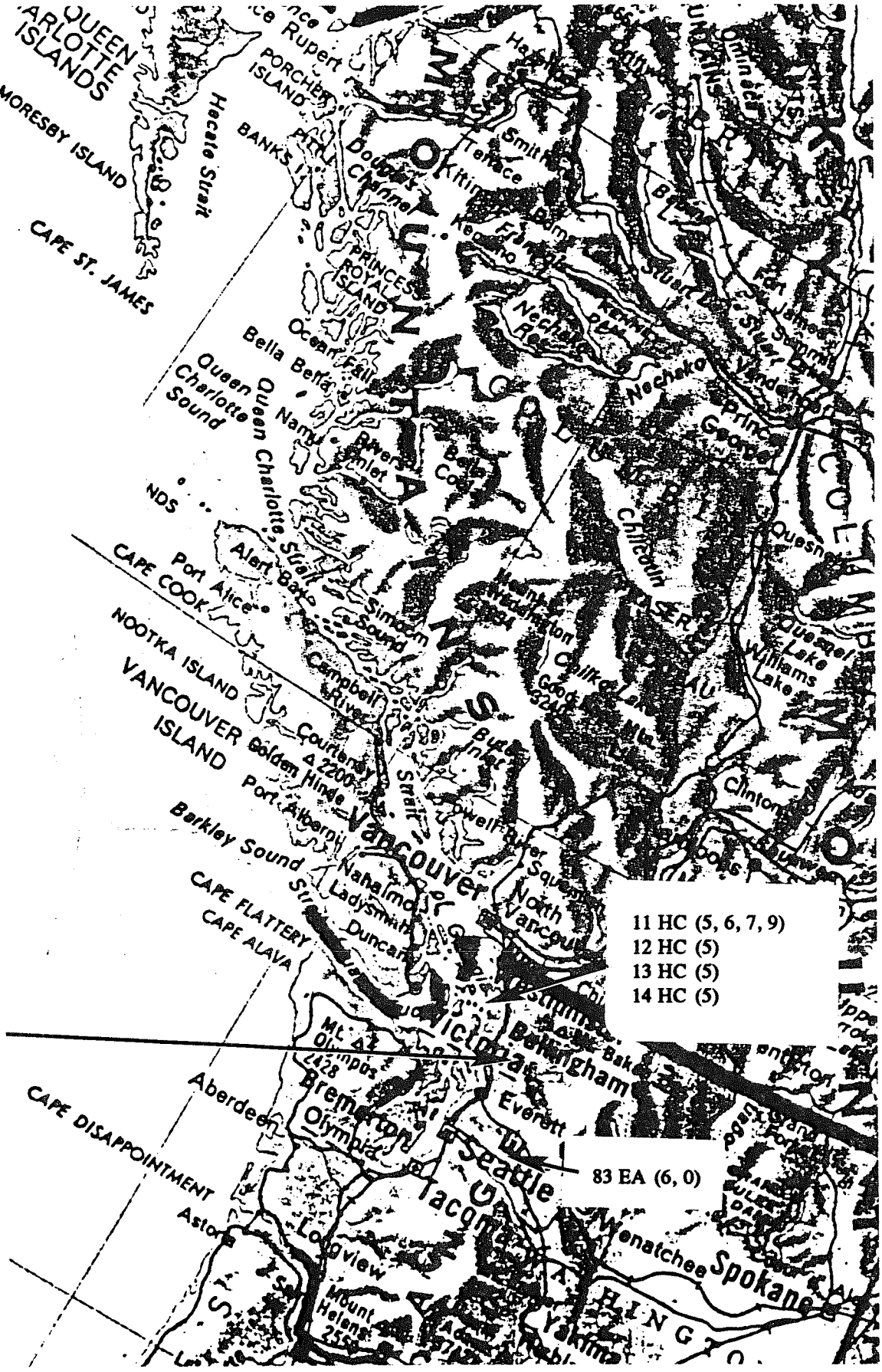

Figure 6. Washington Trumpeter Swan neck band observations.

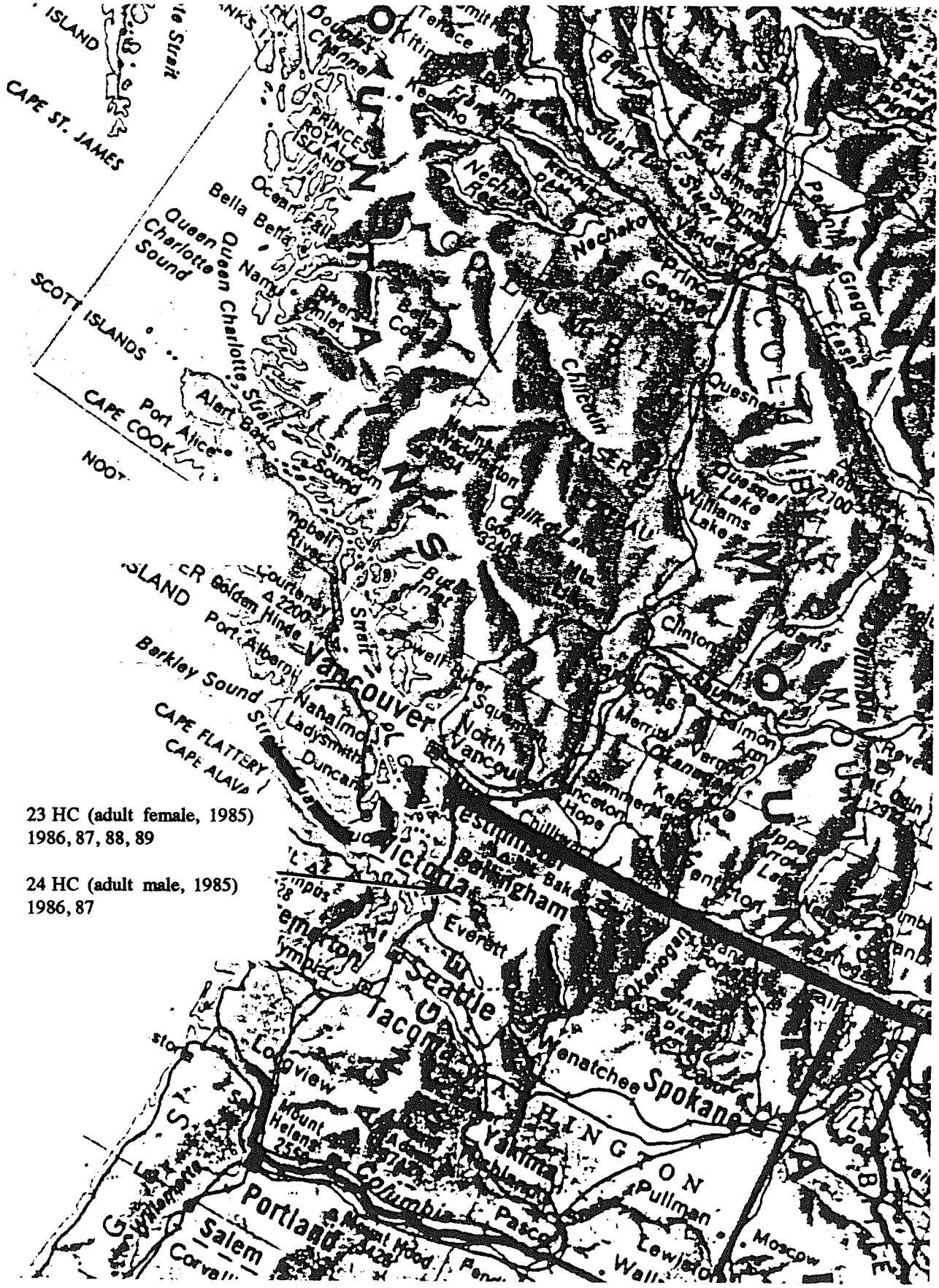

Figure 7. Observations of neck banded Trumpeter Swans 23 HC and mate 24 HC.

two of those winters. It is believed that 24HC lost his neck band during the 3rd year because a metal leg banded adult (believed to be 24HC) has accompanied her during each winter (Canniff 1990).

Normally, mated pairs winter together, however, there are exceptions. Mated pair 29HC and 40HC have been observed wintering separately in the Fraser River Delta, British Columbia (Figure 8). During winter 1986-87, 29HC and 40HC wintered together near Abbotsford, British Columbia. In winter 1988-89, 29HC was observed near Delta, British Columbia, with three of five neck banded cygnets, but no neck or metal banded adult accompanied them. The next winter (1989-90), 40HC was observed northwest of Vancouver near Pitt Lake with no other neck banded swans. After 29HC and her neck banded cygnets were observed in winter 1988-89, they were observed again on Summit Lake near Paxson, Alaska, on 18 April 1989 and both neck banded adults were together on the nesting lake in Minto Flats that summer. (The Paxson Lake route was not previously known to be used by Minto Flats breeding Trumpeter Swans.)

At the same time (July 1985) that 23HC and 24HC were banded at their nest lake, 29HC, an adult female, and her mate, 40HC, were neck banded approximately 4 km to the east. In the fall of 1988 (3 years later), 29HC and 40HC with a brood of five flightless young were observed on the original nest lake of 23HC and 24HC. 23HC or her mate were not located in Minto Flats, but were observed on the wintering area. The 29HC and 40HC family could have moved to this lake after they were hatched on another lake nearby.

Spring migration is thought to take place over a 6-8 week period. This migration may take less time for breeding adults without young of the previous year, anxious to return to the breeding area.

What is believed to be a typical example of spring migration of Trumpeter Swans returning to Minto Flats from the wintering area has been observed for 22EA, an adult female, banded in 1983. This bird was observed during the winter of 1983-84 accompanied by neck banded cygnet (63EA) and an unmarked adult (Figure 9). The first observation of this family was in the Skagit Valley on 12 December 1983. They were last observed near the same area on 3 March 1984. The next sighting of 22EA was southeast of Whitehorse, Yukon, on 18 April 1984 (with 63EA) and then in Minto Flats 5 days later with an unmarked mate and without (63EA). She was observed on her nest site on 5 May.

Adult Trumpeter Swans may return to the same wintering area on consecutive years, but some subadults are more nomadic. A typical example was 27HC, neck banded as a 2nd-year male in July 1985. Subsequent observations have been characterized by the use of different wintering areas 4 out of 5 years (Figure 10). The 1986 observation near Smithers, British Columbia, was a marginal date for winter, but this bird was not observed at any other location previously.

However, the opposite was observed for 11HC. This bird was neck banded as a flightless male cygnet in fall 1984. He was observed in the same general wintering area of Skagit Valley in 4 of the next 5 years and in winter of 1988-89 brought its first observed cygnet and mate (Canniff 1990) to the same area. This bird appears to have bred successfully at age 4 (Figure 11).

Some siblings appear to differ widely in selection of wintering areas, yet find wintering together an option after initial brood break up. 36HC and 46HC were neck banded as sibling males in fall 1986. They were observed wintering together in 1987, not observed together in 1988, (although 36HC was observed in 1988), both observed wintering in areas separated by over 150 km in 1989, wintering together again in 1990, but separate again in 1991 (Figure 12).

Young birds may be nomadic because of their search for mates or may become associated with other subadults from other breeding areas and follow them to other wintering areas. More effort must be made to observe neck banded birds in molting flocks.

Some adults do appear to be more experimental in their selection of wintering areas. Adult

Figure 8. Observations of neck banded Trumpeter Swans 29 HC and 40 HC,
29 HC (adult female, 1985)
40 HC (adult male, 1985).

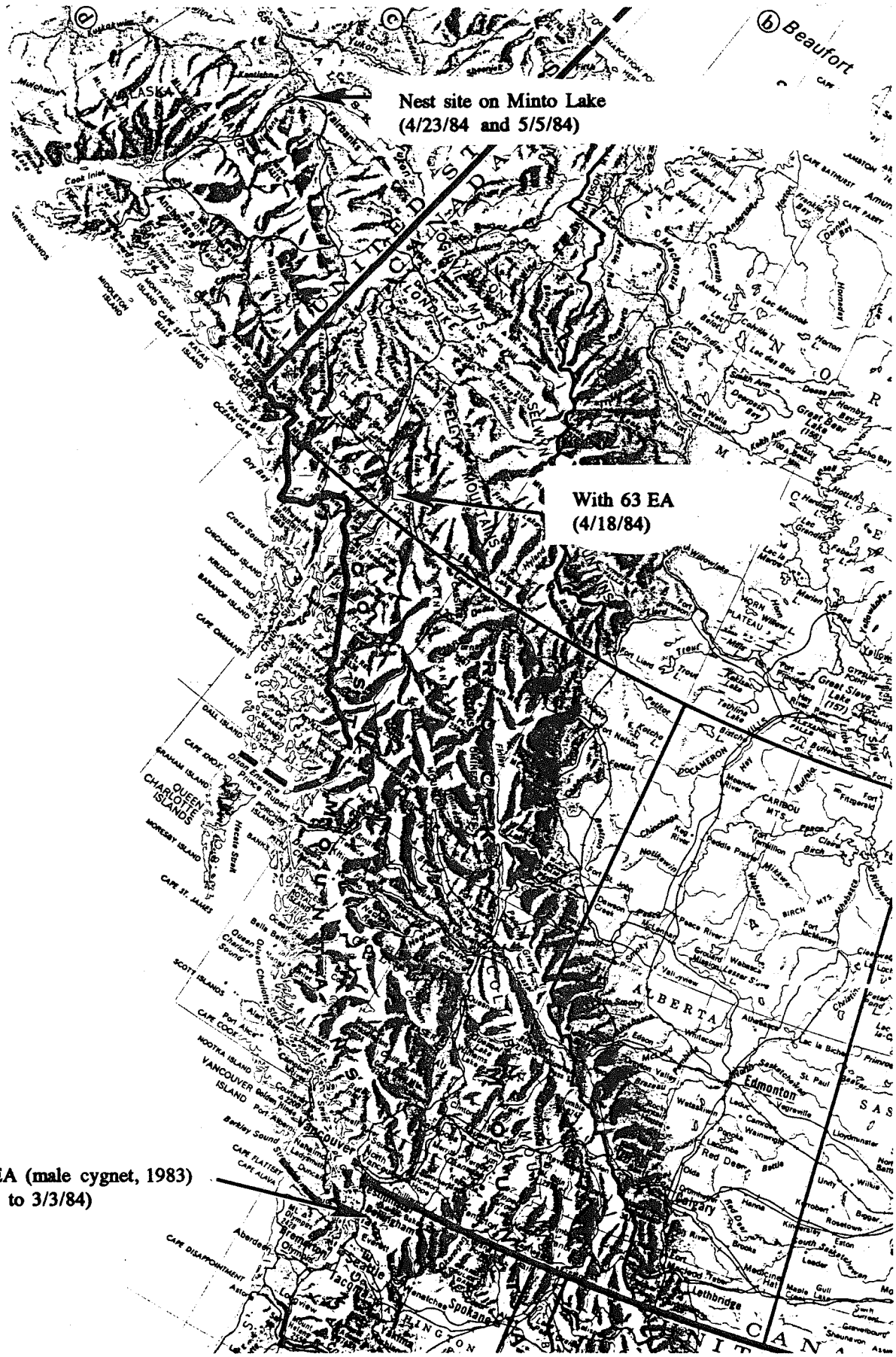

Figure 9. Observations of Trumpeter Swan 22 EA (adult female, 1983).

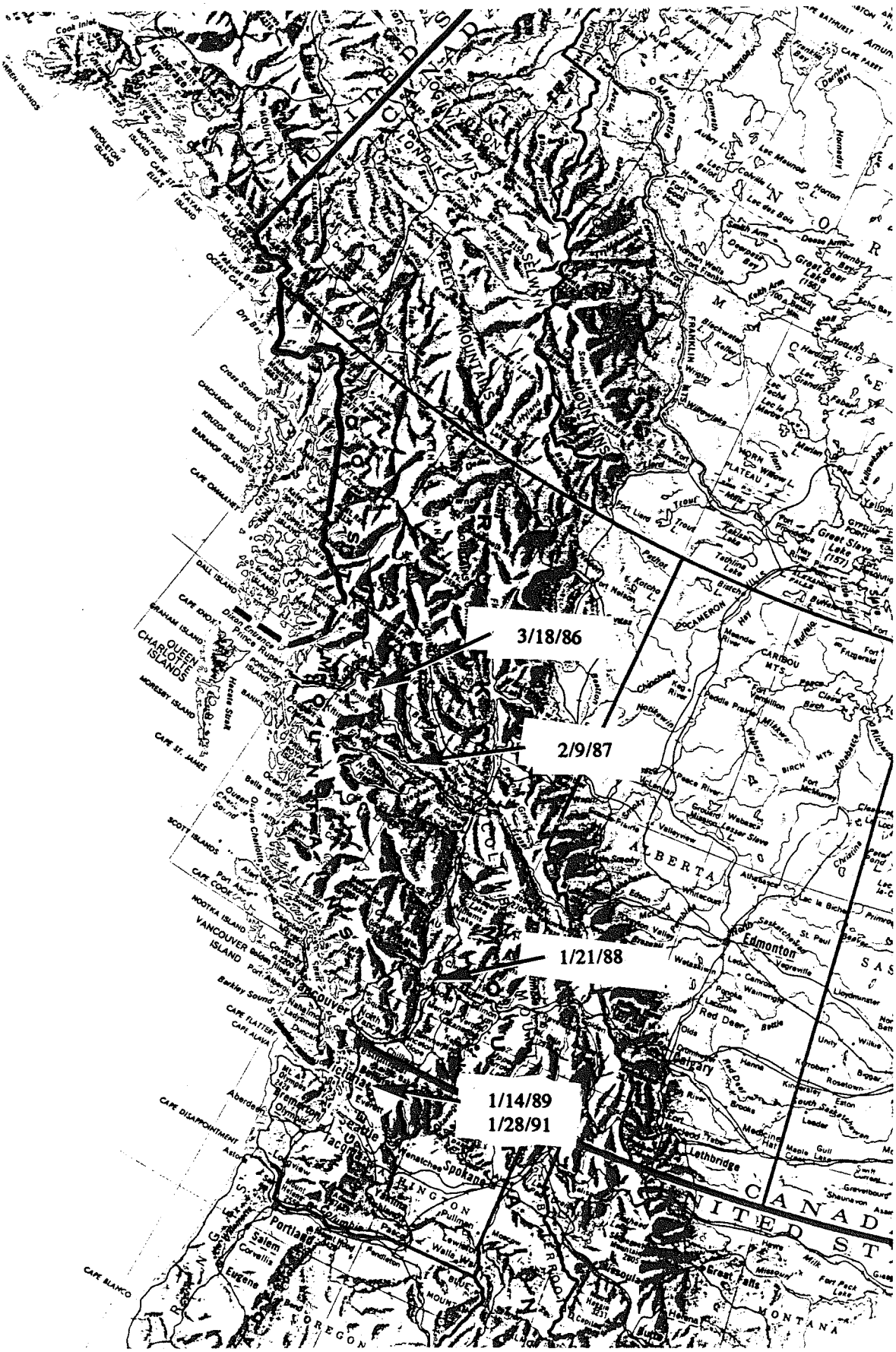

Figure 10. Observations of Trumpeter Swan 27 HC (second year male, 1985).

Figure 11. Observations of Trumpeter Swan 11 HC (local male, 1984).

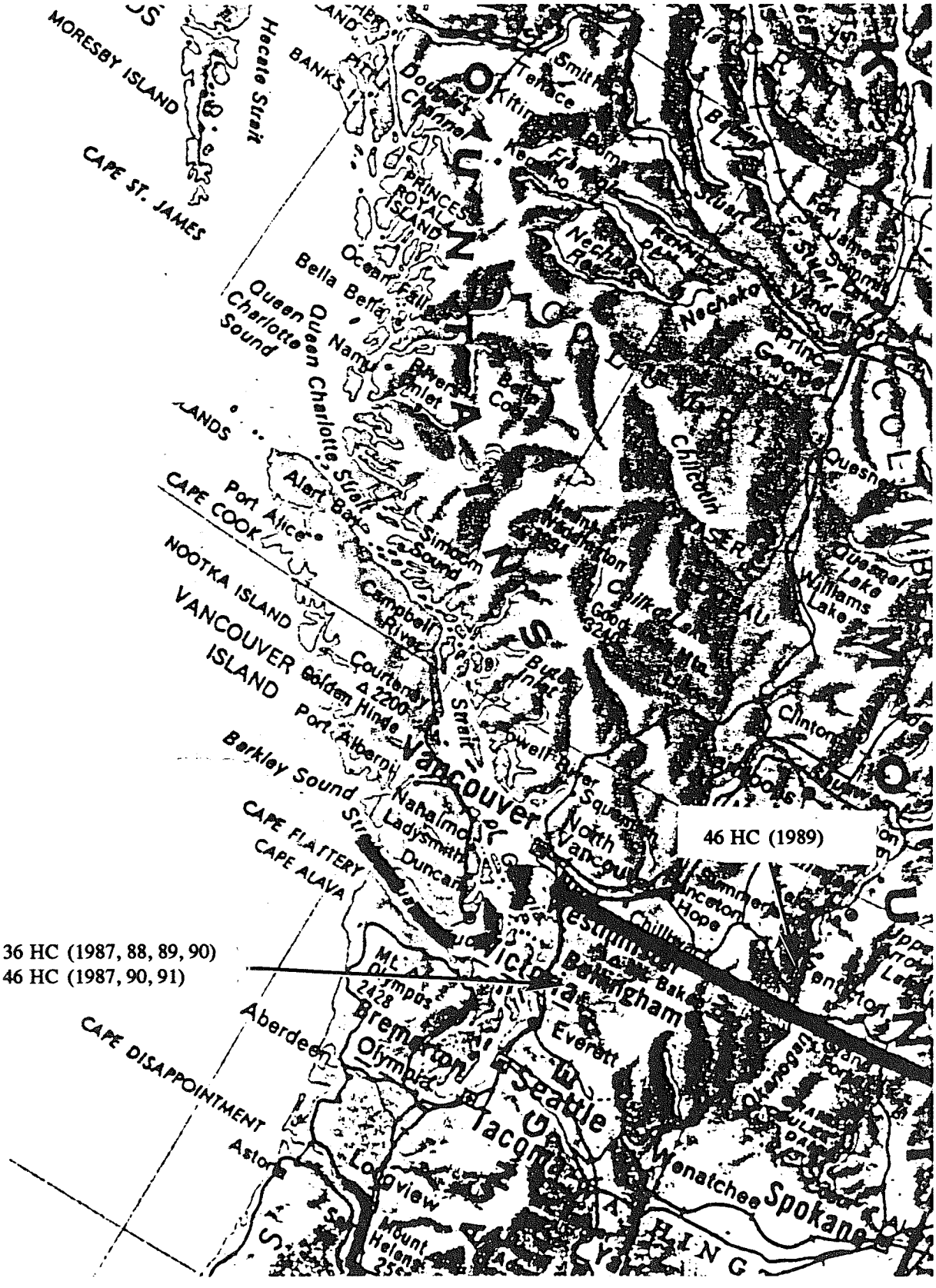

Figure 12. Trumpeter Swan siblings 36 HC and 46 HC banded as juvenile males, 1986.

female 83EA was captured as a failed breeder in 1984. She was observed wintering near a small reservoir east of Seattle, Washington, in January 1986, then observed again with an unmarked adult and four cygnets in January 1990 (Figure 13). It is believed that this bird was not on the reservoir described above during any winter between those years as this area has limited habitat where she may have escaped detection.

CONCLUSIONS

Neck band observations have not only identified some Trumpeter Swan migration routes and wintering areas, but have given us evidence of the timing of those movements.

In general, the data above and observations by the author indicate the following about Trumpeter Swans from the Minto Flats: Trumpeter Swan families begin staging on large water bodies about 1 October. These water bodies (in most years) become partially or totally ice covered by 10 October. Swans must begin their migration well before this date. Once swans leave the Minto Flats, they are found on ice free water bodies or warm, spring fed streams along the route southeast up the Tanana River Valley (Figure 1). As freeze up progresses, they continue along the Upper Yukon River drainage into the Yukon Territory by late October.

Trumpeter Swans generally migrate through central British Columbia during November. Neck band observations indicate some birds migrate southwest through the fjords and inlets of coastal British Columbia while others continue to linger in central British Columbia. These "central" birds are forced south by colder weather and shorter day length until they reach the Fraser River Valley and finally winter mainly in south coastal British Columbia including Vancouver Island and northwest Washington. By the first 2 weeks of December, most birds appear to have selected a wintering area.

Winter is spent in these maritime environments. Observations indicate that once a bird reaches its primary winter area, it remains there until spring migration begins in March. This study recorded no evidence of neck banded swans from Minto Flats spending considerable time in one winter area and then migrating more than 30 km to spend the remainder of the same winter in another area.

Migration north generally begins by mid-March with birds making short stops of varying length in open water habitat. The sequence of spring migration may depend on the age and sexual status of individuals. Minto Flats Trumpeter Swans generally migrate through central British Columbia near Prince George and Smithers during late March or early April, after which they continue north to southern Yukon Territory near Whitehorse by mid-April.

Breeding birds arrive on the Minto Flats by early to mid-May and immediately begin the task of nesting. Nonbreeding subadults may linger longer in the Yukon Territory or eastern Alaska areas.

Trumpeter Swans in the Minto Flats migrate in similar patterns with other migratory waterfowl during spring and fall. Distribution of birds in wintering areas appears to be related to food availability or weather. Data from neck band observations indicate that some adults relocate in different winter locations between years. More information on possible winter habitat changes needs to be documented to understand this behavior.

Some family groups of cygnets and adult parents remain together throughout their first winter, even returning to near the breeding area before separating.

Adult pairs appear to winter together, but on occasion will winter separately in different areas, then rejoin on route to the breeding area. Evidence of this behavior needs further documentation.

Nonbreeding subadults (at least males) appear to be more nomadic and exploratory during their first few winters. At present we do not have any consistent resightings of subadult females. Female cygnets have a higher mortality rate if neck band observations are an indication. Some other means of marking this cohort needs to be considered.

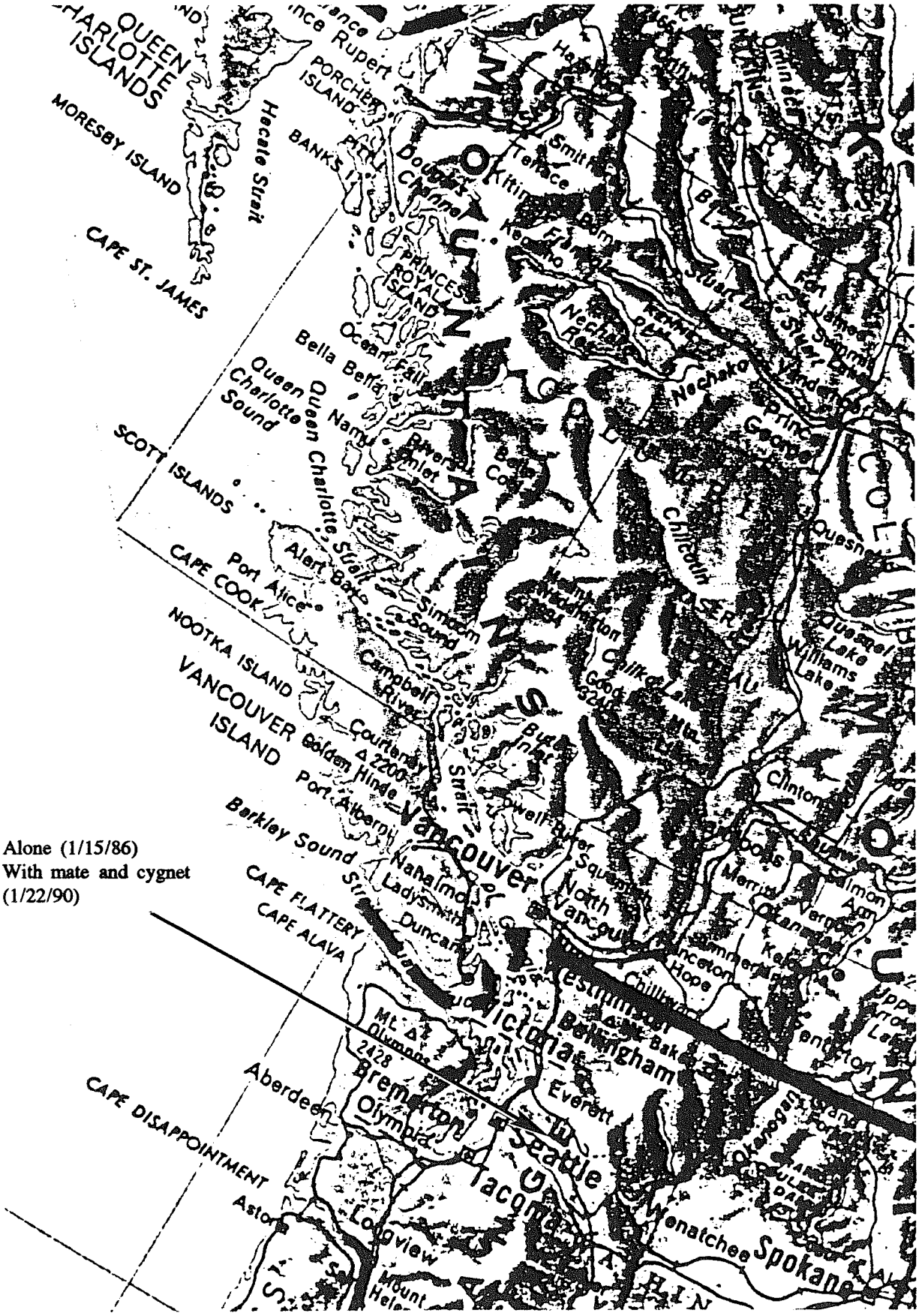

Figure 13. Observations of Trumpeter Swan 83 EA (adult female, 1984).

RECOMMENDATIONS

Observations reported here have given us an insight into the travels of Minto Flats Trumpeter Swans. With each year of marking and subsequent observations during migration and winter, we learn more about the movements and use of areas by swans. Observations reported here are by no means the story on the life of the Trumpeter Swan. Each observation is only a brief view into the year. It is believed that we have only begun to understand the movements of these birds and the complicated interactions of this species. This species is now experiencing a significant increase in the population and will probably continue to be observed in areas never thought to be Trumpeter Swan habitat.

The following are recommendations for future study of marked Trumpeter Swans:

- Continue to mark mated pairs and families of Trumpeter Swans in as many subpopulations of Alaska as possible to document differences or similarities in migration and wintering areas.

- Make coordinated efforts with state and federal agencies and the public to relocate these birds on migration routes, wintering and breeding areas.

- Incorporate more systematic searches for marked Trumpeter Swans in an effort to estimate mortality.

- Document the genetic lineage of Trumpeter Swans selected in reintroduction programs by marking individuals on the breeding ground.

- Encourage states and provinces which have (or propose to have) restoration projects to assist in funding the marking of pairs where egg or cygnet collections are made.

- Implement the establishment of Trumpeter Swan refuges in wintering areas of British Columbia and Washington as soon as possible.

We must continue to extend the "Celebration of Swans" to all wildlife by a renewed dedication of learning, sharing, accepting and promoting the significance of all creatures as a benefit, not hindrance to our lifestyles. It is imperative that The Trumpeter Swan Society find new and innovative methods to win public sentiment for Trumpeter Swans. These efforts will be the example of how all wildlife species can be assured necessary habitat to successfully carry out all phases of their life cycles.

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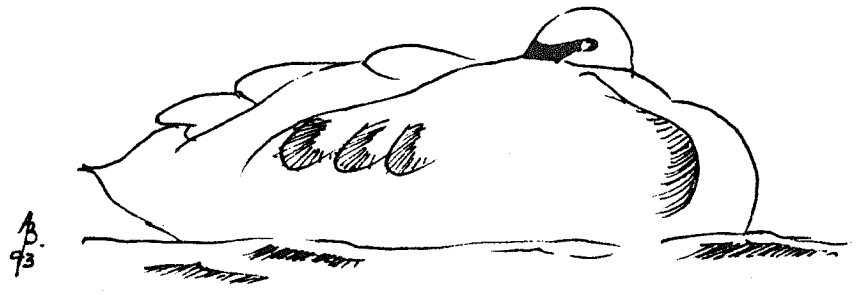

RECRUITMENT AND OVERWINTER SURVIVAL OF PACIFIC COAST TRUMPETER SWANS AS DETERMINED FROM AGE RATIO COUNTS

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ABSTRACT

Cygnet recruitment and overwinter survival of Pacific Coast Population Trumpeter Swans were estimated from age ratio data obtained during spring migration at Marsh Lake, Yukon Territory, during April 1986-92, and from population counts and age ratios obtained on the breeding grounds in central Alaska 1985-90. Age ratios at Marsh Lake ranged from 3.5 cygnets per 100 adults in 1986 to 18.7 cygnets per 100 adults in 1988. A simple population model was used to calculate population growth rates from these age ratios. Calculated population growth was then compared to observed growth of the population on the breeding grounds in Alaska 1985-90. In order to account for the observed annual growth during 1985-90 of 5-10+ percent (depending on the exact breeding areas involved), either annual survival of adults (1 year and older) is very high (>0.925), or immigration is occurring. Alternatively, there could be biases causing underestimation of the true age ratio at Marsh Lake or overestimation of the actual population growth in Alaska. Overwinter (August to April) survival of cygnets, calculated from age ratios in Alaska and at Marsh Lake, ranged from 13.5 percent in 1985-86 to 35.6 percent in 1987-88.

INTRODUCTION

The Pacific Coast Population (PCP) of Trumpeter Swans (Cygnus buccinator) has been growing steadily for at least the past 20 years. At some point, the carrying capacity of either the wintering, breeding, or migration habitat is going to be reached and the population should stabilize. The question arises as to which population parameters will change to bring the growth rate to zero when this carrying capacity is reached. For example, will there be a decrease in the proportion of adults which attempt to breed, a lower clutch size, lower fledging success, or lower overwinter survival of cygnets and/or adults?

In this paper we use censuses on the Alaska breeding grounds in combination with ratios of grey plumaged:white plumaged birds on spring migration to estimate the recruitment and overwinter survival of Trumpeter Swan cygnets. We also discuss the consistency of the results with the observed growth of the PCP and with existing estimates of adult survival.

METHODS

Total counts of swans were conducted by Canadian Wildlife Service at a major spring migration area, M'Clintock Bay on Marsh Lake near Whitehorse, Yukon, every spring beginning in 1986 (Figures 1 and 2). For the period 1986-92, total counts of swans were obtained at intervals varying from daily to every 4 or 5 days, beginning in late March or the first few days of April and continuing until at least 10 May. The plumage (grey or white) of all swans was recorded on most occasions as well. An observer using a 15-45 power spotting scope mounted on a tripod conducted each census from a single vantage point on the shore.

Ratios of grey:white plumaged birds were derived from these data. Not all of these ratios were useful, however. Trumpeter Swans are the first species to arrive at M'Clintock Bay in the spring, but Tundra Swans (Cygnus columbianus) arrive shortly after mid-April. Unlike Trumpeter Swans, Tundra Swan cygnets moult into white plumage by their tenth month of life and are thus

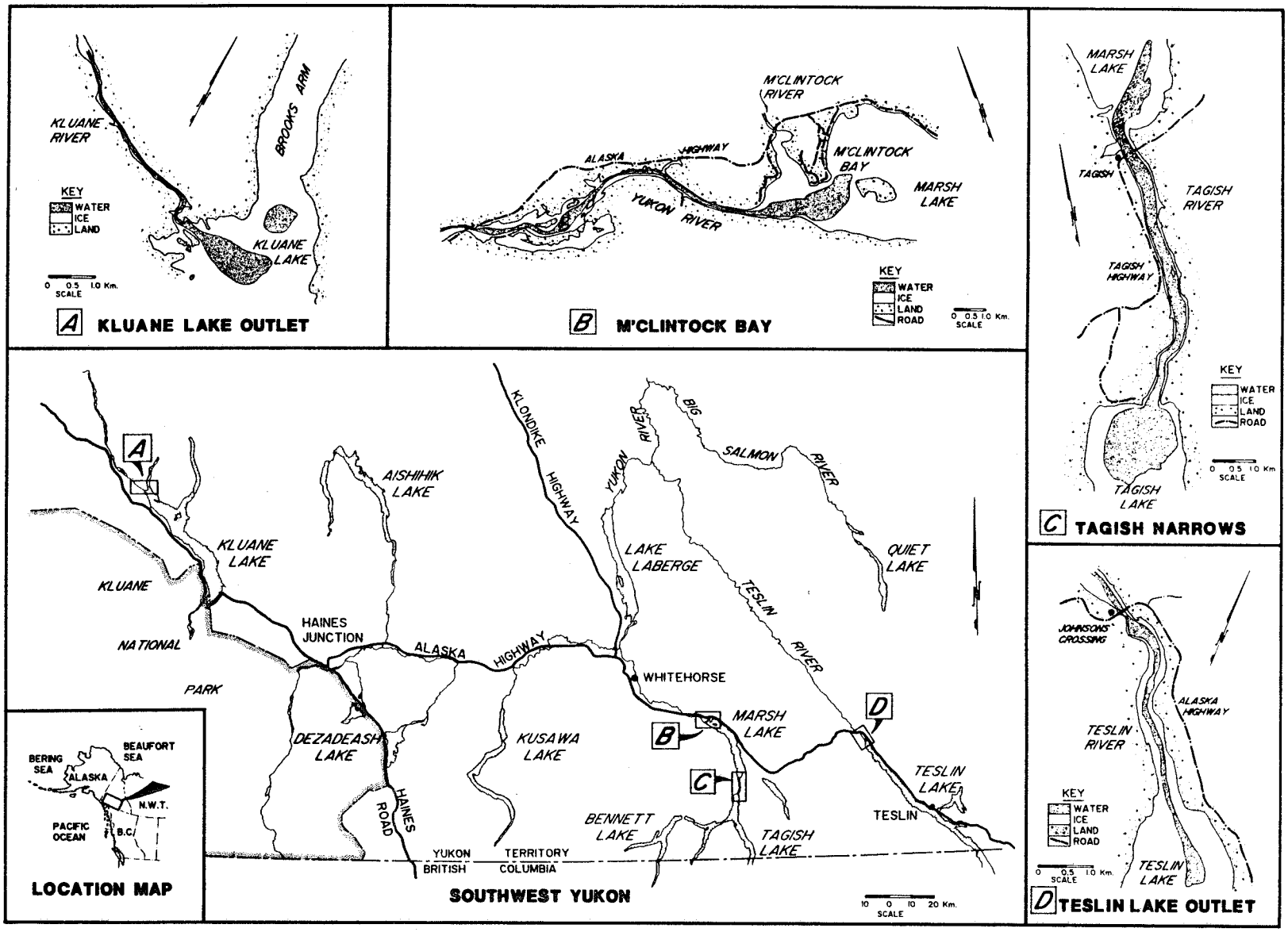

Figure 1. Important spring migration areas for Trumpeter Swans in the southwest Yukon.

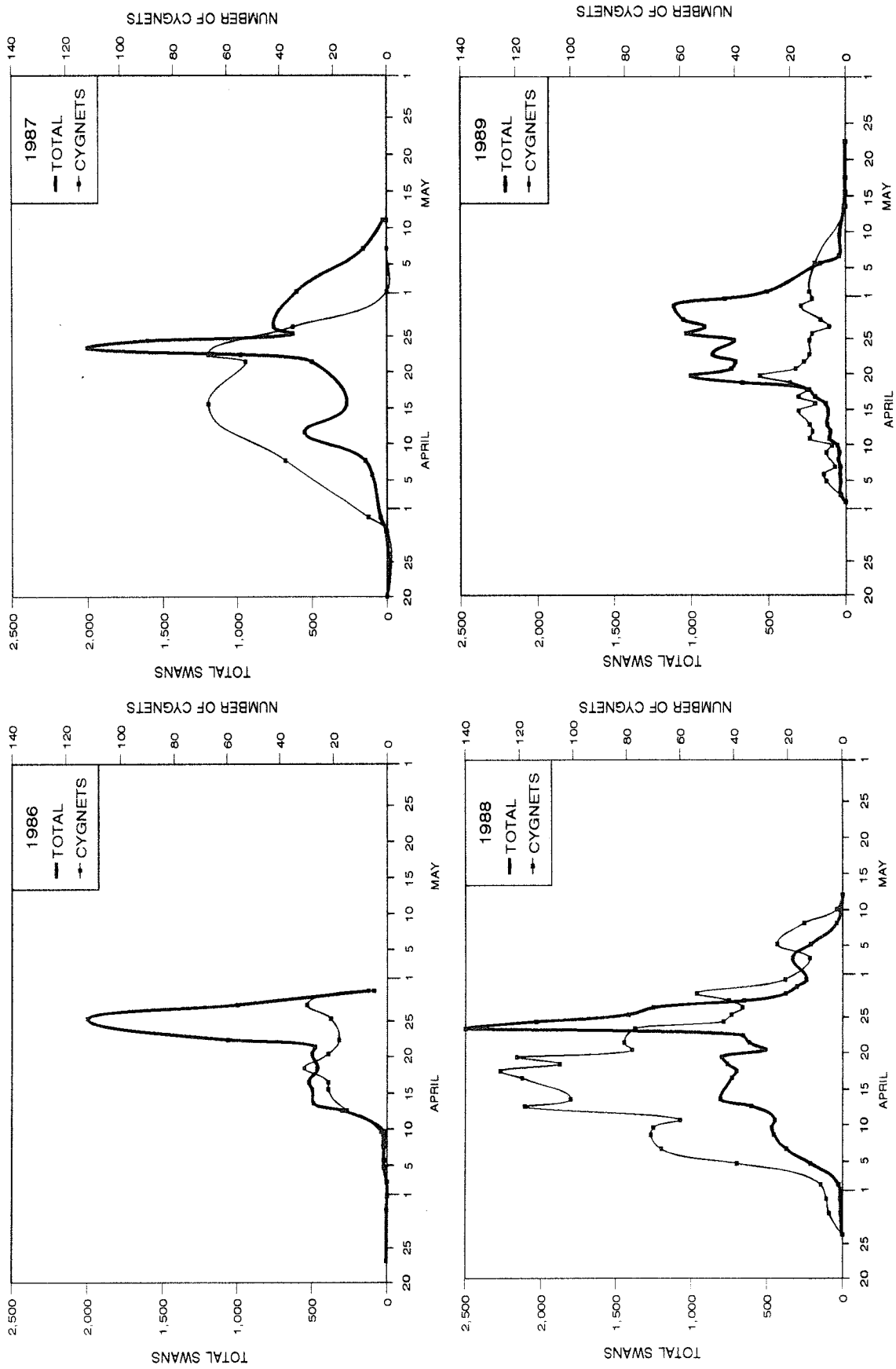

Figure 2. Total numbers of swans and Trumpeter Swan cygnets counted at M'Clintock Bay, Yukon, during spring migration 1986-92.

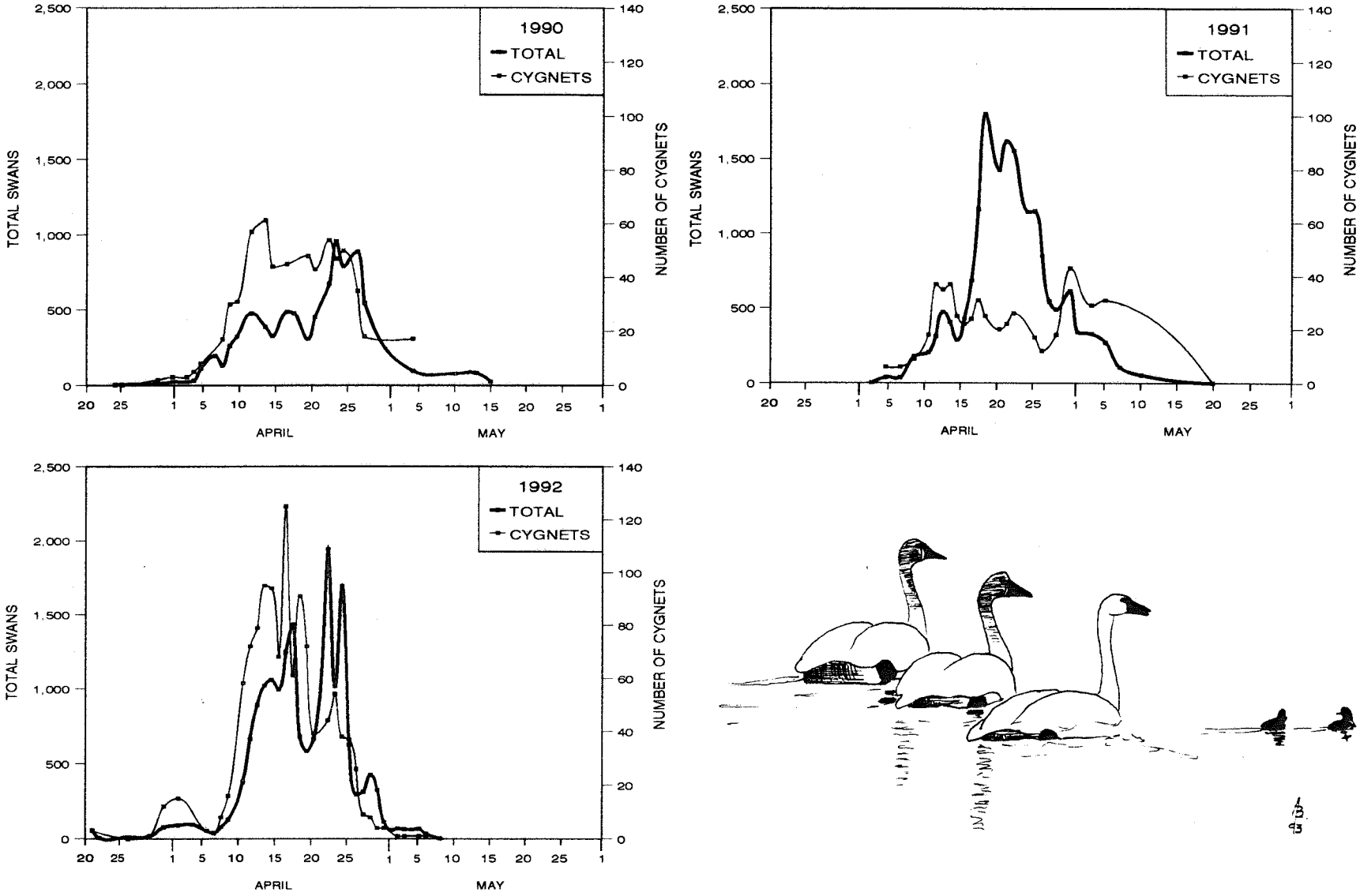

Figure 2. Total numbers of swans and Trumpeter Swan cygnets counted at M'Clintock Bay, Yukon, during spring migration 1986-92.

indistinguishable from older birds (Hansen et al. 1971). Therefore, we only used age ratio data obtained prior to the arrival of large numbers of Tundra Swans each spring. Cutoff dates were determined for each spring (Table 1), based on the observer's estimate of the number of Tundra Swans present (using sound as the major criteria). To generate the best single estimate of the age ratio for each spring (Table 1), we simply compared the sum of all grey swans to the sum of all white swans observed on all counts up to and including the cutoff date.

Yearling recruitment and population growth

We used a simple population model (Table 2) to project the growth of the population each year from summer 1985 to summer 1992, using published estimates of adult survival, and our cygnet/adult ratios from April. We started with the equation (1), where the subscript "a" is the year. For this analysis we assumed that immigration and emigration were not major contributing factors, and were therefore zero. That gives equation (2), where (3) and (4) can be substituted. To avoid overestimating yearling recruitment, we multiplied our observed cygnet/adult ratios in April by the number of adults estimated to be surviving from the previous April, given by equation (5). The net number of birds added to the population each year is given by equation (6), and the annual rate of growth of the population, expressed as a percentage, is given by equation (7).

In this model we used only two age classes, 0-1 years and 1+ (which we will refer to as adults). There were no estimates available of annual adult survival from the PCP, so we substituted values of 0.90, 0.925, 0.950, and 0.975. These range upwards from the only published estimate of 0.90, which was calculated from banding data in the Tristate Subpopulation (TSP) in Montana by Anderson et al. (1991).

We compared these projections with observed summer populations in 1985 and 1990 in various parts of central Alaska (Conant et al. 1991). These data were collected as part of the Alaska Trumpeter Swan Survey which has been conducted every 5 years since 1975.

Overwinter survival

We estimated 7 month overwinter survival rates for cygnets from our April age ratios at Marsh Lake, age ratios from central Alaska (Gulkana, Upper and Lower Tanana units) the previous August or September (Hodges et al. 1986, Hodges et al. 1987, Groves et al. 1990, Conant et al. 1991), and an annual adult survival rate of 0.925 (Table 2: equation 8).

RESULTS

Recruitment and population growth

Actual counts of cygnets (grey birds) and total swans at M'Clintock Bay, Yukon, 1986-92 are depicted in Figure 2. Overall observed ratios of cygnets to adults (white birds) in April, up to and including the cutoff dates, ranged from 3.5 cygnets per 100 adults in 1986 to 18.7 in 1988 (Table 1). Actual recruitment figures are directly proportional to these, assuming a constant annual survival rate for adults.

When we projected population growth with this model using our observed cygnet:adult ratios and adult survival rates of 0.90, 0.925, 0.950, and 0.975, the total growth over 5 years (1985-1990) was 9.1, 25.1, 42.9, and 62.8 percent, respectively (Table 3, Figure 3). Observed growth of the population in Alaska determined from the counts in August of 1985 and 1990 indicate that annual adult survival rates greater than 0.95 would be necessary to make the Marsh Lake data consistent with summer counts of the five or six interior Alaska units. However, a rate of only 0.925 would make our data match the observed growth rate in the Gulkana unit alone or in the entire state.

The only published estimate of adult Trumpeter Swan survival rates is 0.90 for a nonmigratory population in Montana (Anderson et al. 1991), and although there is ample evidence that migratory swans have higher adult survival than non-migratory ones, it seems unlikely that adult survival in the PCP could exceed 0.95. In our analysis we have also assumed that second and third year survival rates are the same as those of older birds, although the bulk of evidence from other swan species suggests that survival rates

Table 1. Trumpeter Swan age ratios and cutoff dates for determining age ratios, as observed at Marsh Lake, Yukon, April 1986-92. Data obtained after these dates were biased by the presence of Tundra Swans.

Year	Cutoff date	Observed age ratio (Cygnets per 100 adults)
1986	22 April	3.5
1987	22 April	11.4
1988	22 April	18.7
1989	18 April	11.7
1990	20 April	13.9
1991	15 April	9.8
1992	20 April	13.3

Table 2. Equations used to estimate recruitment and overwinter mortality of Trumpeter Swans.

(1) $population_{(April\ a)} = population_{(April\ a-1)} + yearling\ recruitment_a + immigration_a - emmigration_a - adult\ mortality_a$

(2) $population_{(April\ a)} = population_{(April\ a-1)} + yearling\ recruitment_a - adult\ mortality_a$

(3) $adult\ mortality_a = population_{(April\ a-1)} \cdot (1 - adult\ survival\ rate_a)$

(4) $yearling\ recruitment_a = (cygnets/adult)_{(April\ a)} \cdot surviving adults_{(April\ a)}$

(5) $surviving\ adults_{(April\ a)} = population_{(April\ a-1)} \cdot adult\ survival\ rate_a$

(6) $population\ growth_a = yearling\ recruitment_a - adult\ mortality_a$

(7) $population\ growth\ rate_a = \frac{population\ growth_a}{population_{(April\ a-1)}} \cdot 100$

(8) $overwinter\ survival_a = \frac{cygnets/adult_{(April\ a)} \cdot (monthly\ adult\ survival\ rate)^7}{cygnets/adult_{(August\ a-1)}} \cdot 100$

Table 3. Projected growth of a hypothetical adult (1+ years old) population of Trumpeter Swans using recruitment values observed at Marsh Lake, Yukon, in April, and four different annual adult survival rates. In each case the initial population is 1,000 white birds in summer 1985. Immigration and emmigration are assumed to be zero.

Annual adult survival rate	1985	1986	1987	1988	1989	1990	1991	1992	Growth: Total 1985-90 (%)	Growth: Mean annual (%) 1985-90	Growth: Mean annual (%) 1985-92
0.900	1,000	1,002	1,071	1,077	1,103	1,091	1,112	1,101	9.1	1.8	1.9
0.925	1,000	1,030	1,131	1,169	1,231	1,251	1,311	1,334	25.1	4.6	4.2
0.950	1,000	1,058	1,193	1,266	1,370	1,429	1,538	1,607	42.9	7.4	7.0
0.975	1,000	1,086	1,256	1,369	1,520	1,628	1,798	1,928	62.8	10.2	9.8

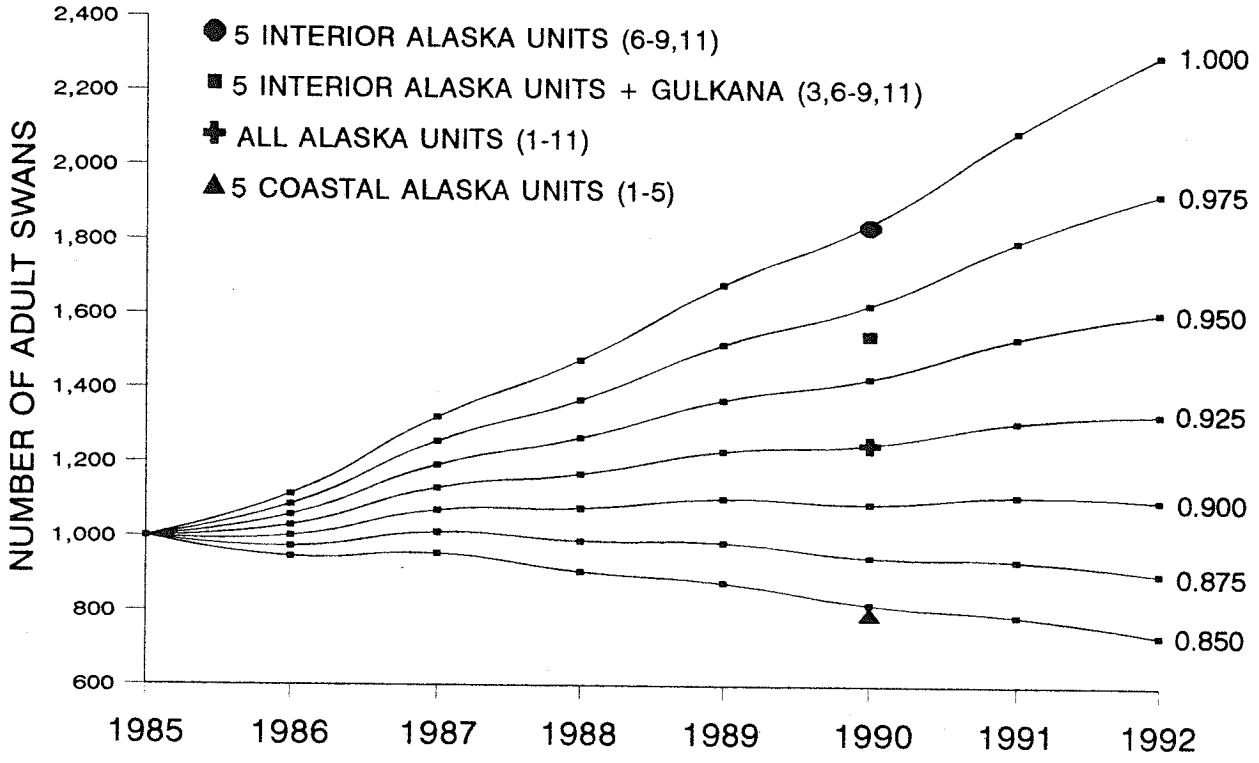

Figure 3. Projected growth of a population of 1,000 adult Trumpeter Swans from 1985 to 1992, using annual recruitment figures estimated from age ratio counts at Marsh Lake, Yukon, and seven different annual adult survival rates. Symbols for 1990 correspond to relative population growth observed in various units in the Alaskan breeding range (Conant et al. 1991): 1=Gulf Coast, 2=Copper River, 3=Gulkana, 4=Kenai, 5=Cook Inlet, 6=Lower Tanana, 7=Kuskokwim, 8=Koyukuk, 9=Yukon Flats, 10=Chilkat Valley, 11=Upper Tanana.

are lower in the second year than in subsequent ones (Bart et al. 1991, Nichols et al. 1992).

Migration studies at Tok and Gulkana, Alaska, suggest that Trumpeters migrating through southwestern Yukon could be destined for any of six units (Upper Tanana, Lower Tanana, Gulkana, Yukon Flats, Koyukuk, Kuskokwim), and perhaps Cook Inlet as well (Cooper et al. 1991). A careful analysis of existing band recovery and collar sighting data, and some additional banding and collaring in new areas would undoubtedly shed some further light on migration routes and thus make the Marsh Lake age ratio data more conclusive.

Other possible explanations for the inconsistency of our data with that from central Alaska are:

1. Marsh Lake age ratios may be biased downwards by differential migration of cygnets versus white birds. That is, proportionately more cygnets may migrate later in April, after our cutoff dates for age ratio calculation. However, the scanty evidence on this subject suggests that, if anything, breeding birds and their young migrate earlier than nonbreeders (Haapanen and Hautala 1991).

2. At Marsh Lake some cygnets may be mistaken for white-plumaged birds. This seems unlikely from the literature on plumage development. A more likely mistake is that 2-year-old Trumpeters retaining a few grey scapular feathers might be mistaken for cygnets. However there generally tend to be very few birds that are difficult for an experienced observer to classify.

3. At Marsh Lake some Tundra Swans are counted as white Trumpeter Swans just prior to the cutoff dates, resulting in an underestimate of cygnets. This undoubtedly happens, but not to the magnitude that could significantly influence the resulting overall age ratios.

4. Part of the apparent increase in the Alaska population between 1985 and 1990 has been due to an increase in the amount of survey effort.

5. The population is not closed, i.e. there is significant immigration from other units, such as along the Alaska Gulf Coast.

Overwinter survival of cygnets

Age ratios from central Alaska which were used to estimate cygnet survival in this analysis ranged from 25.3 to 50.1 cygnets per 100 adults (Table 4). These figures are the actual ratios of birds counted each year rather than estimates (Hodges et al. 1986, Hodges et al. 1987, Groves et al. 1990, Conant et al. 1991). Our estimates of overwinter (August to April) cygnet survival for interior Alaska breeding areas ranged from a low of 13.5 percent in 1985-86 to 35.6 percent in 1987-88, with the remaining values between 24 and 30 percent (Table 5, Figure 4). The 2 years with excellent production data from complete surveys of the Alaska breeding grounds were 1985-86 and 1990-91. Of these two survival estimates, the first (13.5%) resulted from poor production combined with a cold winter and late spring, and the second (28.2%) resulted from a more normal summer for production followed by a more normal winter and spring.

There are no other estimates of overwinter survival of Trumpeter Swan cygnets, but Nichols et al. (1992) concluded that North American Tundra Swan cygnets of the Eastern Population had 6-month (July to January) overwinter survival rates of not less than 21 percent. The weak link in our data appears to be the late summer counts from central Alaska during 1987-89. In these 3 years, maps were not chosen for surveying in a random fashion, and only one or two maps were surveyed each year in the Gulkana unit (Table 5).

DISCUSSION

Age ratio information gathered at M'Clintock Bay appears to be well correlated with productivity on the Alaska breeding grounds and provides a valuable and easily obtained index of annual cygnet recruitment in this part of the PCP. The existing data suggest that adult survival rates are very high in this population, but for now this cannot be

Table 4. Numbers of Trumpeter Swan adults and cygnets counted on aerial surveys of three units in Interior Alaska 1985-90. Data from Conant et al. 1985, Hodges et al. 1986, Hodges et al. 1987, Conant et al. 1991.

Year	Unit	# of Maps surveyed	Total adults	Cygnets	Cygnets per 100 adults
1985	Gulkana	77	2,474	533	21.5
	Upper Tanana	58	141	64	45.4
	Lower Tanana	76	1,741	503	28.9
	Total	211	4,356	1,100	25.3
1986	Gulkana	27	984	469	47.6
	Upper Tanana	16	41	14	34.1
	Lower Tanana	29	734	310	42.2
	Total	72	1,759	793	45.1
1987	Gulkana	2	319	110	34.5
	Upper Tanana	14	135	44	32.6
	Lower Tanana	26	1,117	641	57.4
	Total	42	1,571	795	50.6
1988	Gulkana	3	456	81	17.8
	Upper Tanana	13	135	76	56.3
	Lower Tanana	22	1,615	663	41.0
	Total	38	2,206	820	37.2
1989	Gulkana	1	116	60	51.7
	Upper Tanana	14	182	90	49.4
	Lower Tanana	19	255	97	38.0
	Total	34	553	247	44.6
1990	Gulkana	85	3,143	778	24.8
	Upper Tanana	64	301	224	74.4
	Lower Tanana	117	2,808	1,072	38.2
	Total	266	6,252	2,074	33.2

Table 5. Estimates of overwinter survival of Trumpeter Swan cygnets, and the observed cygnet:adult ratios from which they were calculated. Cygnet:adult ratios were observed in August and September in Interior Alaska (Gulkana, Upper Tanana, and Lower Tanana units) and the following April at Marsh Lake, Yukon. An annual adult survival rate of 0.925 and a corresponding adult monthly survival rate of 0.9935 were used to generate estimates of overwinter cygnet survival.

	Year						
	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92
August cygnets per 100 adults in Alaska	25.3	45.1	50.1	37.2	44.6	31.7	
April cygnets per 100 adults at Marsh Lake, Yukon	3.5	11.4	18.7	11.7	13.9	9.0	13.3
Estimated cygnet overwinter survival (%)	13.5	24.1	35.6	30.1	29.7	28.2	

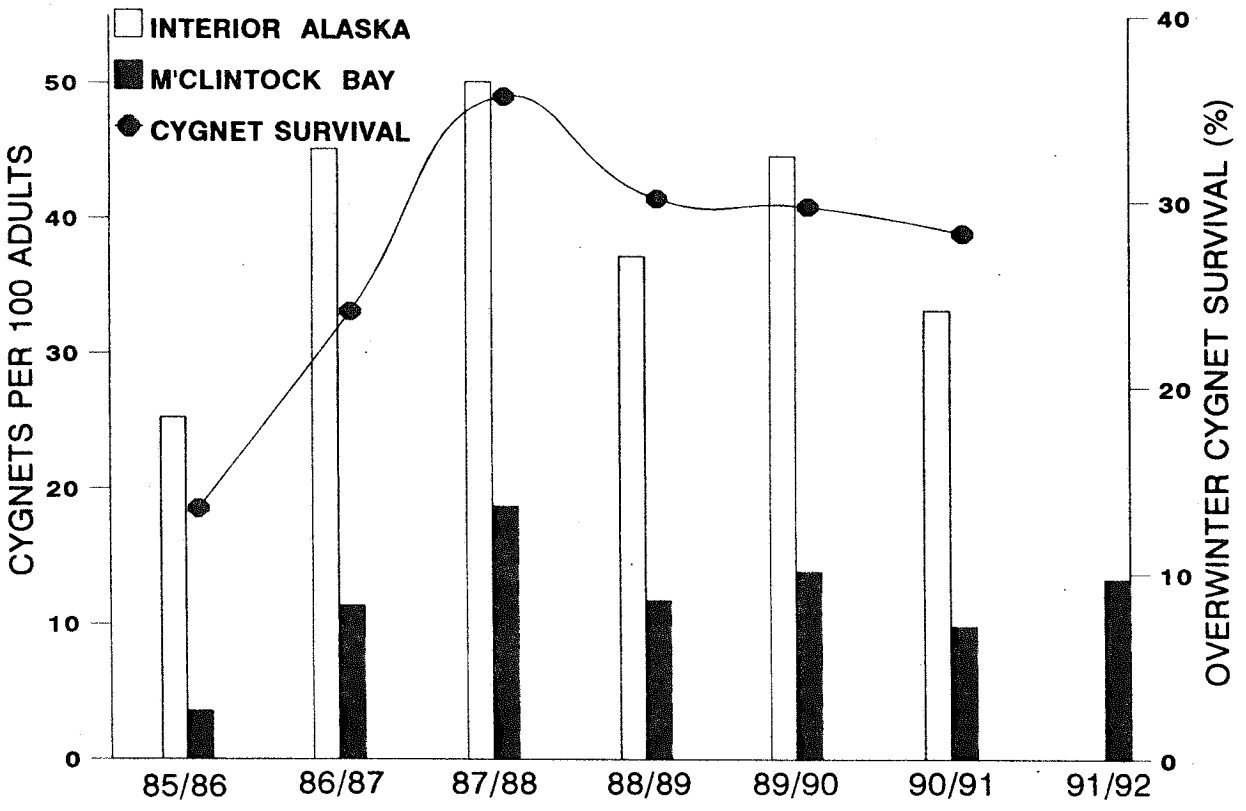

Figure 4. Cygnet:adult ratios and estimated overwinter survival of Trumpeter Swan cygnets. Cygnet:adult ratios are those observed in late summer in interior Alaska (units 3, 6, 10; see Figure 3) and the following spring at M'Clintock Bay, Yukon.

confirmed. The overwinter survival rate of cygnets estimated from our data is within the range of previous estimates for Tundra Swans, but again, this remains to be confirmed.

Annual estimates of recruitment can be generated easily in the future from counts at M'Clintock Bay, but estimates of cygnet survival can be generated on an annual basis in the future only if counts are also conducted on the breeding grounds in Alaska. Until the exact breeding areas of migrants passing through M'Clintock Bay are known, it is important to have a representative sample each year from each of the major breeding units in central Alaska.

ACKNOWLEDGEMENTS

Jack Hodges and Bruce Conant kindly provided reports and helpful comments regarding the data from the Alaska breeding grounds. Rick McKelvey was encouraging and provided wintering population data from Vancouver Island. James Weiers and other dedicated individuals helped conduct the many counts at M'Clintock Bay, sometimes under difficult conditions. Don Russell and Pam Sinclair reviewed the manuscript and made helpful suggestions.

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ABUNDANCE PATTERNS OF TRUMPETER SWANS AND TUNDRA SWANS ON THE FRASER RIVER DELTA, BRITISH COLUMBIA

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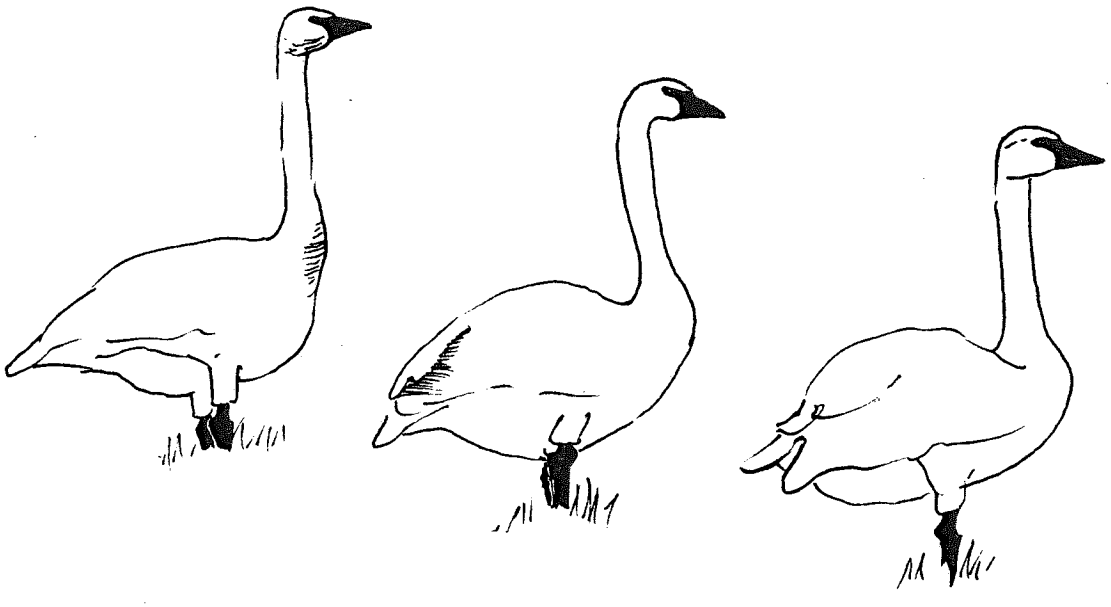
ABSTRACT

Over the last two decades, swan populations throughout the Pacific Northwest have increased exponentially at 7 percent per year. Trumpeter Swans (Cygnus buccinator) accounted for most of that growth. The swan population wintering near Ladner on the Fraser River Delta grew at 15 percent per year, from only 50 in the early 1970's to over 700 in the early 1990's. Recruitment alone (at 20% young) could have accounted for much of that increase. At present, swans are responsible for only about 8 percent of the grubbing impact on the bulrush zone. Snow Geese (Anser caerulescens caerulescens) account for the rest. At the current rate of growth, however, and provided no density dependent effects emerge, the number of swans on the Delta could exceed 4,000 by the year 2006. Swans could then account for about 38 percent of the total grubbing impact, provided the goose population remains the same. Under that scenario, total grubbing impact would increase by about 50 percent over the present level, and the carrying capacity of the bulrush zone would likely be reduced as a result. Studies are proposed to track the swan population and the interaction between swans and bulrush marsh and farms on the Delta.



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TRUMPETER SWANS WINTERING IN THE THOMPSON-OKANAGAN AREAS OF BRITISH COLUMBIA

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ABSTRACT

The Trumpeter Swan (Cygnus buccinator) occurs as a migrant and localized winter resident in the interior portions of British Columbia. Breeding has been documented north of 54 degrees latitude (Campbell et al. 1990). East of the coastal mountain chain, wintering birds occur as far north as about 55 degrees latitude, depending upon open water and suitable habitat. The numbers at each location vary from several to hundreds, but annual censuses are not conducted on most local populations. An annual census of all swans conducted for 20 years in the south - central portion of the Province is, therefore, worthy of documentation. The results of surveys conducted in the Thompson - Okanagan drainages along with Christmas Bird Count results are presented and discussed.

HISTORICAL STATUS

The numbers of birds wintering in the interior of the Province is not well documented except for the highly publicized population at Lonesome Lake. Brooks and Swarth (1925) do not mention wintering Trumpeter Swans, but Munro and McTaggart-Cowan (1947) note a small population at Vaseux Lake near 49 degrees latitude during the winter of 1924-25 (Figure 1). This group of 17 birds was apparently shot and poisoned by lead pellets such that it was eliminated by 1927 (Cannings et al. 1987). Cannings also noted that there were a few sightings of birds during occasional winters throughout the 1930's, but numbers were small. They indicate that from the late 1960's through the late 1980's, Trumpeters were seen most winters in the Okanagan Valley in numbers ranging from three to 28 birds. The mean size for 11 December flocks was 14 birds and the mean for 18 January flocks dropped to four.

Bellrose (1976) makes no mention of wintering birds in the interior except at Lonesome Lake, but notes that about 400 Tundra Swans (Cygnus columbianus) winter in the British Columbia interior. The possibility of Trumpeter Swans occurring with the Tundra Swans was not mentioned. Similarly, Palmer (1976) refers only to the Lonesome Lake population.

Wintering Trumpeters were not discussed in detail by McKelvey et al. (1988) in their review of the 1985 population status in western Canada. Only the coastal and Tristate Region were mentioned as key wintering grounds, but the intent of the review was to document the breeding population as opposed to other factors of interest. Campbell et al. (1990), indicates that the interior wintering population varies from rare to locally common, but does not refer specifically to birds in the Thompson River drainage. The main wintering areas noted are Stuart River, Francois Lake, Crooked River and Lonesome Lake. Away from this latter locality, the highest number noted by Campbell was 105 at the Stuart River in December 1967. The Canadian Wildlife Service has sporadically censused Trumpeters in the more northerly portions of the wintering range. The total population was last counted in 1990 and numbered about 1000 birds (McKelvey and King, pers. comm.). These birds are quite widely scattered and not easily censused without aircraft. Counts done on the Crooked River by local naturalists are probably not representative of real population changes due to the difficulty of counting inaccessible portions of the river. The number of birds is traditionally about 75 individuals. Since the 1950's, the northern population has probably increased, but details of the changes and timing are not well documented (King, pers. comm.). None of these censuses included

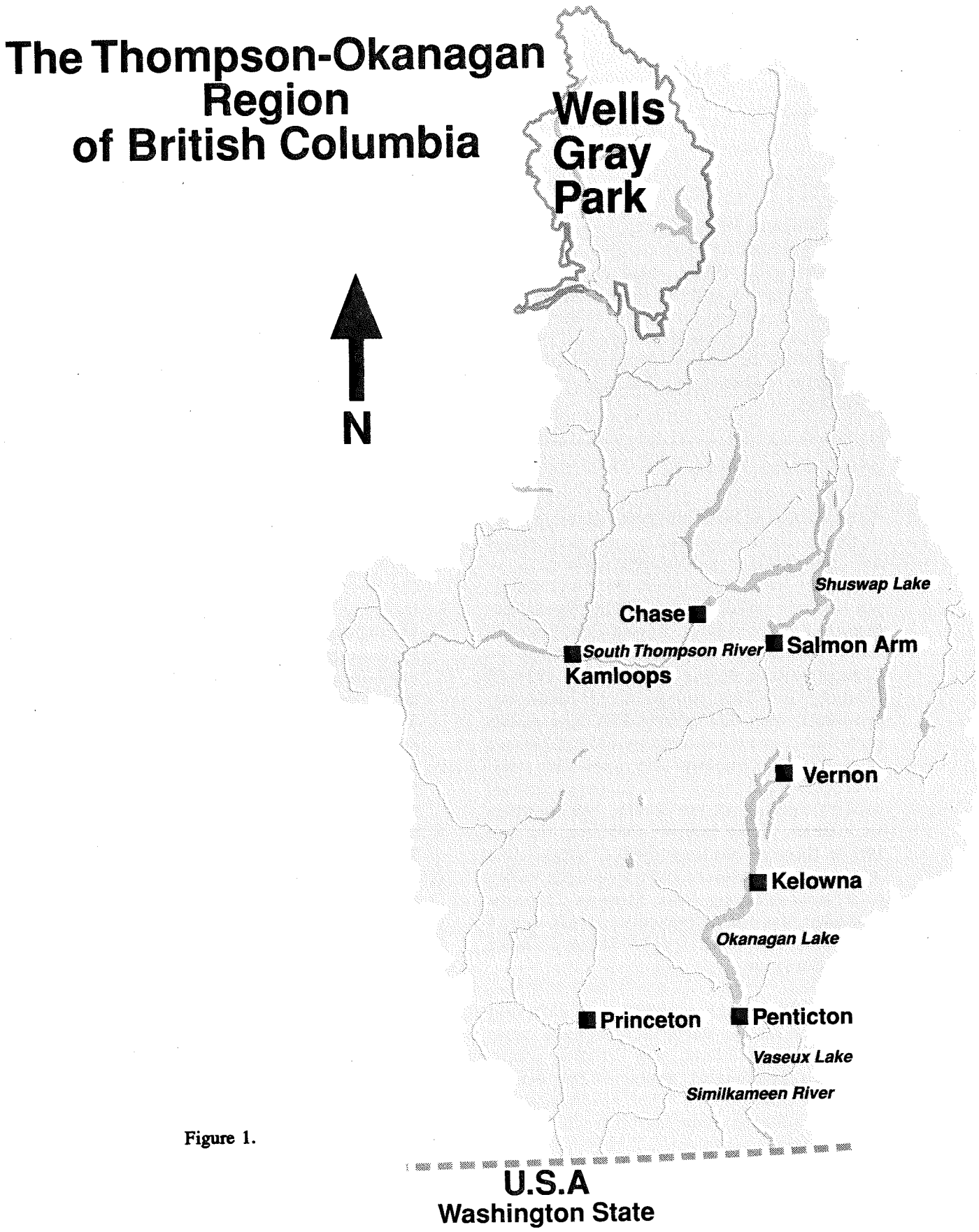

The Thompson-Okanagan Region of British Columbia
Wells Gray Park
N
Shuswap Lake
Chase
South Thompson River
Salmon Arm
Kamloops
Vernon
Kelowna
Okanagan Lake
Princeton
Penticton
Vaseux Lake
Similkameen River
U.S.A
Washington State

Figure 1.

the Thompson River drainage or the Okanagan Valley.

Audubon Society Christmas Bird Counts have been conducted in portions of the study area for over 20 years. The general centres for these counts have been Kamloops, Shuswap Lake Provincial Park, Salmon Arm, Vernon, Kelowna, Penticton, Oliver-Osoyoos and Vaseux Lake. Only some count circles include areas traditionally frequented by swans of any kind and not all counts have been conducted for the entire period of 20+ years. In some cases, such as the Shuswap Lake Park count, swans enter the count circle in larger numbers only when the South Thompson River is completely or nearly all frozen. Christmas Count data is a useful indicator of overall population trends, but the counts do not represent all of the wintering birds and the results are strongly influenced by the weather and local icing conditions.

In 1974, member clubs of the Federation of British Columbia Naturalists (FBCN) began an annual survey of swans wintering in the Thompson and Okanagan drainages. This is a 1-day count taken in mid-winter that was originally prompted by the highly visible population of Tundra Swans that utilize the South Thompson River. In the early years of the count, it was assumed that Trumpeters did not occur on the river and the only birds documented on the tally were very small numbers in the south Okanagan. The lack of trained observers and the difficulty of accessing much of the South Thompson River makes it difficult to know whether the assumption was a valid one or whether Trumpeters were being overlooked. Personal conversation with some participants during the early years suggest that vocal birds were unlikely to have been missed, but birds counted at long distances were always assumed to have been Tundra Swans. At best, the numbers of Trumpeters present during the 1970's and early 1980's was likely low and few birds were overlooked. Further evidence that this species was not here in any numbers from the 1950's onward was the failure of local biologists to note them during routine field work. No specific attempts were made to locate or distinguish Trumpeters from the more common Tundra Swans (Ritcey, pers. comm.). By 1983, Trumpeters were being noticed annually and numbers increased dramatically over the next decade.

STUDY AREA

The study area extends from 49 to 51 degrees north latitude and from 118 to 121 degrees west longitude. Within these boundaries, the surveyed areas are the valley bottom of the South Thompson River and Kamloops Lake, the Shuswap Lake basin and Shuswap River, the Okanagan Valley and occasionally, the Nicola and Similkameen Valleys. These areas range from 277 - 375 m in elevation for a difference of approximately 100 m at the extremes. The grades in all of the valley bottoms are gentle, resulting in extensive areas of slow-moving water in all of the major rivers.

The Shuswap Lake and inflowing drainages are glacially scoured basins within the Shuswap Highlands - an area of complex metamorphosed rock and more extensive uplift and relief than the Interior Plateau to the west. The remaining valleys are all glacially scoured trenches within the Interior Plateau - an area of diverse geologic history dominated by extensive basaltic flows and complex intrusive rocks.

Shuswap Lake is a large H-shaped water body with several major rivers entering it. The most important for swans is the 70 km long Shuswap River that drains Mabel Lake. Shuswap Lake is drained by the South Thompson River which flows in a westerly direction for some 70 km to Kamloops Lake. This is a deep, cool lake about 30 km long. Nicola Lake stretches for about 23 km in a generally north-south direction and is located south of Kamloops on the Thompson Plateau.

The Okanagan Valley consists of one major north-south trench and some parallel valleys carved into the easterly edge of the Interior Plateau. It is about 200 km in length from Armstrong in the north to the U. S. border in the south. Okanagan Lake stretches for 115 km in a gently curving fashion through much of the Valley. Its size makes it an imposing physical and biological feature of the Valley. Skaha, Vaseux and Osoyoos Lakes occupy

much of the remaining valley floor south of Okanagan Lake to the 49th parallel.

Floristically, the South Thompson and Okanagan Valleys adjacent to the water bodies bear some resemblance to each other. Both have dry climates with mean annual precipitation ranging from 225 to 450 mm. The major vegetation types are either shrub-grasslands or ponderosa pine forests interspersed with riparian habitats of black cottonwood and a variety of smaller trees and shrubs. In the northeastern portion of the study area, increased precipitation around the Shuswap basin has resulted in more densely wooded shorelines and hill slopes that consist of varying admixtures of Douglas fir, hemlock, western red cedar, ponderosa pine and western white pine, depending upon localized variation in precipitation. Deciduous trees are also more common with trembling aspen, paper birch and black cottonwood predominating.

The climate over most of the study area is a dry, continental one with most of the lower valleys having a cold, semi-arid, steppe climate. In the Shuswap area, the climate is still dry at the western extremes, but it grades into a more humid continental to the east. The mean temperature for January at Kamloops averages -6°C which is similar to the northern portions of the Okanagan Valley. The southern portions of this valley average closer to -3°C. The mean minimum temperature for Kamloops is again similar to the north Okanagan at -10°C whereas the southern Okanagan is somewhat warmer at -6°C. January extremes can reach -30 to -40°C in all areas.

METHODS

Trumpeter Swans were counted as part of an overall tally of all swans wintering in the study area. Annual censuses were initiated in 1974 and took place around mid-January. The exact dates varied slightly depending upon observer availability and the occurrence of a Sunday nearest to the middle of the month.

Teams of observers were assigned specific geographic areas, all of which were sufficiently large to require travel by vehicle to ensure coverage. Teams varied in size from one to 15 people depending upon a variety of factors ranging from availability to the simple desire of enjoying a social outing. Wherever possible, observers lacking skills at separating Trumpeter and Tundra Swans were assigned to teams with the necessary field skills.

The observers drove and walked their areas in order to position themselves in the best locations to adequately identify swans wherever they were encountered. Observation distances varied from 10 m to 1 km, but in most cases observers were able to approach birds to within 200-500 m. In the case of the 10 m observations, the birds were being hand fed and were very tame. Not infrequently, vocalizations assisted in confirmation of species identified visually. Minimally, all teams were equipped with binoculars and most enjoyed the advantage of spotting scopes with magnifications varying from 20-45 x and access to a variety of field guides and other references for identification tips. All results were phoned to the author at the end of the count day and a compilation made while details were fresh in the minds of the observers. Brief annual reports were created and maintained on file with results variously reported in FBCN and member club newsletters. Notes about ice conditions were generally taken, but calculations of total available foraging habitat were not made.

Christmas Bird Count data was extracted from reports published in American Birds from 1974 to 1992. There were a few years where some counts were not published in this journal, but no attempt was made to locate the data for the missing years.

RESULTS

Wintering population from surveys

Trumpeter Swans were first noted on the surveys in 1977, but were not seen annually until 1983. Table 1 and Figure 2 indicate the total numbers found in all areas in all years tabulated according to age.

Of the total population wintering in the study area each year, the percentage of juveniles varied from 7 to 43 percent with a mean of 21 percent. Almost all juveniles were found in the northernmost parts of the study area.

Juveniles were not found in the early years of the survey when small numbers of swans were found. Table 2 and Figures 3 and 4 indicate the percentage of juveniles in the wintering population.

Distribution

Swans were not distributed evenly throughout the study area. Most birds were concentrated along the South Thompson River between Chase and Kamloops. During periods when most or all of the river was frozen, birds could be found on the Little River at the west end of Shuswap Lake. Small numbers of Trumpeters were found in recent years in the southern parts of the Okanagan Valley. At the west end of Kamloops Lake, a small flock of birds was being fed annually by local residents and increased to become the largest population found regularly away from the South Thompson River. This group of birds was not counted on an annual basis. Occasionally, birds were noted in small numbers on the southernmost arms of Shuswap Lake and the Shuswap River in the Enderby area. Table 3 indicates the major geographic locations and the numbers of birds seen each year. Figure 5 shows the total numbers of birds seen for all years in the major geographic areas of Savona, South Thompson River, Shuswap Lake, Shuswap River, Vernon, Kelowna, Summerland-Penticton, Vaseux Lake.

Christmas Bird Count results

Trumpeter Swans were not recorded on any of the eight counts until 1980 and then, only two were seen on the Shuswap Park tally. From 1983, Trumpeters were seen annually on one or more counts. A total of 218 birds have been recorded on all of the counts since 1974. The Shuswap Park count recorded swans on all but 2 years since 1983 and has accounted for 73 percent of all birds recorded on all Christmas Bird Counts conducted in the study area since 1974. Vaseux Lake is the only other count to have recorded Trumpeters more than twice in 20 years with the total being 15 birds over four occasions. On all other counts, swans confirmed as Trumpeters have only been reported either once or twice during the 20-year period. The Oliver-Osoyoos count has reported birds only twice, but the total of 13 birds is close to the Vaseux total. The count circle is also in the southern part of the Okanagan Valley, confirming this area as a traditional, if inconsistent wintering area. However, the numbers are low compared to the Thompson River and western end of

Table 1. Wintering populations of Trumpeter Swans in the Thompson-Okanagan areas of British Columbia.

Year	Adults	Juveniles	Total
1974	0	0	0
1975	0	0	0
1976	0	0	0
1977	2	0	2
1978	0	0	0
1979	0	0	0
1980	0	0	0
1981	2	0	2
1982	0	0	0
1983	13	0	13
1984	12	0	12
1985	13	3	16
1986	49	8	57
1987	19	10	29
1988	29	22	51
1989	94	22	116
1990	109	28	137
1991	148	23	171
1992	226	67	293
1993	204	15	219

Table 2. Percent juveniles in wintering population.

Year	% Juveniles
1985	19
1986	14
1987	34
1988	43
1989	19
1990	20
1991	13
1992	23
1993	7

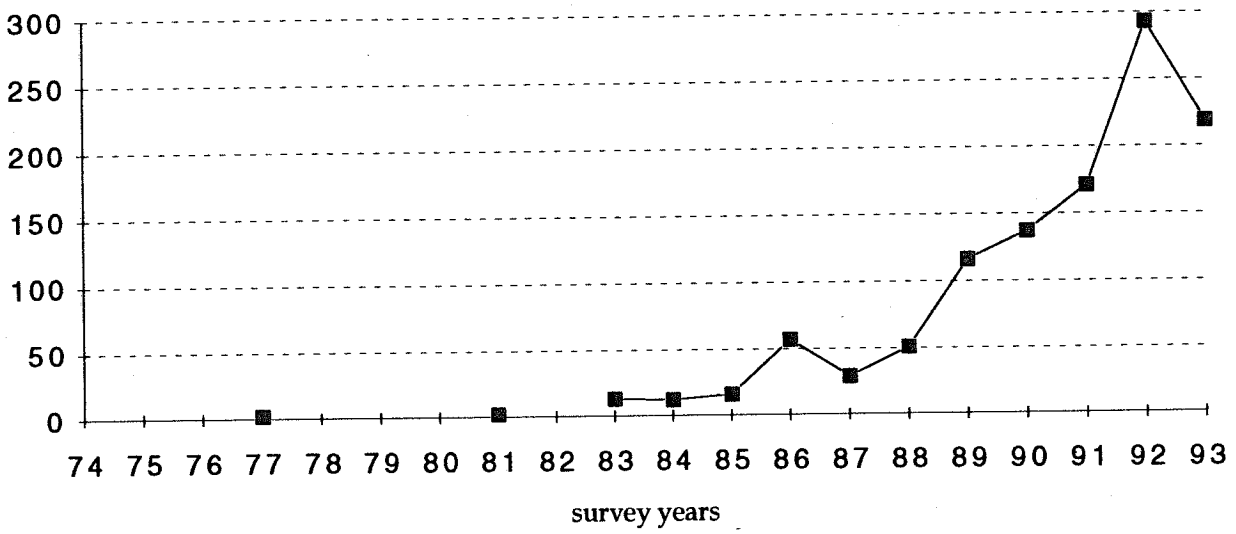


Figure 2. **Wintering populations.**

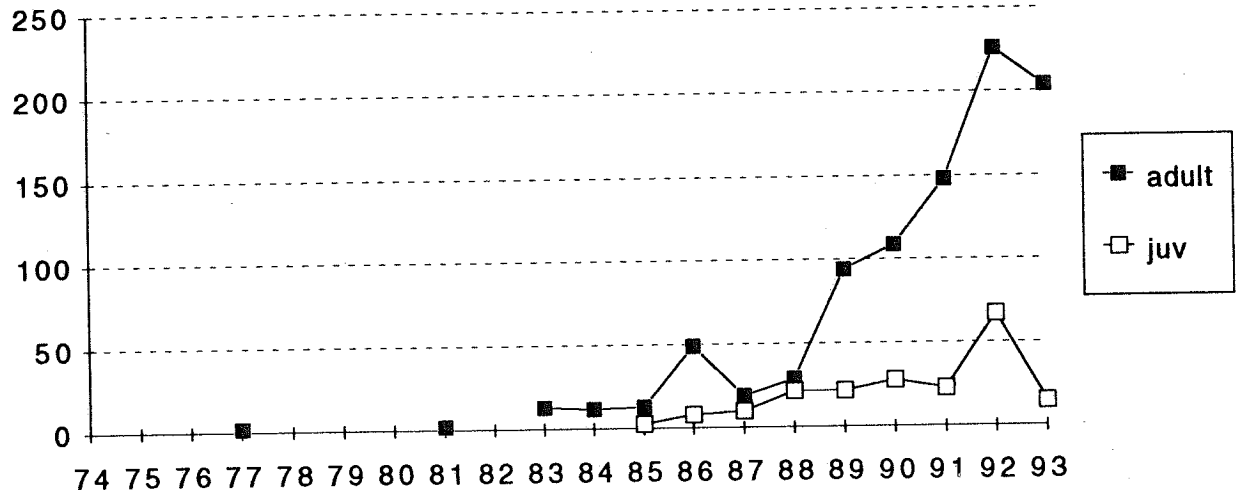


Figure 3. **Adults and juveniles in wintering populations.**

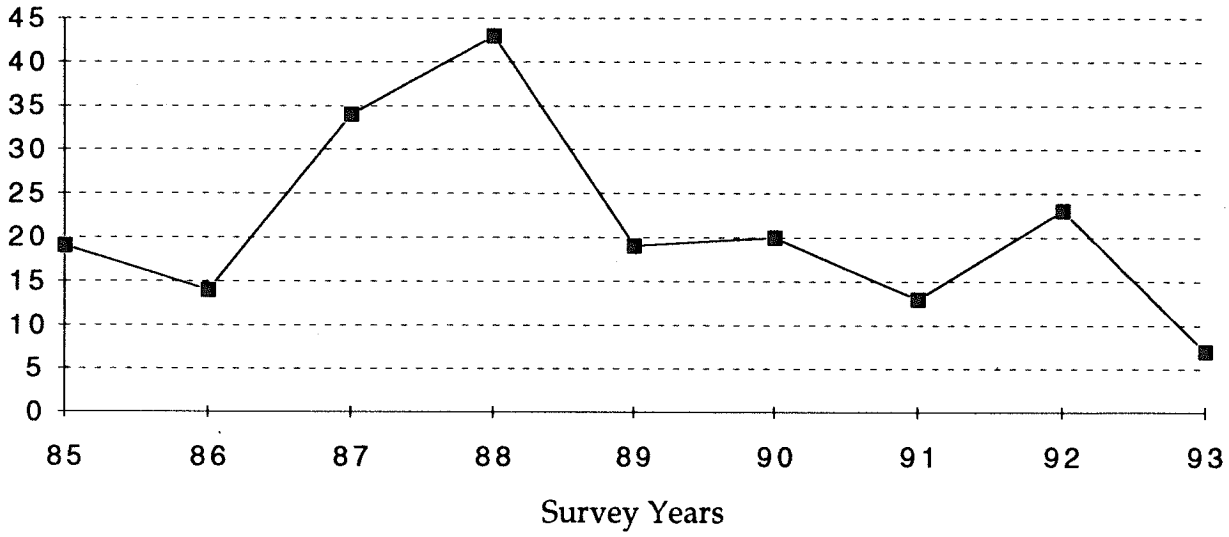
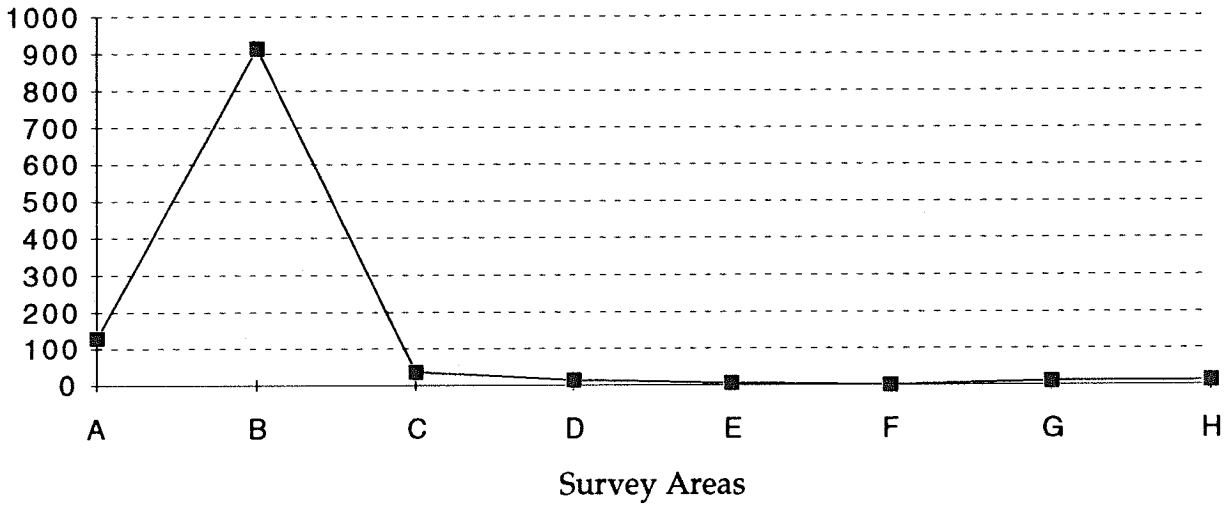


Figure 4. Percentage of juveniles in wintering populations.



A = Savona
B = South Thompson River
C = Shuswap Lake
D = Shuswap River
E = Vernon
F = Kelowna
G = Summerland-Penticton
H = Vaseux Lake

Figure 5. Total number of swans for all survey years.

Table 3. Wintering populations by geographic areas.

Year	Savona	South Thompson River	Shuswap Lake	Shuwap River	Vernon	Kelowna	Summerland-Penticton	Vaseux Lake
1974								
1975								
1976								
1977								2
1978								
1979								
1980								
1981		2						
1982								
1983	13							
1984		12						
1985		16						
1986		40	13	4				
1987		25		1				3
1988		30	16		5			
1989		113	3					
1990		125	2	9				1
1991	43	126	1					1
1992	29	260						4
1993	44	165					10	

Shuswap Lake. The results of the counts are presented in Table 4 and illustrated in Figure 6.

DISCUSSION

Census data clearly indicate an increase in Trumpeter Swans wintering in the study area. This increase has not been uniformly distributed and it has not been significant in the historic areas of the south Okanagan Valley. The increase has taken place along the South Thompson Valley and adjacent western ends of Shuswap Lake and Kamloops Lake. Birds at this latter location near the town of Savona, have been fed by local residents thus creating an artificial situation that may not have otherwise prevailed. Birds wintering along the South Thompson River are totally dependent upon natural foraging conditions and are entirely aquatic in their habits. There have been no observations of swans utilizing agricultural fields as noted for the Comox area (McKelvey and Verbeek, 1988).

Since 1983, the total wintering population increased by nearly 2300 percent (Table 1, 1992), with the bulk of the birds being found on the South Thompson River between the towns of Chase and Kamloops. Distribution along the river was clumped and reflects favoured foraging areas. Most of the birds appeared to prefer the eastern half of the river. In times of severe icing, the birds congregated below Chase where the river tended to remain somewhat ice-free. An alternate location during these conditions was Little River which connects Shuswap and Little Shuswap Lakes. This is a 15 minute flight eastward from the South Thompson River near Chase. It is likely that this location cannot sustain large numbers of birds for long periods due to limited forage production, but plant growth was not measured. Consumption of aquatic insect larvae has been observed in the Prince George area (King, pers. comm.), but was not proven in the Kamloops area. Swans moved back onto the more extensive South Thompson system as early as ice conditions would allow.

Table 4. Trumpeter Swan totals from Christmas Bird Counts.

Year	Kamloops	Shuswap Park	Salmon Arm	Vernon	Kelowna	Penticton	Oliver-Osoyoos	Vaseux Lake
1973								
1974								
1975								
1976								
1977								
1978								
1979								
1980		2						
1981								
1982								
1983		13						
1984		1					10	
1985		15					3	
1986		3			1			2
1987								5
1988		5				6		2
1989	15	4	4	1				
1990		71		2				
1991	5		2					6
1992		45						

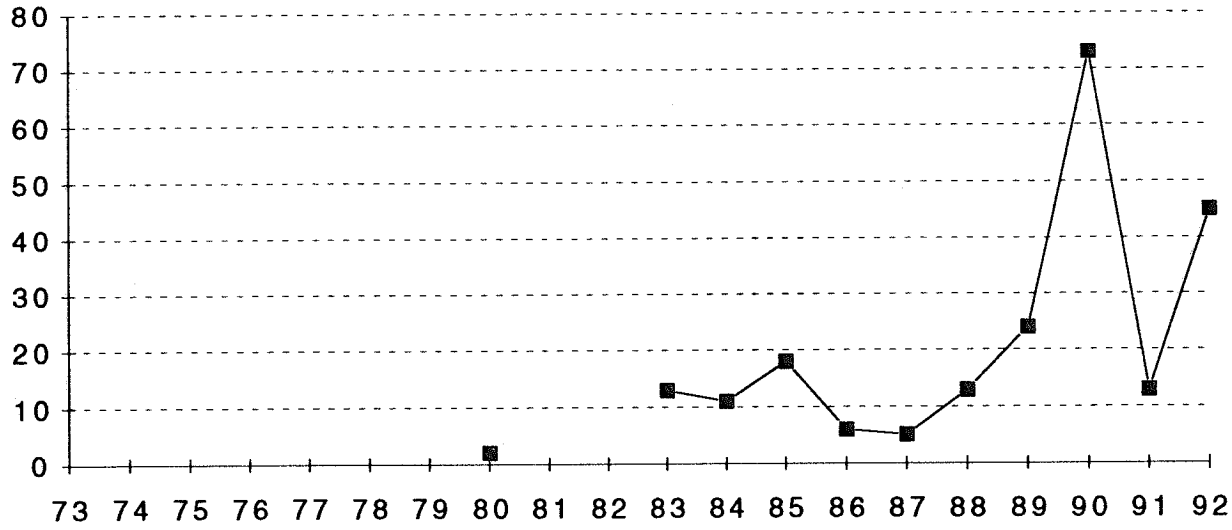


Figure 6. **Trumpeter Swan totals from Christmas Bird Counts.**

During the 20-year census, observers were initially under the impression that they were counting only Tundra Swans. In the early years of the census, this was likely true. During mild winters, the number of Tundra Swans in the study area exceeded 500 birds and they freely mixed with Trumpeters in many areas. However, during the early years of the census there were many long-term observers who admitted to having difficulty separating the two species, unless the birds were vocal. Some of the observers were nonetheless, very skilled and were certainly unlikely to miss vocal birds. In 1978, the author took over the role of count coordinator and possessed sufficient expertise to separate non-vocal birds at considerable distances. Even so, Trumpeters were not detected until 1981. This was corroborated by Christmas Count data which showed that Trumpeters were not detected at the western end of Shuswap Lake until 1980. There had been a considerable number of expert observers on this count since its inception in 1971 and it is likely that Trumpeters would have been found if they were present. While it is possible that historically there were some Trumpeters interspersed in the South Thompson Tundra Swan population that went undetected, the numbers were likely very low. During colder winters, most of the Tundra Swans left the South Thompson for unknown destinations. The Trumpeters remained behind, and, in those circumstances, became the most common swan to be found after Christmas.

Historically, the Okanagan Valley was known to have small numbers of wintering Trumpeters, but the census data do not show any significant increase in this geographic area. The key locations were in the southernmost part of the valley in the Vaseux Lake and Oliver/Osoyoos areas. While observers around Okanagan Lake debated the identity of some swans, the majority appear to have been Tundra with a few Trumpeters in the mid or north Okanagan Valley locations. If there were errors being made, it was in underestimating Trumpeters that were present, rather than identifying Tundra Swans as Trumpeters and overestimating the population. Even so, the numbers of Tundras wintering on Okanagan Lake was only about 30 birds. If some of them were misidentified as Trumpeters, the numbers would not have been significant. Christmas Counts were taken up to 4 weeks prior to the annual swan census. In some years, more Trumpeters were found on

these counts than on the swan census. The numbers were still very small, and the discrepancies may have been due to an exodus of birds as winter conditions worsened.

Christmas Count results were indicative of the general population trend, but probably closely approximated the total wintering population only in the eastern Shuswap Lake and Okanagan areas. These count circles appear to have enclosed much of the traditional wintering areas. In the case of the Shuswap Lake Park count at the western end of the lake, small numbers of Trumpeters were found in the count circle when the lake was ice-free. Under these circumstances, the South Thompson River was also ice-free and retained most of the birds in this preferred habitat. In years when more than a few birds were found on the Shuswap count, icing conditions on the South Thompson River were forcing some birds to move around in search of foraging habitat which was found in the Christmas Count circle. The entire South Thompson River population was never found in the count circle during any Christmas Bird Count day.

Juveniles

The percentage of juveniles present in the population varied widely from 1985-93, but appeared to be relatively stable over the long-term. The actual number of juveniles counted was on a very gradual upward trend until the winter of 1992-93, when the numbers were quite low. Low numbers of juveniles were noted elsewhere in British Columbia during the same year (McKelvey, pers. comm.). The mean proportion of juveniles in the population was 21 percent which compares favourably with a range of 22-26 percent for populations wintering on coastal Vancouver Island from 1968 to 1986 (Campbell et al. 1990). The proportion of juveniles in the coastal population during the first half of the 1980's was 23 percent. This suggests that the breeding population that provided birds to the interior wintering grounds was as stable as the population supplying the coastal wintering areas.

Winter mortality

Within the study area, winter mortality seemed to be insignificant. King (pers. comm.) has witnessed winter mortality due to starvation and birds becoming ice-bound in the Prince George area. Dead birds were relatively rare in the South Thompson - Okanagan areas. One bird became ice-bound and died in early January 1993, at Shuswap Lake and the occasional swan carcass was reported during the 15 years that the author counted birds along the South Thompson River. Causes of mortality were not determined, but Bald Eagles (Haliaeetus leucocephalus), and coyotes (Canis latrans), frequented the wintering areas. A Trumpeter Swan was observed flying into a high voltage power line near Chase, but the bird was not killed immediately. Whether it survived the winter was not determined. King, on the other hand, reported not infrequent observations of carcasses and occasionally 20 or more birds being frozen into the ice and perishing. Power lines were a higher cause of mortality in the north as well.

CONCLUSIONS

The wintering population of Trumpeter Swans has increased significantly along the South Thompson River since 1983. This appears to be a natural increase unrelated to artificial food supplies. Relatively mild winters during the last few years of the decade probably aided the winter survival rate. Weather conditions when swans arrive in late October/November are seldom severe enough to prevent birds from staying once they have arrived. Christmas Bird Count data corroborates the pattern of increase, but are poor sources from which to estimate the total wintering population.

The distribution of birds is highly dependent upon the availability of foraging areas which, in turn, is influenced by the presence of ice. Swans scatter widely along the South Thompson River when little ice is present, but aggregate on open water during periods of extensive freezing. So long as some water is available, Trumpeters do not leave the area as readily as Tundra Swans do during these severe conditions. Historic areas in the Okanagan Valley continue to winter small numbers of

Trumpeters and there appears to have been no significant change to this situation.

The general increase in Trumpeter Swans on the southern interior wintering grounds should perhaps come as no surprise, given the increase in the Pacific Coast Population (PCP) over the past 40 years. Whether milder weather patterns over the past decade have finally allowed more birds to utilize the South Thompson River is open to speculation. There appear to be no records in existence that would indicate the extent of ice conditions on the river during the early years of the increase in the PCP. Weather records for the time period are not reliable indicators of whether the river was frozen or not. It is not known how long it takes for the ripple effect of population increases to result in more birds appearing in non-traditional areas. The Alaskan population had more than tripled from 1968 to 1985 when 9,500 birds were counted (Campbell et al. 1990). Certainly by the time the population had reached this critical mass, more birds were in evidence away from traditional wintering areas.

Population surveys of birds wintering in the southern interior of British Columbia should continue as it is one of the few accessible and easily surveyed populations away from the Pacific Coast. The potential for further studies of habitat utilization, behavior patterns, temporal and spatial movement patterns and general ecological relationships remains great.

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DISTRIBUTION AND HABITAT SELECTION BY WINTERING TRUMPETER SWANS IN THE LOWER SKAGIT VALLEY, WASHINGTON

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ABSTRACT

Weekly Trumpeter Swan surveys were conducted by automobile between November and April in the Skagit Valley of northwestern Washington State (48° 30' N, 122° 20' W). Twenty-three surveys were completed in 1990-91 and 1991-92. Mean swan abundance increased 15 percent while the mean number of flocks/survey increased 55 percent from 1991 to 1992. Both years the majority of the flocks seen were of fewer than six birds and two-bird flocks were the most common.

Trumpeter Swans were seen in 146 fields in 1990-91 and 147 fields in 1991-92, 51 of which had been used by swans in 1990-91. Fields used by Trumpeters were distributed throughout the Skagit Valley, but were predominantly in the northern half of the study area. There were no major changes in swan geographic distribution during the winter. Swans were seen the entire winter in three fields in 1990-91 and in 16 fields in 1991-92.

The temporal pattern of crop use was the same both years; corn in early winter, potatoes in midwinter, and potatoes and grass (pasture or winter wheat) in late winter. Trumpeter Swans were seen in pastures more frequently in 1990-91 and in winter wheat and carrots more frequently in 1991-92. Potato fields received the highest swan use in 1990-91 (4,098 swans) and 1991-92 (4,287 swans).

Of 11,885 ha of corn, pasture, potato, carrot and winter wheat available to Trumpeters in 1991-92, swans were seen on 2,860 ha, 24 percent. Goodness-of-fit analysis revealed a highly significant difference between crop (acreage) availability and use in 1991-92 ($X^2 = 754.9$, d.f. 4, $p < 0.001$). Use of corn, potatoes, and carrots was higher than expected and use of pastures and winter wheat was less than expected.

INTRODUCTION

Within the past 15 years, significant numbers of Pacific Coast Population (PCP) Trumpeter Swans (Cygnus buccinator) have wintered in the Comox Valley on Vancouver Island and the Skagit Valley. Both of these valleys are important agricultural areas, and swans have shifted to a diet of agricultural crops including corn, potatoes, winter wheat, and pasture grass (McKelvey 1981; Caniff 1988). During the winter of 1988-89 over 800 Tundra Swans (C. columbianus) and nearly 600 Trumpeters wintered in the Skagit Valley, qualifying this area as one of the most important wintering grounds on the Pacific Flyway (Jordan 1991). (This study only examined Trumpeter Swan habitat use; in this paper "swan" shall refer only to Trumpeters.) Typically, swans begin arriving in early November and depart by late March with the peak concentrations in January (M. Jordan, pers. comm.). The recent increase in Skagit Valley Trumpeters has paralleled the overall growth of the PCP.

Because Trumpeter Swan foraging in agricultural fields is a recent phenomenon, there has been relatively little published research on the subject (McKelvey 1981; Hamer 1990). Food availability and weather conditions on the wintering grounds effect the fitness and reproductive success of breeding adults (Scott 1972).

The objectives of this study were to determine the distribution and abundance of Skagit Valley Trumpeter Swans through the winter and to test whether swan habitat selection was proportional to availability.

Study site

This study was conducted on the lower floodplain of the Skagit River in northwestern Washington State (48° 30' N, 122° 20' W). The study area covers approximately 380 km^2, most of which is in agriculture. Maximum elevation within the study area is 140 m. The elevation of the agricultural fields is from sea level to 25 m. Silt loams are the prevalent soils of the lower Skagit Valley, covering roughly 23,000 ha (Soil Conservation Service 1989).

Winters are generally mild as a result of the maritime climate. At Mount Vernon, located near the geographic center of the study area, the 20-year average daily minimum temperature for January is 0.3 °C (Soil Conservation Service 1989). The 40-year average annual rainfall at Mount Vernon is 78 cm, but most of the rain falls between November and April, necessitating summer irrigation for some crops (Havens 1991).

Agriculture is the primary industry in Skagit County. In 1988, 44,467 ha were classified as farmland, producing $120 million in revenue. By acreage, the most important crops are wheat, barley, oats, grass and corn silage, peas, potatoes, seed crops (cabbage, spinach, beets, mustard), cauliflower and sweet corn (Havens 1991).

METHODS

Weekly swan surveys were conducted by automobile from mid-November through March during the winters of 1990-91 and 1991-92. Data for November and a portion of December for each year was collected by the Washington Department of Wildlife and is used here with permission. Surveys began at about 0930 and took approximately 6 hours to complete. Starting points were alternated between days and roughly the same route was driven each day. Only surveys that covered the full study area were included in the analysis.

All swan surveys were made with a 20X-45X spotting scope. A Clay Adams five-key laboratory counter was used to tally flocks of more than 20 individuals.

Each flock and lone swan was assigned a unique flock identification number. The identification number of each flock and the following attributes were recorded on a field form: the total number of swans, the number of Trumpeter Swan juveniles and adults, the number of Tundra Swan juveniles and adults, the number of swans for which the species was indeterminate, the color and alphanumeric code of collars, and the habitat type. The flock's geographic location was recorded on 1:24,000 scale USGS topographic maps. Monthly summaries of daily temperatures and precipitation for the 1990-91 and 1991-92 study seasons were obtained from the Mount Vernon weather station (Washington State University, unpub.).

Descriptive statistics and frequency distributions for the full data set were calculated with the personal computer spreadsheet program Quattro Pro Release 3.0 (Borland 1991). Swan abundance, distribution and habitat selection were compared between the 2 study years. Habitat selection, relative to availability, was analyzed for 1991-92 only.

To examine temporal changes in habitat selection, each study season was divided into three periods of approximately equal length. These periods were named early winter (11/16-1/3), midwinter (1/4-2/14) and late winter (2/15-3/31). Swan density was arbitrarily classified as high use ($\geq$ 200 swans) and low use ($<$ 200 swans).

All pastures, corn, carrot, potato and winter wheat fields within the study area during the winter of 1991-92 were mapped on 1:24,000 scale USGS topographic maps. The study area was surveyed by automobile during December 1991 and January 1992. Black and white 1:24,000 scale orthophotos taken in August 1991 (US Army Corps of Engineers, unpub.) were used to confirm crop types, field locations and configurations.

ARC/INFO Revision 5.0 (ESRI 1991) for the VAX main frame computer was used for

geographic analysis. Pertinent fields mapped during the habitat availability survey were hand traced on a 1:63,360 scale base map which was then digitized using a CalComp 9100 digitizing table. Data files for each study season summarizing crop types and swan abundance for each field were compiled with Quattro Pro (Borland 1991) and imported into ARC/INFO's data base. Once field sizes were determined, the smallest field (by area) used by swans in either 1990-91 or 1991-92 was identified, and all fields less than 75 percent as large as this field were eliminated from the data base, as it was felt that smaller fields would not be used by swans. A X^2 test, $p = 0.05$, (Zar 1984) was used to test whether the acreage (ha) of crops used by swans was proportional to the available acreage of those crops.

RESULTS

Weather during both of the study years was atypical. December of 1990 was unusually cold with subfreezing temperatures and two major windstorms the last 2 weeks of the month. By contrast, the winter of 1991-92 was milder than normal (Figure 1). In November 1990, two subtropical storms brought record rainfall which caused extensive flooding (Figure 2). Fir Island, in the southwest portion of the study area was inundated with up to 2 m of floodwater for 5 weeks.

A total of 23 surveys was completed in each of the study years (Table 1). Adverse weather conditions (primarily fog) prevented the completion of four surveys in 1990-91 and three surveys in 1991-92. Due to the essentially flat topography over most of the Skagit Delta, swans could often be seen at distances of over 1 kilometer. The hilly nature of the eastern portion of the study area sometimes obscured clear views of flocks. On warm, sunny days heat shimmer complicated swan identification and collar reading.

The mean population of Trumpeter Swans wintering in the Skagit Valley was 471.9 in 1990-91. In 1991-92 the mean population was 541.8 swans, an increase of 14.8 percent (Table 1). The highest daily census in 1990-91 was 805 swans on 28 February 1991 and in 1991-92 was 962 swans on 30 January 1992. Juvenile Trumpeters accounted for 19.5 percent of all Trumpeter Swans observed in 1990-91 and 21.5 percent in 1991-92.

The mean number of flocks located in each survey increased 55.9 percent from 14.3 flocks in 1990-91 to 22.04 flocks in 1991-92 (Table 1). Flocks of fewer than 20 birds were by far the most common, particularly in 1991-92. The mean flock size in 1990-91 was 33.4 swans and in 1991-92 was 24.6 swans, reflective of the higher number of small flocks (< 10 birds) in 1991-92. The largest Trumpeter flock in 1990-91 was 294 swans and in 1991-92 was 218 swans.

For each flock size class of one to 19 swans there were fewer flocks seen in 1990-91 and overall, there were substantially more of these flocks in 1991-92 (349) than in 1990-91 (193) (Figure 3). During both years, single birds were seen infrequently, while flocks of two birds were the most common. Flocks of four swans were seen 51 times in 1991-92, the second most frequently observed flock size. Three - five- and six-bird flocks were also common.

Trumpeter Swans were found in 146 fields in 1990-91 and in 147 fields in 1991-92, 51 of which had been used by swans the previous year. Of these 51 fields, 30 fields were planted to the same crop in both years, and of those fields, 18 were corn fields. Thirty-two of the 51 fields used by swans both years were in the northern half of the study area.

For 1990-91 and 1991-92, the dispersion pattern of fields where swans were seen appears to be clumped, but these clumps or clusters of fields were found throughout most of the study area. Fields used by swans were most often adjacent to or near one another. Swans were not seen in the far western portion of the study area. Mixed flocks of Tundra and Trumpeter Swans were found in 61 fields in 1990-91 and 65 of the fields in 1991-92. Tundra Swans were rarely seen in the eastern third of the study area.

Figure 4 classifies fields by the number of days swans were present. Trumpeters were seen only once in 82 of the 146 fields used by swans in 1990-91 and in 51 of the 147 fields in

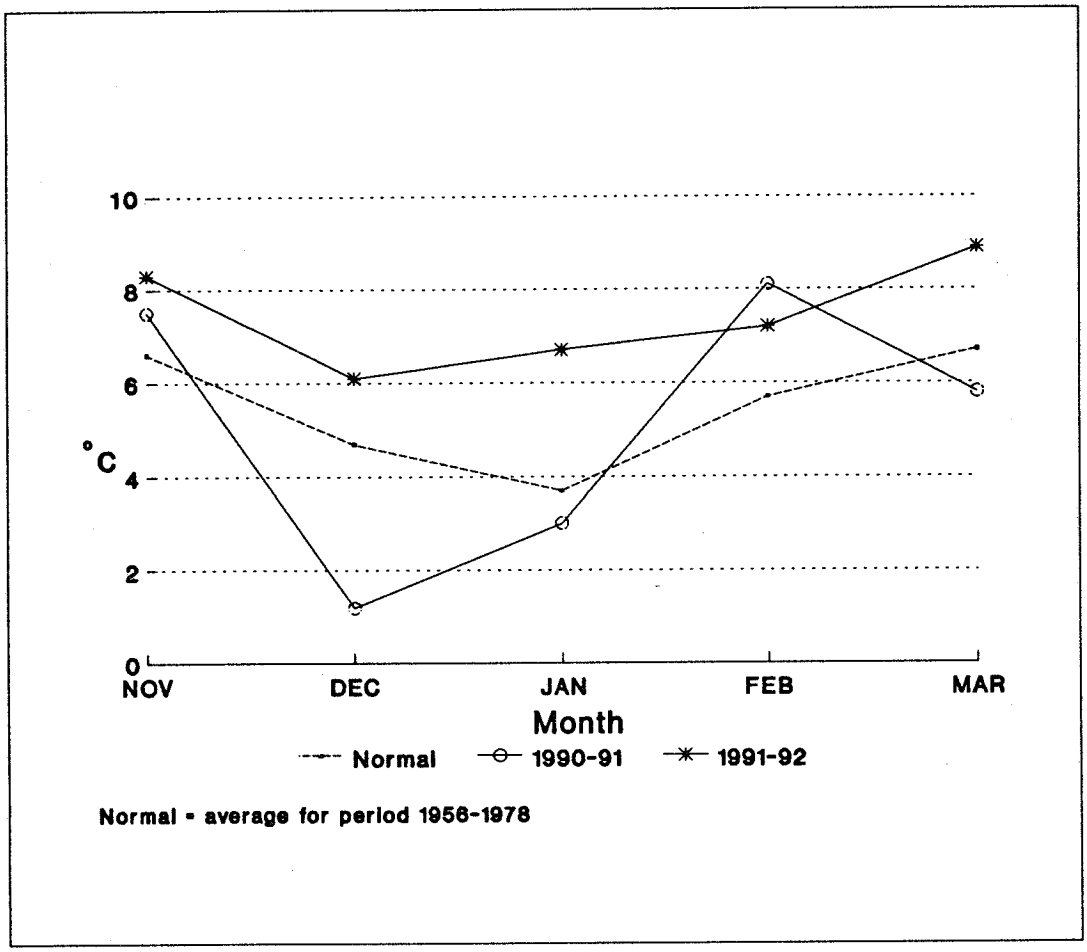

Figure 1. Mean monthly temperatures, Mount Vernon, Washington (Soil Conservation Service 1989; Washington State University, unpub.).

1991-92, a substantial difference. The maximum number of days swans were seen at the same field was 10 days (two fields) in 1990-91 and 15 days (two fields) in 1991-92. Both of the fields in 1990-91 were pastures, one 15 ha in size and the other 68 ha in size. There were nine fields in 1991-92 where swans were seen 10 or more days; five potato fields; two winter wheat fields, and a carrot and corn field. These 10 fields were between 14 and 72 ha in size.

The distribution and density of Trumpeter Swans did not appear to change significantly during the course of the winter. During late winter, swans were found in fewer fields than in early or midwinter. From early winter to late winter, Trumpeters shifted from the southern and eastern portions of the study area to the northwestern region. Both years, the north central region was consistently used by high numbers of swans throughout the winter.

The most striking difference in Trumpeter Swan distribution between 1990-91 and 1991-92 was for those fields where swans were seen the entire winter (early, mid, and late winter). In 1990-91, there were only three fields (corn), two of which were located in the southeast, while in 1991-92, there were 16 fields, located throughout the study area, where swans were seen all winter. Of the 16 fields used by swans the entire winter in 1991-92, six were winter wheat and five were potato

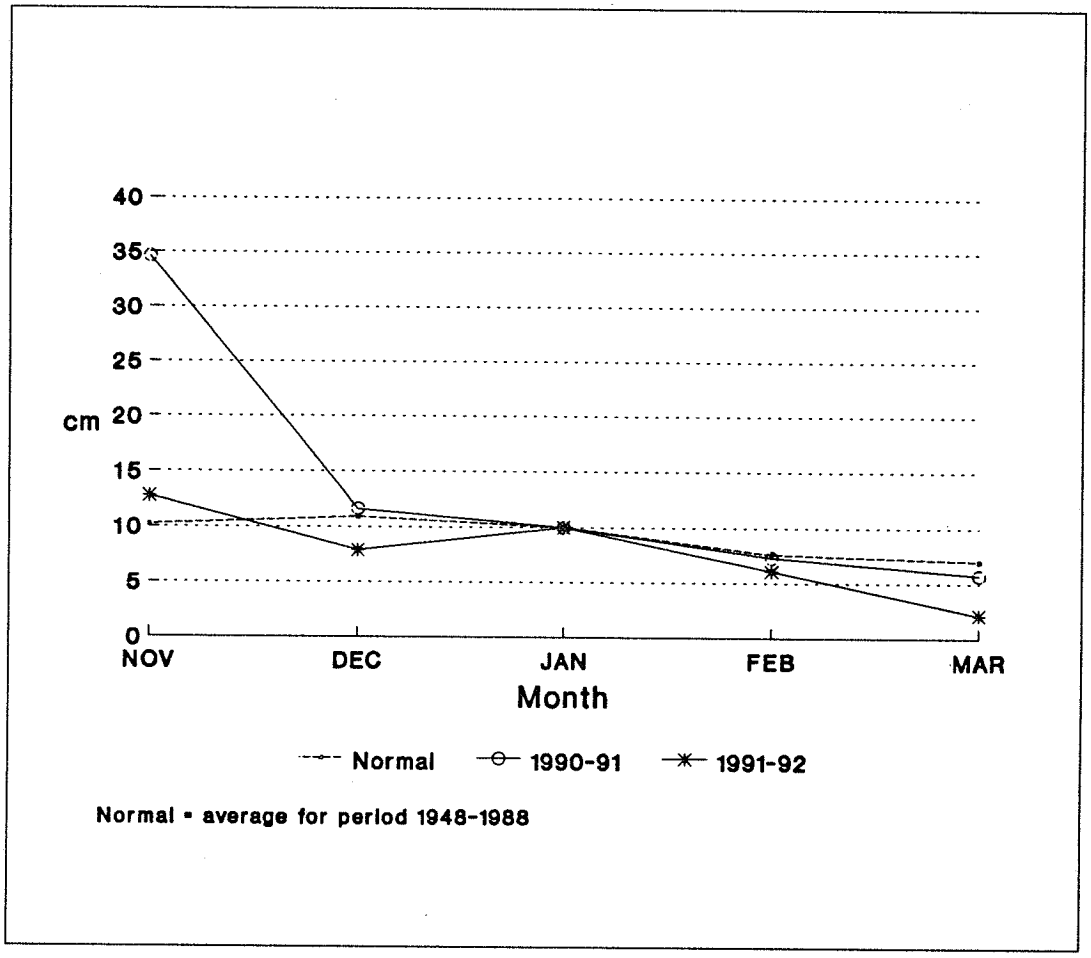

Figure 2. **Mean monthly precipitation, Mount Vernon, Washington (Havens 1991; Washington State University, unpub.).**

fields. Two of the fields in 1990-91 and seven of the fields in 1991-92 had seasonal totals of over 200 swans.

Swan habitat use

There were some similarities in the patterns of Trumpeter Swan crop use by time period between 1990-91 and 1991-92. The general pattern of crop use was corn in early winter; potatoes in midwinter, and potatoes and pastures in late winter (Figure 5). Swan use of corn and carrot fields decreased sharply in late winter. Carrots and winter wheat were not important crops for Trumpeters in any period of 1990-91.

In 1990-91, the shift from potatoes to pastures was remarkable. On 20 February 1991, 132 Trumpeters were seen in pastures and 565 were seen in potato fields. On 27 February, after several sunny days, 682 swans were seen in pastures and 15 were found in potato fields. There were no comparable shifts in 1991-92.

In 1991-92, winter wheat was an important crop for swans throughout the winter, being second in use, after potatoes, during mid and late winter. The number of Trumpeters in carrot fields was higher in 1991-92, with peak use in midwinter. Use of pastures in 1991-92 was not as high as in 1990-91. Twenty-one fields (15.3%) were classified as high use (> 200 swans) in 1990-91 and 12 fields (8.5%) in

Table 1. Summary of Trumpeter Swan surveys for 1990-91 and 1991-92, Skagit Valley, Washington.

	1990-91	1991-92
Surveys	23	23
Km travelled	3,202	3,703
Mean[a]	139.22	161.00
Total flocks	325	507
Mean	14.13	22.04
Standard deviation	5.72	8.22
Range	2-25	1-34
Total swans	10,854	12,461
Mean	471.90	541.80
Standard deviation	211.12	214.36
Range	17-805	5-962
Fields	146	147
1991 & 1992	51	

[a] Mean = seasonal total/23 surveys

1991-92, accounting for 67 percent and 55 percent, respectively, of all Trumpeters seen. The total area of the 12 high use fields in 1991-92 was 372 ha, representing 3.1 percent of the available acreage. Both years, the most frequent high use crop was potatoes. In 1990-91, nine potato fields accounted for a total of 3,383 swans and seven pastures were used by 2,407 swans. In 1991-92, 3582 swans were seen in seven potato fields.

A disproportionately small number of fields received the highest use by swans. There were no high use winter wheat fields in 1990-91, and no high use corn fields in 1991-92. A winter wheat field in 1991-92 had the highest number of swans (1,266) for any field, either year. Eighty-four was the maximum number of Trumpeters for any winter wheat field in 1990-91.

Availability of crops

The habitat survey identified 705 fields of crops (corn, pastures, potatoes, carrots, winter wheat) consistently used by swans. Pastures and winter wheat fields were the largest and most numerous fields available, accounting for 68 percent of the available acreage (Table 2) and 65 percent of available fields. Carrots had the lowest available acreage, 171 ha in nine fields, of the five crops analyzed. Ranked by the density of Trumpeter Swans per available acreage in 1991-92, carrots received the highest use (8.5 swans/ha), followed by potatoes (2.8 swans/ha), corn (1.0 swans/ha), winter wheat (0.6 swans/ha), and pastures (0.4 swans/ha).

Of the 11,885 ha of crops available to Trumpeters in 1991-92, swans were seen on 2,860 ha, 24.1 percent of the acreage. The proportional acreage used for each crop differed significantly from the available acreage (Table 3). From Figure 6 it is clear that neither the hectares used nor total swans was proportional to the available hectares of crops. Corn had the highest use by acreage (939 ha). Based on swan abundance, potatoes were the favored forage. Thirty-six percent of

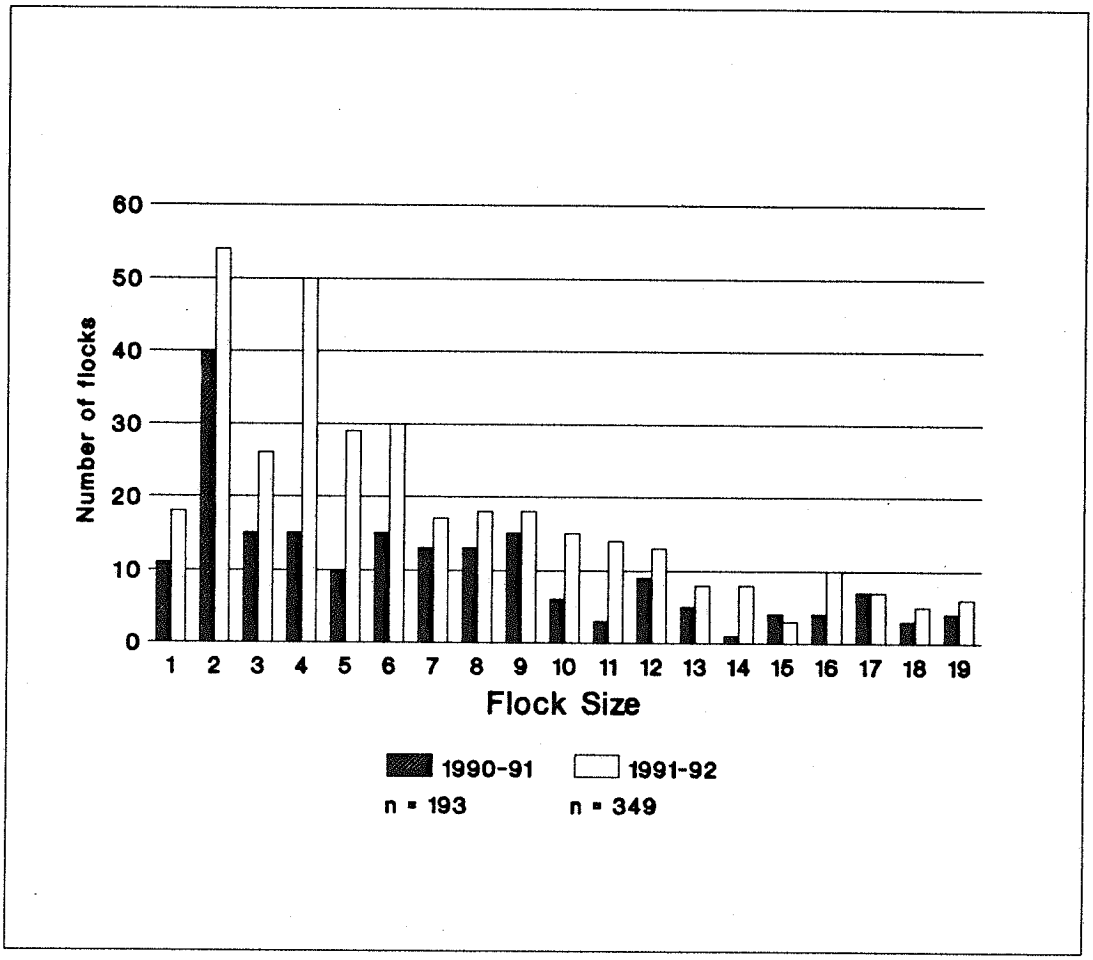

Figure 3. **Frequency distribution of Trumpeter Swan flocks of fewer than 20 birds during the winters of 1990-91 and 1991-92, Skagit Valley, Washington.**

total swans were seen in 22 potato fields which comprised 3.8 percent of the available acreage. The goodness-of-fit analysis indicates that for all of the principal crops used by swans, the acreage (ha) used was not proportional to the acreage available (Table 3). There was a highly significant difference between crop availability and use (X^2 = 754.9, d.f. 4, $p < 0.001$).

CONCLUSIONS

The Pacific Coast Population of Trumpeter Swans has increased substantially in the past 40 years with little or no assistance from man. For the short term at least, it is expected that the PCP will sustain a high rate of growth. In all likelihood, the number of Trumpeters wintering in Washington State and the Skagit Valley will also continue to increase. In the past 20 years swans wintering along the Pacific Coast have adapted to a diet of agricultural crops. Initially, swans were found exclusively in pastures, but today, swans feed on a half-dozen crops and continue to expand their diet and geographic distribution. This adaptation has apparently been beneficial.

In this study, Trumpeters were seen in fields throughout the Skagit Valley, but were seen predominantly in the northern half of the study area. The temporal pattern of crop use was similar for 1990-91 and 1991-92, although more swans were seen in carrot fields in

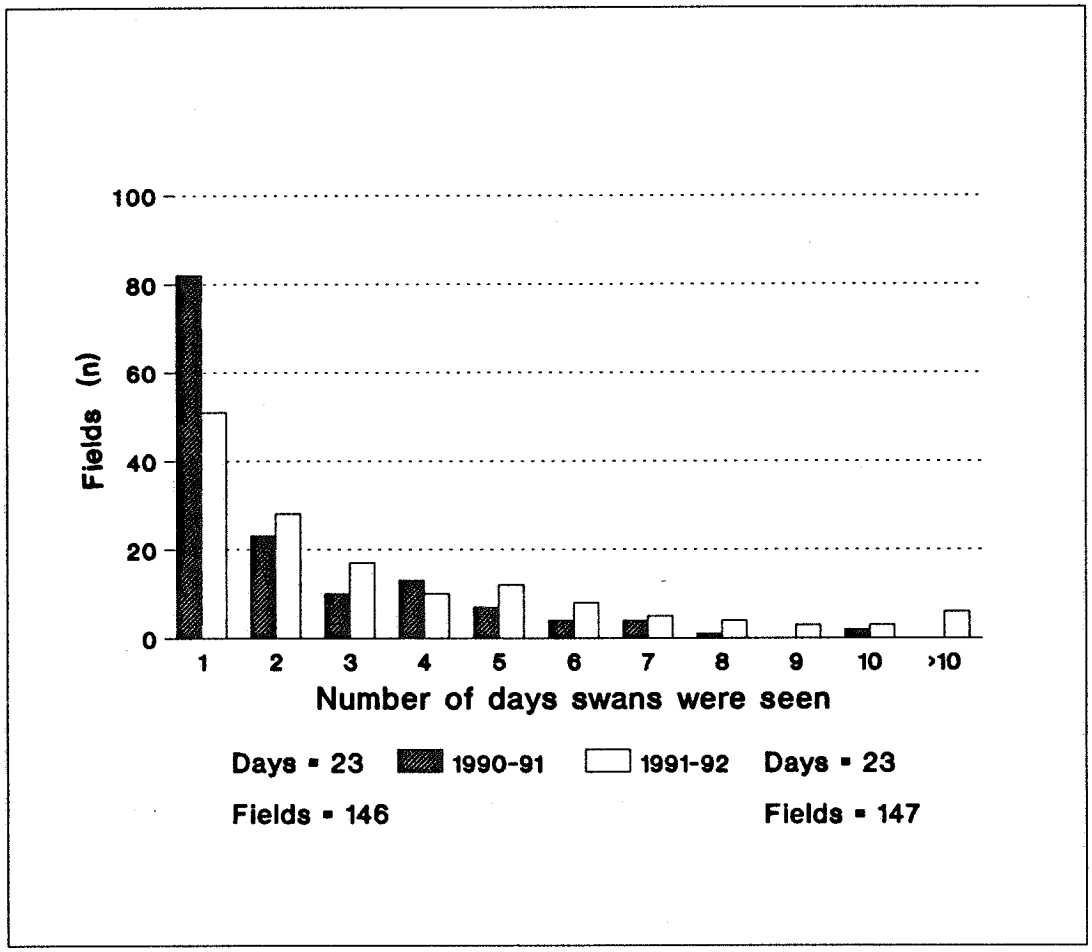

Figure 4. Number of fields classified by the number of days Trumpeter Swans were seen during the winters of 1990-91 and 1991-92, Skagit Valley, Washington.

1991-92. It would be interesting to follow future swan use of carrots to see if it continues to increase.

Swans were seen on only 24 percent of the available acreage in 1991-92, and 67 percent of swans were seen on approximately 4 percent of the acreage. Based on the acreage available to swans in 1991-92, the Skagit Valley could support a higher wintering population of Trumpeter Swans.

ACKNOWLEDGMENTS

I thank The Trumpeter Swan Society for partially funding this project and the many Society members who offered their insight and suggestions, especially Martha Jordan whose assistance and encouragement was invaluable.

I thank the Washington Department of Wildlife for partial funding, and Don Kraege and Mike Davison for the use of data collected for the Department.

I thank my wife Dianne whose patience and support made this endeavor possible.

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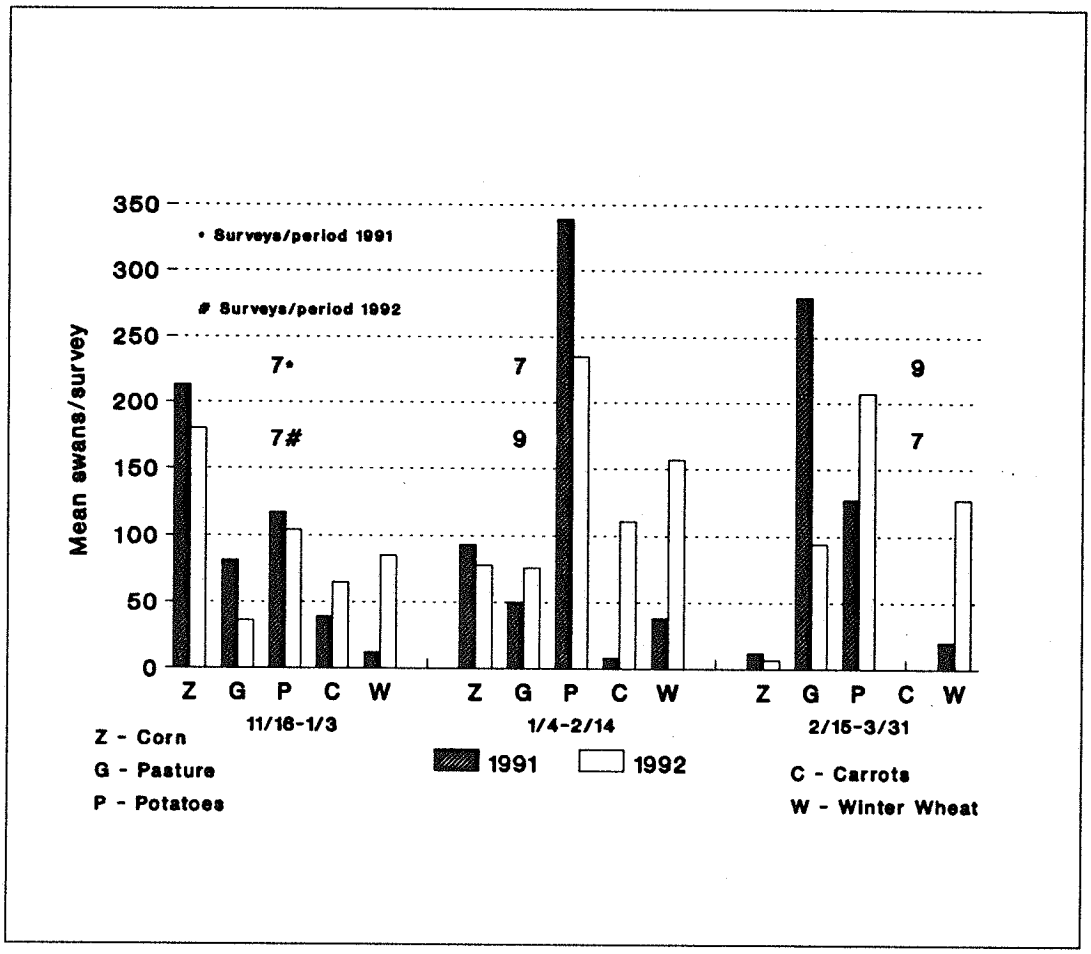

Figure 5. Trumpeter Swan crop selection by year and period of winter, Skagit Valley, Washington.

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Table 2. Acreage (ha) of available crops used by Trumpeter Swans, winter 1991-92, Skagit Valley, Washington.

	Hectares			
Crop	Avail.[a]	% Avail.[c]	Used[b]	% Used[d]
Corn	1,999	16.8	939	46.9
Pasture	3,639	30.6	505	13.9
Potato	1,574	13.2	462	29.4
Carrot	171	1.4	103	60.2
Wheat	4,502	37.9	851	18.9
Total	11,885	99.9	2,860	24.1

[a] Available ha
[b] Total ha for fields used by swans
[c] Available ha/11,885
[d] Ha used/ha available

Table 3. Goodness-of-fit analysis for principal crops used by Trumpeter Swans during the winter of 1991-92 in the Skagit Valley, Washington. H_o = ha used is proportional to ha available, p = 0.05.

	Observed[a]	Expected[b]	X^2	P. value[c]
Corn	939	481	438.90	<0.001**
Pasture	505	876	157.12	<0.001**
Potato	462	379	18.18	0.0013**
Carrot	103	41	93.76	<0.001**
Wheat	851	1,083	49.70	<0.001**

[a] Ha used by Trumpeter Swans.

[b] Expected ha used by Trumpeter Swans = (% avail. ha) X (Total ha used) from Table 2. For corn, expected ha = 0.168 X 2,860 = 481 ha

[c] Probability, * = significant difference ($p \leq 0.05$) between observed and expected use, ** = highly significant difference ($p \leq 0.01$) between observed and expected use.

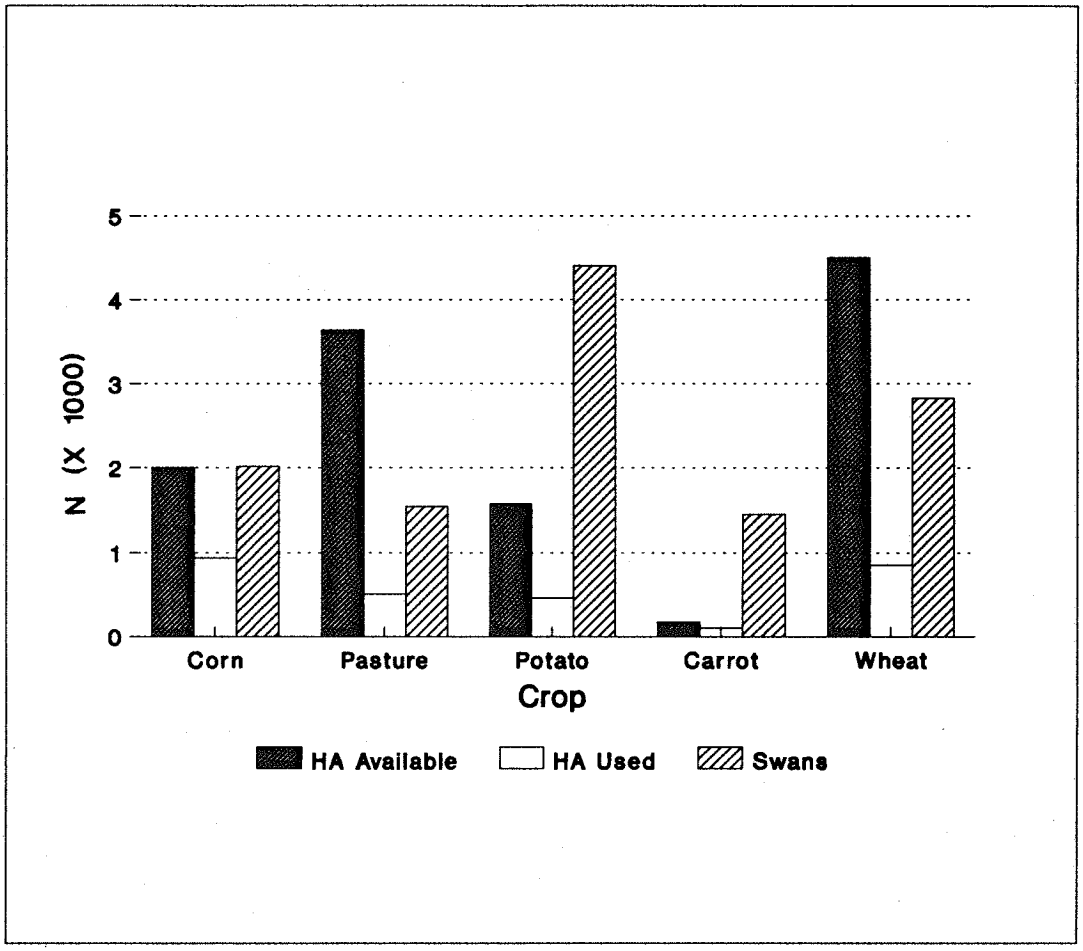

Figure 6. Total acreage available, acreage used for the principal crops utilized by Trumpeter Swans, and swan abundance in the winter of 1991-92, Skagit Valley, Washington.

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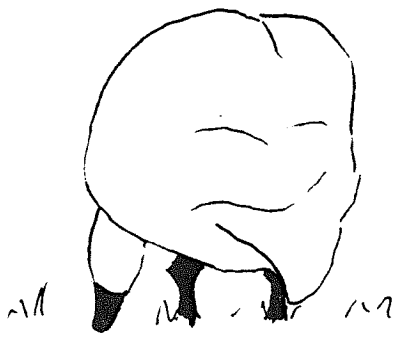

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TRUMPETER SWAN PACIFIC COAST POPULATION STATUS IN THE COMOX AREA OF VANCOUVER ISLAND, BRITISH COLUMBIA

Doug Innes, 2267 Stewart Avenue, Courtenay, British Columbia V9N 3J1

Four years ago in order to answer the simple question, "How many swans are there?" some 30 members of the Comox-Strathcona Natural History Society (C-SNHS) began a project to keep track of - how many? This winter is now the 5th year of the project. We've come to know some other facts about the swans in the course of the counts, that for the first 2 years were held monthly, and for the last 2 plus this year, have been weekly. We learned when to expect the first arrivals (October), and where to look for them. And, we've learned something about their daily feeding patterns.

While we can now expect to have over 1000 swans wintering in the Comox area, that hasn't always been the case. Looking over the literature at my disposal, it is evident that there has been a build up of swans attracted to this area. Christmas Bird Counts document this build up. In a letter to Doug Jans (British Columbia Fish and Wildlife), in March 1985, C-SNHS reported the following totals for such counts:

1964 - 1
1970 - 45
1975 - 113
1980 - 460
1983 - 508

During 1972, our club made a weekly survey of swan totals and reported a peak total of 67 on 26 December 1972. That was 20 years ago. A postscript for that report states: "The majority of the swans were in the estuary ... however, there were usually a few on the farmland where ... once 17 were counted ...." The temperature for that day, was 42 °F. A report published in the Canadian Field Naturalist states, "One of the largest concentrations of wintering Trumpeter Swans on Vancouver Island is located in Comox Harbour" (Smith and Blood 1972). "Between 6-50 birds were found wintering in the harbour in the winter 1970 - 1971."

Personal communication with interested local residents yielded additional evidence of the build up. It was stated for 1976-77, "As many as 120 observed in the Comox Harbour near Millard Creek" (Davies pers. comm.). Totals for the following year 1977-78 were reported by R. McKelvey, "During the winter a maximum daily count of 264 birds." It's apparent from these sources that the build up of wintering swans started about 20 years ago. There are verbal accounts of swans in the area 30 and 40 years ago, but no indication of how long they stayed. It is known that small numbers of Whistling Swans, now Tundra Swans, were in the area in those early years, as they are today. Stories are told of one well known naturalist not accepting reports of Trumpeter Swans being on the estuary, stating in rebuttal that Trumpeter Swans aren't to be found on salt water.

The 1972 survey by the C-SNHS reported that the majority of Trumpeter Swans counted during the Christmas Bird Count were on the estuary and a few had been found on farmland. This feeding pattern is borne out by studies done by R. McKelvey. Mr. McKelvey reports in the foreward of his thesis, "Early in the winter, feeding was concentrated on the emergent vegetation of the Harbour, where large amounts of material was excavated as the swans grubbed for rhizomes. In late winter swans began to feed on adjacent agricultural fields, spending less time on the estuary" (McKelvey 1981). This observation by Mr. McKelvey regarding the feeding behavior was during the winter of 1979-80, when the wintering swan population was still under 500. Mr. McKelvey refers to the pressure feeding swans bring to the dairy pastures; "As the number of swans wintering in the Comox Harbour area increases, greater pressures result on both the newly acquired food source (pasture grasses) and on the traditional diet of estuarine emergent plants." Today the feeding pattern is different in that almost 100 percent of swans counted at 10:00 a.m. are on

farmland. Only during periods of heavy snowfall and freezing temperatures are the majority of swans found in the Comox Harbour during the daytime.

The above pattern is evident from when the swans first arrive in October. The swans favor farmlands where potatoes have been harvested as well as pasture land. Our largest counts of swans are usually in the potato fields until freezing temperatures prevent any further grubbing, or the potatoes are gone. While a few swans spend the night on the waters of the harbour or local marshes, we have come to expect these birds to leave for the farm fields by 9:30 a.m. During the months of February and March, we can expect to find swans on the dairy pastures in concentrations of up to more than 100 in some places.

A review of the peak totals of swans counted the past 5 years causes us to ponder whether the numbers are at some kind of plateau. Consider the following:

Year	Date	Peak totals	Locations reporting swans
1988-89	28 Feb.	1209	17
1989-90	28 Jan.	1381	18
1990-91	29 Jan.	1198	17
1991-92	11 Feb.	1077	23
1992-93	22 Dec.	1224	16

Obviously, the totals fluctuated with as much as a 300-swan difference. Mild weather perhaps is a factor in the large fluctuations, or the swans are finding other attractive locations along the coast or on Vancouver Island. The number of locations used by the swans usually increases as the season advances. Before one is tempted to average out the number of swans per location, do bear in mind the following:

First, one location on the 22 December 1992 count contained over half of the total 1224. One dairy pasture on the Comox Valley Produce property had over 600 swans at 10:00 a.m. in the morning. Second, three and sometimes four locations are frequently favoured by the majority of swans wintering in this area, at least up to the end of January. The Courtenay Flats, which can be seen from the Westerly Hotel, quite often contains 300-500 swans. After January, other dairy pastures receive greater numbers of swans. These pastures are located off Dove Creek Road, Minto/Fraser Road and Headquarters Road.

In summary, wintering swan numbers have been increasing in the Comox area of Vancouver Island beginning about 1972. Sometime between 1983 and 1988 the numbers doubled, and after 1988 over 1000 swans have regularly been found on the farmlands. While up to 23 locations report swans, 10 percent to 50 percent of the total swans can frequently be found on one dairy pasture. Feeding during the day is almost 100 percent on farmland. Only during periods of heavy snow and freezing temperatures are the majority of swans found spending the day in the Comox Harbour. One final note regarding Tundra Swans, usually during the winter, one, two, or a family of four may be reported among the Trumpeter Swans. Last March 1992, I had the experience of seeing a flock of 15 on a local marsh, keeping to themselves, along with about 250 Trumpeter Swans. This is the largest number of Tundra Swans I've seen at one time. Just after dawn, the Trumpeter Swans began to leave for the fields in groups of up to 20. The Tundras were the last to go.

Thank you.

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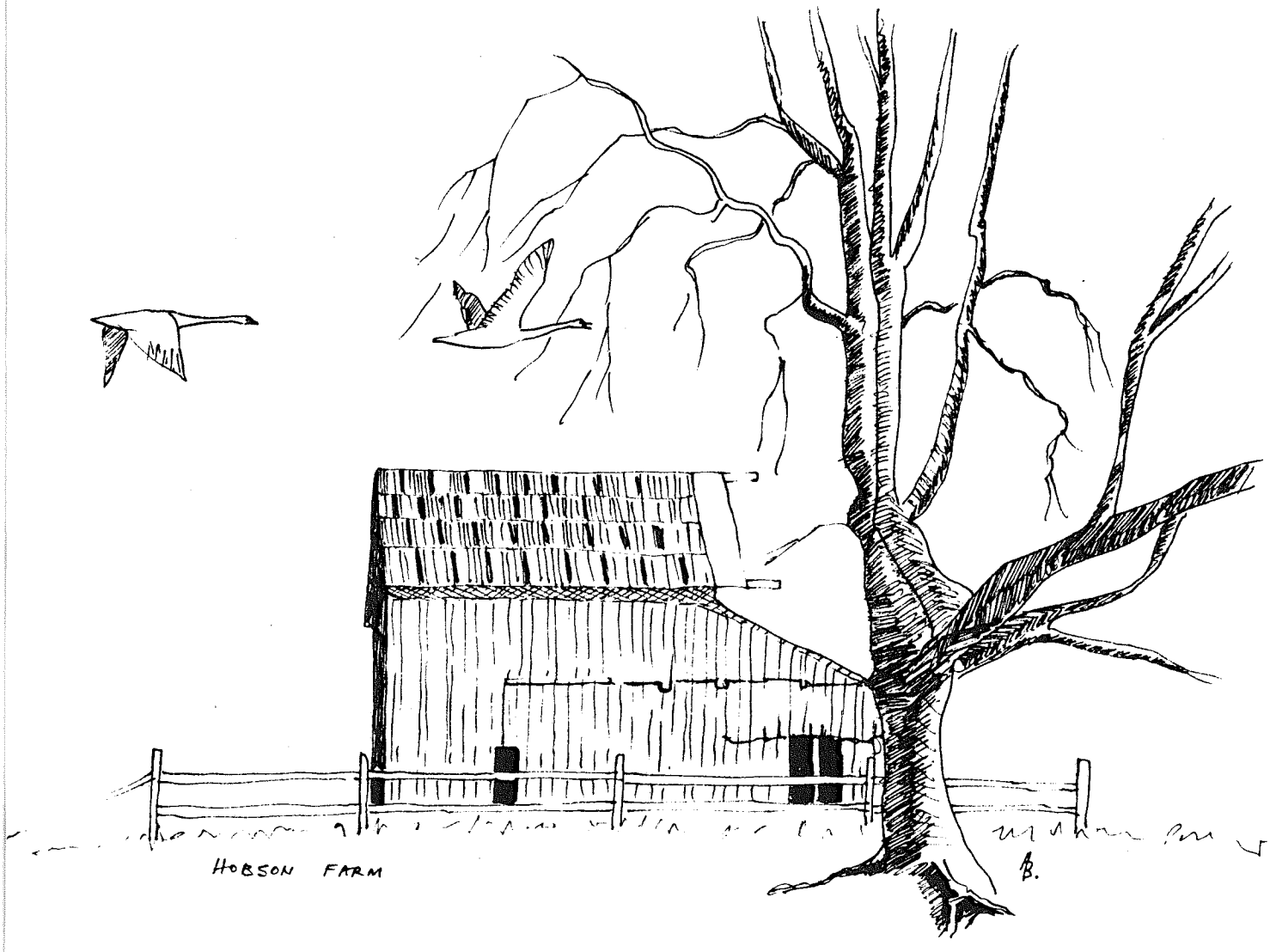
LAND USE PROBLEMS IN COMOX VALLEY, BRITISH COLUMBIA



LAND USE CONFLICTS IN THE COMOX VALLEY

Gary Rolston, British Columbia Ministry of Agriculture, Fisheries and Food, 2500 Cliffe Ave., Courtenay, BC V9N 5M6

It would be more appropriate for farmers to talk about specific land use conflicts in the area than for me to talk about them. I would prefer to talk about general problems and the fact that I believe that there is only one major problem - **perception.** To borrow (and break) an old saying, the general public seems to think "Farmers, you can't live with them, you can't live with them." I will give you a few examples to reinforce what I am saying.

There are a lot of people out there who, based on a bundle of misinformation, want to rid the world of cattle. They claim that cattle are causing global warming, using the world's water supplies and eating cereals that could feed the starving people of the world. People do not eat grass. Cattle do and they convert it into food. About three quarters of the world's farmland is only capable of growing grass for various reasons. Grass is also used in crop rotations to reduce erosion, to build up soil organic matter and to reduce weed and pest populations among other functions. There is far more to saving the environment than removing livestock. In fact, livestock are a critical part of sustainable agriculture for the reasons just mentioned, but public perception may result in reduced livestock production at the expense of the environment.

What is the number one food safety concern in North America? If you ask the general public they will tell you that it is pesticide contamination of food. The recent experience of 'Jack in the Box' restaurant in the U. S. gives you the true answer to this question. Food poisoning by bacterial contamination is a far more serious problem. A lot of it happens on the kitchen counter, but the farmer gets the blame. Perception.

Another one! People occasionally phone and say, "There's a man in a space suit out spraying in the orchard next door! They're going to kill us with those deadly chemicals." If farmers wanted to kill people they would just stay in bed in the morning. Within a year or two, everyone in the world would starve to death. It is ludicrous to suggest that they are trying to kill anyone. Farmers have to eat, too.

This summer we aerially seeded some grasses and cereals into standing corn. If we waited until after the corn was harvested in this area, there may not be enough time to establish a cover crop for the winter. Using this method the cover crop was already there when the corn came off. Also, part of the experiment was to see how attractive these forages would be to swans. The reason I mention this though is that we had a complaint about the noise of the prop plane doing the seeding. We had started at 10:30 a.m. and went until 8:00 p.m. Nobody complained, however, about the fighter jets that were buzzing around all day doing the war game exercises at the nearby air base! Perception.

People have to decide if they want green space or food self-sufficiency. If you ask this question in the Third World countries, there is no doubt that they would choose food self-sufficiency. Here people tend to think that, "We can always buy our food from California." Are people in California thinking that, "When we run out of water, we'll just get our food from somewhere else?"

People say "look at that rich farmer" when they see a farm with a nice house and a Cadillac in the driveway. In town, in the same circumstances, those same people say, "Now there's a successful businessman!" It's easy to see farmers' assets, but you cannot see their liabilities. Perception.

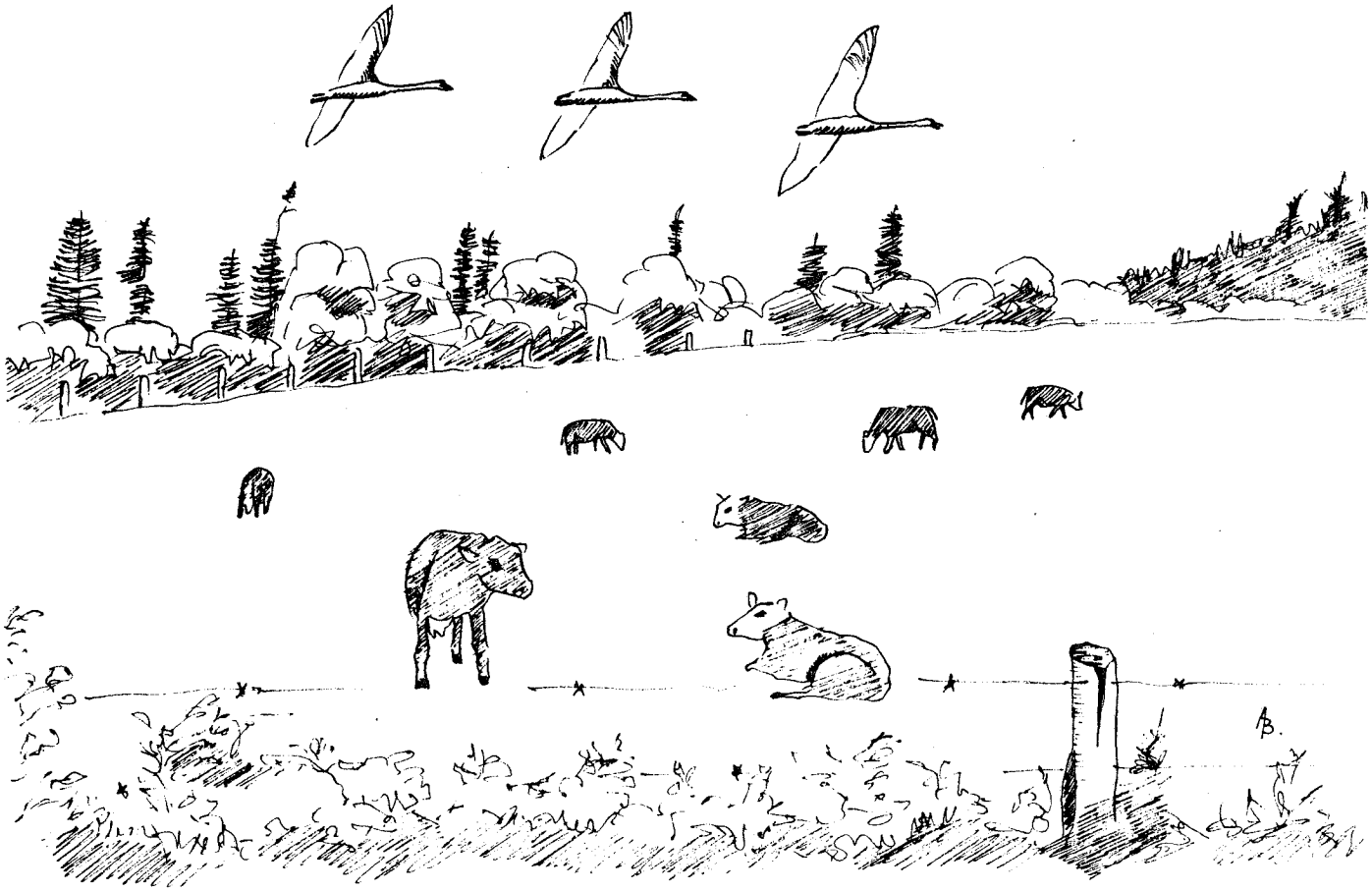
Consider the plight of the prairie grain farmer. Twelve years ago when I worked in Alberta, farmers were getting about $5.50 per bushel for their wheat. They were able to make a small profit. Today, they are getting about $2 per bushel. I defy anybody to live on 35 percent of what they earned 12 years ago.

Having said all that, I think farmers have to shoulder part of the blame for their predicament. Some of them say, "I'm just a farmer." They should be saying, "Dammit, I'm a Farmer!" They should brag about what they are doing. It is an honorable profession. If they did, perhaps people would think "Farmers -- we can't live without them."

There is one major local land-use concern that must be mentioned here, and that is water. Even though we are on the West Coast, in what is considered to be a wet area, there is a growing concern over water. The area gets too much water in the winter and not enough in the summer. Low lying farmlands are flooded by run-off from upland areas that have been logged or subdivided. Heavy winter rains run off these developed areas rather than percolating down into the ground. The result is winter flooding and reduced recharge of groundwater resulting in less water for summer irrigation. Farmers are very concerned that their future water supplies are in jeopardy.

More specific concerns and conflicts are better addressed by the people who experience them, so I will leave that for them to do next.

Thank you for the opportunity to speak at your conference.



SWAN GRAZING PROBLEMS FROM THE DAIRYMAN'S PERSPECTIVE

Don Hurford, P. O. Box 3071, Courtenay, BC V9N 5N3

Editors Note: The following paper is a summary compiled from Don Hurford's talk outline presented during the 14th Conference session "Land-use problems in the Comox Valley Area".

There are many problems faced by dairy farmers in Canada today. Overall, urban growth has meant that farms are surrounded by development. There are complaints from neighbors of smell from manure and silage. With urbanization comes an increase in trespassing from hikers, bikers and horseback riders. Development and urbanization has produced excess run-off water. At the same time, there is no water reserve which is needed for irrigation for the growing season. Lack of water means that the dairy farmer would be forced into renting more land or buying additional feed. Urban growth has forced wildlife such as deer, cougars, bears, ducks and geese onto farms. Ducks and geese have become a major problem on some farms.

At the same time that farms are feeling surrounded by pressures from urbanization, the world trade situation has made farming much more difficult. The profit margin of farming is getting continuously tighter. Overall, the future looks questionable for the farmer. The bottom line is that the dairy farmer must run a very efficient operation to stay in business.

I feel that in order to combat some of these problems facing the dairy farmer, a dairy farmer must do the following:

- Be able to use rye grasses
- Have sufficient water management
- Have an organized system in place to pay farmers the real cost of lure crops
- Have a swan harassment and damage prevention program in place to ensure that the swans utilize only the areas provided for them
- Have a system in place to control ducks and geese

From the dairy farmer's perspective, I believe that deer, bears and cougars need to be eliminated. My final comment is that, in no way can a dairy farmer tolerate swans and geese nesting in the area Oyster River to Fanny Bay. Following are some tables I have compiled to illustrate the details of swan damage costs (Tables 1 - 3).

Table 1. Swan damage costs.

Reseeding (tillage)		
Crop loss in year of reseeding 4 ton of hay/acre @ $150/ton		$400/acre
		+$600/acre
	Total	$1000/acre
If 3 ton of hay loss = $450/acre than	Total	$850/acre
No-till seeding plus spot till seeding		
Crop loss = 1 1/2 ton of hay/acre @ $150/ton		$225/acre
Reseeding (seed, equipment, labour)		$25/acre
Forage loss that swans ate = 1 ton/acre @ $150/ton		+$150/acre
	Total	$400/acre

Reseeding = $800 - $1000/acre

Salvage reseeding = $400/acre

Table 2. Swan damage cost example.

100 Acres in grass

70 Acres salvage damage = 70 x $400/acre		$28,000
10 Acres extensive damage = 10 x $800/acre		$ 8,000
20 Acres normal reseeding on a 5-year-rotation		$ N/A
	Total cost for 1 year	$36,000
	Cost for 10 years	$360,000

Table 3. Comparison of two different farms (100 acres).

Farmer "A"		Farmer "B"	
High debt		Low debt	
Older farm operation		Efficient operation	
Farmer has to take away from another part of his operation in order to compensate for the swan damage.		Farmer can absorb swan damage without seriously affecting his operation.	
From where: - equipment not replaced,			
- buildings not replaced,			
- lower wages for employees,			
- longer hours for farmer?			
	10 years later		
Swan damage	$360,000	Swan damage	$360,000
Older, smaller harvest equipment		Larger, modern equipment	
25 days longer/year for 3 men		Efficient buildings	
25 x 3 x $10/hr x 10hrs/d x 10yr =	$75,000	Efficient labour	
Repair costs and down time?		Family time	
Inefficient buildings and equipment?			
Lower hourly wages for employees?			
Longer hours for farmer = loss of family time			
Extra labour required by the farmer @			
$10/hr x 50 hrs/wk x 52wks x 10yrs =	$260,000		
Total	$695,000		$360,000

Difference between Farmer A and Farmer B = $335,000!

A farmer without any swan damage has $695,000 more than Farmer "A!"

WILDLIFE AND LAND USE CONFLICTS FROM A VEGETABLE GROWER'S PERSPECTIVE

Norm Sieffert, RR 1, Comox, BC V9N 5N1

We operate two farms, one at low elevation, close to tidewater and the other at higher elevation and several miles from the beach. The low elevation site is mineral soil while the other site is organic soil (sedge peat).

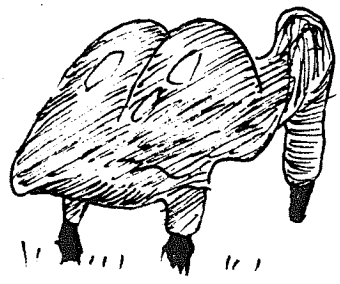
Losses in direct crop damage to swans are nonexistent. Small losses of cover crops occur at the mineral soil site. Cratering in the organic soil causes some difficulty in land preparation, but is not a big problem.

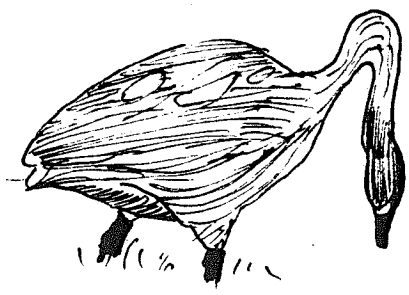
Flooding to control potato volunteers creates areas attractive to swans (and other species of waterfowl) providing a food supply from potatoes left behind at harvest. Carrots are also very much sought after by swans -- following freezing or suffocation by flooding, as in the case of potatoes.

In the Comox Valley, as in many other areas, human activities have damaged or reduced natural winter habitat. At the same time, other human activities (largely agricultural) have produced an unnatural winter habitat capable of sustaining large numbers of wintering waterfowl including swans when weather conditions are favorable. However, periods of severe winter weather, which are entirely natural, must be expected to occur at unpredictable intervals. For this reason, excessively large populations of any wildlife species can be at very great risk if the natural winter habitat has been damaged or reduced to the point where such a population cannot be sustained.

Blacktail deer have become very numerous in the urban-rural sections of the Comox Valley. Our vegetable-potato operation suffers average annual losses and extra costs of $3,000 - $5,000. Carrots must be protected by an electric fence or frequent applications of repellents such as Hinder and dried blood. Potatoes in organic soil are particularly vulnerable to serious damage and yield reduction. Certain other crops such as peas, beans, beets and romaine lettuce often suffer varying amounts of damage. The only practical means of reducing deer damage is by carefully timed applications of commercial repellents.

Many of us are very happy to observe wildlife frequently. It is unfortunate that some of us have to pay a rather high price to provide some of these opportunities.





URBAN CONFLICTS FROM THE DAIRYMAN'S PERSPECTIVE

Guy Sim, RR 1 Knight Rd., Comox, BC V9N 5N1

Editors Note: The following paper is a summary compiled from Guy Sim's outline for the talk he presented during the 14th Conference session "Land-use problems in the Comox Valley Area".

Mr. Sim's dairy farm has been in his family since 1920. Conflicts with urbanization began 14 years ago when a road was put through his property, splitting the family farm in two and causing difficulty moving cattle and machinery. The new road was designated as a four lane highway, a primary feeder route for the city of Comox.

When development began, it was done in haste without allowance for a buffer zone. There have been flooding problems caused by clear cutting for housing development. Living on the border has produced problems with jurisdiction over water flooding and road work. The developers' sales pitch in the local newspaper advertised new lots overlooking a farm with scenic countryside. However, from the perspective of the Sim's family farm, housing development has meant numerous conflicts and constraints upon farming work.

The development stage produced considerable garbage. Even now, residential areas generate a certain amount of garbage blowing over the fence onto farm fields. Items such as kids' toys, golf balls, plastic and glass are all picked up by his harvesting equipment. In addition, the neighbors think it is acceptable to dump grass clippings over the Sim's property fence. There is always the threat of clippings from yew trees being dumped into pastures with cattle. There is a school at one end of the road and a corner store at the other end. The Sim's cattle have even been used for target practice. One must take time to explain to trespassers why one does not want them trespassing. Also, with the development, it is important that all gates be kept locked. There have been complaints by neighbours about trees blocking a view, refuse burning and manure spreading. In general, there is always the concern by the real estate developer regarding how farming practices affect property values.

Farmers face water supply shortages and yet neighbours can continually water with automatic sprinklers.

One major underlying conflict is that new development raises the value of the land, so much so that a young farmer can not afford to buy. In addition, a farmer in financial difficulty can see the dollars being earned from development across his fence line. Large market outlets can provide cheap food for the consumer and thereby threaten local, smaller farmers who struggle to pay expenses.

British Columbia can grow and process the greatest variety of food anywhere in this world. Farming can provide valuable habitat for wildlife. In general, swans do not cause too much damage. Deer, however, are a greater problem. To put urban - farming conflicts in world-wide perspective, the Hudson Institute, based in Indianapolis, estimates that without higher yields for the next 40 to 50 years, world food demand would require a cultivated land mass equal to the area of North and South America, Asia, all of Europe and Australia. This would result in the cultivation of approximately 40 million square miles of land and ploughing down of more than 30 million square miles of plant and wildlife habitat.

LIVING WITH SWANS

F. E. Strong, Hazelmere Farms, P.O. Box 567, Cumberland, BC V0R 1S0

You have just heard some reports that are not "swan-friendly". To some of us, swans can be very useful. On our small farm we grow some potatoes and carrots, not many but enough for us, with land left over. "Now potatoes are like planaria, cut one in half and it doesn't kill them - instead you've got two new ones". When you harvest potatoes, a few invariably get buried; they overwinter and next season they become a major pest. They are a terrible weed. You cannot kill a potato without herbicidal sprays, plowing, or rototilling. Only three things kill a potato: freezing (rare in our area), flooding them for several days or swans. I am pleased to report that no potato variety yet discovered has been known to survive the corrosive actions of a swan's gut. Best of all, swans like them and root them out like pigs do. Given a few weeks and a couple hundred swans in this year's harvest fields, you can be assured of clean ground next year. And that's worthwhile. Same is true with carrots, a biennial plant which will go to seed next summer if it survives the winter. My point is that for some farmers swans are not very welcome, but for others, swans play a useful role.

Swans do not like everything. They like corn roots but not winter wheat planted in early August, or even winter wheat kernels left on the ground. I have never seen them feeding on the barley that my old combine spills and I do not think they like fall rye very well (either the plant or the seeds) but they love alsike clover and some perennial crops, and if thick enough to make it worth a swan's while, they will decimate Italian rye planted in late summer or oats planted not later than mid-September.

Farmers plant forages for use as either hay (including haylage) or a cover crop. Cover crops, usually managed as annuals, are planted in late summer and are plowed down the following spring. But with only a few months to grow, often under a descending sun and declining temperatures, the biomass is not great, as compared, say, to an established hay field. Cover crops are by their nature temporary (to save soil, stop wind erosion, increase soil humus). Thus, if swans or deer should graze on them in late fall/early winter, the loss is difficult to document. In our experience, cover crops, as an adjunct in swan biology, offer two benefits; they are easy to manage because you do not have to worry about weeds or bugs and they are well suited for incorporation either into the soil or into a swan enhancement program. They can be used as a holding crop to sustain a population of birds or as a lure crop, i.e. a crop intentionally planted to lure birds or animals away from a crop raised by a farmer for profit.

August 29, 2 years ago, we had a heavy rain, which precluded harvesting all of our carrots. The swans, being swans, soon zeroed in on our orphaned carrots. We watched and concluded that carrots might make a very attractive lure crop. Carrots are easy and inexpensive to raise, as long as you are not going to harvest them. $40 buys 3 lbs. of seed - enough for an acre and, with a little fertilizer and some water to encourage them along, you can raise around 25,000 kg fresh weight or about 3,000 kg dry matter of carrots, which yields about 2,500 kg of available carbohydrates. Of what use are data like these?

Cattle and sheep men devised a common denominator which expresses the carrying capacity of various ranges called Animal Unit Month or AUM's. Ten AUM's means a given grazing area will support 10 animals for 1 month or one animal for 10 months. Question is, how many Swan Unit Months is equivalent to 2,500 kg? The biologist should be able to tell us this, but a quick calculation indicates on the assumption of 0.5 kg dry matter per day per swan, 1 acre of carrots (=$200) should adequately sustain 200 swans for almost 1 month or 6,000 swans for 1 day. A quick division indicates a price per bird per day of roughly 3½¢. This is about the same as one puff on a cigarette. There must surely be

other crops beside carrots that will provide the same economic returns - something many small landowners trying to enhance the swans' winter range might investigate.

I have been discussing this agricultural material because if we want to provide winter feed, we must know what is best. We have tried a number of things. Under our conditions we find that unharvested corn left in the field does not appear to be a practical lure crop because of migratory habits of our waterfowl. The ducks arrive and decimate the corn before the first swans reach the table.

This observation brings up an interesting question: if we are going to live with swans, we need to know how they identify and locate their food. We should understand this mechanism to effectively plan the management of our lure crops or long term overwintering feeding sites. I do not know the answer, but I do not think swans are capable like host-specific insects of homing in on the appropriate wavelengths of light which fingerprint each plant species. After watching swans for almost 10 years now, I feel the first arrivals land in an open space that looks green (minimum size of three acres), wander around aimlessly and eat whatever they stumble upon that tickles their fancy. If this is true, it raises yet another question: how does one swan tell another, "Follow me and I'll show you a fine field of carrots"? Is food finding a chance affair followed up by decoying instincts? Does vocalizing play a role in food finding? Again, I hope the biologist can provide answers.

The title "Living with Swans" is an Orwellian newspeak expression which translates as "how do we manage these critters so they don't annoy us, because if they start getting as thick as Canadian honkers or white-tailed deer, there will be a surge of vigilantism or authorized management activities which is more newspeak for illegal and legalized hunting". To avoid such measures, who is responsible for carrying out swan care and preservation activities? Ducks Unlimited (DU)? Pacific Coast Joint Venture and other quasi-government organizations? They can provide advice, seed money, education and encouragement, but ultimately, the responsibility falls to the 3 percent of us that are privileged to own the land swans trample. I have absolved the city dwellers of this responsibility, because swans do not trample lawns or eat backyard vegetable gardens. But I would not exclude the participation of city folk in developing and operating a "Living with Swans" program. The entire concept of "Living with Swans" is not unlike the salmon enhancement programs now operating in British Columbia. School kids, Rotary Clubs and sportsmans' groups and others could get involved. Ultimately though, it is the landowner, the family that owns that land the stream traverses or the swans occupy, who must take the final action. Considering this, I suggest the following action plan for "Living with Swans".

1. First contact the local officials (the District Agriculturist in your area) and tell them your desires.

2. Survey your land with a local member of the Natural History Society. (If there is not such an organization, start one.) Make a list of what you can do and want, commensurate with your budget. (With a zero budget, just sit, watch and record.)

3. Remember, in British Columbia things you do to enhance a farm's productivity may be a tax write-off; enhancement includes land clearing and pond construction. Check with a tax advisor. I do not know of any tax benefits that accrue to persons who incur expenses to protect and preserve wildlife, but there may be some. (Check with your tax consultant. Maybe someone in this room knows the answer.)

4. Dedicate up to 3 percent of your land exclusively for wildlife use. Do not restrict your actions to just swans. Pheasants, ducks, mink, muskrats, beavers plus minnows and mayflies and all the other organisms on the displaced animal list should be included. If you do this, you will have unknowingly created a sanctuary for swans which may only need a place to sleep for the night. You would not notice a loss of 3 percent. If you own 10 acres, this is a plot only 130 by 100 feet. All farms seem to have a misplaced piece of

ground that is a bit annoying and not very useful. A cost benefit analysis will probably show that there is no profit from this piece. Give it back to wildlife and restore the native habitat the farm destroyed.

5. Discuss your plans with your neighbor. If he is a cauliflower grower and you want to enhance the elk population, there will be problems.

6. If you have kids or grandkids in school, approach the school with the idea of helping the kids get a tiny piece of nature. Suggest your little donated piece become a Grade 3 nature reserve. And be out there when the kids come, don't leave it to the teachers - help them.

7. If you have some parts that flood every year and are often too wet to harvest in the fall, consider turning it into a permanent wetland. DU will provide advice and if the project is sufficiently large, funds might be available. The most exciting local example of this is what DU has done on John Walsh's farm near Little Qualicum. I will leave this story for one of the specialists. Ask them about it. It is a wonderful wildlife refuge: Hundreds of swans and geese and thousands of ducks, habitat created by nothing more than installations that permit managing the water levels during the winter months.

Where are we now in the swans' struggle to live with us? Here are a few thoughts to mull over. I suspect you are aware of E. O. Wilson's books which elaborate on the number of organisms which become extinct each year and the need for maintaining our biodiversity. They make for dismal reading, but it is not all bad. Some animals have undergone genetic shifts qualifying them to prosper by man's presence, ergo, the Bald Eagle, or the white-tailed deer, or the Canada Goose. I wonder if the Trumpeter Swan might be in this same category. Consider the following quotes:

"Outside of a few pairs in Yellowstone National Park, the main stronghold of the Trumpeter now is in northern British Columbia. Possibly 500 birds are scattered through that rugged region in the summer. This swan, one of the largest living native birds in North America, presents a problem for its perpetuation that requires all the intelligence and effort that conservationists can concentrate on it" (Brooks 1934). In 1938, Taverner wrote "at present, strenuous efforts are being made to preserve the last remaining individuals of this beautiful species. Attempts have been made to preserve waters they frequent, but they refuse to stay in narrow but safe confines and their numbers are diminishing. Unfortunately, only the stations at the winter end of the migratory range can be reserved." (Kortwright 1942)

Today, after 55 years, I do not think it is unfortunate that only the winter range can be reserved. We are the stations at the winter's end and the swans are surviving admirably. As we watch our valley's people population double, the competition for winter's end will build. So set aside that 3 percent to not only preserve the winter range, but to enhance it.

In conclusion, I would like to ask "are we learning to live with swans?". The evidence indicates we are getting there. I am not yet certain, but I am certain of one thing. In spite of the things we have done, the swans have accepted us and have learned to live with us and as long as we behave in a half way decent manner, we will both co-exist for a long, long time.

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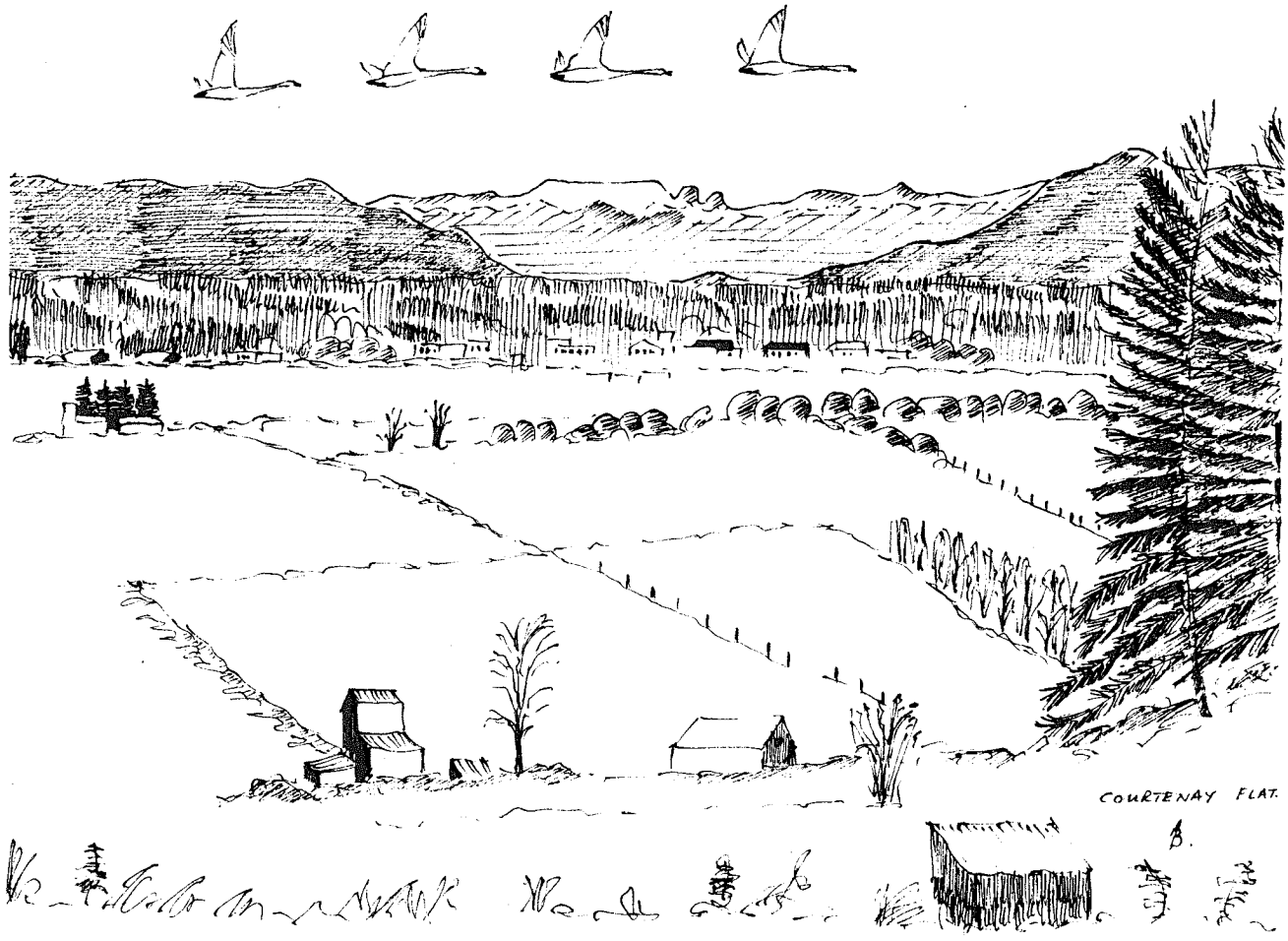
TOOLS FOR DEALING WITH LAND USE PROBLEMS ON THE COASTAL WINTERING AREAS



TOOLS FOR DEALING WITH LAND USE PROBLEMS ON THE COASTAL WINTERING AREAS, THE AGRICULTURAL LAND RESERVE

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INTRODUCTION

Agricultural Land Commission Act

A provincial farmland preservation program was initiated in the early 1970's because large tracts of good quality agricultural lands were being converted to residential subdivisions and other urban uses. The Agricultural Land Reserve was created in 1973 and it presently encompasses approximately 4.7 million hectares of land throughout British Columbia. The Agricultural Land Commission Act establishes a commission to administer land use regulations within the Agricultural Reserve. There are two principal goals of the Act: (a) the preservation of agricultural land and (b) the encouragement, establishment and maintenance of farms and the use of land in an Agricultural Land Reserve compatible with agricultural purposes.

With regard to wildlife management, the regulations define activities which are permitted without requiring an application to the Commission in an Agricultural Land Reserve under Section 2(1) of B. C. Regulation 7/81. Of interest to this group are two permitted uses:

e) ecological reserves established under the Ecological Reserve Act.

f) a reserve or area of land or habitat set apart for wildlife providing the surface of the land is not subject to substantial works; for the purposes of this paragraph, burning or thinning of natural growth from time to time is not a substantial work.

Uses not defined as permitted uses in the Act require application to the Commission. Commissioners are appointed by government to adjudicate applications under the Act. In addition to use applications, the Commission considers a number of different types of applications of which applications for exclusion of lands from the Reserve or subdivision within the Reserve are most common.

The determination of activities which constitute substantial works under section (f) is best established by staff at the Commission offices in Burnaby. Individuals or organizations engaged in wildlife activities on lands within the Agricultural Land Reserve that are contemplating activities which might possibly be judged as substantial works, should contact Commission staff to avoid potential future delays and expense.

In instances where substantial works such as trails, soil disturbance or construction of any sort are envisaged, the regulations provide for special cases under Section 44 of B. C. Regulation 313/78. Clause (b) identifies a reserve or area of land or habitat set apart for wildlife that does not qualify under B. C. Regulation 7/81. In other words, when substantial works are contemplated, the regulation requires that an application be made, and that approval from the Commission is received before this non-farm use can occur. Individual applications are judged on their own merits. Applicants considering such an application should consult with Commission staff and allow 6 months time for the application to be processed. The Commission will be interested in overall land use in the area of the application, with particular regard for any impacts on adjacent agricultural activities.

SPECIFIC TOOLS FOR DEALING WITH LAND USE MANAGEMENT

A number of specific land-use related tools are available to assist in managing agriculture/wildlife interactions where negative impacts on agriculture occur. In most instances, there is not a conflict between

agriculture and wildlife. It is only in those instances where wildlife has or threatens to have serious, negative implications for a farmer's financial success, that conflict occurs. The available options include land purchase, fiscal compensation, cooperative management, research, communication and conservation covenants. These options are reviewed from an agricultural land preservation perspective.

Land purchase

Land purchase should not be considered a panacea. Too often land purchase results in exclusivity of use. This is most often the concern from an agricultural perspective. When pressure on land from alternate uses is impacting on agriculture and wildlife, and when there is opportunity to foster and manage both resources, this should be a mutual objective.

Increases in wildlife populations as a result of outright land purchases may aggravate conflicts on operating farms in the vicinity. If this option is to be successful, it is essential that mitigation strategies are in place to minimize potential future conflict. Some options are discussed further under management/research/communication.

In many areas, agricultural activity is fragile as a result of inadequate financial returns in the market place. While there are numerous reasons for these situations, including multinational and international agricultural regulatory influences, this topic will not be discussed here. What is of concern, is support for, and maintenance of, the overall agricultural infrastructure within the farming community. The outright purchase of farm lands for wildlife purposes, particularly when the use is to be exclusive, may weaken the support for the agricultural infrastructure. In many communities, the infrastructure is marginal and any deterioration in the overall land base can have larger implications. If this scenario is compounded by increased conflict from greater, unmanaged wildlife populations, everybody's life becomes more complicated.

Frequently, outright land purchase may lead either immediately or over time, to modification of habitat. In some instances, particularly with waterfowl, habitat enhancement may impact negatively on agricultural soil capabilities. In these circumstances, it is important that adequate planning be in place to minimize such conflicts.

Outright acquisition may be accompanied by enhanced public access opportunities. Once again, these activities need to be managed not only for the sake of wildlife, but also with the agricultural community in mind. Traffic on farm roads, trespass, vandalism, litter and public concern about agricultural practices which may include noise, odours or dust are all issues of concern to farmers and should be considered early in the process and in consultation with the farm community.

Outright purchase has traditionally been the most expensive option for conserving wildlife habitat, both from the perspective of capital and fiscal operating requirements. Furthermore, this option can only hope to provide a small component of an overall strategy to manage wildlife. While land purchase may provide clear advantages in very significant and sensitive habitat, it can only be part of an overall strategy. To ensure wildlife interests are addressed, there is a growing need for cooperation between agriculture and wildlife. While not necessarily fully compatible, these land resource uses have more in common than most other competing land uses.

Compensation for wildlife damage

The notion of compensation for wildlife damage has been resisted in British Columbia for a long time. It is recognized that it is a complex mechanism, subject to interpretation and dispute. Nevertheless, it has been successfully used in other jurisdictions such as Manitoba. Perhaps it is appropriate to revisit this option and try to address some of its limitations.

From an agricultural and wildlife perspective, this option has much to recommend it. The farmer generally sees wildlife as a public resource. While farmers are generally sympathetic to some wildlife cost, they do not feel that the farm should be supporting a

public resource at the risk of their livelihood. Most farmers would prefer to earn their income from agricultural production; however, when wildlife damage is significant, compensation would be an effective compromise. Too often historic biases neglect to recognize that farming is a business first and a lifestyle second. The farmer needs to run a profitable business in order to remain on the land. Competing interests for farm land are likely to be sympathetic to wildlife interests, but will displace it.

The area of compensation needs to be seriously revisited by government, the farming community and wildlife interests.

Management/research/communication

Whatever tools are used as options to facilitate compatibility amongst farm and wildlife uses, management, research and communication are indispensable companions. These tools should be encouraged by both the agricultural community and wildlife interests. Certainly the local activities in our area regarding Trumpeter Swans, are an excellent example of how this strategy can work. While there are still many questions to be answered, the demonstrated willingness of both parties to work towards satisfactory strategies for conflict resolution is laudable.

For this strategy to work over the long run, it is essential that both parties define their long-term goals. Too often hidden agendas that result in disguised program objectives, lead to long-term mistrust. Realistic long-term goals, followed by appropriate planning and management strategies to ensure goals are confined to mutually acceptable objectives, are the key to long-term success for all parties. Such mutual understanding will also assist in keeping the lines of communication open, when plans do not achieve their exact objectives.

Conservation covenants

Conservation covenants are legal instruments that may be held by government agencies and adjacent land owners. At this time, there are no opportunities for third party interests to hold such covenants. Discussions are underway to develop a mechanism to permit third party conservation covenants. Such a tool would provide potential lower cost options to outright purchase while being less restrictive to agricultural interest. It is clear that a mechanism will have to be developed to ensure that there is continuity by the covenantor in order that covenants can adapt to changing needs or circumstances. This tool offers some unique opportunities and warrants further consideration.

CONCLUSIONS

In my view, it is essential for agricultural and wildlife interests to work cooperatively. Each interest needs to recognize the goals and aspirations of the other and the value of both resources.

It is important that wildlife managers do not raise false expectations by creating the spectre of financial resources to manage wildlife only to have the resources ultimately be meagre. In addition, it is essential that hidden agendas do not conspire to destroy the best of intentions on the part of all interests.

Both the agricultural community and the wildlife sectors need to cooperate, not only in words, but in actions. For example, the construction of an office building by the Canadian Wildlife Service in the Alaskan National Wildlife Area, which would normally require the approval of the Provincial Agricultural Land Commission were it not Federal land, fails to convey a sense of understanding and cooperation. Too often these minor issues build fences rather than bridges.

The farmers and wildlife interests are working with limited financial resources. The potential to achieve sectoral goals is possible in a spirit of mutual support and difficult, if not impossible, under confrontation. The failure of agriculture and wildlife to reach consensus will ultimately result in failure of both to achieve their goals. It is essential to recognise that agriculture and wildlife, while having different interests, have far more in common than competing land-uses.

Farmers must be responsible in their approach to wildlife interests. At the same time, wildlife managers recognize that the survival of the farmer in business terms is of critical interest to wildlife. Other competing land-uses are likely to have more profound and irreversible impacts.

The cooperation in the Comox Valley over the past 2 years is encouraging. The fact that the agricultural interests have been invited to this conference, and that they have participated, is a positive step.

ACKNOWLEDGEMENTS

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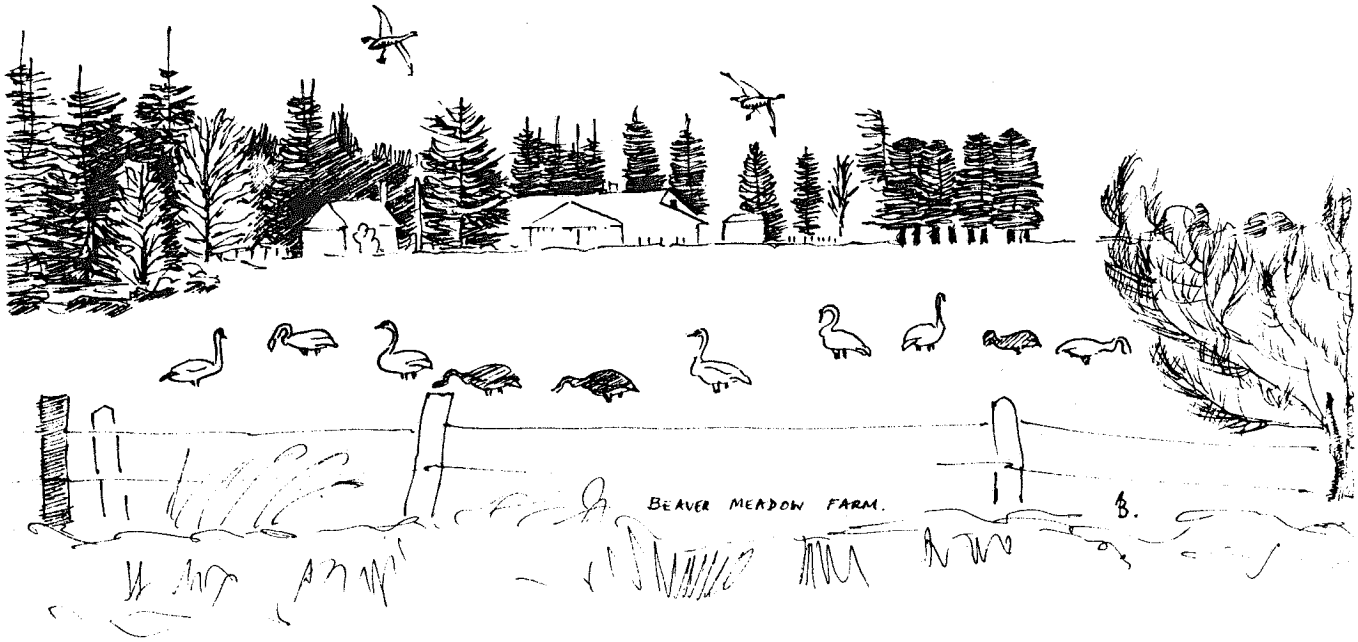


THE COMOX VALLEY WATERFOWL MANAGEMENT PROJECT, 1991 - 93

Bill Wareham and Graeme Fowler, Ducks Unlimited Canada, 14343 - 44th Avenue, Box 1170, Station A, Surrey, BC V3S 4P6

PROJECT HISTORY

The Trumpeter Swan population overwintering on Vancouver Island, British Columbia, has increased steadily over the last 30 years. Historically, these birds wintered and fed in estuarine habitat along the coast of the island. Over time, however, the swans became accustomed to feeding on agricultural lands. The lush green grass fields and winter-flooded vegetable fields proved to offer these birds a safe habitat and abundant food supply. When the swan numbers were relatively low the birds were welcomed by local farmers and residents. However, with now up to 1,300 swans overwintering in the Comox Valley many farmers are frustrated by the swans which can inflict serious damage on grass fields and economic losses on farm operations.

It is the farm community's view that farmers should not have to bear the brunt of the impacts of an ever increasing swan population. They feel it is the responsibility of all people in our society (i.e. our public agencies), to assist the farmers in managing these birds. To this end, in August 1991 the Comox Valley farmers submitted a Trumpeter Swan Management Proposal to the Pacific Coast Joint Venture Committee. The proposal was forwarded to the Canadian Wildlife Service (CWS) and Ducks Unlimited Canada (DU) for consideration. CWS and DU agreed to contribute funds to the initiative and DU agreed to administer the project, which was titled "The Comox Valley Waterfowl Management Project". The project started in September 1991.

GOAL AND OBJECTIVES

After discussions with local farmers and government agriculture and wildlife agencies, the following goal, objectives and the project design were agreed upon.

Goal

The project goal is to address farmers' concerns about feed loss and permanent crop damage caused by Trumpeter Swans.

Objectives

1. Encourage farmers to plant winter cover crops for use by swans;
2. Monitor swan and other waterfowl distribution, behavior and field preferences;
3. Determine the effectiveness of scaring swans from fields that farmers wish to protect;
4. Publish a monthly newsletter to help improve the communication and understanding between the agricultural community, wildlife agencies and the general public.

PRELIMINARY RESULTS

Some farmers had success with trained farm dogs. Depending on the layout, topography and size of the farm, these dogs can do a remarkable job of chasing swans off the farm before large numbers accumulate and cause serious crop damage.

During the 1992-93 season, flags and flash tape did not work as effectively in cold weather. The swans were more persistent at feeding in desirable fields and, therefore, were less bothered by these devices. Frozen ground forced birds to feed on grass fields and more frequent scaring was required. As a result, in 1993 electronic noise-making devices have been tested in fields where swans have ignored other scare devices. Preliminary results are encouraging.

Scaring swans is a relatively new activity and no one is certain about what techniques will work in the long-run and be cost-effective for the farmer. This project provides us the opportunity to experiment with a variety of techniques and make recommendations on the best tactics to employ in different farm conditions.

FARMER COOPERATION

The farming community has been very cooperative and interested in this initiative. Twenty-five farms have signed onto the project. Over 426 acres were planted to cover crops in the project's first season. In 1992-93, 414 acres were planted on selected sites. Approximately 1,000 acres of grass fields are registered by agreement for protection from swan grazing.

The success of this initiative depends on continued farmer cooperation. This requires a constant assessment of the farmers' site specific needs and problems. The farmers hope to see the public acquire a better understanding of the impacts that swans have on farm operations.

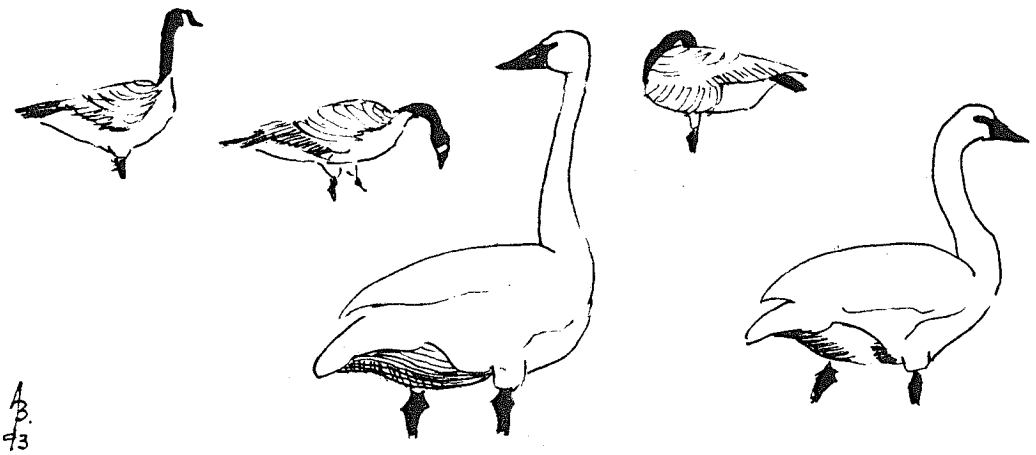
PROJECT FUTURE

Continuation of this project depends on the availability of funding from the Canadian Wildlife Service, other agencies and the local community. The long-term objective is to find some solutions which farmers can use on their own. Wildlife agencies will likely remain involved to some degree, in order to manage the swans as their population increases.

The real challenge will be to foster the community attitude so that the public sees the value in supporting the local farmers and assisting in the funding of the Trumpeter Swan Management Program. The swans are a unique species on an international level. The local community must recognize the aesthetic and economic benefits the swans can offer and take steps to ensure that the swans and the farmers can coexist in relative harmony.

For more information contact: Bill Wareham, Program Administrator, Ducks Unlimited Canada (604) 591-1104.

If you are interested in receiving our project newsletter or would like a copy of the final report, please contact Graeme Fowler, CVWMP Project Coordinator, (604) 339-0673 or write to 2022 A Bolt Avenue, Comox, BC V9N 8H2.



THE COMOX VALLEY PROJECT WATERSHED SOCIETY

Chris Hilliar, RR 3, Site 338 C - 5, Courtenay, BC V9N 5M8

Editor's Note: The following paper is a summary prepared from an educational and informational brochure and letter submitted by Chris Hilliar.

INTRODUCTION

Thank you for inviting me to speak about "Fish" and "Fish Habitat" at the 14th Trumpeter Swan Society Conference. World population is growing at an alarming rate with our present population of 5.4 billion people expected to double in the next 50 years to 11 billion. As the growing human population places heavier demands on the habitat requirements of other species, it is imperative that agencies, individuals and communities band together to protect habitat and to share our experiences. The Trumpeter Swan Society Conference has given us that opportunity. The following is a brief summary of "Project Watershed" and its objectives.

The Comox Valley Project Watershed Society is registered as a non-profit society in British Columbia. It is dedicated to promoting community stewardship of Comox Valley watersheds through education, information and action and by providing a regional network for all steward groups. The society will provide environmental information ranging from local watershed issues to global concerns such as ozone depletion. The society strives to provide all available information to user groups, the public, government agencies and local boards to encourage a more informed decision-making process. In the Comox Valley, an Environmental Information Library will provide computer access to British Columbia statutes and acts and to maps showing existing and potential water storage, land-use and fish and wildlife habitat. Information will be continually updated by Resource Center staff and a society funded "Environmental Response Team" will carry out environmental monitoring, inventories and be trained in responding to environmental emergencies.

SOCIETY OBJECTIVES

The Comox Valley Project Watershed Society has the following objectives:

1. Promote community stewardship of every watershed from Oyster River to Deep Bay Creek.
2. Provide and promote environmental education and research.
3. Acquire and disseminate environmental information.
4. Enhance community understanding of local ecosystems and recognition of the requirements of indigenous species.
5. Improve awareness of local action opportunities in watershed stewardship.
6. Provide and promote employment opportunities in sustainable watershed activities.
7. Work with government agencies, private companies and other interest groups to conserve, restore and develop habitat for indigenous fish, flora and fauna.
8. Encourage all ages and cultures to become involved in community stewardship of watersheds.

For further information please write Chris Hilliar at the above address or telephone 604/339-1361.

WEST COAST ISLANDS' STEWARDSHIP AND CONSERVANCY SOCIETY OF BRITISH COLUMBIA

Michael Mascall, Box 658, Quathiaski Cove, BC V0P 1N0

"LAND TRUST" VS "CONSERVANCY "

We cannot use the word "trust" in our name as only Trust companies (a type of banking institution) are allowed to use the term in Canada; therefore, we use the terms conservancy and stewardship societies. A land trust is a nonprofit corporation which can own land for its members. It differs from government in that it defines its own constitution and membership. It can hold land in perpetuity -- legally defined as 30 years longer than the existence of the crown!

Politicians are not involved in a land trust's decision making process. (The land is not always well cared for by politicians.) We all know what has happened with Strathcona Provincial Park where its boundaries have been moved to accommodate logging and it has an operating mine inside its boundaries. A current example is the Beaver Lodge lands in Campbell River, British Columbia, where the government is trying to set up a subdivision on lands which were donated as a gift to the Province in 1934.

Types of land trusts and conservancies include: conservation of special areas that people care about such as wilderness, recreational, scenic, historical or community forest areas; stewardship for areas which can be managed, such as community agricultural or forest areas; socially-based organizations like cooperative housing which can be set up to build a community.

The United States is ahead of Canada in this area. Because of high inheritance taxes, there are very compelling tax advantages to encourage United States residents to make donations to a land trust. In addition, the United States legal structure is set up so that covenants with third parties can be placed on land areas, eg. the San Juan Preservation Trust owns no land. (The West Coast Environmental Law Society has prepared a document outlining what laws they feel the Canadian and British Columbia governments need to assist local control of lands through covenants.)

Overall, land trusts are organizations which work within our economic system of private land ownership and allow public land ownership or commons. Most of all, in this day and age of government and institutional control, land trusts offer a viable alternative for local control and give a sense of empowerment! Monitoring is important to ensure that there is no abuse of the common land. In British Columbia today, there are approximately 20 conservancies.

WHO WE ARE

The West Coast Islands' Stewardship and Conservancy Society of British Columbia is commonly called "Coast Islands' Conservancy." Set up in 1983 to hold lands for the Islands Trust area, it has charitable status with Revenue Canada, and is connected with a charitable organization (Tides Foundation, San Francisco, CA) in the United States. The Coast Islands' Conservancy does not own land now, but acts as an umbrella organization for other conservancies. Member organizations include: Quadra Island Conservancy and Stewardship*, Galiano Club*, Denman Conservancy*, Comox Valley Conservancy and Land Society, Hornby Island Conservancy and Galiano Island*. We offer the following services to beginning organizations:

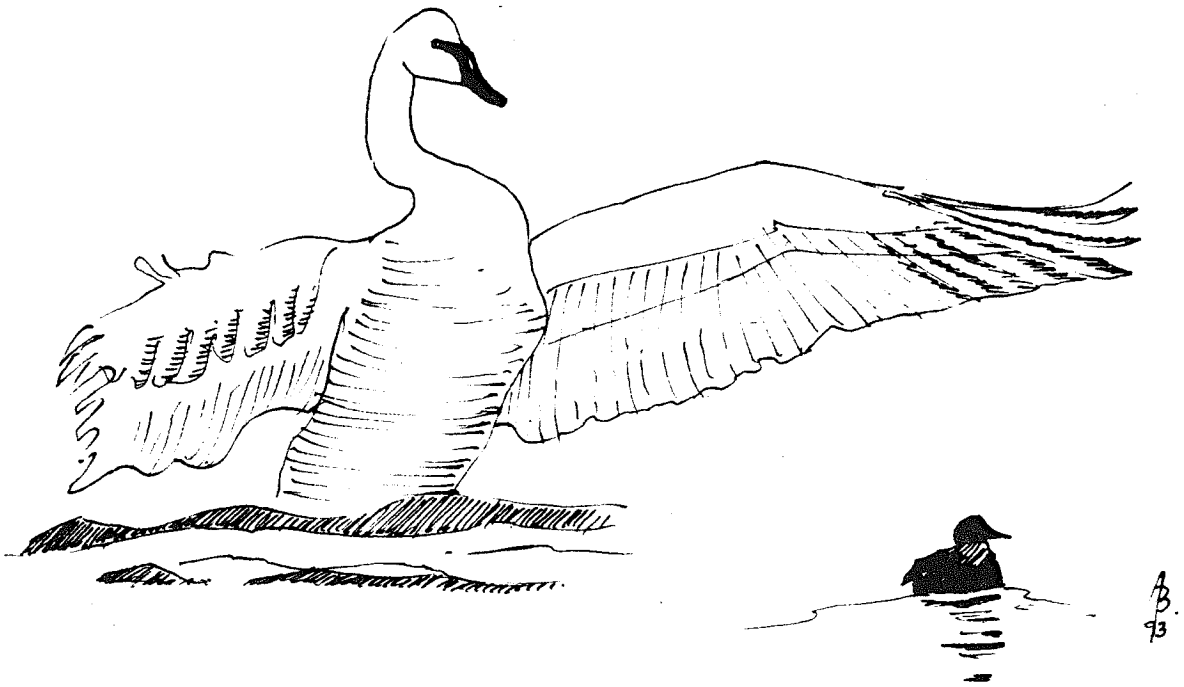
- knowledge in setting up and structuring a conservancy: constitutions, by-laws and applying for charitable status.
- tax forms for donations coming from Canada and the United States.
- fundraising experience.

WHAT WE HAVE DONE?

Four of the above (those noted with an *) organizations have purchased land. This cements their position forever in the community as they actually have something to look after. Together, they have raised almost $1 million in the last 3 years. It has been a lot of hard work, but there is widespread support. Anybody who cares about their area, (area having a different definition for each person) can participate in a conservancy at some meaningful level.

HERE IN THE COMOX VALLEY

Here, in the Comox Valley of British Columbia, there is the Comox Valley Conservancy and Land Society. Jackie Somerville (604/337-8873) and Margot MacLaughlin (604/334-0874) are the area contacts.



MANAGEMENT CHALLENGES IN THE 1990'S RELATED TO PACIFIC COAST POPULATION TRUMPETER SWANS IN OREGON AND WASHINGTON

Bradley D. Bales, Oregon Department of Fish and Wildlife, 2501 S.W. First Avenue, P.O. Box 59, Portland, OR 97207

Don Kraege, Washington Department of Wildlife, 600 Capitol Way N., Olympia, WA 98501-1091

Numbers of wintering Trumpeter Swans (Cygnus buccinator) from the Pacific Coast Population have been increasing in Oregon and Washington since the 1970's. For example, in Washington, winter counts have shown a two-fold increase in wintering Trumpeters over the last decade. A wintering population of 1500-1800 Trumpeter Swans currently occurs in western Washington. Oregon's wintering population is less than 200 birds. In addition, Trumpeters are expanding their southern range and pioneering into vacant wintering habitat primarily west of the Cascade Mountains. Small flocks have also been observed in selected areas east of the Cascades in both states.

Concurrent with the increase in population size and distribution has been an increased emphasis on management of the species by state wildlife agencies. In the past, emphasis of the wildlife programs in Oregon and Washington has been directed toward hunted game species, since almost all agency revenue has been and remains derived from the sale of hunting and fishing licenses. During the 1980's, the Washington Department of Wildlife (WDW) began to receive state tax revenue. This fact resulted in shifted management emphasis toward a broader range of wildlife species, which in part, has also reflected changing public participants in wildlife recreation. Recent changes in Oregon Department of Fish and Wildlife (ODFW) policy and long-range objectives will also put more emphasis on total wildlife species management. These changes in agency direction have resulted in higher priorities given to issues and management concerns related to swans in Oregon and Washington. For example, ODFW has spent monies derived from the sales of waterfowl stamps to fund the expansion of Rocky Mountain Population Trumpeter Swans into eastern Oregon.

MANAGEMENT CHALLENGES AND POTENTIAL SOLUTIONS

Habitat

In Washington, numerous coastal estuaries bordered by agricultural lands provide prime habitat for waterfowl, including swans. The Skagit Delta area winters a large percentage of the total population of Trumpeters found in the State. Given the increase in Trumpeters wintering in the delta area and elsewhere in Washington, it is apparent that the carrying capacity for swans has not been attained in that state. Birds in the Skagit area have been using new areas and have recently broadened their forage base. Washington is currently completing a long-term project to document and monitor habitat utilization patterns of swans in the Skagit Valley. This study has documented specific habitat types utilized by swans, seasonal habitat utilization preferences, and shifts in habitat use. This information, in conjunction with additional research at the University of Washington, should add insight on the capacity of the Skagit area to accommodate more swans. Empirical evidence to date has indicated that wintering swan populations will increase given continuation of present agricultural trends.

One factor that threatens to limit the potential for increase of the Trumpeter population in Washington, and in the Skagit Valley in particular, is the loss of agricultural land to residential and commercial development. Skagit and Snohomish Counties are two of the fastest growing areas of Washington and are threatened by urban expansion from the Seattle metropolitan area. In addition, agricultural trends are by no means static. Swan habitat losses due to the advent of "clean" farming and conversion to bulb and some vegetable crops may reduce winter habitat acreage.

In Oregon, the lower Columbia River estuary and agricultural lands of the Willamette Valley provide an ample food base for swans. There is a large wintering population of Tundra Swans in Oregon, mainly in the Willamette Valley, lower Columbia River, and various coastal areas. Trumpeters are no doubt mixed in with these Tundras and surveys, in conjunction with The Trumpeter Swan Society (TTSS), have been initiated in recent years to obtain a baseline figure on total wintering numbers. Trumpeters have been observed in numerous areas and range as far south as Eugene in the Willamette Valley. While winter surveys have centered on western Oregon, increased training of field personnel on the identification of Trumpeters will improve baseline information Statewide.

Trumpeters wintering in the Willamette Valley are probably facing loss of potential habitat due to urban sprawl, as in Washington. Oregon also has many suitable areas for wintering birds that are not currently being utilized. Of greater concern, however, for all waterfowl species is the expansion of hybrid cottonwood plantations along the lower Columbia River. Pasture lands important to numerous wintering birds are being converted to plantations for the purpose of growing wood for pulp. A strong economic market is expected to expand this industry. Many local farmers and ranchers oppose this conversion, but many find themselves unable to ignore the potential monetary income involved.

To counter potential habitat losses for all water bird species, Washington, Oregon, California, the U.S. Fish and Wildlife Service (USFWS) and the Canadian Wildlife Service in conjunction with private conservation organizations have developed and implemented the Pacific Coast Joint Venture (PCJV) under the North American Waterfowl Management Plan. The PCJV is a plan designed to acquire and enhance waterfowl habitat and establish indirect landowner programs to encourage management practices to benefit waterfowl. A high emphasis is placed on participation by the private sector. To date, over 12,000 acres of important habitat in Oregon and Washington has been acquired, enhanced, or protected under the PCJV. One high priority is to acquire 700 acres at Debays Slough in the Skagit area of Washington. This parcel could provide roosting and feeding habitat for up to 400 Trumpeters, a number which could be increased with improved management. A proposal to secure this area will be submitted for Federal funding in April 1993.

Depredation

Depredation by Trumpeter Swans is currently not a major issue in Oregon and Washington. However, increased problems may be perceived by landowners in the future as the swan population expands. This could be extremely important in Oregon's Willamette Valley and lower Columbia River area where an expanding wintering Canada Goose population, now over 100,000 birds, is already creating numerous crop damage issues. Harvest of Canada Geese in northwest Oregon is limited due to restrictions imposed to protect the Dusky Canada Goose (Branta canadensis occidentalis). An increasing Trumpeter Swan population may not be as well received by landowners because of the current goose issues. These problems are not predicted to lessen in the near future and will likely worsen. However, swans have a high public appeal in both states. A proposed Tundra Swan season in Oregon a few years ago caused a major public outcry against the season, which eventually resulted in withdrawal of the proposal. But again, attitudes and politics could change as overall goose and swan populations increase.

Mortality factors

Lead poisoning and aspergillosis continue to be a problem in Trumpeter Swan wintering areas of Washington. In spite of the fact that Skagit and Whatcom Counties have been steel shot zones since 1987, lead continues to be available to swans feeding in these areas, but may be decreasing. Significant losses of waterfowl due to disease are infrequent in Oregon, especially in western Oregon.

Accidental and malicious shooting does occur on the wintering grounds in both states, but is considered inconsequential to the overall population. Increased education and enforcement efforts can reduce accidental harvest. Washington currently publishes swan

identification material in its annual waterfowl hunting pamphlet and posts areas with informational signs if shooting incidents occur. Oregon plans to publish similar materials beginning in 1993.

Mute Swans

Because of the potential for competition with native waterfowl, the Washington Wildlife Commission voted in 1991 to place Mute Swans on the list of deleterious exotic wildlife. Washington has removed or ordered removal of Mute Swans found in the wild, and prohibits further importation, propagation, sale, or transfer of Mutes.

Oregon is just beginning to assess the Mute Swan problem. It is believed Mute Swan numbers are much lower in Oregon than Washington. In 1992, the Oregon Fish and Wildlife Commission adopted a policy that prohibits any captive-reared waterfowl from being released into the wild. Mute Swans found in the wild have and will be dispatched.

Population inventory

Concurrent with the expansion of Trumpeters into new wintering areas has been a greater emphasis on securing accurate population estimates and documenting interchange among wintering areas. In conjunction with monitoring of habitat utilization patterns, Washington has intensified monitoring of population levels in the Skagit Valley during the past 6 years. The objectives of this portion of the project are as follows:

1. Document and monitor changes in swan distribution in agricultural areas (historical to 1993).

2. Document and monitor species interaction patterns (historical to 1993).

3. Document and monitor annual population levels.

4. Document and monitor family unit size.

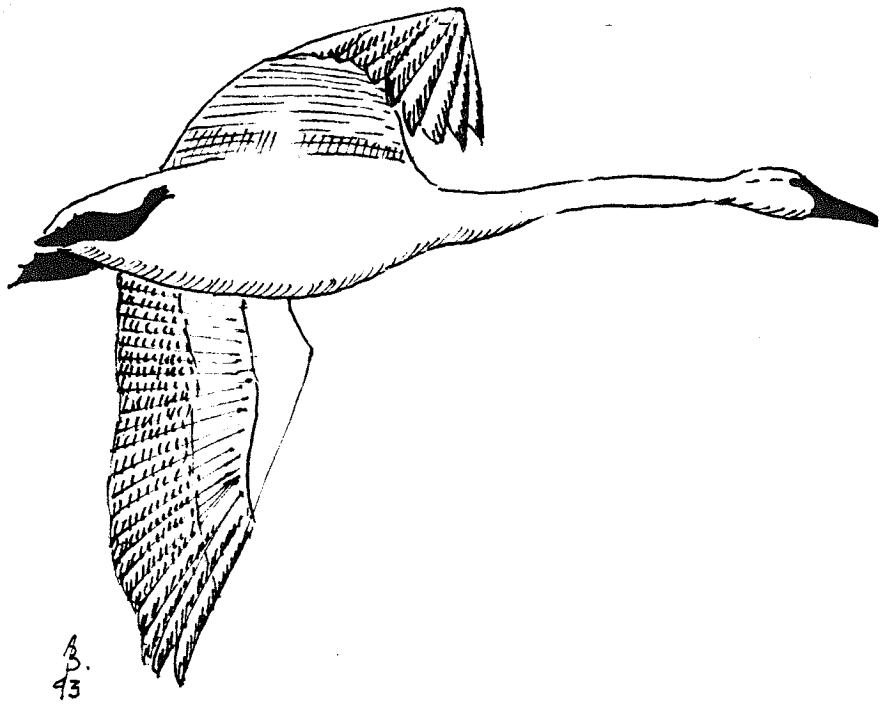
In addition, the Midwinter Waterfowl Inventory has been upgraded in conjunction with The Trumpeter Swan Society (TTSS) to get better estimates of swan numbers throughout the State, following each range-wide survey (5-year-cycle).

Again, Oregon has just begun to secure population estimates and plans on working closely with WDW and TTSS in the future to compliment efforts on Trumpeters in both states.

SUMMARY

Concurrent with the increase of the Trumpeter Swan population and distribution in Oregon and Washington, there has been an increased emphasis on management of Trumpeters by both state agencies. Progress is being made toward obtaining better wintering population data, securing wintering habitat and decreasing various mortality factors. Given the current population and habitat status, the population of wintering Trumpeters will increase both in size and distribution in Oregon and Washington, but management conflicts are likely to increase also.

THE ROCKY MOUNTAIN POPULATION -- INTERIOR CANADA AND TRISTATE SUBPOPULATIONS



INTERIOR CANADA SUBPOPULATION OF TRUMPETER SWANS -- STATUS 1992

Gerard W. Beyersbergen and Len J.Shandruk, Canadian Wildlife Service, 4999-98 Ave., Edmonton, AB T6B 2X3

ABSTRACT

In 1992, the Interior Canada Subpopulation of Trumpeter Swans is estimated at 1,437 individuals. This represents an increase of 22.6 percent over the 1990 population estimates. Aerial surveys, incidental observations and adjustment of 1990 data were used to provide the 1992 population estimates. Populations increased in Alberta and British Columbia, but declined in the Yukon and Northwest Territories. Saskatchewan's swan numbers increased overall with establishment of a new flock in the east central part of the Province.

INTRODUCTION

Trumpeter Swans (Cygnus buccinator) nesting in Canada, reduced to near extinction in the early 1900's, have since increased in numbers and expanded their range. Range wide surveys were conducted in 1985 (McKelvey et al. 1988) and 1990 (Shandruk 1991) in order to assess the status of the Interior Canada Subpopulation (ICSP). In 1992, surveys were conducted in selected locations of the ICSP Trumpeter Swan breeding area. This report will present the current population status in the surveyed regions as well as a projected population estimate of areas in northeastern British Columbia and the Yukon Territory, which were not surveyed. A brief history and the population status of a new flock of Trumpeter Swans, located in the Greenwater Provincial Park area of eastern Saskatchewan, will also be presented.

METHODS

Aerial surveys were flown for the Grande Prairie, Chinchaga/Whitemud River, Otter/Russell Lakes, Edson/Whitecourt, Dawson Creek and southwest Mackenzie District flocks (Figure 1). Surveys were conducted using Cessna 185 or 206 fixed-wing aircraft or a Bell 206L helicopter. During the survey, the fixed-wing aircraft was flown along a designated route at an approximate altitude of 200 m above ground level (agl) and an average speed of 200 km/h. The helicopter surveys were conducted at 150 m agl and 100 km/h. The survey crew consisted of a pilot, navigator/observer and a second observer. Each observer plotted location and number of Trumpeter Swans observed along the survey route onto maps. When swans were sighted, the pilot was requested to reduce speed and altitude in order to get an exact number of adult swans, young or eggs, dye-marking on adults and collar colour. While in the helicopter, we were also able to read the alpha/numeric code on the collar. When possible, ground crews later checked collar codes located during fixed-wing aerial surveys.

Observations at the other Alberta flock locations were made incidental to field operations by Alberta Fish and Wildlife, Alberta Forest Service and Canadian Parks Service personnel, as well as local naturalists. Saskatchewan Parks and Renewable Resources and Forestry personnel provided observation data for the Cypress Hills and Greenwater Lake Provincial Park areas.

RESULTS AND DISCUSSION

Alberta

Grande Prairie flock

After the peak of 413 in 1986, this flock (Table 1) had, except in 1988, shown a continual decline. The high winter mortality of cygnets in 1989 was evident in the area, with fewer unpaired adults observed over the following years. The number of broods increased slightly from 1990 to 1991, but cygnet numbers were low. In 1992, the

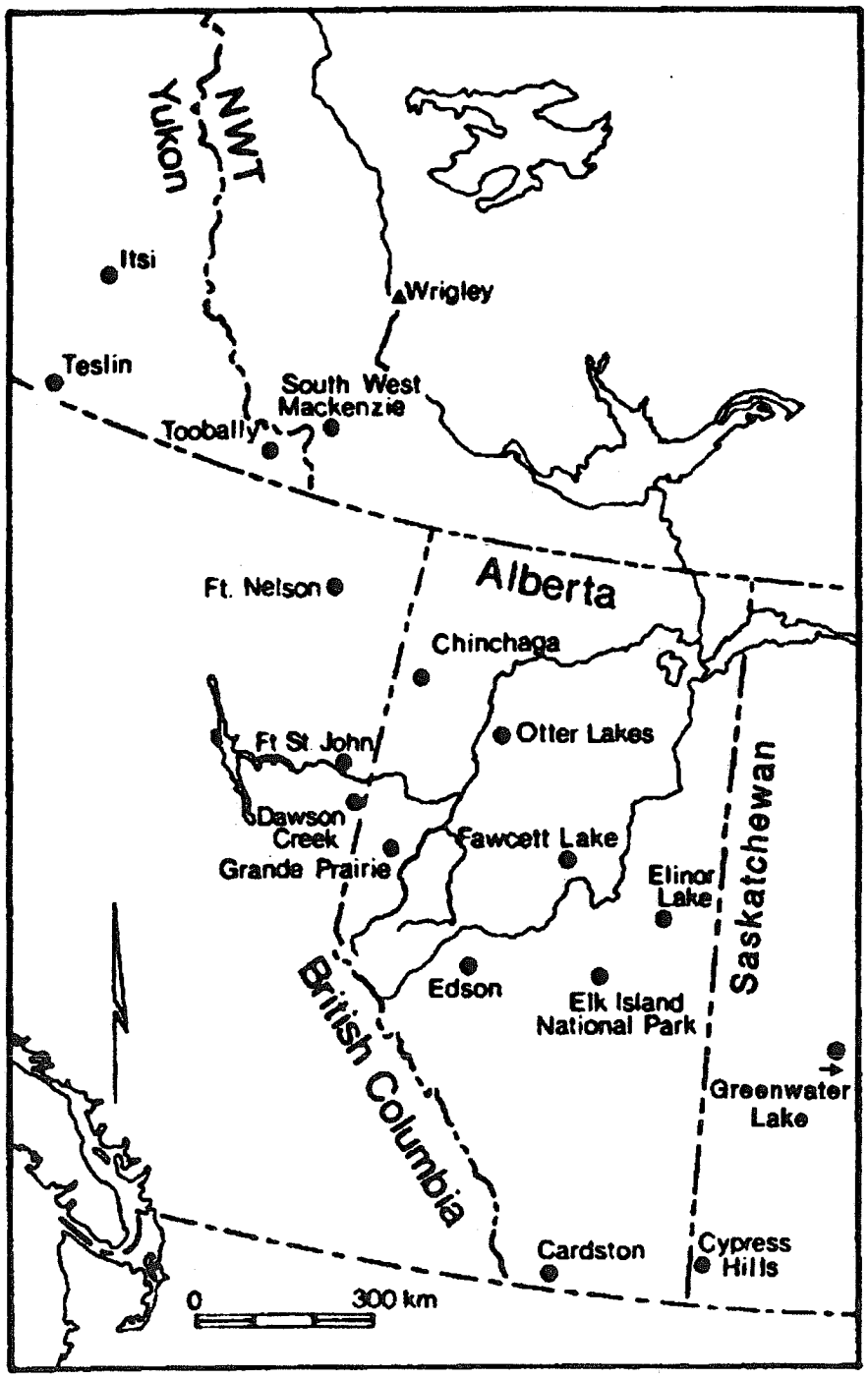


Figure 1. Map of the locations of the Trumpeter Swan flocks in the Interior Canada Subpopulation - 1992.

Table 1. Population trends for the Grande Prairie flock for the years 1985-92.

	1985	1986	1987	1988	1989	1990	1991	1992
Paired adults	100	132.	104	112	126	134	112	156
Other adults	141	157	178	177	161	99	57	92
Total adults	241	289	282	289	287	233	169	248
Cygnets	93	124	101	112	81	88	98	211
Broods	25	33	29	32	28	30	34	53
Total swans	334	413	383	401	368	321	267	459

Table 2. Population changes in the Trumpeter Swan flocks in the Peace River region of northern Alberta for the years 1985, 1990 and 1992.

	Chinchanga/Whitemud R.			Otter/Russell Lakes		
	1985	1990	1992	1985	1990	1992
Paired adults	2	28	34	4	8	8
Other adults	0	5	3	4	2	2
Total adults	2	33	37	8	10	10
Cygnets	3	25	35	3	3	7
Broods	1	6	10	2	1	2
Total swans	5	58	72	11	13	17

population showed a dramatic increase as a result of the production of 211 cygnets in 53 broods. The adult component comprised 156 paired birds and 92 birds seen as singles or in flocks.

Environmental conditions on the breeding grounds have a major effect on hatch success. Both the number of nesting attempts for the period 1990-92 (39, 50 and 62 respectively) and the number of broods (30, 34 and 53 respectively), showed yearly increases. In June of 1990, exceptional amounts of precipitation (approximately 100mm in 72 hours) and runoff resulted in the flooding of swan nests. The percent hatch success (the number of broods produced divided by the number of nesting attempts) was 76.9 percent, which is only slightly lower than the yearly mean of 77.2 percent (1987-92). However, the average brood size was only 2.93 cygnets.

In 1991, during the peak hatch period, unseasonably low temperatures combined with high winds and precipitation resulted in high mortality of newly hatched cygnets. (Author observed death by exposure of newly hatched Trumpeter Swan cygnets at the Camrose swan facility during the same period.) Hatch success was only 68.0 percent and average brood size was 2.88 cygnets.

In 1992 spring weather conditions were mild, resulting in a hatch producing the largest number of cygnets ever recorded for the area. More breeding pairs with increased brood size (3.98 cygnets) and a hatch success of 85.5 percent resulted in this highly productive breeding season.

Chinchaga/Whitemud River flock

Surveys on 8 September 1992 located 34 paired and three flocked swans (Table 2). There were 10 broods for a total of 35 cygnets. The surveys in 1985 showed a new flock being established with five swans observed (Holton and Shandruk 1987). Since the 1990 survey, there has been an increase of six paired swans. The number of broods increased by four for a

total of 10 more cygnets, but the average brood size was smaller in 1992 at 3.5 cygnets compared to 4.2 in 1990. This lower average brood size may be a result of younger pairs producing smaller broods. The total swan numbers increased by 14 to 72 in 1992.

Otter/Russell Lakes flock

Aerial surveys on 9 September 1992 (Moyles and Johnson 1992) located four pairs with seven cygnets in two broods. There were also two single birds for a total of 17 swans. Adult numbers were similar in 1990 and 1992 compared with two less in 1985. Lower cygnet production in 1985 and 1990 compared to 1992 accounts for the major differences between the survey years. These results may be caused by the area having reached its carrying capacity of pairs and totals will vary depending on the yearly cygnet production, or the wintering habitat may be limiting recruitment to this flock.

Edson/Whitecourt flock

Aerial surveys 9 September 1992 recorded 12 paired and two single adult Trumpeter Swans (Table 3). Additionally, 17 cygnets in five broods accounted for the total of 31 swans (Kirby Smith, pers. comm.). Similar adult totals were observed in all survey years. Variable average brood size (4.0, 1.7 and 3.4 for 1985, 1990 and 1992 respectively) and variable numbers of broods account for the difference. This flock may have used all available high quality habitat and population totals should vary according to yearly cygnet production.

Other Alberta flocks

The Cardston/Pincher Creek flock, located in southwest Alberta, experienced poor production in 1992 with six pairs of swans producing one cygnet in total. The adult population increased from six to 11 to 12 in the years 1985, 1990 and 1992 respectively. The decline in the flock in 1992, to 13 from the 1990 total of 20, was a result of fewer cygnets in 1992. (No cygnets were observed during the surveys in 1985.)

The Elinor Lake flock, located in northeastern Alberta, was not intensely surveyed in 1992, therefore birds may have been missed. In 1990, we had eight adults and six cygnets in the area, but in 1992 only one pair with no young was observed. Fawcett Lake had one pair with three cygnets in 1990, but no birds were observed in 1992. Swans were not observed in 1985 in either Elinor or Fawcett Lake.

The Elk Island National Park transplant flock had five adults return to the area in 1992. Similar numbers of adults were observed in 1990 (Kaye and Shandruk 1990). The only production for this flock occurred in 1990 with the observation of two cygnets. Six yearlings overwintered at the Camrose swan facility and were released into the park in April 1992. Predation by coyotes on two of the yearlings, brings the population total to nine adult swans. This flock will continue to grow depending on breeding and transplant successes and winter survival of the swans.

Winter survival is a key point. The Elk Island birds, in the winter of 1991-92, were observed around Rexburg and south to Fort Hall, Idaho, and in the Flathead Valley north of Missoula, Montana. In January 1993, five Elk Island swans were observed wintering on Harney Lake near Malheur National Wildlife Refuge in south central Oregon. These observations confirm that a new wintering area has been established by the Elk Island National Park transplanted swans. This use of existing wintering habitat away from the traditional but critical Tristate area, and the pioneering of new wintering areas could improve the winter survival of the Elk Island swan population.

Saskatchewan

Cypress Hills Provincial Park flock

The Cypress Hills flock attained a population high in 1972 (Nieman and Isbister 1974) of six adults and 10 cygnets. This population has since experienced a steady decline (Table 4) with four adults and two cygnets present in 1985, two adults and one cygnet present in 1990 and one adult swan in 1992. Limited habitat and high cygnet mortality are believed

Table 3. Population trends for the Edson/Whitecourt flock in Alberta for the years 1985, 1990 and 1992.

	1985	1990	1992
Paired adults	14	14	12
Other adults	1	0	2
Total adults	15	14	14
Cygnets	8	12	17
Broods	2	7	5
Total swans	23	26	31

Table 4. Population changes in the Saskatchewan Trumpeter Swan flocks during the survey years 1985, 1990 and 1992.

	Cypress Hills			Greenwater Lake		
	1985	1990	1992	1985*	1990	1992
Paired adults	2	2	0	-	2	6
Other adults	2	0	1	-	0	1
Total adults	4	2	1	-	2	7
Cygnets	2	1	0	-	0	7
Broods	1	1	0	-	0	2
Total swans	6	3	1	-	2	14

*Surveys not conducted this year; Trumpeter Swans were first observed in 1988.

to be preventing flock increase (Mitchell and Shandruk 1992). We expect this flock to be extirpated with the death of the lone adult.

Greenwater Provincial Park flock

In 1988, a Trumpeter Swan was first observed in the area by local naturalist, Donald Hooper. In 1990, a pair without young was seen by Saskatchewan Parks and Renewable Resources (SPRR) personnel during fire patrols by helicopter. A pair, which failed at their nesting attempt, was banded and collared in 1991 and observed that winter at Lacreek National Wildlife Refuge (Shandruk et al., 1992). Two pairs with broods totalling seven cygnets plus the three other adults made a flock total, in 1992, of 14 Trumpeter Swans (pers. comm. Rhys Beaulieu, SPRR). This flock should continue to increase if conditions on the wintering and breeding areas are as favourable as those observed in the other flocks.

Northwest Territories (NWT)

Southwest Mackenzie District flock

This flock increased from 44 adults and 24 cygnets in 1985 to 117 adults and 65 cygnets in 1990. However, the 1992 survey results (Table 5) showed a decline of 16.2 percent in adults and 36.9 percent in cygnets from 1990. A very cold, wet spring could account for the poor cygnet production. There were five less broods observed in 1992, and the average brood size was 2.9 cygnets, compared to 3.4 in 1990. The total of 139 swans in 1992, represents a decrease from 1990, but is still above the mean population size of 124 recorded between 1986 and 1989 (Shandruk and McCormick 1990).

Table 5. Population changes in the Trumpeter Swan flock of the southwest Mackenzie District, Northwest Territories during the years 1985, 1990 and 1992.

	1985	1990	1992
Paired adults	34	84	80
Other adults	10	33	18
Total adults	44	117	98
Cygnets	24	65	41
Broods	7	19	14
Total swans	68	182	139

This population will probably fluctuate on a yearly basis depending on cygnet production and the effects of wintering area mortality. Collar observations in California and Nevada indicate that this flock has been pioneering new wintering habitat and may be subject to higher levels of wintering mortality due to hunting seasons for Tundra Swans (Cygnus columbianus) in parts of these wintering areas.

British Columbia

Dawson Creek flock

Surveys conducted in 1985 provided incomplete coverage, but were expanded in 1986 to address the total breeding range. In 1986, the flock consisted of 31 adults and 24 cygnets. This number increased in 1990 to 46 adults and 21 cygnets. Population figures in 1992 (Table 6), based on spring survey results, showed an increase of one pair and 17 unpaired adults over 1990. Seven broods more in 1992, averaging 4.1 cygnets per brood, added to the increased population size. The low number of broods in 1990 may be a result of the same environmental factors which affected the Grande Prairie population.

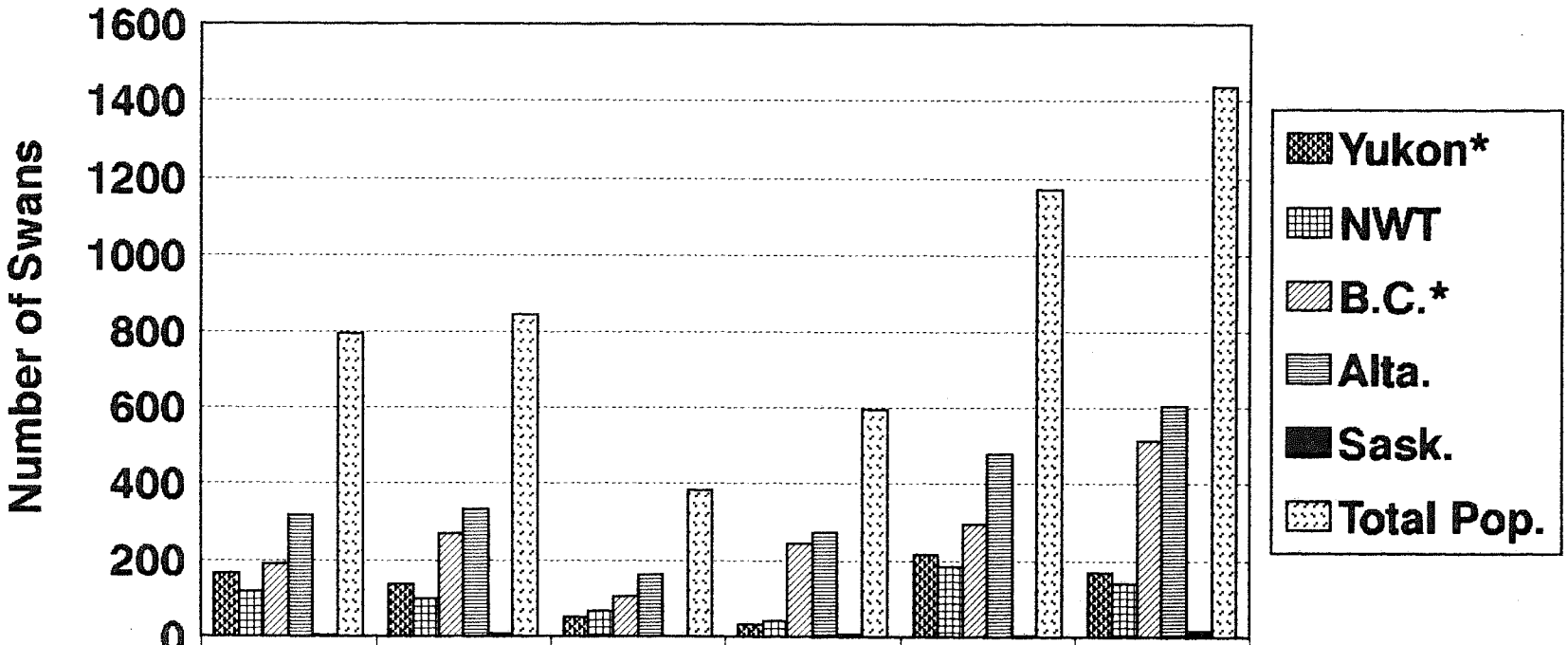
INTERIOR CANADA SUBPOPULATION 1992 ESTIMATE

The Subpopulation (Figure 2) is growing overall from the 1990 estimates. The estimated population for the ICSP in 1992, would be 844 adults and 593 cygnets, for a total of 1,437 Trumpeter Swans. This figure represents a 22.6 percent increase over the 1990 population estimates. However, we still have not accounted for 500 or more Canadian Trumpeter Swans observed on the wintering areas. The Alberta flocks, which represent

Table 6. Population changes in the Dawson Creek, British Columbia, Trumpeter Swan flock for the years 1986, 1990 and 1992.

	1986*	1990	1992**
Paired adults	16	40	42
Other adults	15	6	23
Total adults	31	46	65
Cygnets	24	21	49
Broods	8	5	12
Total swans	55	67	114

* Lakes surveyed in 1986 more compatible with later surveys.
** Data from spring surveys used in 1992 (incomplete fall surveys).



	Ad90	Ad92	Cyg90	Cyg92	Tot90**	Tot92**
Yukon*	164	137	51	32	215	169
NWT	117	98	65	41	182	139
B.C.*	191	269	104	242	295	511
Alta.	317	332	160	271	477	603
Sask.	2	8	1	7	3	15
Total Pop.	791	844	381	593	1172	1437

* Estimated population from 1990 ** Total cygnets & adults for the year

Figure 2. Interior Canada Trumpeter Swan Subpopulation estimates and changes for 1990 and 1992.

42.0 percent of the Subpopulation, increased by 15 adults and 111 cygnets. Saskatchewan birds, 1.0 percent of the Subpopulation, increased by six adults and six cygnets. The 1990 data for Ft. St. John and Ft. Nelson, adjusted by the percent increase in the 1992 Dawson Creek flock was combined with the Dawson Creek figures to give us the population estimate for British Columbia. There was an increase of 78 adults and 138 cygnets. The British Columbia flocks represent 35.6 percent of the Subpopulation. The NWT population suffered a decline of 19 adults and 24 cygnets. The Yukon population, if it experienced similar decreases as the NWT flock, would result in a decline of 27 adults and 19 cygnets. The NWT and Yukon flocks represent 9.7 percent and 11.8 percent of the Subpopulation, respectively.

CONCLUSION

The Interior Canada Subpopulation, which has experienced yearly growth, should continue this process. The rate of growth will be governed by quality habitat availability and environmental conditions on their wintering and breeding grounds. If the winter transplant program in the Tristate area is successful, it should result in the establishment of more favourable wintering areas. This, in turn, should result in higher winter survival and better recruitment on the breeding grounds of the Canadian Trumpeter Swan.

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OVERVIEW OF EFFORTS TO EXPAND THE RANGE OF THE ROCKY MOUNTAIN POPULATION OF TRUMPETER SWANS

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ABSTRACT

Trumpeter Swans (Cygnus buccinator) of the Rocky Mountain Population (RMP) were near extinction in 1900, but increased to ±2200 by 1992. The foremost problem currently facing the RMP is its diminished winter distribution and resulting vulnerability. Since 1990, the U. S. Fish and Wildlife Service (USFWS) has led the implementation of range expansion efforts developed and approved by the Pacific Flyway Council. Objectives include creating new wintering areas, reducing swan numbers at Harriman State Park (HSP), Idaho, to prevent additional habitat damage and lessen mortality potential and terminating artificial winter feeding at Red Rock Lakes National Wildlife Refuge (RRLNWR), Montana. Although much progress has been made, these objectives have not yet been achieved. Accomplishments to date include: development of capture techniques and transplanting 962 swans, positive new swan behavior patterns at several new wintering sites, beginning use of new migration routes, reduction of swan numbers at RRLNWR and HSP, improvement of aquatic vegetation at HSP, avoidance of high winter mortality and success of initial steps to terminate artificial feeding at RRLNWR. Continued effort is needed to sustain this progress and achieve objectives. Inadequate security from human disturbance is reducing the ability of Trumpeter Swans to adapt to new habitats, particularly on the Snake River in southwestern Idaho. Creative actions to provide adequate security at release sites and along migration routes are essential for success of range expansion efforts. Techniques used in other flyways to enhance waterfowl hunting through creation of security sites could be used to allow RMP Trumpeter Swans to successfully pioneer new areas while minimizing impacts to recreational activity.

HISTORY

By 1900, Trumpeter Swans had been eliminated from most of their historic range across the United States and Canada. Traditional migration patterns to southerly wintering areas ranging from Chesapeake Bay (Maryland), to the Sacramento Delta (California), were also eliminated. Outside of Alaska, the last surviving flocks wintered near remote warm springs in the Tristate Region of Montana, Wyoming and Idaho, in and near Yellowstone National Park. By 1933, this remnant population contained only about 70 year-round residents and a similar number which migrated to breeding areas in western Canada. These were the ancestors of the resident Tristate flocks and migratory Canadian flocks, which today comprise the RMP (Gale et al. 1987).

Through six decades of habitat protection, reduction in illegal shooting, and artificial winter feeding, the RMP increased to ±2,200 by 1992 (Niethammer 1992a). Although numbers have begun to recover, migrations to other wintering areas remain severed. Currently over 90 percent of the population winters in the harsh Yellowstone region. In summer, the RMP disperses; ±500 swans remain year-round and ±1,700 swans migrate to breeding habitats in Alberta, British Columbia, Yukon, Northwest Territories and Saskatchewan. Since the mid-1970s Tristate

flocks have been relatively stable, while Canadian flocks have grown from ±190 to ±1,700 (Subcommittee on Rocky Mountain Trumpeter Swans 1992).

Due to a lack of natural winter habitat, artificial feeding was initiated at RRLNWR in 1935 to sustain its resident flock. In recent years the growing Canadian flocks have increasingly concentrated at RRLNWR and HSP, 20 miles to the southeast on the Henrys Fork of the Snake River, Idaho, below Island Park Dam. At HSP, sanctuary from waterfowl hunting and lush beds of aquatic plants attract swans and other waterfowl when the river remains ice-free. The aquatic plants also slow and deepen water releases from Island Park Dam, creating habitat for a world famous trout fishery. When water releases are low, extensive ice covers much of the river (Subcommittee on Rocky Mountain Trumpeter Swans 1992).

The foremost problem facing the RMP is its diminished winter distribution and resulting vulnerability to severe winter conditions, overuse of limited habitat, overcrowding on winter habitat and potential for disease. These risks increase as winter numbers in the Tristate Region increase, particularly in eastern Idaho (Subcommittee on Rocky Mountain Trumpeter Swans 1992). In winter 1988-89, low water flows, thick ice and a blizzard resulted in the deaths of about 100 swans near HSP. Emergency flows were increased from Island Park Dam to melt ice and save hundreds of swans that were too weak to disperse (Gale 1989).

In April 1989, the Idaho Chapter of the Wildlife Society petitioned the USFWS to list the RMP as threatened. In winter 1989-90, while the petition was under review, 55 percent of the RMP wintered at RRLNWR and HSP; record numbers of swans and other waterfowl gathered at HSP. By late winter, the vegetation at HSP was virtually gone and >800 swans crowded into the RRLNWR feeding ponds. Regrowth of the aquatic plants was only 25 percent of normal by October 1990 (Vinson 1991). Habitat quality at HSP for both waterfowl and fish abruptly declined, and the potential for further mortality of swans at HSP increased (Shea 1992a).

The USFWS recognized the serious problems facing the RMP, but ruled in April 1990 that listing was not warranted because management efforts currently underway were capable of solving the problems. USFWS specifically cited 1) its commitment to purchase water to maintain adequate flows from Island Park Dam for swans, and 2) its commitment to increasing efforts to expand the RMP's winter distribution. USFWS also recognized that range expansion is a long-term process. The rationale of the ruling was that adequate flows would maintain secure feeding areas at HSP, thus alleviating the major threat to the population. This would provide USFWS with the necessary time to expand the population's winter distribution in order to provide adequate security (Federal Register, 26 April 1990). Management actions to prevent the need for listing are preferable to managing a listed population for recovery.

It soon became apparent, however, that without adequate vegetation at HSP, purchase of additional water could not create secure habitat. The USFWS, therefore, shifted its efforts to accelerate winter range expansion and to prevent waterfowl from causing further damage to vegetation and fish habitat at HSP (Shea 1991).

The Pacific Flyway Council approved a range expansion project in March 1988. In 1990, USFWS took the lead in funding and implementing this project. USFWS contracted with the Wildlife Research Institute, University of Idaho, to develop and implement a capture and translocation program (Drewien et al. 1992). USFWS also hired a biologist to identify and evaluate potential winter habitats and monitor range expansion efforts. Recognizing that successful range expansion requires a long-term commitment by the USFWS, Canadian Wildlife Service, states and provinces, the Pacific Flyway Council adopted a revised management plan for RMP Trumpeter Swans in July 1992 (Subcommittee on Rocky Mountain Trumpeter Swans 1992).

GOAL

The goal of the management plan is "to restore Rocky Mountain Trumpeters as a secure and primarily migratory population, sustained by

naturally occurring food sources in diverse breeding and wintering sites" (Subcommittee on Rocky Mountain Trumpeter Swans 1992).

Key strategies include:

1. dispersing the population to at least four new wintering areas, that winter at least 700 Trumpeters;

2. reducing the concentration of swans at HSP in order to lessen the potential for high winter mortality and further damage to aquatic vegetation; and

3. terminating artificial feeding at RRLNWR primarily to stop baiting migratory Canadian Trumpeter Swans into the area.

The management plan also recognized the high value of the fishery at HSP and stressed the need to keep waterfowl numbers at levels that would allow recovery of the vegetation and restoration of a once world-class fishery (Subcommittee on Rocky Mountain Trumpeter Swans 1992).

ACCOMPLISHMENTS

Significant progress has been made to resolve the problems facing the RMP. Major accomplishments include the following.

1. Since 1988, 962 Trumpeters Swans (768 in winter, 194 in summer) have been transplanted from HSP and RRLNWR to sites in southern Idaho (557), Oregon (253), Wyoming (103) and Utah (49). Although difficult and labor intensive, winter capture and transplant methods have been well developed. Including resident swans that were marked and released at RRLNWR, over 1,070 swans have been neck banded and monitored to evaluate distribution, movements, survival and response to management actions (Drewien and Clegg 1992, 1993; Drewien et al. 1992; Niethammer 1992b; Shea 1991, 1992). Efforts by the Canadian Wildlife Service to resight marked swans as they return to Canada and monitor the impacts of winter management actions on the Canadian breeding flocks are key aspects of the monitoring program.

2. Transplants to 1) Summer Lake, OR, 2) Fort Hall Indian Reservation, ID, and 3) Grays Lake NWR, ID/ Salt River, WY, show indications of success in the near future. Summer Lake, Grays Lake and Fort Hall show good potential for establishing new breeding flocks. Summer Lake also shows promise for wintering a resident flock, and slight progress toward wintering migrant Trumpeters. Salt River is receiving recurrent use by ±60 wintering Trumpeters, particularly swans that summer at Grays Lake NWR, but also some Canadian migrants. Fort Hall shows the best progress toward recurrent winter use by ±60 migrant Trumpeters, as well as by a small resident flock that could gradually pioneer into southeastern Idaho. Salt River and Fort Hall will succeed if these pioneers return with their offspring in future years.

In addition, efforts by the Canadian Wildlife Service to create a new flock at Elk Island National Park, Alberta, (Kaye and Shandruk 1992) have begun to create new migration patterns to both southeastern Idaho and eastern Oregon.

3. Some transplanted swans have shown positive new behaviors including: use of new migration routes to Canada and return to release sites; movements between release sites; summering in the vicinity of release sites; nesting at Grays Lake; attempted nesting at Fort Hall; leading cygnets and unmarked adults to new wintering areas and exploration of various winter habitats in Arizona, California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington and Wyoming.

4. Wintering swan numbers at RRLNWR and HSP have been temporarily reduced by >85 percent through a combination of terminating artificial feeding, translocations and high levels of disturbance. By 23 December 1992, after trapping ended, only 123 swans remained at HSP and two at RRLNWR. In comparison, these two areas combined held approximately 1,100 swans on 22 December 1989 before trapping and hazing efforts began. In addition, many ducks and Canada Geese (Branta canadensis) vacated both areas when disturbance increased.

5. High mortality has been avoided at HSP since 1989, despite the decline in vegetation and return of high numbers of swans. Dispersal of swans from HSP, coupled with three relatively mild winters, has avoided a recurrence of the high mortality observed in winter 1988-89.

6. Despite continued low water flows, aquatic vegetation at HSP increased in percent cover, plant height and species diversity after two winters of reduced waterfowl use. Most significantly, the pooling effect from increased plant biomass decreased water velocities and increased depths, thus improving habitat conditions both for fish and waterfowl, and for the further recovery of aquatic plants. The pattern of recovery is irregular. Slow-moving, silty areas which continue to receive heavy use by swans and other waterfowl have shown less recovery than deeper or swifter, rocky areas.

7. Initial attempts to terminate artificial feeding at RRLNWR appear successful. Drawdown of two winter feeding ponds plus hazing moved all swans off the Refuge in winter 1992-93. Resident swans appear to be wintering with little known mortality.

REMAINING CHALLENGES

Important steps to increase population security, expand winter distribution, and restore habitat at HSP have been implemented. Several challenges remain and must be resolved, however, before the goal of the management plan can be accomplished.

1. Use of alternate wintering areas outside the Tristate Region has not yet been successfully established. Human disturbance, primarily waterfowl hunting, powerboating and miscellaneous recreation, is limiting use of new sites, particularly on the Snake River in southwestern Idaho. Increased efforts are needed to create adequate security in alternate habitats.

For range expansion to succeed, hundreds of swans must become established at suitable wintering sites outside the Tristate Region. To successfully adapt to new habitats, these birds need to "settle in" to the area, establish new patterns of habitat use, and lead their young to those areas in subsequent years.

Two sites adjacent to the core Tristate Region, Fort Hall and Salt River, show promising trends toward success. Transplants to Summer Lake and Green River, Wyoming, are too recent to yet evaluate. Transplants to Fish Springs NWR, Utah, were halted due to mortality from parasitic infection during winter 1991-92. Transplants to the Snake River at Bruneau Dunes State Park, Idaho, have done poorly and will likely fail unless action is taken to increase security.

The 100 miles of Snake River between Twin Falls and Grandview, Idaho, offer some of the best potential winter swan habitat in the Intermountain West. The Bruneau Dunes State Park release site lies near the western end of this stretch of river. Located in the center of the potential range expansion area, the Snake River provides abundant aquatic vegetation and does not freeze. It will be very difficult to disperse hundreds of Trumpeter Swans entirely out of the Tristate Region unless a major wintering site for migrant swans can be established on this portion of the Snake River.

During the past three winters, 251 swans were released at Bruneau Dunes. Approximately 15 non-migrating swans of RRLNWR origin have remained in the release site vicinity, but only seven known Canadian migrants returned in winter 1992-93. Lack of any sites with adequate security during mid-November through early January is preventing Trumpeter Swans from successfully using the area.

Pioneering swans also need adequate security from disturbance and shooting mortality to establish new migration routes and wintering areas. Swans dispersing from HSP need adequate security along the Henrys Fork to encourage their continued southward movement. As range expansion proceeds at Fort Hall, Salt River and Green River, increasing numbers of Trumpeters are migrating into Utah. Increased security will be needed to enhance this migration.

2. We lack a practical long-term method to prevent wintering waterfowl from causing

recurrent damage to the vegetation and fish habitat at HSP.

Disturbance from trapping and hazing within the park has reduced waterfowl use at HSP during the past three winters. However, hunting pressure outside the park quickly pushes geese and swans back in when disturbance ceases. So far, hazing by ultralight aircraft shows the most promise, but the long-term practicality of this method is doubtful. Other methods must be tested and their costs and benefits analyzed. Swans might be easier to disperse from HSP if they and other waterfowl were permitted to consume and exhaust the aquatic vegetation; however, impacts to the fishery would likely be unacceptable. In order to manage for a healthy aquatic plant community and fishery at HSP, the relationships between waterfowl grazing, low water flows, ice formation, heavy silt deposits, and fish habitat require increased attention. What cost and effort should be expended to recover the vegetation and fishery? Whose responsibility should this be? The current costs of annual trapping and hazing cannot be sustained indefinitely by the USFWS. Other strategies must be developed.

3. As artificial feeding is terminated, survival of a viable breeding flock at RRLNWR requires that swans successfully return to the Refuge from suitable new wintering sites.

Most RRLNWR swans appear to be surviving this relatively mild winter of 1992-93 at sites within a 50 mile radius, primarily within Island Park and the Madison River drainage of Montana. These high elevation sites are also receiving increased use by Canadian swans due to their displacement from both RRLNWR and HSP. For long-term survival, RRLNWR swans must successfully pioneer to lower elevation sites that will not freeze during a severe winter and return to RRLNWR for the summer.

CONCLUSIONS

1. Efforts to achieve successful range expansion are at a crossroads. Much has been accomplished. To sustain these accomplishments and achieve the objectives, continued efforts are necessary. Success will require increased efforts to help pioneering swans adapt to new areas and development of long-term methods to disperse waterfowl and protect habitat at HSP.

Efforts will not succeed unless hundreds of Trumpeter Swans adapt to new areas and return with their young in subsequent winters. Trumpeter Swans are very sensitive to human disturbance and vulnerable to shooting. Unless steps are taken to create adequate security for transplanted swans, particularly at the more distant release sites, the strategy of translocations to create significant wintering areas outside the Tristate Region has minimal chance of success. New strategies to recover a secure RMP will be necessary. If adequate security can be created, such as exists on the Fort Hall Indian Reservation, new wintering sites can be established.

The current fall and winter distribution of the RMP is primarily shaped by avoidance of human disturbance. This reality poses a challenge to wildlife managers. Can we restore RMP Trumpeter Swans while minimizing impacts on conflicting recreational activities, including waterfowl hunting? The impacts of human disturbance on migratory and wintering waterfowl have been recognized in other flyways (Dahlgren 1988, Havera et al. 1992). We cannot ignore this question and still succeed in restoring the RMP to a secure distribution. We believe solutions are possible.

2. Solutions will require creative actions by wildlife management agencies to increase security for pioneering Trumpeters. This is not an issue with a simple "hunt or don't hunt" answer. In other flyways, strategically located security sites have been created as a management tool to enhance hunting. Modifications in the timing or location of hunting at specific sites could significantly increase security. Public education could help reduce disturbance. Occasional site-specific closures to hunting might be the best solution in some circumstances. Hunting of other waterfowl species, as a tool to push swans out of undesirable sites, might be the best solution at other locations. Once the pioneering swans have become established at new sites, less security from human disturbance will likely be adequate. We will need to experiment.

Increased security on the Henrys Fork between Ashton and St. Anthony, Idaho, for example, would help swans moving southward from HSP become established at lower elevations. On a ±10 mile stretch of river, merely scheduling a shortened hunting season, from early October to 15 November would likely be adequate. After 15 November, a lack of disturbance in this area will likely reduce the number of swans that currently return to HSP.

Successful establishment of wintering Trumpeters along the lower Snake River will also require creation of at least one site with adequate security, somewhere between Twin Falls and Grandview, Idaho. Transplanted swans would be released within this security area. Powerboating complicates the situation; experimentation will be necessary. Here again, an abbreviated hunting season during October would have no impact on Trumpeter Swan range expansion. On no more than 10 miles of river, ending the season by 1 November would likely create adequate security. A smaller area might be sufficient if powerboats can be effectively managed, or if adjacent secure off-river habitat is available. If properly designed, this security area should enhance opportunity for nearby field hunting of ducks and geese.

Similar modifications of recreational activities may be helpful to improve success at other release sites or to protect pioneering Trumpeters as they attempt to migrate into Utah.

3. Trumpeters that remain at high elevation wintering sites in eastern Idaho will continue to be at risk. As the Canadian flocks increase and swans are displaced from HSP and RRLNWR, marginal sites in eastern Idaho are receiving increasing use. Range expansion efforts can delay, but not prevent substantial mortality at these high elevation sites during a severe winter. The future security of the RMP and the continued growth of the Canadian flocks will depend on adequate numbers of swans surviving at lower elevation sites during severe winters.

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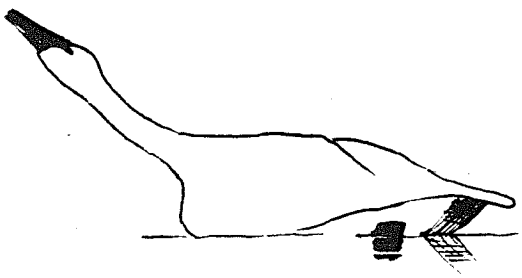

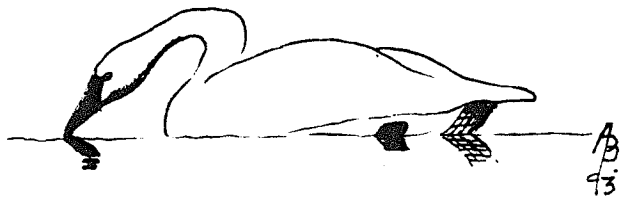

TERMINATION OF WINTER FEEDING OF TRUMPETER SWANS AT RED ROCK LAKES NATIONAL WILDLIFE REFUGE - A PROGRESS REPORT

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ABSTRACT

Artificial winter feeding of Trumpeter Swans at Red Rock Lakes National Wildlife Refuge (RRLNWR) has attracted increasing numbers of swans into inadequate habitat and reduced the effectiveness of winter range expansion projects. During the winter of 1992-93, Refuge staff initiated actions to terminate the feeding program, disperse swans to natural winter habitat, and restructure the Centennial Valley flock so that summer residents migrate out of the valley to suitable wintering sites. Success of our efforts will be determined by two factors: 1) our ability to disperse swans to natural winter habitat while 2) maintaining a summer breeding population of a minimum of 38 nesting pairs within the Centennial Valley/RRLNWR area. The effort required to disperse swans from the feed ponds was less than anticipated. Spring surveys and collar sightings will determine how many of the dispersed Centennial Valley swans return.

INTRODUCTION

By the early 1990's, Trumpeter Swans (Cygnus buccinator) had been eradicated from most of their historic range in North America. In 1935, RRLNWR was established to protect a small remnant population of swans in the Greater Yellowstone Region.

Upon the creation of the Refuge, all open water within the Centennial Valley iced over during winter, except portions of two spring heads on the eastern side of the Refuge. In severe weather, only about 0.2 hectare of water remained open (USFWS 1935-36). Early Refuge managers decided to supplement the insufficient natural foods by providing grain for the swans. By providing grain during the winter, managers hoped to minimize migration to wintering sites in eastern Idaho where mortality from illegal shooting was feared (Banko 1960). Artificial winter feeding began in 1935. Since then, the amount of water that remains open during the winter has been increased by damming up the flow from the two springs. Culver Pond (10.9 hectares) was formed at Culver Springs and MacDonald Pond (4.9 hectares) at Elk Springs. Only about 2.5 hectares of each pond remain open during the winter.

Through habitat protection in the United States and Canada, protection from illegal shooting and artificial winter feeding at RRLNWR, the Rocky Mountain Population (RMP) recovered from less than 200 swans in the early 1930's to about 2200 in 1992 (Niethammer 1992). Over 90 percent of the population currently winters in the Tristate area of Montana, Idaho and Wyoming.

Artificial feeding and protection from disturbance now attracts increasing numbers of swans into inadequate habitat. The continued growth of the Canadian flocks and the security of the Tristate flock is at risk if increasing numbers of swans continue to attempt to winter in this limited habitat.

The current restricted winter distribution and increasing reliance on winter feeding at RRLNWR subjects the RMP to increasing disease risk by crowding swans into confined areas. It also jeopardizes the health of aquatic vegetation and fish habitat at Harriman State Park and other areas where swans have exceeded the winter carrying capacity of the habitat. Present conditions also limit restoration of this population to its historical range by discouraging dispersal of wintering swans.

Swan managers recognized some of the detrimental effects of the Refuge's winter swan feeding program many years ago. During the winter 1969-70, Refuge staff attempted to terminate swan feeding (USFWS 1970). Their abortive attempt consisted of one action: withholding grain. Even without the supply of grain, swans remained at the feed ponds. After swans failed to leave and their condition began to deteriorate, Refuge staff resumed feeding.

The revised RMP Trumpeter Swan Management Plan (Subcommittee on Rocky Mountain Trumpeter Swans 1992) directs aggressive actions to broaden RMP distribution. The goal of RMP management is to restore the Rocky Mountain Trumpeters as a secure and primarily migratory population, sustained by naturally occurring food sources in diverse historical breeding and wintering sites.

Terminating the artificial feeding of Trumpeter Swans at RRLNWR is a major objective of the RMP Management Plan. The Centennial Valley flock would be restructured so that summer residents migrate out of the valley to suitable wintering sites.

If the RMP/Canadian flocks continue to grow, the numerical importance of the Tristate flocks to the entire population will continue to decrease. The need for RRLNWR to provide swans for restoration efforts has declined as swans have become available from Canadian and Alaskan flocks. However, management efforts recognize that social, historical and aesthetic values of breeding Trumpeters in the Tristate area, particularly at RRLNWR, Yellowstone and Grand Teton National Parks, likely will equal or surpass their biological importance. Management strategies will be implemented to maintain nesting Trumpeters at RRLNWR and elsewhere in the Tristate area, where they can exist on natural food sources.

METHODS

During the summer of 1992, Refuge staff prepared an environmental assessment on the proposed action of terminating winter feeding of Trumpeter Swans. The effects of our actions on a year-round resident pair of Bald Eagles (Haliaeetus leucocephalus) was addressed by means of a Section 7 consultation with the USFWS's Ecological Services Office in Helena, Montana.

The preferred alternative as addressed by the Environmental Assessment consisted of the following plan of action. Water levels in Culver and MacDonald Ponds were to be lowered during October to reduce the attractiveness of the area to wintering Trumpeter Swans. Grain feeding was to be discontinued, and if swans insist on remaining in the area they will be hazed. Hazing would consist of approaching the ponds on snow machines. (Swans will usually flush upon approach. If not, a few arm waves and yells will usually convince them to leave.) Hazing would occur during the day and night. Any swans which still failed to disperse would be captured and transported to Fort Hall Indian Reservation in Idaho, a previously used and successful release site.

In the event that some swans fail to disperse and cannot be captured, feeding will be resumed to prevent starvation. However, this measure was considered a last resort, as any feeding would attract larger numbers of Canadian migrant swans into the Refuge, thereby defeating the purpose of the dispersal effort. All reasonable efforts will be made to remove swans from the drained ponds before resuming feeding.

We collared about 60 percent (110 swans) of the Centennial Valley flock so that their response to the termination of winter feeding could be monitored. Collar sighting data will allow us to document movement and survival. These data are essential to evaluating the success of this venture.

RESULTS

Between 26 October and 4 November, we lowered the water levels at Culver and MacDonald Ponds. This action was timed to coincide with freeze up of waters in the Centennial Valley. Both ponds were lowered as much as possible; however, each pond maintained a small (about 1 hectare) pool of shallow (<0.3 m) ice-free water.

As other waters froze, swans made the traditional move to the feed ponds. In early November, as many as 190 swans were at the ponds (Figure 1). This number slowly decreased to about 60 swans. On 23 November, the remaining pockets of open water in the surrounding area froze. Swans that were using those areas moved to the feed ponds, causing a brief increase to 172 swans.

By 1 December, about 60 swans were on the Refuge. Refuge staff hazed these remaining swans for most of the first 2 days of December. Swan numbers remained at about 60, so another 2-day hazing was conducted on 15 and 16 December.

Following the second hazing, Refuge swan counts were less than 20 (Figure 1). Based upon collar sightings and family group size, these counts represented different groups.

By January 1993, all of the collared Centennial Valley swans had left the valley. After 1 January, seven of these swans returned for brief visits to the feed ponds. Only 29 of the 110 collared Centennial Valley swans were observed outside of the valley. Three were seen in Yellowstone National Park, 25 on the upper Henry's Fork and Buffalo River, Idaho, and one collared cygnet was shot near the Great Salt Lake, Utah. The remainder of the dispersed collared Centennial Valley swans had not been sighted as of 31 January 1993.

DISCUSSION

The success of our efforts to terminate winter feeding of swans at RRLNWR will be determined by two factors: 1) our ability to disperse swans to natural winter habitat while 2) maintaining a summer breeding population of a minimum of 38 nesting pairs within the Centennial Valley/RRLNWR area.

The effort required to disperse swans from the feed ponds was less than anticipated. We conducted two 2-day hazing actions which probably encouraged a few swans to leave the area. However, most of the apparent reduction in swan usage of the feed ponds and surrounding area was due to reducing the attractiveness of the area by lowering the water levels in the ponds. Contingency plans to trap or resume feeding swans that failed to disperse did not need to be initiated.

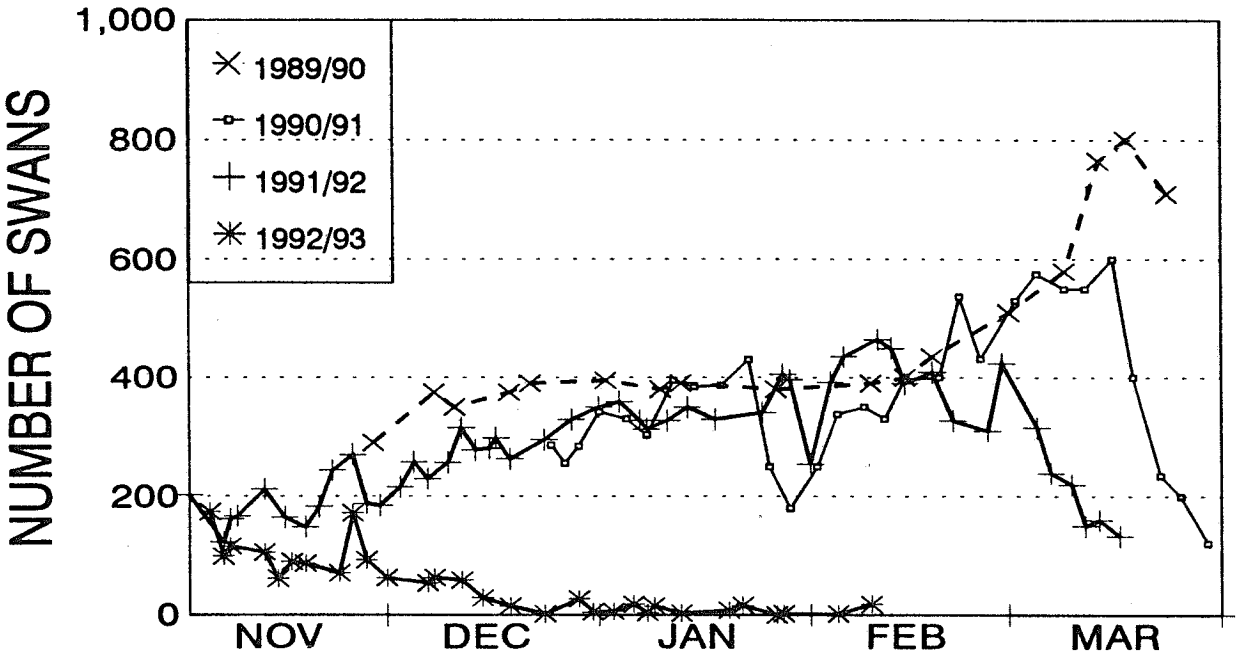

Figure 1. Counts of Trumpeter Swans wintering at Red Rock Lakes National Wildlife Refuge during the last four winters.

Efforts to monitor movements of collared Centennial Valley swans have documented locations of less than 33 percent of the collared swans that dispersed from the valley. Hopefully, more sightings will occur during the remainder of the winter.

Spring surveys and collar sightings will determine how many of the dispersed Centennial Valley swans return. If we do not achieve our goal of 38 nesting pairs and determine that natural population expansion and pioneering will not meet our goal within a reasonable time frame, the population will be augmented through translocations.

Our efforts demonstrated that we can disperse the Centennial Valley swans from the traditional winter feed ponds. Continued success of this project is dependent on providing secure and diverse wintering areas for Trumpeter Swans.

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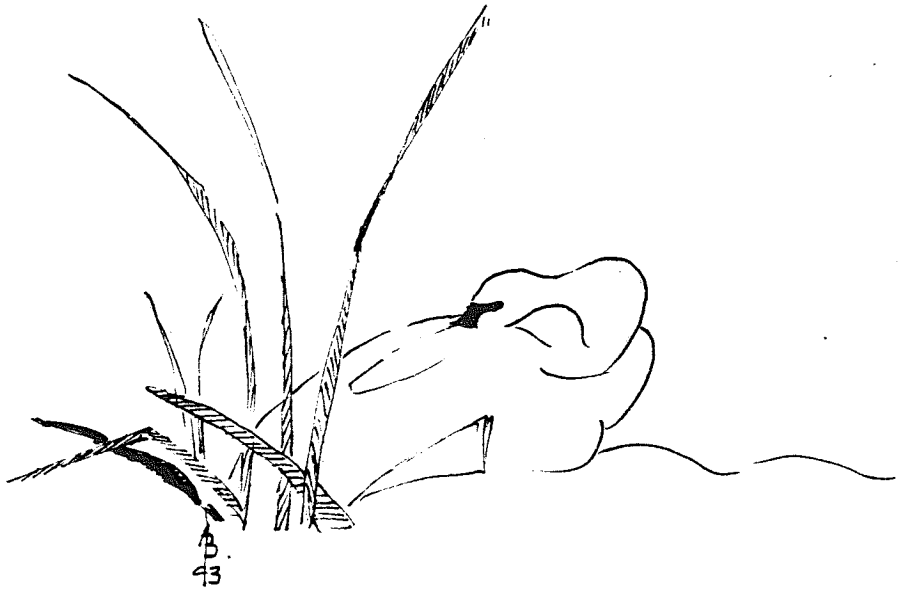

STATUS OF OREGON'S TRUMPETER SWAN PROGRAM

Martin J. St. Louis, Oregon Department of Fish and Wildlife, Summer Lake Wildlife Area, 36981 Highway 31, Summer Lake, OR 97640

INTRODUCTION

Prior to 1991, Trumpeter Swan (Cygnus buccinator) management in Oregon focused on a restoration flock found at Malheur National Wildlife Refuge (Malheur) in the southeast part of the State.

Declining Trumpeter populations at Malheur prompted the development of Oregon's Trumpeter Swan Program. This paper reports on the first year of the program, and actions undertaken in 1992.

BACKGROUND

Trumpeter Swans from Red Rock Lakes National Wildlife Refuge (RRLNWR) were introduced to Malheur beginning in 1939, and the first nesting occurred in 1958. This population increased and peaked in 1981 (Cornely et al. 1985). Drastic fluctuations in population size, breeding pairs and young fledged have occurred since then (Ivey 1990, Cornely et al. 1985). However, recently the trend has been downward and cause for concern regarding the viability of the flock (Ivey and Carey 1991).

Ivey (1990) identified the factors limiting this population to be food resources, low recruitment, mortality and water management. The impact of introduced carp (Cyprinus carpio) populations on aquatic habitat quality, coupled with ice formation during winter, drastically limits the availability of food resources. Low recruitment and mortality were directly related to the poor habitat quality, harsh weather conditions and lack of a migration tradition in the flock (Ivey 1990). Inadequate water control facilities further compounded the problem by limiting potential breeding habitat and food resources.

In 1988, a plan to enhance Oregon's Trumpeter Swan populations was developed (Ivey and Carey 1991). This plan was approved by the Pacific Flyway Council in July 1991.

A major thrust of the plan is to restore the productivity of the Malheur flock and establish other breeding populations within the State.

The goals of the plan are:

1. Enhance wintering habitat at Malheur.

2. Establish a migration tradition in the Malheur flock.

3. Establish two new breeding flocks at Summer Lake Wildlife Area (Summer Lake) and Klamath Forest National Wildlife Refuge (Figure 1) with population goals of:
    a. 25-50 breeding pairs,
    b. Population of 100-150 total swans.

Winter habitat enhancement at Malheur is to be accomplished through improvements to water management facilities and control of carp populations.

Translocation of Malheur subadults and family groups to Summer Lake is to be undertaken to teach this sedentary population migration routes to more favorable wintering locations. And, the introduction of birds from sources other than Malheur to Summer Lake and Klamath Forest NWR is to create breeding flocks at those locations.

During the development of implementation strategies, the potential for Oregon to assist in redistribution of Rocky Mountain Population (RMP) Trumpeters wintering at Harriman State Park (HSP), Idaho, was identified. (Figure 2; the RMP winters primarily in the Tristate Area, RRLNWR and HSP are part of that area.) Potential sites in south central Oregon were surveyed in early May 1991 and habitat conditions at Summer Lake were deemed suitable as a translocation site for

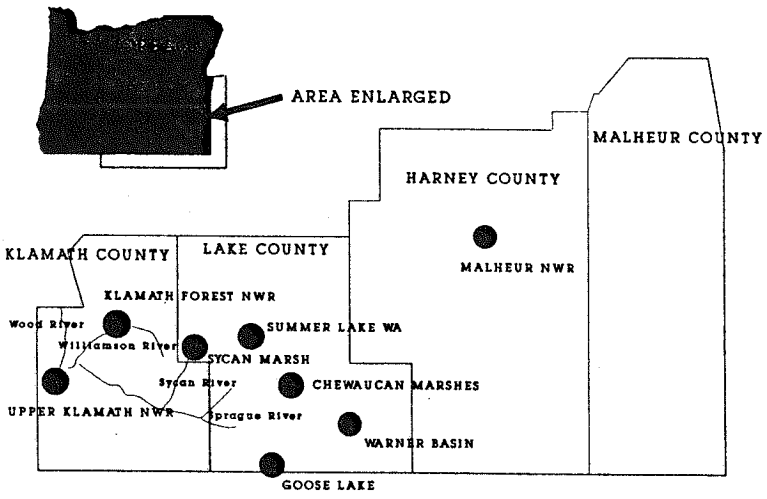

Figure 1. Potential Trumpeter Swan habitat sites near Summer Lake Wildlife Area, Oregon.

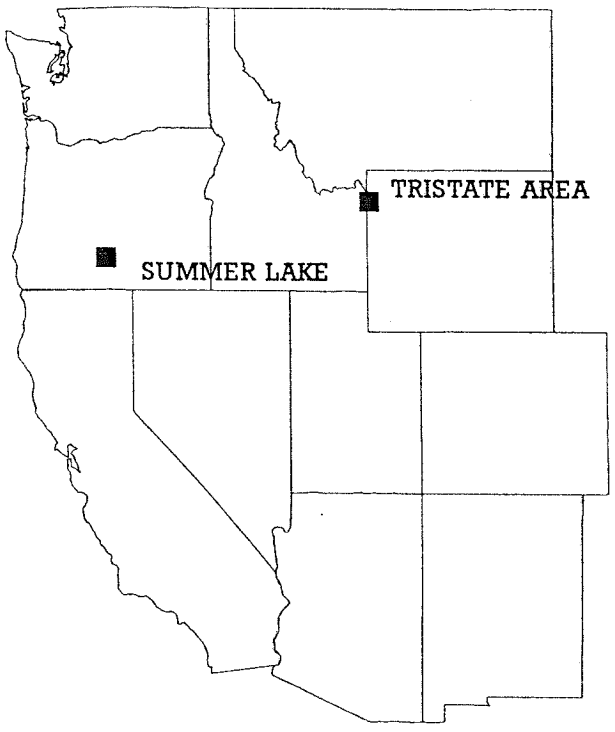

Figure 2.

redistribution of wintering Trumpeters from HSP.

Summer Lake is an 18,500 acre wetland complex owned and managed by Oregon Department of Fish and Wildlife (ODFW) in Lake County, south central Oregon. The area lies 80 miles west southwest of Malheur. Within an 80-100 mile radius, several major wetlands are located including Klamath Forest NWR, Upper Klamath NWR, the Sprague, Sycan, Williamson and Wood River systems, Sycan Marsh, Chewaucan Marshes, and the Warner Basin wetlands.

Summer Lake WA lies at the head of a large, highly alkaline playa lake and encompasses the entire Ana River system (9 miles) that is diverted to and impounded in various wetland units before entering Summer Lake. Elevation is 4,193 feet and winter climates are generally mild compared to the rest of the Great Basin.

Water supplies for the area arising from a series of springs beneath Ana Reservoir are extremely dependable and of high quality. Water emerges from the springs at a temperature of 58° F. Combined with other springs which emerge downstream from the reservoir, total flow in the system is over 150 cfs year round. During severe cold weather conditions, a minimum of 600 acres of potential waterfowl feeding sites remain ice free. Additional spring fed wetlands in the basin near Summer Lake contribute another 100 acres of critical wintering habitat.

Over half of Summer Lake is open water habitat. A myriad of ponds and impoundments exist with extremely high shoreline development and interspersion of emergent vegetation. Water levels are shallow, rarely exceeding 3 feet in depth. Submergent aquatics flourish in the carp free, alkaline environment, creating dense mats that fill the entire water column. Sago pondweed (Potamogeton pectinatus) is the most abundant species comprising over 50 percent of the biomass. Other common species include curl-leaf pondweed (P. crispus) and floating-leaf pondweed (P. natans), water buttercup (Ranunculus aquatilis), water milfoil (Myriophyllum exalbescens), coontail (Ceratophyllum demersum) and widgeon grass (Ruppia maritima).

Tundra Swan (Cygnus columbianus) use of the area during migration is high with population peaks of 2,000-3,000 occurring in late November and early March. Wintering populations range from 400-1,000 birds.

Wintering and migrant Trumpeter Swans have been documented in the area (Ivey 1990, Ivey and Carey 1991, Paullin 1987), but numbers have been small and occurrence has been infrequent.

Actions undertaken

Four molting subadults (2 males and 2 females) were captured at RRLNWR in July of 1991 and translocated to Malheur to replace birds to be moved to Summer Lake and to improve genetic diversity. Swans were captured by hand or net from airboats. All birds were collared for future identification.

Two adults (male and female) were moved from Malheur to Summer Lake in late July 1991. Both birds were captured by net from an airboat and collared for future identification.

Eight translocations totalling 100 birds captured at HSP were made at Summer Lake in early winter 1991. Swans were captured between 11 November and 12 December by night-lighting from boats (Drewien et al. 1992). All birds were collared and left wings were dyed with yellow-orange picric acid to aid in future identification. Date, sex and age composition of releases of birds captured at HSP and translocated to Summer Lake during winter 1991 is displayed in Table 1. Since it is nearly impossible to distinguish Interior Canada Subpopulation (ICSP-migratory) from Tristate Subpopulation (TSP-nonmigratory) Trumpeters, TSP swans, if translocated, may remain at Summer Lake and become breeding residents.

Table 1. Release date and age and sex of 100 Trumpeter Swans translocated to Summer Lake Wildlife Area, Oregon, Winter 1991.

	Adult		Juvenile		
Release date	Male	Female	Male	Female	Total
11 Nov.	1	3	6	4	14
14 Nov.	2	2	3	4	11
2 Dec.	8	4	2	1	15
4 Dec.	3	5	1	1	10
6 Dec.	5	4	5	4	18
7 Dec.	6	0	4	3	13
9 Dec.	2	1	2	3	8
12 Dec.	5	1	4	1	11
Total	32	20	27	21	100

RESULTS

RRLNWR subadults translocated to Malheur

Shortly after release, one female was killed, apparently by a Golden Eagle. It is suspected one male lost its collar and has not been detected since August of 1991. The other male was observed 20 miles northeast of Malheur briefly, then disappeared. One female has remained at Malheur through 1992.

Malheur adults translocated to Summer Lake WA

Both Malheur adults have remained at Summer Lake since release.

Redistribution of wintering HSP Trumpeters to Summer Lake

Winter 1991-92

Five mortalities (four or 8% of all cygnets and one or 2% of all adults) occurred during winter at or near Summer Lake. Three cygnets (6% of all cygnets) and six adults (12% of all adults) were not observed after release. One adult and one cygnet returned to the Tristate Region (TR) shortly after release (Figure 3). Another adult moved to Malheur in early winter then later returned to the TR. Three adults and two cygnets dispersed south. An adult was reported near Fallon, Nevada, within 3 weeks following release. Another adult was reported in Warner Valley (60 miles southeast of Summer Lake) where it spent the winter. One adult remained at Summer Lake for 1 month before being observed in Death Valley, California. One cygnet was observed from an aircraft on Goose Lake along the California-Oregon state line on two occasions during early winter. Another cygnet was found in an upland area 15 miles south of Summer Lake, 2 days following release. It was picked up by a passing motorist and released on a small pond. A few days later it was captured and returned to Summer Lake. Ninety-two percent of all cygnets and 79 percent of all adults were observed or accounted for (as mortalities) at or near Summer Lake through the winter. Of interest was the observation of at least nine unmarked Trumpeters that joined translocated swans at Summer Lake during the winter.

Spring 1992

Dispersal from Summer Lake began in late February and by the second week of March all but four cygnets had migrated out of the area (Figure 4). One mortality (a cygnet) was reported near Summer Lake during spring dispersal. Three northward migration paths were observed. Sixteen Trumpeters (12 adults,

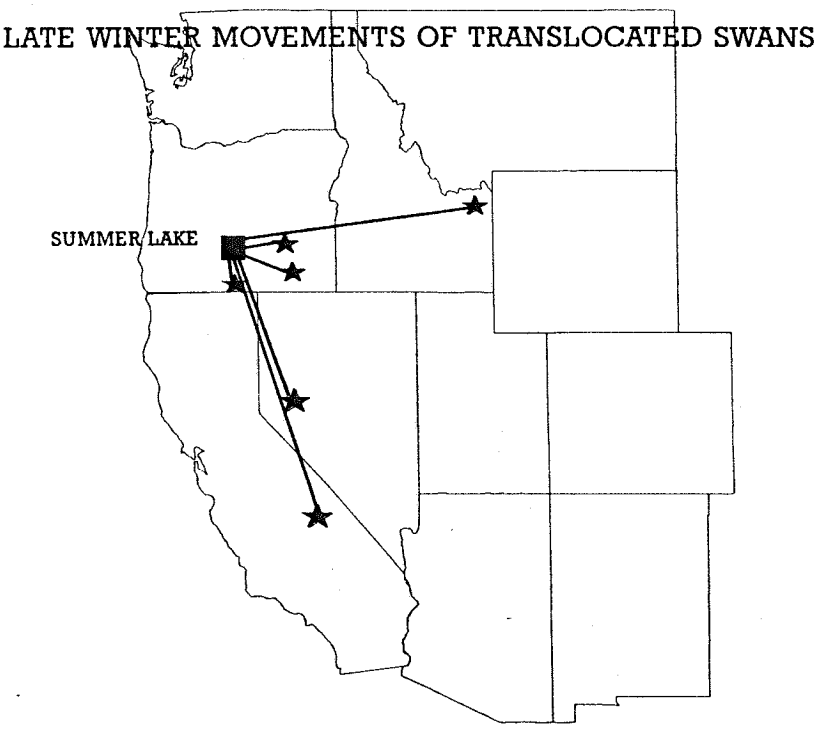

Figure 3. Late winter movements of translocated swans.

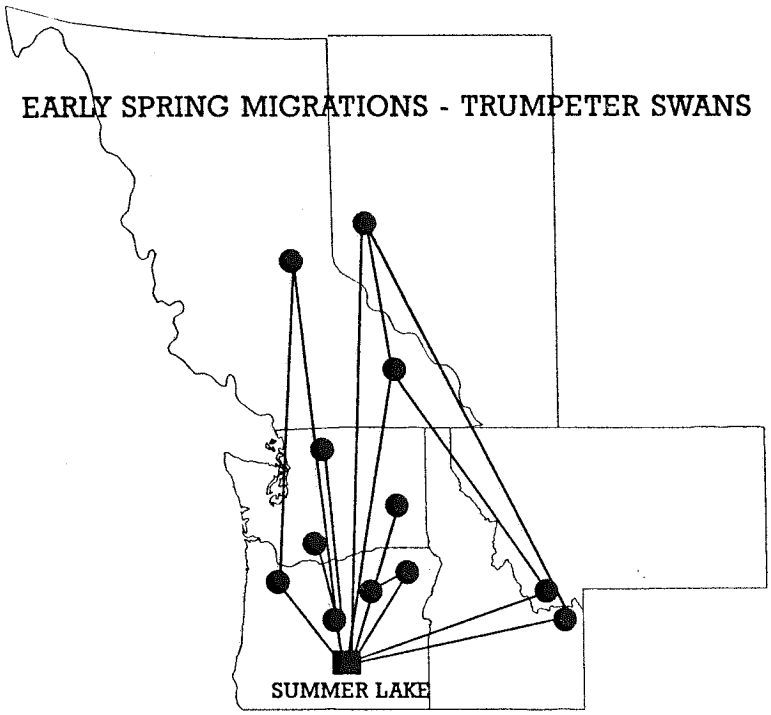

Figure 4. Early spring migrations.

four cygnets) were reported in early spring in the TR. One mortality (adult) was reported from RRLNWR. Six of the birds observed in the TR (three adults and three cygnets) continued north and were later observed in ICSP breeding areas. Ten swans (six adults, four cygnets) were reported in southeast British Columbia (BC). Two of these cygnets were later observed in ICSP breeding areas. One adult that had returned to the TR shortly after release at Summer Lake, was also observed in southeast BC prior to arriving in ICSP breeding areas. Eighteen Trumpeters (three adults, 15 cygnets) were observed along routes north and northwest of Summer Lake. Eleven birds (two adults, nine cygnets) were observed at Ridgefield NWR along the lower Columbia River in southwest Washington in mid-March. Four cygnets stopping at Ridgefield were later observed in ICSP breeding areas. A cygnet summered at Ridgefield, and another probably summered in northwest Washington or southwest BC as it was observed in early fall prior to the arrival of fall migrant Trumpeters in southwest BC. Seven swans (one adult, six cygnets) were observed in central Oregon, 100 miles north of Summer Lake. One cygnet from this group was later found dead in northwest Washington. The adult from this group was observed in south central Washington in May. This bird may have summered in southern Washington, as it was reported along the Columbia River in southeastern Washington later in the fall. A cygnet was observed in northeast Oregon (200 miles northeast of Summer Lake) in early March, moved west southwest to central Oregon (150 miles north of Summer Lake) in early April, remained there through the end of the month, then disappeared. Six Trumpeters were reported in central Washington, but collars were not identified. Three cygnets and six adults were not observed following dispersal from Summer Lake.

Summer 1992

The status of translocated swans during summer (especially those in ICSP breeding areas) is somewhat sketchy due to the lack of collar observations. One cygnet summered in the TR, and six cygnets and 12 adults were reported from ICSP breeding areas. Four cygnets summering at Summer Lake were joined in early June by the adult that had spent the winter and spring in Warner Valley (60 miles southwest of Summer Lake). One cygnet was reported on Vancouver Island, BC, in May and remained there throughout the summer (Figure 5).

Fall 1992

Two cygnets returned to the Pacific Coast in mid-November and were observed on the Skagit River Delta in northwest Washington (Figure 6). One of these birds had stopped at Ridgefield in early spring before being observed in the ICSP breeding area during summer. The other bird had not been observed since it left Summer Lake in spring. Eight cygnets were re-sighted in the TR. One of these continued south and west from there, and was later observed at Fort Hall Indian Reservation in southern Idaho. Another cygnet was seen in southwest Idaho in November. Five of the 15 (33%) cygnets that migrated north via routes along the Pacific Northwest were observed in the TR during the fall. The four cygnets that summered at Summer Lake were present in the area during fall. Twelve cygnets missing since spring departure from Summer Lake were observed during the fall. Twenty-four adults were observed during the fall in the TR. Two others were observed in ICSP breeding areas in early fall. Only two of the translocated adults were observed outside of the TR (one remaining at Summer Lake and one in southeast Washington).

Winter 1992

The first return of winter 1991 translocations occurred on 16 December 1992 when a cygnet from last year was observed 5 miles northeast of Summer Lake. On 3 January 1993 a second 1991 cygnet was observed at Summer Lake. This bird had not been observed wintering at the release site in 1991. It appeared 20 miles west of Summer Lake in early spring 1992, but had not been observed since. Five Trumpeters (one adult, four cygnets) remained at Summer Lake for most of the year following release. Six cygnets and 15 adults were observed in the TR during winter. Many of these were dispersed from HSP during winter 1992 capture and hazing efforts. A cygnet was shot

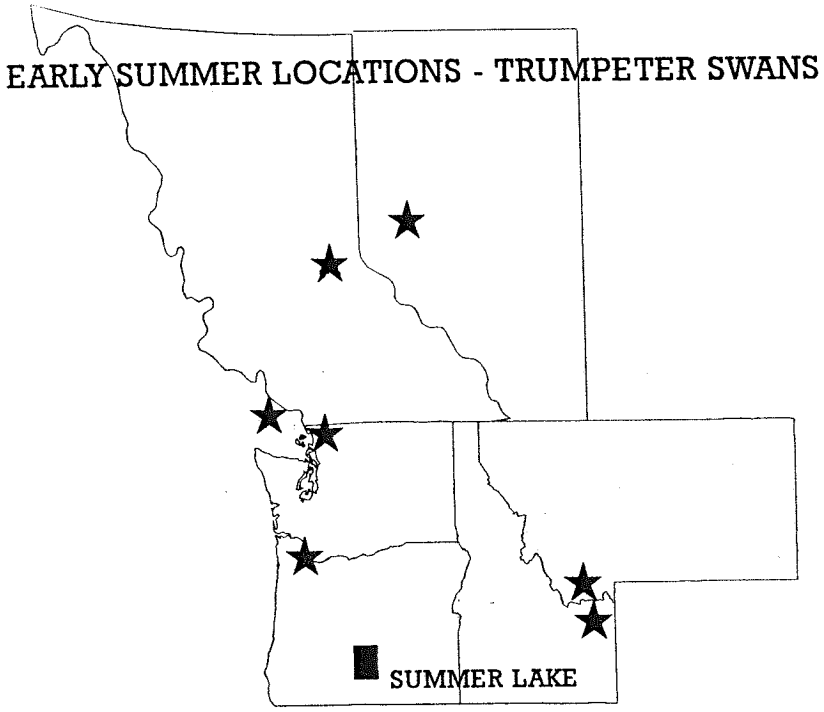

Figure 5. Early summer locations.

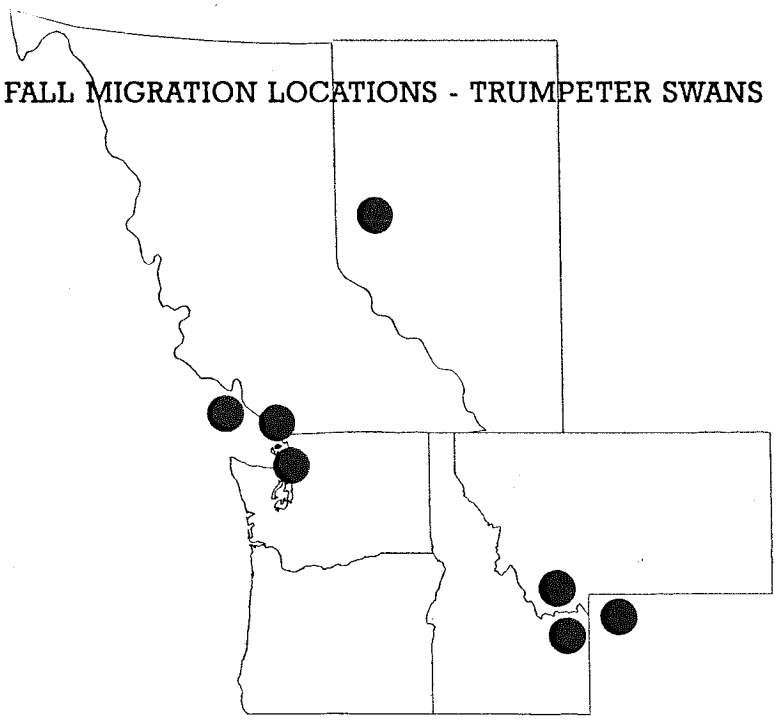

Figure 6. Fall migration locations.

in southwest Idaho and was reported to be flying with another green collared swan at the time of the shooting. On 20 January 1993, a winter 1991 release cygnet was observed at Malheur in the company of 20 Trumpeters from 1992 winter translocations, three Trumpeters from Elk Island National Park, Alberta, translocations and four unmarked Trumpeters. The only reported winter mortality was one adult found dead at HSP.

Actions undertaken in 1992

Four subadults (all females) were captured by hand or net from an airboat at Malheur and translocated to Summer Lake. All swans were collared for future identification. With the cessation of winter feeding at RRLNWR, surplus "subadults" (subadults, as well as nonbreeding or failed breeding adults) and cygnets were available for translocation to other sites. In July, 26 molting subadults (11 males, 15 females) were captured by hand or net from airboats and were translocated to Summer Lake. All swans were collared for future identification. In September, 26 cygnets (10 males, 16 females) were captured by hand or net from airboats and were translocated to Summer Lake. All cygnets were collared and left wings were dyed pink with rhodamine B solution to aid in future identification. Five translocations totalling 101 swans captured at HSP were made to Summer Lake in early winter 1992. All swans were captured between 25 November and 18 December 1992 by night-lighting from boats. All birds were collared and left wings were dyed with yellow-orange picric acid to aid in future identification. Date, sex and age composition of releases of birds captured at HSP and translocated to Summer Lake during winter 1992 is displayed in Table 2.

SUMMARY

Trumpeter Swan management in Oregon has evolved into a major program during the past 2 years. A total of 264 Trumpeters have been translocated to a new wintering and potential breeding area at Summer Lake. Over winter survival of translocated swans was good. First year known mortality was low for both cygnets (six or 13%) and adults (3 or 6%). Several migration paths from the new wintering areas back to breeding areas in the TR or ICSP were observed, and many swans returned along traditional migration paths the following fall. Fifty-five percent of the cygnets and 65 percent of the adults could be accounted for during the fall and winter of 1992. A few unmarked swans dispersed from the TR to Summer Lake and to other wintering locations outside of the RMP core wintering area, showing additional promise for the relocation efforts. Two cygnets (5%) returned to winter at Summer Lake. One adult (3% of adults) and three cygnets (9% of cygnets) moved to new wintering sites outside of the TR. One adult (3%) and five cygnets (13%) remained at "non-traditional" RMP sites (northwest Oregon, Washington, and BC) but are expected to return to natal areas when they reach breeding age. Five swans (one adult and four cygnets) have remained at Summer Lake and may serve as the nucleus of a new breeding flock. It is too early to determine the outcome of our attempts to instill a migratory tradition within the Malheur flock. Future monitoring of these

Table 2. Release date and age and sex of 101 Trumpeter Swans translocated to Summer Lake Wildlife Area, Oregon, winter 1992.

	Adult		Juvenile		
Release date	Male	Female	Male	Female	Total
25 Nov.	5	4	7	2	18
28 Nov.	3	2	11	12	28
29 Nov.	7	1	3	3	14
1 Dec.	2	2	2	4	10
18 Dec.	15	10	4	2	31
Total	32	19	27	23	101

efforts will determine how successful Oregon's Trumpeter Swan Plan will be.

ACKNOWLEDGEMENTS

A large part of the credit for this program goes to Gary Ivey, of Malheur NWR for his conception of this project. Without his efforts and those of Brad Bales of ODFW, the project would not have occurred. I am deeply indebted to Ruth Shea who provided me with considerable education and insight regarding Trumpeter Swan behavior and management. She also coordinated nearly all collar observations. Without her encouragement and help, very little data would have been collected.

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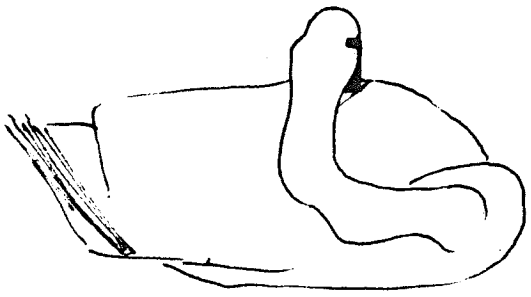
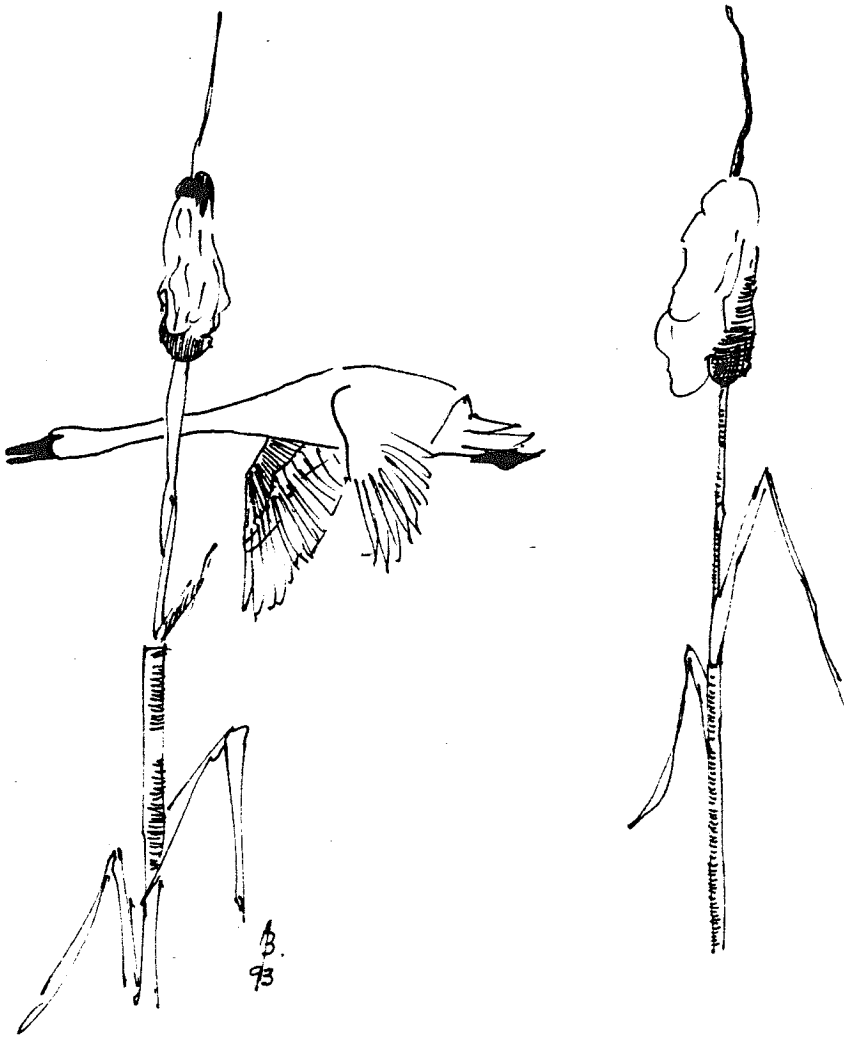


"GENERAL" SWAN SEASON



PACIFIC FLYWAY EXPERIMENTAL "GENERAL" SWAN HUNTING SEASON - A PROPOSAL

Jeff Herbert, Montana Department Fish, Wildlife and Parks, 1420 East 6th Avenue, Helena, MT 59620

ABSTRACT

The Pacific Flyway is proposing the implementation of a 3-year experimental general swan season designed to monitor incidental harvest of Trumpeter Swans and reduce hunter liability associated with the harvest of a Trumpeter Swan during permitted Tundra Swan hunting seasons.

PROPOSAL

Pending favorable acceptance of the Pacific Flyway Study Committee's (PFSC) proposal, the Pacific Flyway Council (PFC) will request that the U. S. Fish and Wildlife Service (USFWS) modify current Tundra Swan hunting regulations to allow the accidental take of other swan species during the 1993-95 Tundra Swan hunts in the Pacific Flyway (PF). The states and the USFWS will develop the methodology for collection of bill measurements to discriminate the species composition of the harvest in Tundra Swan hunting seasons. At the end of the 3-year period, the Flyway and the USFWS will cooperatively evaluate the impact of Tundra Swan hunting on Trumpeter populations and develop strategies to minimize impacts if warranted. The Trumpeter Swan Society (TTSS) will be an important component of these efforts.

INTRODUCTION

Increases in both Tundra and Trumpeter Swan populations, expansion of Tundra Swan hunting zones, and recent Trumpeter Swan range expansion efforts have created or potentially could create several problems: a need to document the degree of incidental harvest of Trumpeters in Tundra Swan hunt zones, a need to reduce hunter liability when a Trumpeter is taken during a Tundra Swan hunt, the biological ramifications of incidental harvest on expanding Trumpeter populations, and the reluctance of states and the flyways to embrace Trumpeter Swan expansion efforts until these concerns can be addressed.

It is important to clarify that this is a PFSC proposal. In discussions last July, the PFC indicated that in order to move the proposal forward, the concurrence of TTSS was imperative. Resolution of these issues therefore offers an opportunity to develop a partnership between the PFC and TTSS that will further the goals of both groups and serve as a model for cooperative work in the other flyways.

We do recognize the conflict. We know that many TTSS members feel that any hunting mortality of Trumpeters is unacceptable and to some, the hunting of Tundra Swans is objectionable. We likewise recognize from current experience that future range expansion efforts for Trumpeters may be delayed or compromised by a lack of resolution of these conflicts. The Society has clarified its understanding of the issues and has indicated it's intent to work cooperatively to resolve them.

With these concerns in mind, we would like to define our rationale for this proposal and request input from TTSS in formulating a final recommendation. We wish to assure TTSS that this proposal is not being made as an attempt to promote the harvest of Trumpeter Swans.

The objectives of this proposal are to:

1. Monitor the incidental harvest of Trumpeter Swans during Tundra Swan hunting seasons.

2. Reduce individual hunter liability associated with the incidental harvest of a

Trumpeter Swan during Tundra Swan hunting seasons.

3. Minimize the risk to migrant or breeding Rocky Mountain Population (RMP) Trumpeter Swans and continue the range expansion program for this population.

4. Demonstrate that Tundra Swan hunting seasons (and other waterfowl hunting seasons) and Trumpeter Swan range expansion programs can be compatible and that efforts within the PF can serve as a model for activities in the other flyways.

DISCUSSION

Historical perspectives

Society members were presented information on the existing Tundra Swan hunt programs in the Pacific, Central and Atlantic Flyways at the Salt Lake meeting. We felt that with this new proposal, it was important to emphasize some of the protection strategies for Trumpeters that were initially built into the PF Tundra Swan hunts.

Utah initiated the first hunting season on Tundra Swans in 1962. At this time, there were few documented records of Trumpeters occurring in Utah and because the state was south of the Tristate region, the entire state was opened to hunting. Fish Springs and Ovray NWR's were closed to swan hunting in 1970 and 1976, respectively. The Fish Springs closure was due, in part, to the growing use of the refuge by swans, some of which were identified as Trumpeters. However, culmen measurements collected between 1964-69 and 1990-91 by the Utah Division of Wildlife personnel documented no harvest of Trumpeters (swans with bill tip to nare measurements of >50mm).

Nevada was permitted a hunt in Churchill County in 1969 and this was expanded to a total of three northwestern counties in 1983. This zoning precluded swan hunting in most of the state, in part, to protect the sedentary, restoration flock of Trumpeters at Ruby Lakes NWR. Incidental harvest of Trumpeters in Nevada and Utah has increased concurrently with the winter range expansion program for RMP Trumpeter Swans.

Montana initiated a Tundra Swan hunt in 1970 in Teton County. Cascade County was added in 1981, and the area was expanded to a six county area in 1988. This hunt avoided Red Rock Lakes NWR (RRLNWR) and the surrounding counties. In 1983, Montana was permitted a season on the Eastern Population of Tundra Swans throughout the Central Flyway portion of the state. In 1991, in order to protect Trumpeters along the east front, the PF swan season in Montana was delayed by 2 weeks to coincide with peak movements of Tundra Swans into the area.

We are aware that some incidental harvest of Trumpeters is occurring. However, this harvest appears to be low and the Canadian flock which migrates through Montana continues to increase.

A Tundra Swan season has been allowed on Alaska's Seward Peninsula where only Tundra Swans occur.

Two years ago, the states of Montana, Nevada and Utah initiated or expanded bill measurement surveys to document the incidental take of Trumpeters during Tundra Swan seasons. We are continuing to refine a reasonably accurate and standardized bill measurement that is completed by hunters (and agency personnel) in the field. Utah has been collecting additional morphological data as an alternative method of species separation.

These data are being compared to measurements taken by Rod Drewien from Trumpeter Swans handled during RMP trapping and relocation activities. These data bases will hopefully provide a reasonable assessment of the species composition in the harvest. While this begins to address the incidental harvest concerns, it does not address the hunter liability issue.

As an initial step to resolve this liability issue, the PFC requested that the USFWS consider a change in their enforcement policy on the incidental take of Trumpeters. The flyway requested that a Tundra Swan hunter not be prosecuted for the accidental take of a

Trumpeter Swan. Federal enforcement personnel were not willing to make this concession without a change in the prevailing regulations.

Range expansion

It is imperative to link the PFSC's proposal with range expansion efforts. The PFC has been very supportive of the winter range expansion efforts aimed at reducing swan numbers at Harriman State Park (HSP) and RRLNWR and at expanding the number of alternate wintering sites for RMP Trumpeter Swans. A steady and significant increase of RMP Trumpeter Swan numbers (primarily migrant Canadian swans) created this problem. The RMP continues to grow based on strong recruitment from the Canadian swans.

To date, a total of 962 Trumpeters have been translocated to sites in Idaho, Oregon, Wyoming and Utah. In addition, swans and other waterfowl have been hazed at both HSP and RRLNWR to move additional birds on through to more southerly wintering locations. Artificial feeding at RRLNWR appears to have been successfully terminated without significant mortality to wintering Trumpeters.

These efforts have been expensive and, in many cases, labor intensive. The distribution of wintering Trumpeters has changed significantly between 1988 and 1993. New migration corridors have been identified and Trumpeters appear to be pioneering new breeding habitat. Also, there appears to be some affinity of translocated swans to the new winter ranges.

As Trumpeters pioneer new locations, increased mortality will occur. Approximately 16 Trumpeters may have been killed during the fall of 1992. While some of this mortality can be attributed to the risk associated with the Tundra Swan seasons, vandalistic shooting in Wyoming accounted for six swans. Even though the loss of pioneering swans may slow the winter range expansion effort, it is important to keep this mortality in perspective relative to overall population growth and the expanding distribution of Trumpeter Swans.

Both the Pacific Flyway Management Plan for the Rocky Mountain Population of Trumpeter Swans (Subcommittee 1992) and the Hunt Plan for the Western Population of Tundra Swans (Subcommittee 1989) acknowledge that some Trumpeter mortality will occur as a result of Tundra Swan hunting seasons. The winter range expansion program has increased this potential conflict. We feel it is important to document incidental harvest where it occurs. Once this information is documented, strategies can be devised for situations where Trumpeter harvest represents a significant problem to continued population growth and expansion. These strategies may include but not be limited to the following:

1. Reconfiguration of the boundaries of existing Tundra Swan hunting zones to protect suspected concentrations of Trumpeters where a minimal harvest of Tundra Swans occurs.

2. Rescheduling the timing of existing Tundra Swan hunts to coincide with peak numbers and harvest of Tundra Swans as a means of limiting the accidental take of migrant Trumpeters.

3. Designating waterfowl sanctuaries within existing range expansion areas to provide secure zones for Trumpeters.

4. Modifying the range expansion objectives.

5. Providing educational material to Tundra Swan hunters that will aid in the identification of Trumpeters and Tundra Swans and developing an effective public information program for the range expansion activities.

Arguments have been made recently that swan hunting states need to make boundary and/or temporal changes in hunting season frameworks prior to this data collection. We do not feel that this action is warranted. Documentation of the occurrence and magnitude of incidental harvest is needed to justify these actions. Continued monitoring of the distribution of Trumpeter Swans during the late fall and winter periods is critical.

CONCLUSION

Significant progress has been made to date in dealing with the major issues affecting the RMP Trumpeter Swan population. This has been possible because of the broad base of support including both the hunting and nonconsumptive publics. Our base of knowledge continues to expand. The ability of Trumpeters to adapt to new situations may surprise many of us. What should be of no surprise is the continued need to work together on wetland habitat protection for the benefit of all migratory bird species.

We look forward to working with TTSS to develop, as soon as possible, a mutually agreeable course of action. We thank TTSS for the opportunity to present this information.

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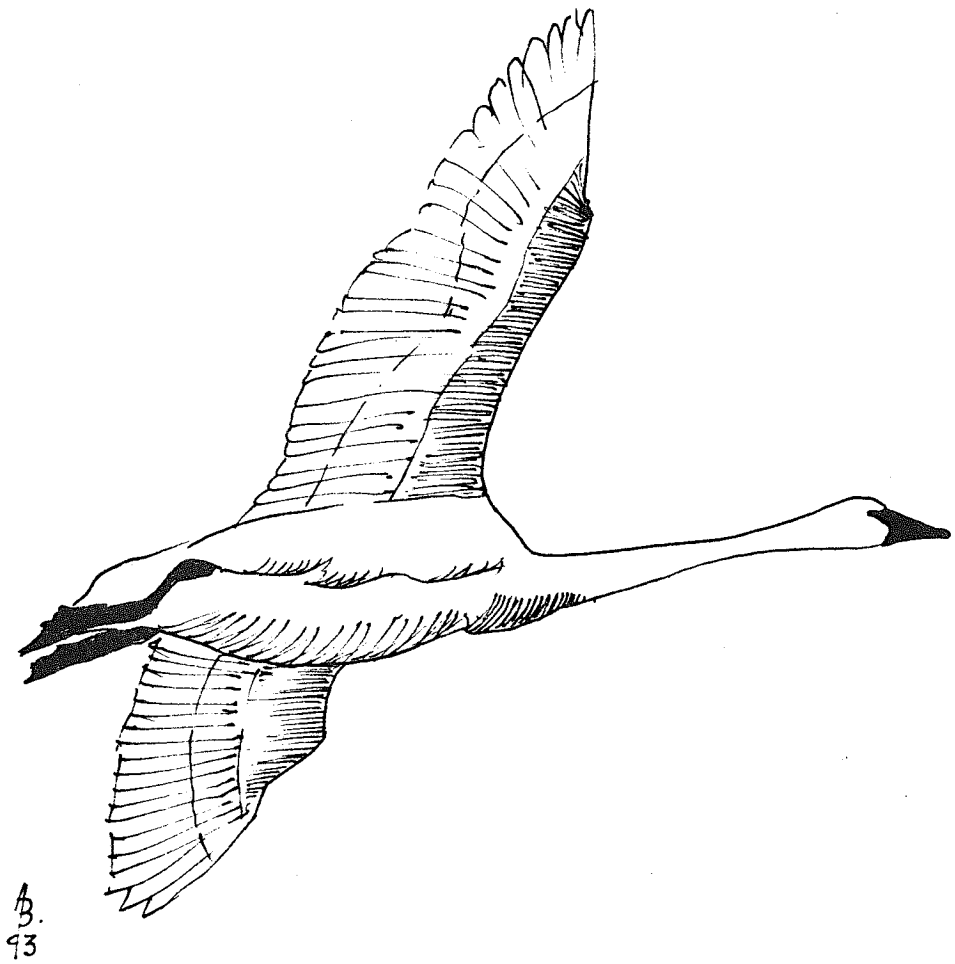

THE TRUMPETER SWAN SOCIETY'S POSITION ON SWAN HUNTING

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ABSTRACT

Existing management plans for Tundra Swan and Trumpeter Swan populations, other published papers and unpublished reports were reviewed to determine current population status, distribution, annual harvest and related management issues. The Trumpeter Swan Society's (TTSS) response to expansion of Tundra Swan hunting seasons is summarized and its position on the proposal by the Pacific Flyway Study Committee for a "general" swan hunting season is presented.

TUNDRA SWAN HUNTING

The Tundra Swan is the most abundant and widely distributed of the North American swans. Tundra Swans are managed by designated populations; Eastern (EP) and Western (WP) based on their wintering distribution (Serie and Bartonek 1991a). Management plans (Anonymous 1982, Pacific Flyway Council 1979) have been developed for each population that establish population, distribution and habitat objectives and prescribe management guidelines. Separate sport hunting plans (Anonymous 1988, Pacific Flyway Study Committee 1989) have been prepared to provide annual harvest guidelines that are consistent with overall population management objectives. The goal for the EP is to stabilize the population within a range of 60,000 to 80,000, based on a 3-year average winter population index, and for the WP to be maintained at a population level above 38,000 swans, later revised upward to 60,000 (Serie and Bartonek 1991b). The population goals in the North American Waterfowl Management Plan (U. S. Fish and Wildlife Service and Canadian Wildlife Service 1986) are to maintain levels of 80,000 for EP and 60,000 for WP. During 1991-92, both populations exceeded these levels, EP-110,000 and WP-63,000. As a general guideline, the annual allowable harvest objective is based on 10 percent of the 3-year average winter population index. If the winter index for EP and WP falls below 60,000 and 40,000 respectively, season closures will be considered (Serie and Bartonek 1991a). All hunting is conducted under a permit system handled by the participating states with specific monitoring, reporting and evaluation requirements. The Tundra Swan management plans, the hunt plans and the Trumpeter Swan Management Plan (Anonymous 1984) recognize the potential conflicts between Tundra Swan hunting programs and Trumpeter Swan restoration efforts, and recommend reconciliation of conflicting management actions.

Legal hunting of swans in North America was terminated with the enactment of the Migratory Bird Treaty Act in 1918. Closure remained in effect until 1962 when the U. S. Fish and Wildlife Service (USFWS) authorized a limited WP Tundra Swan hunting season in Utah. This action was based on survey data that indicated a steady increase in swan numbers to levels more than double the 1950 figures, indicating that this population could sustain a limited harvest. Portions of Nevada and western Montana were authorized seasons in 1969 and 1970, respectively. In 1983, a limited season was approved for EP Tundra Swans in eastern Montana, South Dakota and North Dakota. South Dakota temporarily declined and North Dakota did not exercise the option until 1988, followed by South Dakota in 1990. North Carolina was granted an experimental season in 1984, followed by Virginia and New Jersey in 1988, with New Jersey delaying action until 1989. Alaska opened a specific area in 1988, in addition to ongoing subsistence hunting of swans (Serie and Bartonek 1991b). There has been no Tundra Swan hunting season authorized in Canada to date, but limited subsistence hunting is conducted by Native peoples (Serie and Bartonek, pers. corresp.).

During recent years about 10,000 permits have been issued, resulting in an annual harvest of about 4,200 swans for both populations. Population trends and reported harvest are summarized in Tables 1 and 2. For further details on population trends, determination of allowable harvest, permit allocation and harvest monitoring, refer to individual population management and hunting plans.

TRUMPETER SWAN MANAGEMENT RELATIONSHIPS

With the expansion of Tundra Swan hunting in the Central and Atlantic Flyways in 1983 and 1984, there was increased concern over potential conflicts with the Trumpeter Swan restoration and range expansion programs. While it was recognized that in certain areas where the migration and wintering ranges of the two species overlapped some incidental taking of Trumpeter Swans would likely occur during Tundra Swan hunts, the magnitude was unknown. This problem was initially believed to be more acute for WP than EP swan hunting areas. However, it seemed likely that as Trumpeter Swan restoration efforts expanded in the Midwest, the accidental shooting of a small number of Trumpeters could be critical. Management plans included references for finding ways to avoid chance killing of Trumpeter Swans (Pacific Flyway Study Committee 1989). A revised USFWS policy stressed the avoidance of hunting Tundra Swans in areas at the time Trumpeter Swans were known to occur and encouraged the Flyway Councils to consider such action.

These concerns have resulted in considerable discussion of the pros and cons of these issues for nearly a decade, culminating in the adoption of a position on Tundra Swan hunting by TTSS in January 1990 (Gillette 1992). The proceedings of the 12th and 13th Trumpeter Swan Society conferences contain other papers on this subject, and Serie and Bartonek (1991a and b) and Sladen (1991) also addressed this issue quite thoroughly.

The position statement did not object to hunting of Tundra Swans, but called attention to potential conflicts in management plans for the two species. It recognized that range overlap and difficulty in distinguishing between the two species on the wing would require further consideration of the potential biological and social impacts of incidental taking of Trumpeter Swans. The future well-being of Trumpeter Swans was believed to be dependent on the ability to successfully expand winter distribution of the present populations and to continue range expansion in the Central and Mississippi Flyways. The statement stressed that continued expansion of Tundra Swan hunting will eventually conflict with range expansion efforts for the Trumpeter Swan, and that resolution of potential and actual conflicts must be sought through a cooperative planning process, improved communications and careful coordination. A series of management objectives and coordination procedures were presented to minimize conflicts between Trumpeter Swan management and Tundra Swan hunting.

Based on personal discussions, there is a general feeling among waterfowl managers and wildlife administrators that there is unlikely to be much further expansion of Tundra Swan hunting in the U. S., other than in Alaska, and some modification of hunting zones in certain states. In Canada, it appears that no hunting seasons will be requested by the southern provinces; but some changes, primarily in subsistence hunting, may occur in the Yukon and Northwest Territories.

PACIFIC FLYWAY PROPOSAL - "GENERAL" SWAN SEASON

The most recent development (1993) was the proposal by the Pacific Flyway Study Committee (PFSC) to the Pacific Flyway Council that the Council request that the USFWS modify current Tundra Swan hunting regulations to allow the accidental take of other swans during the 1993-95 Tundra Swan hunts. The rationale was that increases in both Tundra and Trumpeter Swan populations, expansion of Tundra Swan hunting zones and recent Trumpeter Swan range expansion efforts have created or could create several problems:

1. A need to document the incidental take of Trumpeters in Tundra Swan hunt zones.

Table 1. Tundra Swan population trends and harvest[a].

Population	Year	Population[b] index	No. states authzd./hunted	No. permits issued	Estimated retrieved harvest	Estimated unretrieved harvest
Western	1962	-	1/1	1,000[c]	320	80
	1970	31,000	3/3	3,500	1,200	170
	1980	65,200	3/3	3,500	1,160	220
	1981	83,600	3/3	3,500	1,620	280
	1982	91,300	3/3	3,500	1,240	310
	1983	67,300	3/3	3,650	1,170	290
	1984	61,900	3/3	3,650	1,190	130
	1985	48,800	3/3	3,650	880	100
	1986	66,100	3/3	3,600	950	180
	1987	52,800	3/3	3,580	800	60
	1988	59,200	4/4	3,370	850	120
	1989	78,700	4/4	3,450	1,100	190
	1990	40,100	4/4	3,380	1,230	180
	1991	48,900	4/4	3,340	930	170
	1992	63,700	4/4	-	-	-
	1981-1990 Average	-	-	3,530	1,100	180
Eastern	1970	55,000	-	-	-	-
	1980	63,700	-	-	-	-
	1983	87,000	3/1	110[d]	50	0
	1984	81,100	4/2	1,110	340	20
	1985	94,300	4/2	6,120	2,550	260
	1986	90,900	4/2	6,170	2,340	280
	1987	94,500	4/2	6,140	2,710	320
	1988	77,400	6/4	7,100	2,800	310
	1989	90,600	6/4	7,710	2,820	340
	1990	89,700	6/5	6,260	3,854	440
	1991	97,400	6/5	9,800	4,340	420
	1992	110,100	6/5	9,800	4,480	580
	1990-1992 Average	-	-	8,620	4,230	480

[a] Summarized from USFWS reports provided by the Office of Migratory Bird Management; and personal correspondence from Jerry Serie, Atlantic Flyway Representative, and James Bartonek, Pacific Flyway Representative. All numbers rounded.
[b] Surveys conducted in January.
[c] Permits authorized for WP ranged from 1,000 (1962-68) to 3,950 beginning in 1988.
[d] Permits authorized for EP ranged from 2,000 (1983), 3,000 (1984), 8,000 (1985) to 10,300 (1991).

Table 2. Tundra Swan hunting permits authorized/issued and estimated harvest by population - 1991[a].

Population	Permits authorized	Permits issued	Retrieved harvest	Unretrieved harvest
WESTERN				
Alaska	300	80	10	0
Montana (PF)	500	500	80	10
Nevada	650	260	70	(2)
Utah	2,500	2,300	770	160
Totals	3,950	3,140	930	170
EASTERN				
Montana (CF)	500	200	50	(2)
N. Dakota	2,000	2,000	700	110
S. Dakota	1,000	1,000	450	70
N. Carolina	6,000	6,000	2,940	230
New Jersey	200	0	0	0
Virginia	600	600	200	10
Totals	10,300	9,800	4,340	420

[a] Summarized from USFWS reports provided by the Office of Migratory Bird Management; and personal correspondence from Jerry Serie, Atlantic Flyway Representative and James Bartonek, Pacific Flyway Representative. All numbers rounded.

2. The need for a better understanding of biological ramifications of incidental take on expanding Trumpeter populations.

3. The difficulty of distinguishing between the two species in the field, especially in flight.

4. A need to reduce hunter liability when a Trumpeter Swan is taken during a Tundra Swan hunt.

5. The reluctance of some states and the flyway councils to endorse further Trumpeter Swan range expansion efforts until the stated concerns are addressed. The proposal recognized the principal reasons for existing conflicts, recommended specific management and research objectives, and requested continued participation by TTSS to work cooperatively to resolve these issues. The proposal made it clear that this was not an attempt to promote the harvest of Trumpeter Swans.

During 1992 there was continued review of draft proposals regarding a "general" swan season, and an exchange of letters between TTSS, PFSC, PFC and USFWS. Action was

delayed until 1993 pending development of a draft position statement by TTSS for presentation at the 14th Trumpeter Swan Society Conference, in concert with the current proposal from the PFSC (Herbert 1994).

The salient points of the draft position statement were presented and discussed at the Conference. A copy of the draft statement was sent to PFSC for further discussion at their February 1993 meeting. Discussion of this subject and related procedural recommendations by the PFSC at the PFC meeting on 21 March 1993 resulted in the Council referring the issue back to PFSC for further action and coordination with TTSS.

Following review of the statement by the full Board of Directors for TTSS, the final version was approved by the Board and subsequently submitted to the PFSC during June 1993. The approved TTSS position statement in response to the PFSC proposal to conduct a 3-year experimental "general" swan hunting season follows.

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TTSS' POSITION STATEMENT

The Trumpeter Swan Society's position statement in response to the Pacific Flyway Study Committee's proposal to conduct a 3-year experimental "general" swan hunting season (4 June 1993).

The Board of Directors of The Trumpeter Swan Society considered the proposal submitted by the Pacific Flyway Study Committee very seriously. The Board concluded that it could not support any action that would legalize the hunting of Trumpeter Swans. Such action would not be consistent with the goals and objectives of The Trumpeter Swan Society to reestablish self-sustaining populations of Trumpeter Swans within their historical range, and it runs contrary to our efforts to protect the species for the last 25 years.

It is recognized, however, that close coordination will be necessary in conducting Tundra Swan hunting seasons and range expansion programs for Trumpeter Swans to avoid future conflicts in management planning for the two species. It is the desire of The Trumpeter Swan Society to continue cooperative efforts with the Flyway Councils, the respective states, other participating agencies, organizations and individuals in developing management and research arrangements that will benefit both species.

Therefore, the Society encourages further consideration of other alternatives and related management actions which are very similar to the objectives proposed by the Pacific Flyway Study Committee.

Specifically:

1. Recognizing that it is difficult to distinguish between the two species in flight, that it is unfair to penalize hunters for a mistake they cannot avoid, and that severe penalties for accidental shooting of Trumpeter Swans may prevent a true assessment of harvest, the Pacific Flyway Council, together with the U. S. Fish and Wildlife Service, is urged to develop a more comprehensive management program for both species to define the magnitude of the problem, present perceived current and future impacts to Trumpeter Swan populations, and propose potential solutions. The Trumpeter Swan Society would welcome the opportunity to review and comment on a draft of such a program.

2. Proceed with the development of a data collection and evaluation system based on current Tundra Swan hunting programs, that will provide more definitive information on the take and occurrence of Trumpeter Swans and better information on the status, condition and annual harvest of Tundra Swans. Supplement the hunting data with field observations of live birds to determine the percentage of Trumpeters within the total swan population in areas open to Tundra Swan hunting.

3. Continue cooperative work on winter range expansion of Trumpeter Swans in a manner that will minimize conflicts with existing Tundra Swan hunting seasons.

4. Maintain an open dialogue among all parties involved in waterfowl management to maximize the potential for success for approved Trumpeter Swan range expansion projects.

5. Develop longer range plans which consider the future impacts of increased populations of Tundra Swans and Trumpeter Swans and the desired distribution and habitat capabilities that will be required 10 and 20 years hence.

The Trumpeter Swan Society will maintain a scientific, professional and cooperative approach in seeking a mutually satisfactory resolution to these important management and research issues.

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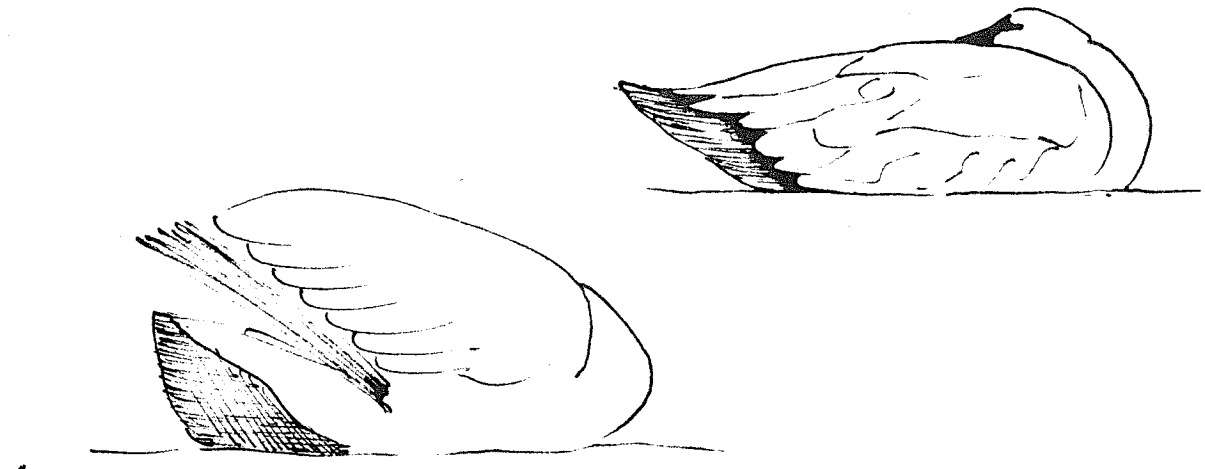
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TRUMPETER SWAN RESTORATION IN THE MIDWEST

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ABSTRACT

Survival of released Trumpeter Swans in Minnesota, Wisconsin, Michigan and Ontario was calculated from bandings and sightings of color marked birds. Cygnets and those released at 23 months each did not survive as well in their first year at liberty as in their second. Cygnet survival did not differ significantly from those released at 23 months in any year at liberty. Thirty-one percent of the cygnets released were dead before they reached 23 months-of-age. Losses of Trumpeters held in captivity until 23 months-of-age were about 1-2 percent while in captivity. There was no significant difference in survival between Trumpeters wintering at a traditional site and those not known to be traditional in their choice of wintering site.

INTRODUCTION

Restoration of Trumpeter Swans in the Midwest has been reported on by Compton (1991) for Hennepin Parks, by Kittelson (1990 and 1991), Kittelson and Hines (1992), Hines (1991) and Pichner et al. (1992) for Minnesota, by Matteson (1991) and Matteson et al. (1992) for Wisconsin, by Johnson (1991) for Michigan, by Smith (1988) for Missouri and by Lumsden (1991 and 1992) for Ontario. This paper examines survival rates of Trumpeter Swans released as cygnets and those released at 23 months-of-age. The U. S. Fish and Wildlife Service, with the agreement of the Alaska Department of Fish and Game, has made available up to 100 Trumpeter Swan eggs per year since 1985. The Ontario program is sponsored by the Ontario Federation of Anglers and Hunters and is funded by Scott Paper Ltd. Without this help restoration programs would have been very difficult.

METHODS

Survival of released Trumpeters was calculated from band recoveries and sighting of live birds marked with collars or wing tags. Birds not seen for more than a year are considered to be dead, however, some birds do turn up after a year or sometimes 2 years absence. Some swans lose their colored markers. Unless the band number can be read, the bird disappears from the record. In Michigan, a few Trumpeters can be lost among 3000 feral Mute Swans. All these factors lead to underestimation of survival.

The anniversary date used here is 1 September. Samples from each release area were tested by chi-square (X^2) analysis and where no significant difference was detected they were combined for further analysis.

RESULTS AND DISCUSSION

Survival of released birds

Table 1 summarizes the survival data for swans released as cygnets by Hennepin Parks, Wisconsin Department of Natural Resources (DNR) and Ontario Ministry of Natural Resources (MNR). Table 2 presents the data for 23-month-old swans released by Hennepin Parks, Minnesota DNR, Wisconsin DNR and Kellogg Bird Sanctuary, Michigan. These samples did not differ significantly one from another and have been combined.

Cygnets did not survive as well in their first year at liberty as they did in their second (X^2 = 6.3072, $P < 0.02$, d. f. 1). Their survival did not differ significantly from those released at 23 months in any year at liberty.

Those released at 23 months-of-age also did not survive as well in their year of release as they did subsequently (X^2 = 13.5503, $P < 0.001$, d. f. 1).

Degernes (1991) and Pichner et al. (1992) recorded unusually heavy losses of Minnesota Trumpeters during and following the drought of 1988. This was caused by a drop in water levels which made spent shot available to the swans. Many died of lead poisoning and from the effects of a hard winter which followed (Compton, pers. comm.). This mortality will

Table 1. Survival of Trumpeter cygnets released by Hennepin Parks, Minnesota DNR, Wisconsin DNR and Ontario from 1979 to 1991.

Year at liberty	Age	Entering period	Surviving period	Dead or missing	Percent survival
First	Fledgling to 1¼	130	82	48	63
Second	1¼ - 2¼	51	42	9	82
Third	2¼ - 3¼	31	26	5	84
Fourth	3¼ - 4¼	11	9	2	82
Fifth	4¼ - 5¼	7	4	3	57
Sixth	5¼ - 6¼	2	2	0	100

Table 2. Survival of Trumpeter Swans released at 23 months-of-age by Hennepin Parks, Minnesota DNR, Wisconsin DNR, and the Kellogg Sanctuary, Michigan.

Year at liberty	Age	Entering period	Surviving period	Dead or missing	Percent survival
First	23 months to 3¼	275	144	131	52
Second	3¼ - 4¼	90	67	23	74
Third	5¼ - 6¼	54	41	13	76
Fourth	5¼ - 6¼	22	19	3	86
Fifth	6¼ - 7¼	15	11	4	73
Sixth	7¼ - 8¼	9	7	2	78
Seventh	8¼ - 9¼	6	6	0	100

have affected two groups, those released in 1987 and 1988. However, there were too few birds released in Michigan and Wisconsin for comparison.

The data on swans released as cygnets suggest that 32 percent of their number were lost before they reached 23 months-of-age. While held in captivity from fledging to 23 months before release, losses were very low at 2 percent in Michigan (Johnson, pers. comm.) and about 1 percent in the DNR program in Minnesota (Kittelson, pers. comm.).

The use of wild Mute Swan foster parents for raising Trumpeter cygnets as practiced in Ontario has precluded release at 23 months. The Ontario Program will use more captive raised birds for release in the years to come and will be holding them, if pen space permits, until they are 23 months old.

Winter survival

There has been much concern because of the apparent inability of restoration flocks of Trumpeters to migrate. Terrill (1991) has defined migration as a movement from the breeding grounds followed by subsequent return to the same breeding area for the next reproductive effort. He was writing primarily of passerines. We need a more comprehensive definition of migration when discussing swans, geese and cranes. A definition which includes a tradition of wintering in a specific locality and a return to the same territory to breed.

Terrill (1991) also discusses dispersal as a movement away from a particular locality without a return to the point of origin. This does not completely fit what we see in restored flocks of Trumpeters. We see, in many flocks, dispersal from a traditional breeding ground under stress of harsh weather and subsequent return to that breeding ground the next spring.

At Lacreek National Wildlife Refuge (NWR), Trumpeters established on the Refuge have pioneered as breeders across South Dakota and Nebraska and traditionally have returned to Lacreek for the winter where they are cared for with food and maintenance of open water. However, when severe weather occurs a substantial number, up to 100 birds, disperse and may suffer severe loss (Kraft 1988). Recently swans have left the Refuge in winter and have returned without severe loss. It is not yet known where they go or whether any have developed a tradition (Kraft, pers. comm.).

Tradition for wintering in the same locality may be developing slowly in Minnesota. Trumpeters from Hennepin Parks, as well as some released by the DNR, are moving annually to the town of Monticello where a hydro-electric generating station maintains open water through the winter. There the swans are fed by the public. It has been suggested that these birds survive better than those that disperse.

Table 3 gives Minnesota DNR data for 1987-90 for 51 birds known to have wintered at a

Table 3. Trumpeter Swans released by Minnesota DNR 1987-90, known to have survived two or more winters, post release.

	Alive in 1992	Dead in 1992	Total	Percent survival
Used the same wintering site two or more times	14	9	23	61
Not known to use the same site more than once	15	13	28	54
Total	29	22	51	

traditional site, i.e. two or more winters at the same place and those not known to be traditional in their choice of wintering ground. The sample size is very small and the difference between the two groups is not significant ($X^2 = 0.2733$, $P > 0.05$, 1 d. f.). It will be worth looking at these data again when more results from Hennepin Parks, Michigan and Wisconsin are available.

Larry Gillette has drafted a proposal to establish wintering sites for Trumpeters in the lower Mississippi Valley. Birds on northern sites would be captured and transported there in November and December for immediate release as fully-flighted birds. The presence of a pinioned decoy flock of swans and food, it is hoped, would hold the birds until it is time for a return north in spring. Rolf Kraft (1991) has pointed out that the natural evolution of migration routes always develops from south to north in the northern hemisphere. He suggested that breeding populations should be established on wintering grounds and be allowed to pioneer to the north.

If Larry Gillette's proposal is adopted, wintering sites should provide good breeding as well as wintering range. Following Rolf Kraft's suggestion, the sites may be used to establish new breeding populations. Decoys placed could be mature breeding pairs, year-round residents. Plans for potential offspring would have to be made. It is also possible that winter visitors from other breeding populations may choose to stay year-round. We need to be open to all possibilities and select appropriate sites.

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STATUS REPORT OF THE LACREEK TRUMPETER SWAN FLOCK FOR 1992

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ABSTRACT

A total of 200 Trumpeter Swans returned to Lacreek National Wildlife Refuge (NWR) following the 1992 breeding season, including 62 cygnets. For the first time there was a significant change in the data pattern. The 1991 and 1992 winter population peaks were less than the total number of birds observed during the respective summer aerial production surveys. A total of 228 Trumpeter Swans was observed in the summer aerial surveys, including 48 nesting pairs, 30 broods with 102 cygnets, and 25 nonbreeders in five flocks. This indicates that the portion of the flock returning to Lacreek to winter has stabilized, while the production population is expanding. If the high plains population is expanding, but apparently not returning to Lacreek, then a fall migration must be occurring.

Several interesting observations were made this past year on Lacreek-associated Trumpeters. A Trumpeter Swan family group was banded (01RC - 05RC) near Colony, Wyoming, this summer, and seen on Lacreek NWR on 7 December 1992. Ten dead Trumpeter Swans were found under a power line crossing Lake Creek west of the Refuge on 8 December 1992. Three of the swans were badly burned. Work is under way to get the power line marked. Five pairs of swans nested on the Refuge in 1992 on Pools 6, 7, 8, 9, and 11. Three broods totaling 11 cygnets were hatched, but only five cygnets survived to fledge. A first flight by a pair of cygnets was observed on Lacreek NWR. Trumpeters banded in northeastern Saskatchewan in 1991 wintered at Lacreek, and one returned to Saskatchewan in 1992.

POPULATION STATUS AND MOVEMENT

A total of 200 Trumpeter Swans returned to Lacreek NWR following the 1992 breeding season, including 62 cygnets (Table 1). This compares to:

	Total	Cygnets
1991	150	45
1990	225	61
1989	282	61

Fall Trumpeter Swan populations began building on 28 October 1992 with the onset of cold weather when 20 Trumpeter Swans moved into the Refuge. Another surge of cold weather increased the swan population to 89 on 27 November reaching the winter peak of 200 on 20 December 1992. Some winter movements continued to occur and the wintering population declined to 117 on 31 December and then increased to 139 on 5 January 1993.

For the first time, there has been a significant change in the data pattern. The 1991 and 1992 winter peaks were less than the total number of birds observed during the respective summer aerial surveys. The winter peak population has usually been significantly higher than the summer production survey total. The assumption has been that the summer production survey does not find all of the dispersed, nesting birds. Normally, the peak number of cygnets wintering at Lacreek is just slightly less than the production survey count. However, for 1991 and 1992, the wintering cygnet count was significantly less than the production survey count. In summation, the population that returns to winter at Lacreek appears to have stabilized (Table 1), while the aerial production survey indicates an expanding population beyond Lacreek's boundaries (Table 2). If the high plains population (beyond Lacreek's boundaries) is expanding, but apparently not returning to Lacreek, the author optimistically suggests that a fall migration must be occurring.

Table 1. Peak wintering populations on Lacreek NWR.

Winter	Adults	Cygnets	% Cygnets	Total
1992-93	138	62	31	200
1991-92	105	45	30	150
1990-91	164	61	27	225
1989-90	221	61	22	282
1988-89	169	78	32	247
1987-88	182	86	32	268
1986-87	166	63	28	229
1985-86	144	43	23	187
1984-85	190	47	20	237
1983-84	206	57	22	263
1982-83	167	48	22	215
1981-82	172	58	25	230
1980-81	140	56	29	196
1979-80	119	65	35	184
1978-79	138	36	21	174
1977-78	126	65	34	191
1976-77	146	41	22	187

Table 2. Breeding performance of Nebraska, South Dakota and Wyoming Trumpeter Swans. (Surveys conducted in late August - early September.)

Year	# Adults	# Pairs	# Broods	# Cygnets	% Cygnets	Total
1992	126	48	30	102	45	228
1991	117	44	24	89	43	206
1990	127	41	22	68	35	195
1989	152	51	30	79	34	231
1988	---------- No Data ----------					
1987	110	34	23	81	42	191
1986	103	41	21	74	42	177
1985	95	40	22	63	40	158
1984	116	42	28	65	36	181
1983	---------- No Data ----------					
1982	---------- No Data ----------					
1981	104	30	16	54	34	158
1980	120	28	18	44	27	164

PRODUCTION OFF REFUGE

The 1992 aerial production survey was conducted 10, 11, 12, and 13 August. The survey included Bennett, Shannon, Pennington, Meade, Butte, Perkins, Ziebach, Haakon, Jackson, Mellette, and Todd Counties in South Dakota; Cherry, Sheridan, Garden, Grant, McPherson, and Arthur Counties in Nebraska; and Crook County in Wyoming. A total of 228 Trumpeter Swans was observed including 48 nesting pairs, 30 broods with 102 cygnets, and 25 nonbreeders in five flocks. Even though the numbers of nesting pairs and broods have remained somewhat stable since 1989, this is the highest number of cygnets ever observed on the summer aerial survey, 15 percent higher than the 89 cygnets observed last year, and 26 percent higher than the last peak of 81 cygnets in 1987 (Table 2). However, the total number of adults, including flocked subadults and young unproductive pairs, is 1 percent lower than the all time high of 231 in 1989. Even though there have been fluctuations in the number of breeding pairs and production, the production trend continues to increase.

PRODUCTION ON REFUGE

Five pairs of swans nested on the Refuge in 1992 on Pools 6, 7, 8, 9, and 11. The first Trumpeter Swan brood was observed on the north end of Pool 6 on 29 May with four cygnets, but lost two by the end of June. The pair, including 56FA, eventually moved to Pool 9 and fledged only one cygnet. The pair on Pool 7 established a nesting territory, but no cygnets were observed. The Pool 7 pair normally raises cygnets, but may have been disturbed this year by Refuge activities in March and April that involved fish trapping in preparation for a summer drawdown of the unit and late summer carp control. It is not known if disturbance of the nesting site a month prior to nesting had an impact on egg laying or hatching success. The pair on Pool 8 hatched five cygnets in June and fledged four. A pair of swans established a nesting site on a muskrat house in the middle of Pool 9, but did not hatch any cygnets. This nest was very remote and was only observed by aircraft. The pair on Pool 11 hatched two cygnets in June, but lost both. In summary, out of five nesting pairs, three broods totaling 11 cygnets were hatched with only five cygnets surviving to fledge (Table 3). With the exception of the pair in Pool 8, swan production was down in 1992. Aside from the fisheries work that may have disturbed the Pool 7 swans, the swans in Pools 6 and 11 may have been impacted by a graduate student who collected data along transects in those units. He conducted walking transects in the dense cattail portions to collect baseline wildlife use data. The transects were adjacent to the isolated muskrat houses used by the Trumpeters.

MIGRATION OBSERVATIONS

Two Trumpeter Swans with Canadian collars were observed on Lacreek NWR on 29 October 1991. The swans were wearing yellow collars with black alpha-numerics and were identified as 30AC and 31AC. The collars were attached by Len Shandruk of the Canadian Wildlife Service (CWS), Edmonton, Alberta, on 23 July 1991 at Greenwater Lake Provincial Park in northeastern Saskatchewan. Shandruk was advised by Rhys Beaulieu, Regional Wildlife Ecologist, CWS, Hudson Bay, Saskatchewan, that the Trumpeters had been nesting in the area for the last 4 years. Mr. Shandruk reported that the pair did nest again in 1991 and produced one cygnet in their first successful hatch. Two other eggs at the nest did not hatch. Mr. Shandruk also obtained blood samples from the two birds during the capture. An unknown blood disorder was discovered that could possibly affect the reproductive physiology of the female. The male tested normal. The cob (30AC) weighed 26 pounds and the pen (31AC) weighed 21.5 pounds. Bill measurements (tip of bill to the distal tip of the nares) were 56.8 mm, and 54.15 mm respectively.

It is believed that the Canadian nesting pair may be part of the high plains flock that normally winters on Lacreek Refuge and nests throughout western South Dakota, western Nebraska, and northeastern Wyoming. If 30AC and 31AC are Lacreek birds, this is a first record for high plains Trumpeters nesting in Canada. Swan 31AC has not been seen since 24 December 1991. Swan 30AC was observed back at Greenwater Park in Saskatchewan in the spring of 1992, but left in August. It

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

Year	Nesting pairs	Broods	Hatched	Fledged
1992	5	3	11	5
1991	6	6	21	6
1990	5	4	18	8
1989	6	6	16	7
1988	6	5	15	8
1987	6	5	13	11
1986	6	6	19	19
1985	6	5	18	13
1984	5	5	15	7
1983	5	4	17	9
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.

returned to Lacreek on 4 December 1992 and was on the Refuge as of 11 January 1993.

Another Trumpeter, 36FA (AHY-M), that was banded on Lacreek Refuge in 1988, spent the summer of 1990 on the Upper Peninsula of Michigan, at Tee Lake near Blaney Park. It was observed again during the first part of January 1991, at the confluence of the Chippewa and Mississippi Rivers near Wabasha, Minnesota. Swan 36FA was observed back on Tee Lake 20 April 1991, and remained there until 8 June 1991. This swan was observed again on Tee Lake on 7 August 1991 and remained throughout the rest of the summer. Recent reports are not available.

Banding and collaring of subadults and adults will continue in the vicinity of the Refuge to provide an increasing number of marked birds in the area to aide in positive observations. Two Trumpeters were banded in South Dakota, six in Nebraska, and five in Wyoming during 1992, but more needs to be done. There is no doubt that considerable winter pioneering and some migration is taking place, but the loss of birds, though undocumented, must be significant. With the best scientific guidance available, we restored these magnificent birds to their former breeding range without adequate consideration for their winter survival. It is now incumbent upon us to designate suitable wintering habitat and assist the swans in finding it.

NOTEWORTHY EVENTS

Trumpeter Swans 01RC - 05RC, banded as a family group near Colony, Wyoming, this summer, were seen in Pool 8 on the Refuge on 7 December 1992. The Wyoming birds were not seen again in December. A cygnet, 01RC, was found in a weakened condition with another unbanded cygnet on the Johnson property west of the Refuge on 6 January 1993. Swan 01RC and the other cygnet were caught and examined. Cygnet 01RC was quite thin and could not fly, but exhibited no other physical injury. The unbanded cygnet was also flightless, but was in much better physical condition, weighing almost twice as much as 01RC. These birds were not siblings, because all the cygnets in the Wyoming brood were caught and banded along with the cob. (The pen was flying and could not be caught.) Both cygnets were released on an open spring-fed pond on the Johnson property with plans to supply supplemental feed. The next day the unbanded swan was gone while 01RC remained on the pond. The unbanded swan was found and caught, and taken to the feeder pond on the Refuge. The following day 01RC was also gone and has not been seen since. The fate of the other banded Wyoming cygnets is unknown. The Wyoming adult, 05RC, was seen without the cygnets on the Refuge on 11 January 1993.

Three dead Trumpeter Swans were found under a power line crossing Lake Creek west of the Refuge on 8 December 1992 by linemen from Lacreek Electric investigating power interruptions. Two of the swans were badly burned. An additional four swans, (three cygnets and one adult) and two feather piles were found 4 January 1993 under the same power line. The power line crosses a normal wintering area, and since the power line is not adjacent to a road, unnoticed fatalities may have occurred there in the past. Work is under way to get the power line marked.

David Graber at Mingo NWR in Puxico, Missouri, provided the following data on Trumpeter Swans wintering at Mingo. Trumpeter Swans 82TY and 98TY, the first released swans to nest at Mingo, have not been seen since 1990. Swan 82TY was banded at Lacreek as an adult (AHY) on 20 July 1976 and 98TY, who had been paired with 82TY for some time, was banded as an adult on 13 July 1982 just prior to the transfer of the pair to Mingo in 1982. Considering the ages of these birds, they may have simply died.

Graber also reported that six Trumpeter Swans wintered at Mingo in 1989-90, as many as six wintered in 1990-91, and 13 wintered in 1991-92, but only two were present in December 1992. Most of the birds wintering at Mingo are Wisconsin-released Trumpeters, but a few unmarked swans were included.

First flights of the cygnets normally occur the last 2 weeks in September. The following is an account of the first flight by a pair of cygnets on Lacreek NWR as observed by Jay Peterson, Assistant Manager, on the morning of 17 September 1991. The observation was made through a spotting scope from the headquarters building that overlooks Pool 8. Peterson explains: "I observed two, young-of-the-year Trumpeter Swans, apparently learning how to fly on Pool #8. Interestingly, they were being followed very closely by one of the parents. The two cygnets were flying awkwardly, with their necks slightly bent in sort of an S-shape, approximately 15 - 25 feet above the water. In addition, their flight attitude was such that it was obvious they were proceeding slowly and had to adjust their center of gravity by "rearing back" their bodies to maintain flight. They looked as though they were dragging their tails in flight. Following close behind was the adult Trumpeter flying in much the same attitude, apparently "coaching" the rookie flyers. This flight by the three birds lasted only a few seconds and they finally all landed in an opening within the cattails. The length of the flight was about 50 yards. I also heard some swan vocalization coming from that area of the marsh, but couldn't identify which bird was actually making the sound."

TRUMPETER SWAN RESEARCH NEEDS

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ABSTRACT

This paper presents some ideas about future research needs for Trumpeter Swans (Cygnus buccinator) based on my personal observations, recommendations from the Third International Swan Symposium, and an informal review of the literature. Recommendations for future research include genetic studies, comparative quantitative evaluation of range expansion programs, and long-term integrated studies of demographic characteristics, behavior, and habitat selection.

INTRODUCTION

The purpose of this paper is simply to stimulate individuals who work with Trumpeter Swans (Cygnus buccinator) to think about what they need to know and what questions they might be able to answer during the course of their own work. It is not meant to provide a comprehensive overview or outline a specific program.

None of the ideas presented here are original. All have their source with other individuals, programs, or published literature.

Typically, "real science" involves the testing of hypotheses developed beforehand from prior observation. This has been termed the hypothetico-deductive, or H-D method (Romesburg 1981). It can be difficult to employ this method before sufficient basic biological and ecological data are accumulated, but enough basic data on many aspects of Trumpeter Swan biology are available so that the H-D method can be employed, and so that we can start asking "better" questions (Gavin 1991, Nudds and Morrison 1991, Sinclair 1991).

Because research priorities are given to other species, swan managers, who rarely have the luxury of time and money for biological investigations of any depth, will remain a primary source of information on swan biology and ecology. Although in many cases, managers can, and do, generate appropriate hypotheses, rigorous testing will remain difficult. Therefore, we can expect "retroduction", i.e. adopting untested hypotheses (Romesburg 1981), to continue to play a major role in swan management, at least until wildlife agencies see fit to fund significant swan research projects.

The correlation of various biological and environmental parameters gathered during the course of normal monitoring (e.g. Gale et al. 1987) can also provide tremendous insight into Trumpeter Swan ecology. However, because the data collected may or may not contain the desired information to test a specific hypothesis, only certain hypotheses can be tested, and results may be ambiguous. A little forethought and consultation between managers and researchers can result in the formulation of solid hypotheses and the collection of sufficient appropriate data to test them. An additional benefit to this dialogue is that managers can express their information needs to the researchers. After all, a primary goal of research should be to provide managers with the information they need to make good management decisions.

METHODS

My suggestions for future Trumpeter Swan research are based on three primary sources. First, having been a swan manager/biologist until recently, I developed some notion of the kinds of information that I would have liked to have had, or thought I would need, to make good decisions. Naturally, these ideas are colored by my own experience and biases. Second, a number of biologists at the Third International Swan Symposium at Oxford, England, in 1989 developed a list of recommendations for future research needs

based on data presented at that conference (Moser 1991). Third, in 1990 I compiled a short literature review for a Swan Research Newsletter to determine prior Trumpeter Swan research emphases and to identify major gaps in the published literature. I have reviewed more recent publications and added them to that analysis for this paper. The following research "needs" are drawn from all of these sources.

RESULTS AND DISCUSSION

Genetic studies

A number of genetic studies are needed. Vyse and Barrett (1981) and Barrett and Vyse (1982) are the only studies on Trumpeter Swan genetics that have been published to date. These studies compared heterozygosity and genetic variability between Alaskan, Grand Prairie, and Red Rock Lakes swan flocks. J. Marsolais at McMaster University, is currently investigating Trumpeter Swan genetics.

I contend that further studies are needed to clarify taxonomic status between swans worldwide (especially the relationship between Whooper Swans (Cygnus cygnus) and Trumpeters); determine the interchange between the several populations, subpopulations, and flocks; investigate correlations between specific genotypes and observed behavioral and biological parameters; and document the mean heterozygosity or allelic diversity of restored flocks and Trumpeters currently used in restoration efforts.

The taxonomy of the various swan species is probably of little concern to most managers. However, there is some question about taxonomic relationships. The American Ornithologists Union (1983) identifies the Trumpeter Swan as Cygnus buccinator and the Whooper Swan as Cygnus cygnus. Others classify these as conspecifics, with subspecific designations C.c. buccinator and C.c. cygnus (Scott 1972, Johnsgard 1974). While it has not yet become an issue with swans, Geist (1992) presents several examples of inconsistencies in ungulate classification that led to controversies, legal cases, and questionable management programs. Taxonomic status *does* impact the management and conservation of species.

Determining the current genetic structure of the various populations and flocks allows measurement of heterozygosity and inferences about genetic interchange (Rhodes et al. 1991). This permits managers to evaluate stocks for uniqueness and monitor changes in them over time. With this information managers can document and quantify the loss of forms or species, such as the hybridization of mallards (Anas platyrhynchos) and Black Ducks (Anas rubripes), define shifts in migration patterns of prairie Canada Goose (Branta canadensis) populations, and correlate genetic variation with "functional characteristics" (e.g. survival, reproductive output) at the population level (Rhodes et al. 1991).

Similar information can be used at the flock or pair level. Bacon (1981) correlated the presence of specific enzymes with various reproductive parameters (esterase with clutch size and laying date, and lactate dehydrogenase (LDH) with breeding, brood size and probability of fledging cygnets) in Mute Swans (Cygnus olor). He was also able to calculate the relative fitness of specific genotypes. Bacon and Andersen-Harild (1987) documented that an allele of LDH was associated with colonial breeding, a relatively rare phenomenon in Mute Swans. The management implications of documenting specific relationships between genotype and characteristics such as reproductive output are obvious. Might there also be genetic correlates with other biological or behavioral characteristics, such as dominance, migratory behavior and habitat selection?

One of the most obvious benefits of associating genotypes with predictable biological characteristics such as reproduction is in range expansion efforts. Rather than placing whatever birds can be obtained, it might be possible to choose swans with preferred attributes for the specific situation, e.g. sedentary versus migratory and high reproductive output. Fewer swans would be needed for any given project, and programs

would be more likely to succeed, saving swans and funds.

Another benefit of incorporating genetic considerations into range expansion projects is preventing inadvertent loss of genetic variability with subsequent problems in the restored flock, by selecting source populations and selecting individuals for release. Leberg (1990) discusses the importance of genetic variation in introduced populations, selection of source "material", and techniques to enhance the success of reintroductions using genetic information. Future range expansion projects should carefully consider whether they have adequate founders and appropriate sources. Similarly, some measure of genetic variation in Trumpeter Swans already released in restoration projects might point out potential problems and allow for remedial action.

Some will argue that the initial data and funding are not adequate to incorporate these techniques into range expansion projects. I would counter with the argument that prior use of these methods might save a great deal more money, and more importantly, swans. Was a lack of genetic variability a factor in the problems with range expansion projects at Malheur, Ruby Lakes, and Turnbull? Is it a factor in the small flocks near Augusta, Montana, and Cypress Hills, Saskatchewan? Will it be a problem in Minnesota or Wisconsin?

Evaluation of range expansion programs

There are other opportunities for valuable research associated with range expansion projects. These include documenting successful and unsuccessful techniques, comparing advantages, disadvantages, and costs of the various methodologies (both now and in future years), and testing predictive models of success.

Every Trumpeter Swan Society Conference has a series of papers on the various range expansion programs underway. At the 1988 Conference I was struck by how everyone was doing things differently. Naturally, each agency has its own policies, funding, facilities, expertise, and biases that it has to work with, and these are unlikely to be duplicated between any two agencies. Still, it seems that a quantitative comparison of techniques and successes would be of immense value to others who may be getting involved in similar programs in the future.

Scott and Carpenter (1987) state "If translocation and reintroduction of birds into the wild are to be viable management tools, an objective way to measure the success of the procedures must be developed." They suggest marking all released birds; distinguishing all birds produced by captive rearing, puppets or surrogate parents from wild reared birds; documenting conditions under which birds are kept, reared and released; documenting conditions of release habitat and environmental conditions; monitoring the movements and activities of released birds; determining the survival and breeding success of released birds by age, sex, rearing and release technique; and documenting the use of medications, drugs, etc. used on birds (Scott and Carpenter 1987). Not only will such analyses benefit others involved in swan programs, but they can be used to develop successful projects involving endangered waterfowl and other birds. I suggest that such analyses might benefit the agencies involved, by indicating which methods are most cost efficient, and ultimately, most successful.

Griffith et al. (1989) evaluated numerous translocation programs and defined criteria that characterize successful programs, including whether a species is native and translocated into historic range, whether it is released into good habitat and how many individuals are released. They also developed a predictive model to estimate potential success of translocations. While most programs involving Trumpeter Swans incorporate appropriate criteria (e.g. native species, release in historic range, etc.), some aspects such as quantifying descriptions of "excellent" versus "good" versus "poor" habitat need clarification. Exactly what is meant by "good" habitat? Is your definition the same as mine? Can different quality habitats be separated quantitatively?

The number of swans needed for specific translocation efforts also needs clarification, if only for planning how many donor eggs or

cygnets are required. How many swans must be released, and how many must survive for how long and reproduce at what rate in order to have a self-sustaining population? Modelling these parameters to generate response curves would be valuable to others planning programs, and allow donor agencies to better allocate existing swans.

Range expansion programs are going to be a major management tool for some time to come. It behooves us to do the best job we can.

Long-term studies

Even a cursory acquaintance with the literature on Mute and Bewick's Swans (Cygnus columbianus bewickii) indicates how many papers are based on long-term studies. Data often goes back decades, and sometimes much farther. Cramp (1972) reports on Mute Swan production records since 1823 on the Thames. The first recorded reference to Mute Swans at Abbotsbury and the Fleet was in *1393*, "although the first surviving record of numbers dates *only* [emphasis added] from 1591, when there were 410 swans and 90 cygnets" (Anon. 1987).

The only long-term waterfowl studies I am aware of in North America are those of the Eastern Population of Tundra Swans (e.g. Bart et al. 1991, Limpert et al. 1991) and Dr. Fred Cooke's and his colleagues' work on Snow Geese. Dr. Harold Hanson of the Illinois Natural History Survey is in the final stages of publishing The White-checked Geese: Taxonomy, ecophysiographic relationships, biogeography and evolutionary considerations. It will present the results of his long-term studies of the Canada Geese of North America. The U. S. Fish and Wildlife Service's (USFWS) Northern Prairie Wildlife Research Center has some limited long-term data on waterfowl at certain sites (primarily arrival dates, nest site selection, and reproductive success for ducks). However, these data are the coincidental result of continuing work at convenient study areas rather than a conscious effort to gather long-term data. As a result, only limited lengthy data sets are available, and these are only useful for certain analyses.

Long-term research requires that a certain amount of basic biological information on a species be available, in order to develop appropriate hypotheses. Much of the basic information concerning Trumpeter Swan biology, ecology, and behavior has been gathered, and this basic work continues. Recent studies by Grant (1991), Paul Henson (pers. comm.), Snyder (1991) and Squires (1991) on foraging ecology, behavior and habitat use, for example, are important additions to our knowledge of Trumpeter Swans.

At the same time, however, I believe there is enough basic information on Trumpeters and other species to begin to look at larger questions dealing with how populations function demographically, behaviorally, and with their biotic environment (e.g. climate, habitat). The length of the study itself is not important. Rather, it is the sort of information and understanding that can only be obtained by examining biological and ecological characteristics over time. The difference is in *description* (i.e. number of nests per habitat type, mean number of eggs per nest or cygnets produced per year), versus *explanation* (i.e. those same data viewed from the standpoint of winter nutrition, social status, experience, duration of pair bond, nest and brood habitat characteristics and genetics). Shorter studies are useful for testing certain hypotheses and providing guidelines for future work, and this work should be encouraged to continue as well.

Examples of questions that can be answered from long-term, integrated studies follow. Bacon and Andersen-Harild (1989), Coleman et al. (1991), Evans (1981), Mathiasson (1987), and Scott (1988, 1991) investigated lifetime reproductive success and the factors involved. Evans (1979) and Rees (1989) studied migratory patterns over time and between parents and their offspring. Winter migration, movement patterns, site selection and the relationship to weather was examined by Evans (1981). Gale et al. (1987) documented relationships between reproductive success and winter feeding programs and weather, and between winter weather and mortality rates, among other things.

Other questions abound. While data on habitat selection, heritability of social status and behavioral traits and lifetime reproductive success are available for some species in some habitats, it seems important to me to try and tie all of the various studies together for each species in specific habitats. Integrating biological and behavioral data on a single flock or population of Trumpeters seems more likely to lead to significant insights and comprehensive models on how swan populations function in relation to their environment than will separate, uncoordinated studies on widely separated flocks.

Sites like the Copper River Delta and refuges like Kenai, Red Rock Lakes, and Lacreek would be excellent places to conduct long-term studies. They have stable flocks of Trumpeter Swans; they are managed by the U. S. government and are unlikely to be significantly altered; they have good data on numbers, habitat use, nesting, and production to build on; and both the U. S. Forest Service and the USFWS have research branches with existing expertise. The problem seems to be convincing either agency, or any government agency for that matter, to fund long-term swan research. I have no answer to that particular dilemma.

CONCLUSIONS

There are, of course, numerous other aspects of Trumpeter Swan biology that need study. Examples include continuing to monitor numbers and distribution, clarifying cygnet food habits, documenting responses to habitat manipulation, surveying diseases and parasites, managing conflicts with hunting programs, testing hypotheses pertaining to nutrition and subsequent reproduction and other "retroductive" knowledge (perhaps with captive swans?), and so on, *ad infinitum*. While I have outlined my thoughts on future research needs, I make no claim that these are the only, or even the most important, topics.

During the informal survey of the literature I referred to earlier, I found 111 papers that I considered research oriented. Many were multi-topical. The majority of those papers dealt with status and distribution, causes of mortality, and behavior. Moderate effort had been expended on "ecology", demographics, food habits and foraging, habitat use and requirements, and migration, movements, and activity patterns. Little has been done with taxonomy, anatomy, physiology and genetics. Since so few papers dealing with Trumpeter Swans were found, one could easily argue that even the most well studied aspects of Trumpeter Swan biology require further investigation.

I hope that the ideas expressed in this paper have made some small contribution towards encouraging more definitive research on Trumpeter Swans.

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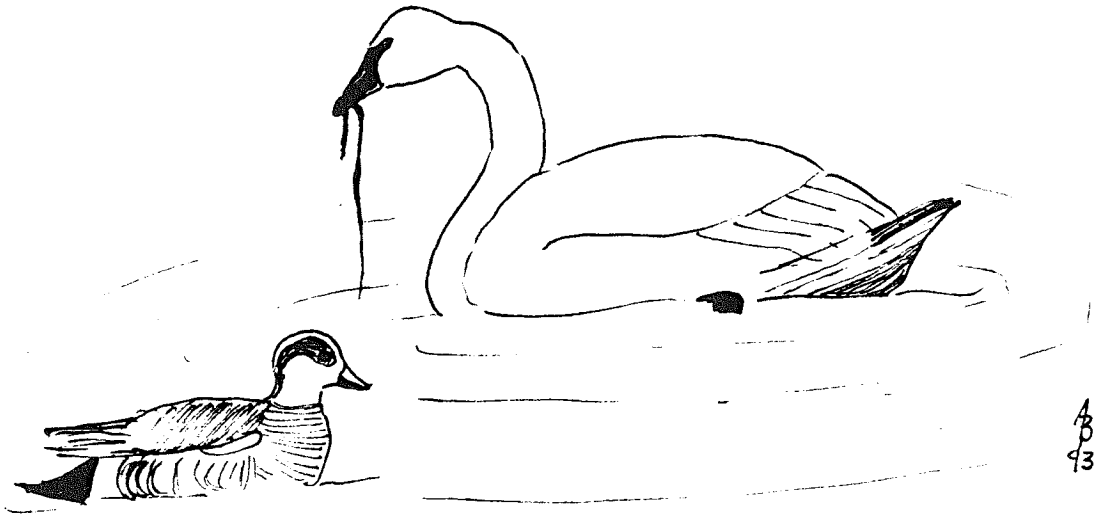

THE GENETIC STATUS OF TRUMPETER SWAN (CYGNUS BUCCINATOR) POPULATIONS

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ABSTRACT

Habitat restoration, captive breeding and reintroduction efforts are all essential strategies used in recovery programs of threatened or endangered species. However, in recent years captive populations, such as the Puerto Rican Parrot population (Brock and White 1992), have begun experiencing reduced productivity and increased incidence of disease which has in turn begun to jeopardize the success of the recovery programs. Concerns regarding the viability of captive populations have led conservationists to recognize the importance of knowing the genetic status of the species when establishing or maintaining a recovery program.

The objective of this research is to provide Trumpeter Swan management teams with genetic information that will enable them to better plan their captive breeding programs and their reintroduction efforts, as well as help better maintain the existing programs. To accomplish this goal, a study of the genetic diversity of this species has been undertaken. We have begun by examining the level of genetic variability within and among the natural and reintroduced populations of Trumpeter Swans. We will then examine whether the three natural populations are different genetic stocks. We also hope that this genetic information will enable us to better understand the mating system and the population structure of this species. These questions are being investigated with the use of such molecular tools as DNA fingerprinting, hypervariable single focus genetic markers and mitochondrial DNA markers.

DNA fingerprinting is a molecular technique which uses hypervariable multilocus genetic markers to examine the DNA profile of an individual (Jeffreys et al. 1985). It has been called a DNA "fingerprint" because in most species examined every individual (except identical twins) has a unique DNA pattern much as every individual has a specific fingerprint. Because these markers are inherited in a Mendelian fashion (Jeffreys et al. 1985), it is possible to determine the genetic relationship of individuals by assessing the proportion of bands they share (Lynch 1988 and 1990, Honma and Ishiyama 1990). This assessment is measured as band sharing coefficients (BSC) or percent band sharing. This technique is, therefore, a general indicator of the level of genetic diversity found in a species.

DNA fingerprints of 28 Pacific Coast birds, nine Interior Canadian swans and 68 Tristate birds have been assessed. Fourteen unrelated birds from the Pacific Coast Population had an average percent band sharing of 28 percent, nine unrelated birds from the Interior Canadian Population shared on average 45 percent of their bands and 14 unrelated swans from the Tristate Population had an average percent band sharing of 36 percent. The fact that unrelated birds from the Interior Canadian and Tristate Populations share a much greater percent of their bands than unrelated birds from the Pacific Coast Population supports the hypothesis that genetic variability was lost when these two flocks experienced a population bottleneck in the early 1900's. These results also support the idea that the Pacific Coast Population is the most outbred and healthiest of the three natural populations. Although the average percent band sharing for the Pacific Coast Population was the lowest, some pairs of individuals did have high percent band sharing. Thus indicating that the assumption that the birds on different ponds are unrelated may not always be valid. These data suggest that Trumpeter Swans return to their natal areas to establish their own breeding territories. However, further analysis needs to be done before this hypothesis can be verified.

DNA fingerprints of Trumpeter Swans from several reintroduced populations have also been assessed. A total of 80 birds from the Ontario population, 65 from the Michigan population and 24 from the Hennepin Parks population in Minnesota has been analyzed.

The Ontario population of Trumpeter Swans numbers approximately 100 birds which includes 17 mated pairs. Recently this population has been plagued with a decrease in productivity due to an increase in infertile eggs and embryo death. DNA fingerprinting was used to determine whether there was a genetic basis for this decrease in productivity. All 17 pairs from the Ontario reintroduced population were DNA fingerprinted and results from eight of these pairs have been analyzed. With the use of a Spearman statistical test a negative correlation of 0.86229 ($P < 0.01$) was found between the reproductive success and the BSC of these eight pairs. This statistically significant result indicates that those pairs with a high BSC have lower reproductive success than those pairs with a low BSC. These data suggest a genetic cause to this population's decrease in productivity. A pairing strategy which should increase this population's reproductive success significantly can now be developed. First, all pairs should be analyzed and those found to have high levels of band sharing should be broken up. Secondly, these birds, as well as all adults should be mated with birds with whom they share the least amount of bands. In order to accomplish this goal, DNA fingerprints of all members of this population must be made and analyzed.

The Michigan reintroduced population is made up of approximately 90 birds, 80 of which are from the Pacific Coast Population. The other birds are of avicultural stock. Twelve of these birds will be used to establish a captive population while the others will or have been released to the wild to form a free-ranging population in the State. DNA fingerprinting analysis will be used to ensure that this captive population begins with the greatest amount of genetic variability possible. To accomplish this goal, DNA fingerprints of all 90 swans must be made and analyzed. Those birds which share the least number of bands will be chosen to found the captive population. DNA fingerprints of 65 of these birds have been made, however, the data is incomplete and thus analysis has not yet begun. The process of making and analyzing DNA fingerprints of the rest of the birds is underway. DNA fingerprinting will also be used to correct a brood mix up which occurred when the eggs were collected in Alaska.

The Hennepin Parks Trumpeter Swan population is one of two reintroduction programs in the State of Minnesota. This population is composed of approximately 80 birds from the Tristate and Pacific Coast Populations. DNA fingerprints of all available samples have been made (i.e. 24 birds), however the results have not yet been analyzed.

DNA fingerprinting will also be used to compare the level of genetic variability within and between broods of Trumpeter Swans from the natural and reintroduced populations. This comparison will give us further insight into the general level of genetic diversity.

The information generated from this genetic analysis will directly benefit the Trumpeter Swan recovery efforts already in place and guide future plans, thereby assisting in accomplishing our goal of reestablishing this magnificent species throughout North America.

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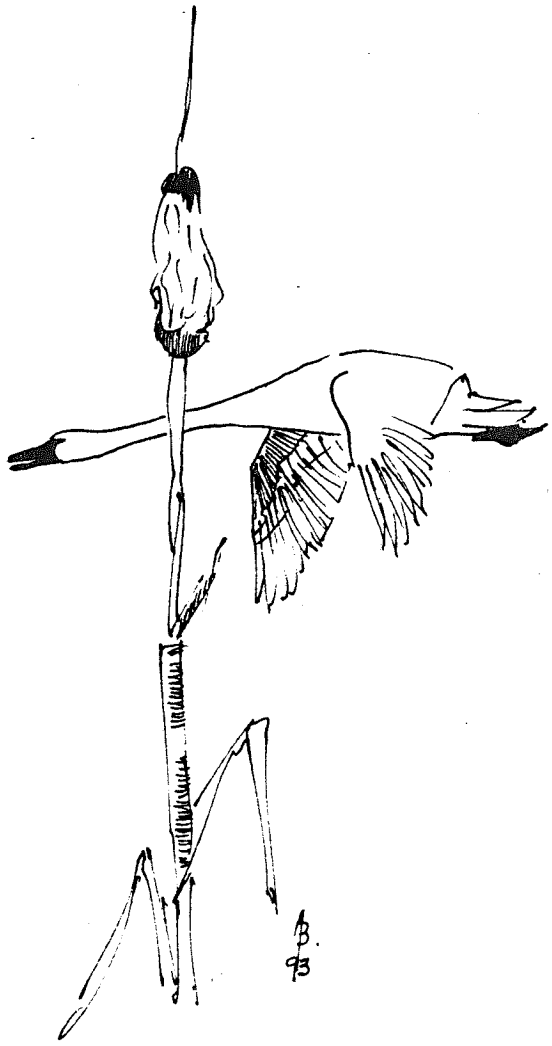

SWANNEST: A DATABASE MANAGEMENT PROGRAM FOR TRUMPETER SWAN NESTING AND REPRODUCTION DATA

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ABSTRACT

In 1990, a computer program called SwanNest was developed at Red Rock Lakes National Wildlife Refuge (RRLNWR) for compiling and analyzing Trumpeter Swan nesting and reproduction data. The program is strictly menu-driven so that it can be used by anyone regardless of their computer skills. The program's operation, capabilities, and potential uses are described. The main advantage of SwanNest is that it allows data to be easily retrieved in a variety of ways and then quickly summarized to help answer questions pertinent to management considerations. SwanNest was designed for use within the Tristate Region, but it could easily be adapted for use throughout the United States and Canada, providing a standardized system for comparing and exchanging Trumpeter Swan reproduction data.

INTRODUCTION

SwanNest is a database management computer program which was originally designed as a tool to help managers at RRLNWR answer questions about basic Trumpeter Swan breeding biology. In the past, data were gathered, but were not fully utilized because there was no time for more extensive organization or analysis. At the same time, managers needed more information to make informed decisions about Trumpeter Swan management. It was decided that a computer program that was quick and easy to use could fill this need, and so SwanNest was developed.

DISCUSSION

How SwanNest works

SwanNest is written for use with the database management program dBASE III+. However, SwanNest is strictly menu-driven so that no knowledge of dBASE is necessary. The only computer skills required to use SwanNest are the abilities to turn the computer on and off, to use the keyboard, and to follow on-screen instructions. Within the program, options are offered in menu form, and users are prompted when and how to enter data.

Arrangements can be made for running SwanNest without dBASE III+ for those who do not have it already, but a fee would be required.

What SwanNest can do

SwanNest sets up three types of data files. The first file is for raw data collected during visits to nest sites. This includes information such as nest status, number of eggs present, incubation stage, date of visit, etc. The second file is for supplemental data collected after the birds have left the nest and for summarizing the raw data from nest visits. This includes information such as whether the nest was successful, dates of nest initiation, egg laying, hatching, fledging and the number of cygnets hatched and fledged. This file also contains information on possible hazards to a nest. The third file is for nest location data and basic habitat information. Table 1 lists the various fields (types of data) recorded in each of these files.

Special data collection forms were designed to be used in conjunction with SwanNest. These forms are set up so that data are collected in exactly the same format as they are entered into the computer. These forms are shown in Figure 1.

After data have been entered, SwanNest can generate three types of reports. These reports correspond to the three file types: nest

Table 1. Data fields for three SwanNest files.

FILE 1: Nest Visit Raw Data

Data Type[1]	Field Size[2]	Description
C	25	Water body name
C	18	Identification number[3]
C	2	Nest number
C	5	Date (month/day) of nest visit
C	2	Year
C	2	Method of nest visit[4]
C	1	Number of adults present
C	2	Age of cob
C	2	Age of pen
L	1	Adult in incubating posture?
C	1	Number of eggs present
C	5	Incubation stage (range, in days)
C	1	Number of eggs which failed to hatch
C	45	Comments regarding egg failure
C	1	Number of cygnets hatched
C	1	Number of cygnets active in territory (after hatching and before dispersal from nest territory)
C	1	Number of cygnets at time of dispersal
C	4	Nest status[5]
C	45	Nest status comments
C	12	Observer (last name)
C	65	General comments

1 C = any character (letters, numbers, symbols)
N = numbers only
D = date
L = logical (true-false, yes-no)

2 Number of characters accepted

3 Identification number
A - B - C - D - E - F
A: State (two letter postal code)
B: County (first four letters)
C: Locale (two letter codes, can be tailored for other areas)
RR = on RRLNWR
CV = off refuge, in the Centennial Valley
D: Habitat type (single digit codes)
C = creek
D = reservoir (dam)
I = irrigation ditch
L = lake
M = marsh
P = pond
R = river
W = wetland
E: Specific water body (two digit code, grouped by habitat type code above, can be tailored to any area)
C - 01 = Red Rock Creek
02 = Elk Springs Creek
03 = Odell Creek
:
L - 01 = Upper Red Rock Lake
02 = Lower Red Rock Lake
03 = Swan Lake
:
:
F: Territory number (For use if any given pair has more than one nest within its territory. This code is to differentiate territories with multiple nests. If there's only one nest within each pair's territory, use nest number here.)

4 Nest visitation method
GR = ground (foot, truck)
BO = boat
FW = fixed-wing aircraft
HE = helicopter

5 Nest status codes (up to four may be used together)
1 = nest/territory occupied (adult present)
2 = nest/territory unoccupied
3 = nest active (eggs laid)
4 = nest inactive
5 = nest successful (eggs hatched)
6 = nest unsuccessful
7 = only one adult present in territory
8 = other species occupying nest/territory
9 = status unknown

FILE 2: Supplemental Data and Summary Information

Data Type[1]	Field Size[2]	Description
C	25	Water body name
C	18	Identification number
C	2	Nest number
C	2	Year of survey(s)
C	1	Source of data
C	1	Survey execution[5]
C	4	Nest status
C	2	Clutch size
C	1	Number of eggs that hatched
C	1	Number of cygnets after hatch and before dispersal
C	1	Number of cygnets that dispersed from the nest site
C	1	Number of cygnets that fledged
D	8	First date: adults arrived on the territory[6]
D	8	Second date (if a range is used)[6]
C	1	Code for adult arrival date(s)[6]
D	8	First date: egg laying
D	8	Second date (if a range is used)
C	1	Code for egg laying date(s)
D	8	First date: hatching
D	8	Second date (if a range is used)
C	1	Code for hatching date(s)
D	8	First date: cygnet dispersal from nest territory
D	8	Second date (if a range is used)
C	1	Code for cygnet dispersal date(s)
D	8	First date: adult dispersal from nest territory
D	8	Second date (if a range is used)
C	1	Code for adult dispersal date(s)
D	8	First date: fledging
D	8	Second date (if a range is used)
C	1	Code for fledging date(s)
L	1	Did the nesting attempt fail? Y/N
D	8	First date: nest failure
D	8	Second date (if a range is used)
C	1	Code for nest failure date(s)
C	65	Comments on the reason for nest failure
C	12	Cob band numbers
C	12	Pen band numbers
C	12	Cygnet band numbers (lowest number of a range)
C	12	Cygnet band numbers (highest number of a range)
C	15	Cob collar (background/character colors, characters)[7]
C	15	Pen collar (background/character colors, characters)[7]
C	1	Potential hazards rating[8]
C	250	Comments on hazards
C	250	General comments
C	45	Person preparing summary report
D	8	Date summary prepared

5 Survey execution
- 1 = nest not checked
- 2 = nest not located
- 3 = no occupancy check
- 4 = no activity
- 5 = unknown
- 6 = complete survey(s)

6 Dates and date codes
Dates may be an exact known date, a range of known dates, or approximate dates.
- K = known
- E = estimated/approximate
- U = unknown
- N = not applicable

7 Collars
Background color (2 digits)/number color (2 digits), number. Example: red collar with white numbers 19 = rd/wh19

8 Potential hazards rating
Include potential and known hazards and conflicts, both natural and man-made, in making this evaluation.
- 1 = low
- 2 = moderate
- 3 = high

FILE 3: Nest Location and Site Description

Data Type[1]	Field Size[2]	Description
C	25	Water body name
C	18	Identification number
C	2	Nest number
C	2	Year of survey
C	3	Legal location: township
C	3	Legal location: range
C	2	Legal location: section
C	2	Legal location: quarter section
C	2	Legal location: ¼ of quarter section
C	4	Elevation (in feet)
C	2	Latilong
C	4	Latitude
C	5	Longitude
C	2	Type of site nest constructed on[9]
C	35	Material used in nest construction
C	35	Landowner's name
C	254	Directions to nest
C	254	General comments on location or site description
C	35	Name of USGS quad map covering the nest site
C	35	Person who prepared this report
D	8	Date this report was prepared

9 Nest site
- BL = built on Beaver Lodge or dam
- MH = built on Muskrat House
- FP = built on artificial Floating Platform
- NI = built on a Natural Island
- EV = built in Emergent Vegetation
- OO = On Other

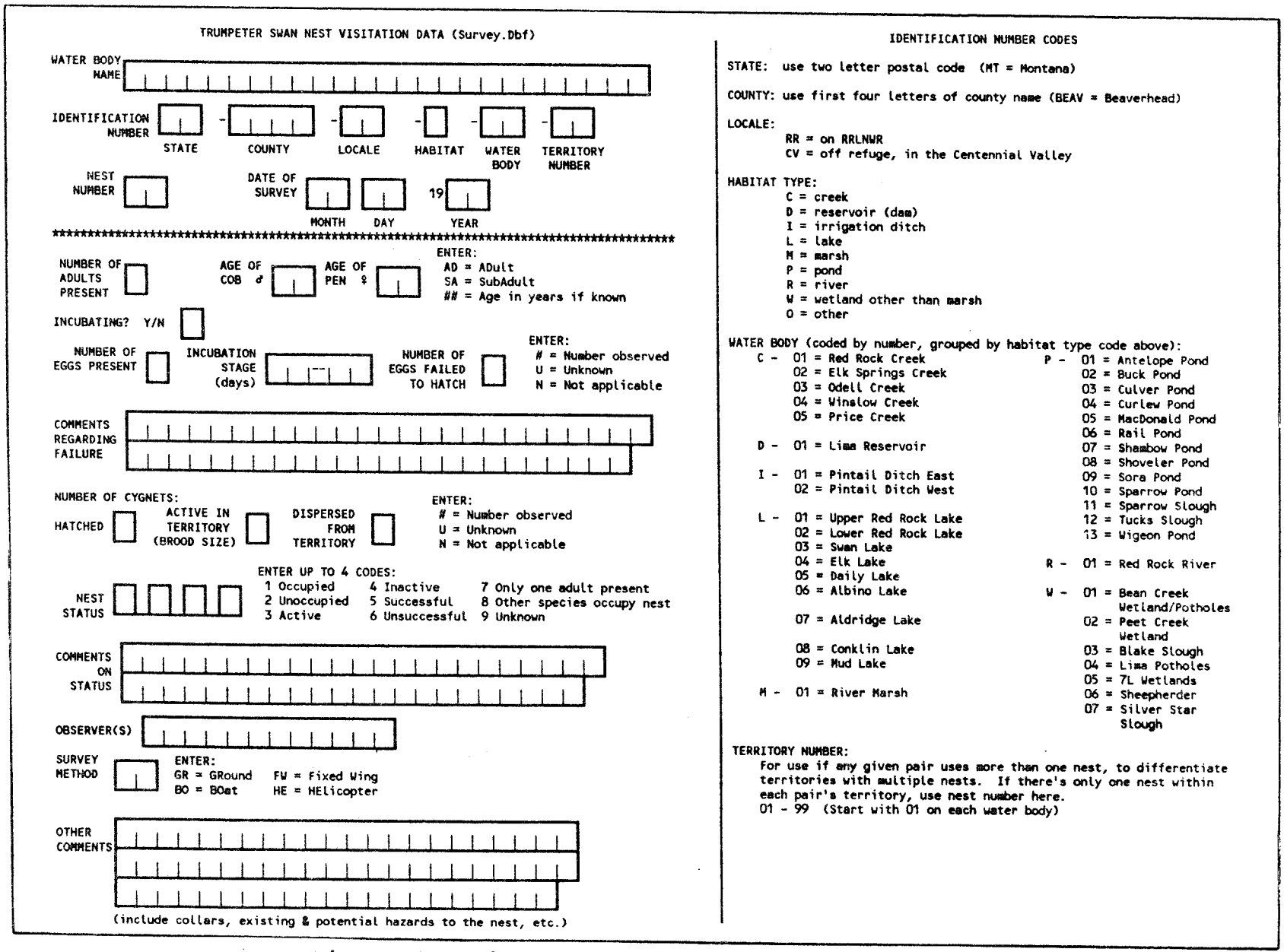


Figure 1. Field data forms used with SwanNest.

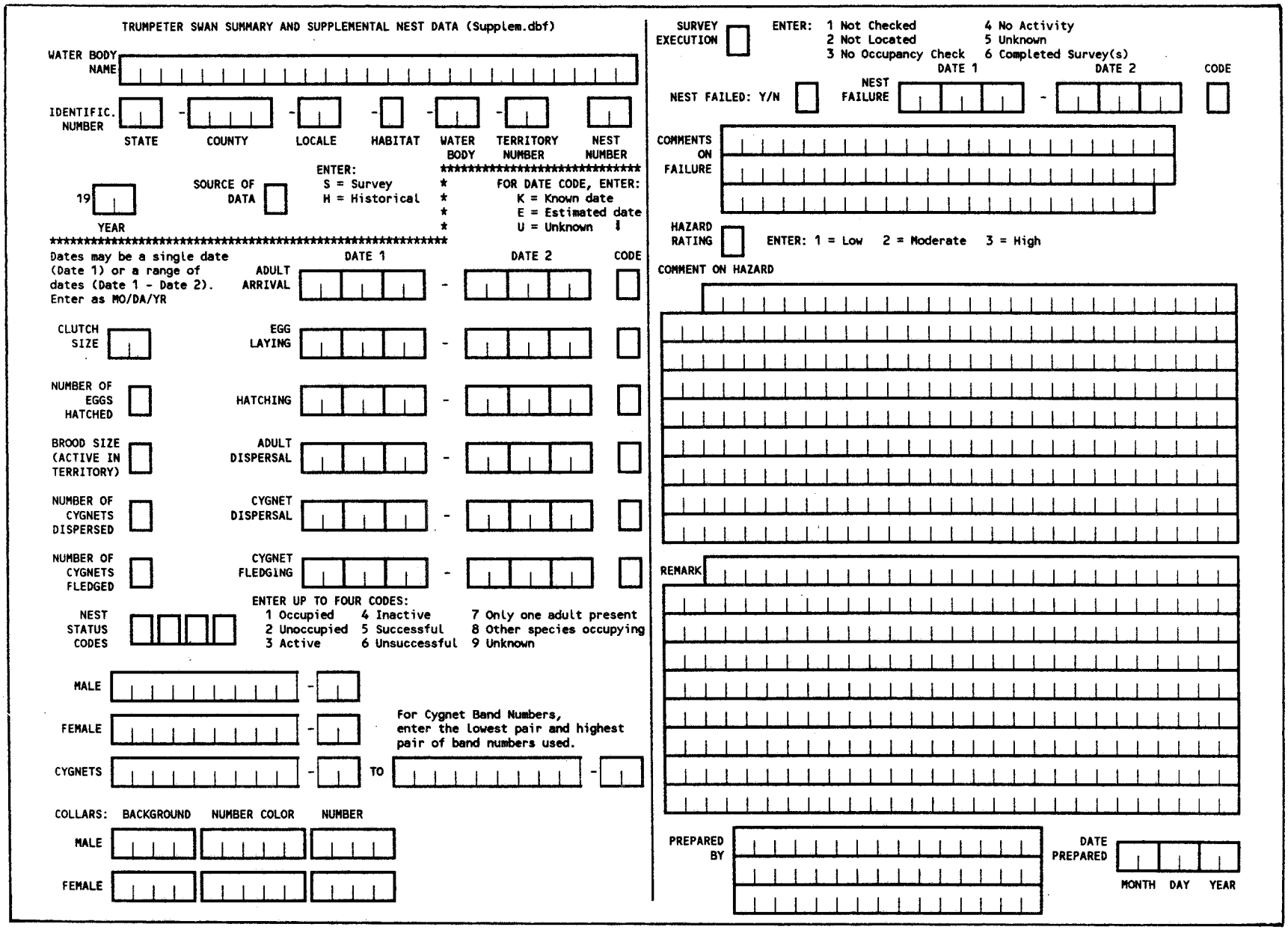


Figure 1 (Continued). Field data forms used with SwanNest.

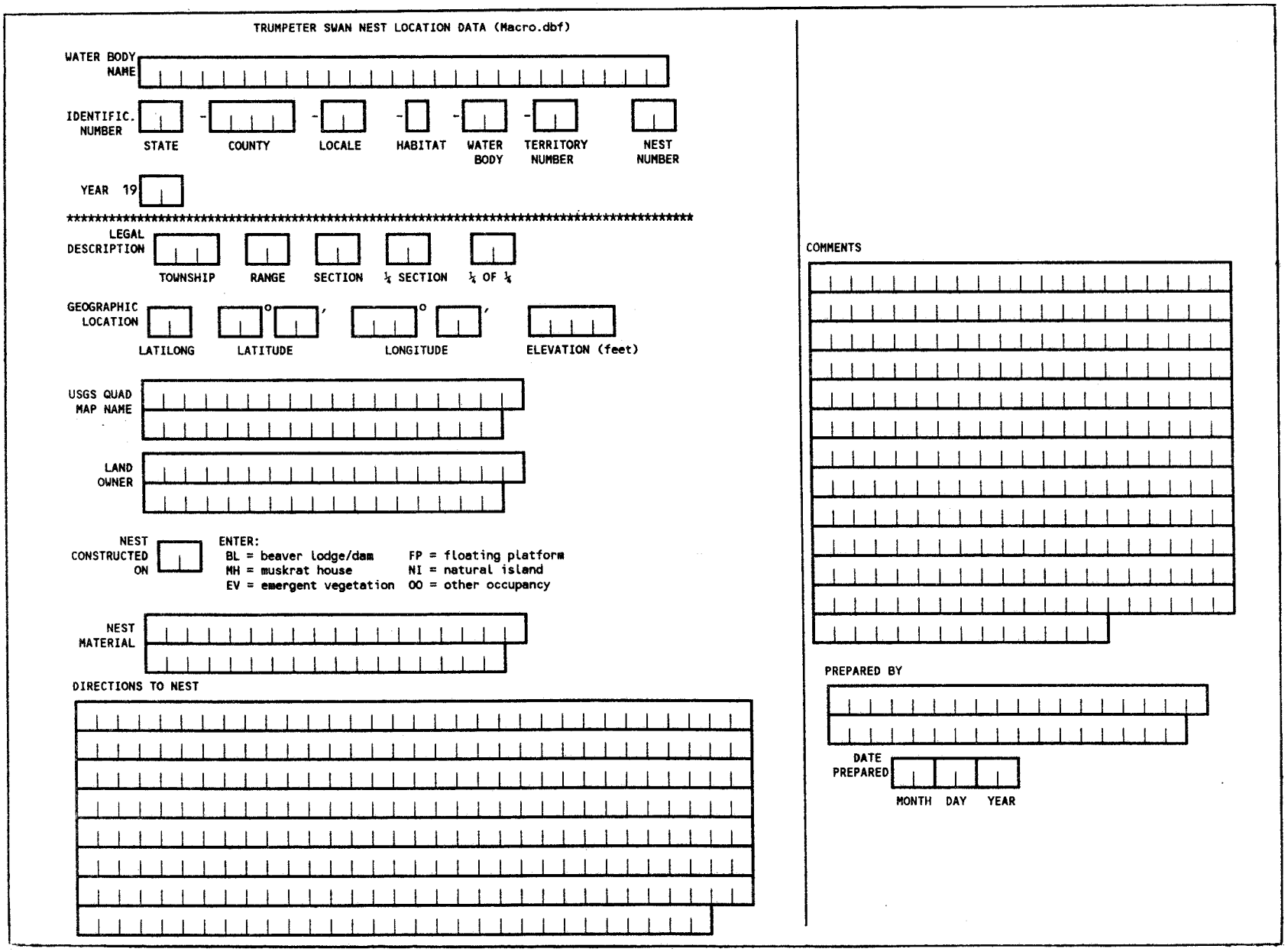


Figure 1 (Continued). Field data forms used with SwanNest.

visitation raw data, summary and supplemental reproduction data, and nest location and habitat data.

In addition to the three data reports generated, which merely list the data, SwanNest can also perform basic statistical analyses on the data. These include totals, percentages, maximums, minimums, and averages of most data fields. Table 2 lists the statistics SwanNest calculates.

One of the main advantages of SwanNest is that it gives the user a great deal of control in retrieving and using data. A variety of criteria can be employed for selecting which records to be used when producing reports, calculating statistics, retrieving records for editing, viewing records on screen, or printing raw data. For example, the user can request data for the years 1980-85 and then have SwanNest calculate the average number of cygnets fledged during that period. Or, the user can compare data between RRLNWR and the rest of the Tristate Region to look at differences in nest success. Or, SwanNest can organize records by habitat type to track the number of nests in each type. Or, the user can track the success of a specific nest, and so forth. Table 3 lists all the possible criteria which can be used, singly or in combination, for retrieving data.

Potential uses of SwanNest for management and research

Obviously, the power of this program is limited by the amount and quality of data available. In designing SwanNest, it was hoped that having a program which makes it easier to answer fundamental questions would encourage managers and biologists to make a greater effort to collect these data.

Consider the possibilities. Suppose a biologist wants to know if there is a correlation between nest success and a nest's location. The biologist uses SwanNest to sort out all nests by location and then has it calculate the percentage of nests that were successful for each location. It takes less than five minutes, if the data were collected.

Suppose a manager wants to know if changes in water levels are adversely affecting nest success. The manager determines which years represent the period before changes in water levels occurred and which years to compare after water level changes occurred. Then the manager asks SwanNest to pull up two data sets, one for the first set of years and one for the latter set, lets SwanNest calculate the average number of successful nests and the average number of cygnets hatched and fledged for each data set, and then compares the two. Again, it takes less than five minutes, if the data are available.

If the effort was made to check nests and collect basic data, with SwanNest our understanding of Trumpeter Swan breeding biology could easily be expanded. While SwanNest does not test for statistical significance, it does facilitate decision-making about which questions to pursue, and it makes calculating tests of statistical significance much quicker and easier.

Current status of SwanNest

As it stands now, SwanNest is operational, but has not been fully debugged or field tested. There are a few features which could be added to make it easier to use, such as expanded file management capabilities and more options for storing and printing statistics. Some existing data fields may be unnecessary and others not included may be desired. An instruction manual needs to be written.

SwanNest is designed for use within the Tristate Region, but it could easily be adapted for use throughout the United States and Canada, providing a standardized system for compiling, comparing, and exchanging Trumpeter Swan reproduction data. The question is whether anyone is interested in using SwanNest and whether it is worth the time to adapt it for use elsewhere.

ACKNOWLEDGEMENTS

SwanNest started out as an adaptation of a program written by Larry Thompson of the Montana Natural Resource Information System for use with Bald Eagles. Although SwanNest grew extensively beyond mere adaptation of Larry Thompson's program, the use of his program as a starting point was invaluable.

Table 2. Statistics compiled by SwanNest. (Numbers used are for example purposes only.)

Total number of nests[1] = 21

CLUTCH AND BROOD DATA

	AVERAGE	MAX	MIN	TOTAL	# NESTS[2]
Clutch size	4.5	7	3	64	14
Eggs hatched	4.0	7	0	53	13
Brood size	3.8	7	0	57	15
Fledglings	2.4	6	0	29	12

	PERCENT	# NESTS[2]
Eggs hatched	86.8	11
Cygnets fledged	67.4	8

NEST STATUS

	NUMBER OF NESTS[2]		
Occupied	15	3	Unoccupied
Active	14	4	Inactive
Successful	13	2	Unsuccessful
One adult only	1		
Other species	2		
Unknown	4		

DATES (Month/Day)

	EARLIEST	LATEST	AVERAGE	# NESTS[2]
Adult arrival on territory	02/01	04/15	03/01	9
Egg laying	05/15	06/15	05/31	14
Hatching	06/15	07/15	06/31	13
Cygnet dispersal	07/01	09/15	08/15	15
Adult dispersal	07/01	09/15	08/15	15
Fledging	09/15	10/15	09/30	12
Nest failure	06/01	07/01	06/15	2

NEST SITES

	%	NESTS[2]
Beaver lodge or dam	18	2
Muskrat house	18	2
Artificial platform	18	2
Natural island	18	2
Emergent vegetation	9	1
Other/unknown	18	2

HABITAT

	%	NESTS[2]
River	7	1
Creek	0	0
Ditch	7	1
Reservoir	7	1
Lake	40	6
Pond	7	1
Marsh	7	1
Wetland	7	1
Other	20	3

FILE MAINTENANCE

FILE 1 (Nest Visit Raw Data) has 26 records:
- 22 with matching records in FILE 2
- 4 without
- 22 with matching records in FILE 3
- 4 without

FILE 2 (Summary and Supplemental Data) has 15 records:
- 2 without matching records in FILE 1

FILE 3 (Nest Location and Site Description) has 15 records:
- 0 without matching records in FILE 1

1 Number of nests sampled
2 Number of nests for which this information is available

Table 3. Criteria for selecting specific records and fields to be used and for placing records in order.

Up to three of the following criteria or conditions may be used in combination to select specific records for editing, performing statistics, viewing, and/or printing reports.

FILE 1: NEST VISIT RAW DATA

- Year(s)
- Location: state(s)
- Location: county(ies)
- Location: locale(s)
- Location: water body(ies)
- Identification number(s)
- Nest number(s)
- Nest status
- Survey method(s)
- Clutch size(s)
- Incubation stage(s)
- Number(s) of eggs failed
- Number(s) of cygnets hatched
- Brood size(s)
- Number(s) of cygnets dispersed
- Number of adults at nest site
- Cob age(s)
- Pen age(s)
- Incubating or not at time of survey

FILE 2: SUMMARY AND SUPPLEMENTAL DATA

- Year(s)
- Location: state(s)
- Location: county(ies)
- Location: locale(s)
- Location: water body(ies)
- Identification number(s)
- Nest number(s)
- Habitat type(s)
- Survey type(s)/data source
- Nest status
- Hazard rating(s)
- Band number(s)
- Collar(s)
- Date(s) of adult arrival at nest
- Date(s) of egg laying
- Date(s) of hatching
- Date(s) of cygnet dispersal
- Date(s) of adult dispersal
- Date(s) of fledging
- Nest failure
- Clutch size(s)
- Number(s) of eggs hatched
- Brood size(s)
- Number(s) of cygnets dispersed
- Number(s) of cygnets fledged

FILE 3: NEST LOCATION AND SITE DESCRIPTION

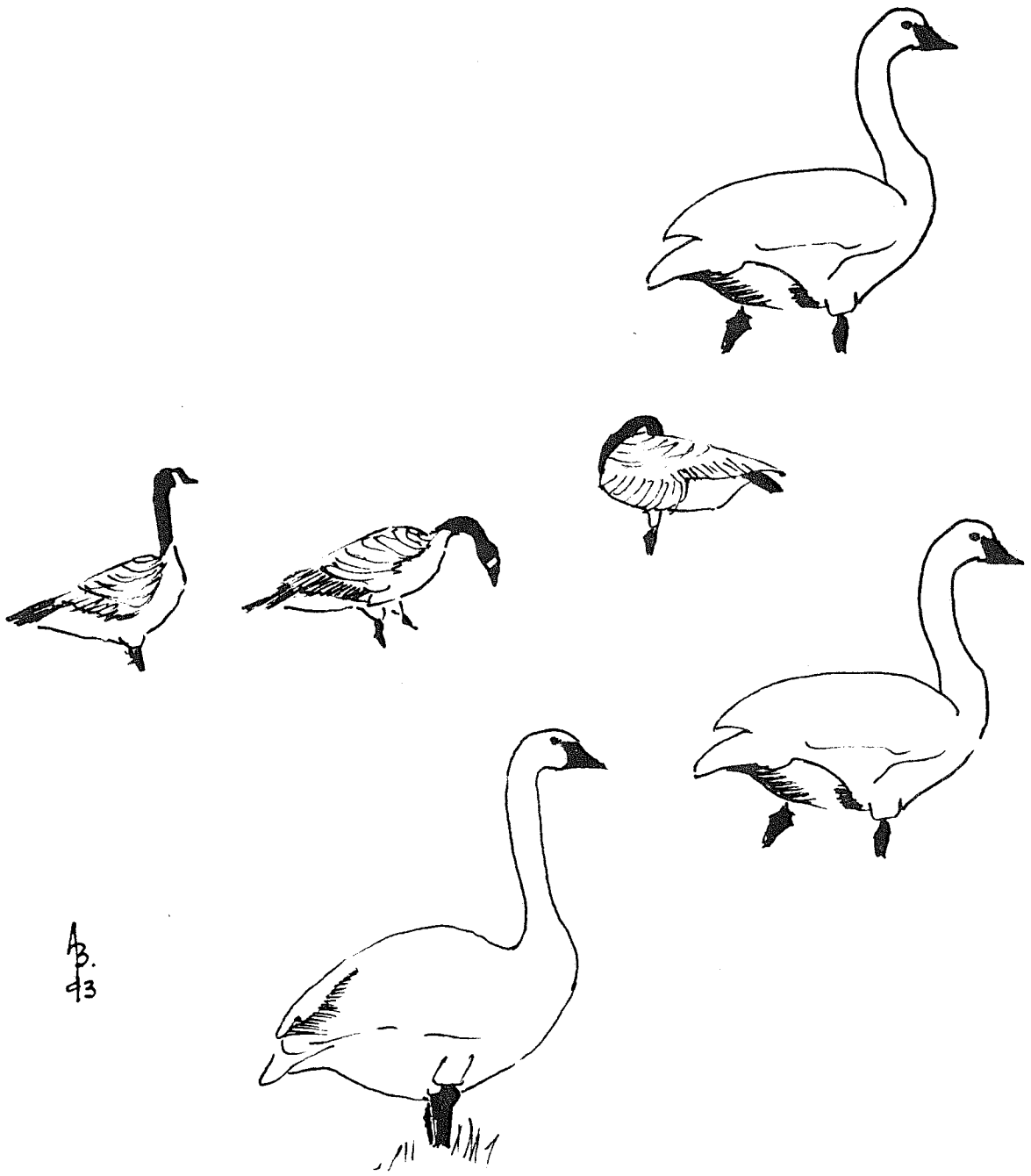
- Year(s)
- Location: state(s)
- Location: county(ies)
- Location: locale(s)
- Location: water body(ies)
- Identification number(s)
- Nest number(s)
- Habitat type(s)
- Legal description(s)
- Latitude(s) / longitudes(s) / latilong(s)
- Elevation(s)
- USGS quad map(s)
- Type of site(s) nest(s) constructed on
- Material(s) used in construction
- Land owner(s)

Up to three of the following may be used in combination to sort selected records and put them in a specified order for editing, viewing, and/or printing reports.

- Water body name
- Identification number
- Nest number
- Year
- Date (month/day only)

Any number and combination of fields (listed in Table 1) may be selected for viewing or editing records on screen and printing data in raw format.

TUNDRA SWANS ON THE BREEDING GROUNDS



HABITAT PREFERENCES OF TUNDRA SWANS ON THEIR BREEDING GROUNDS IN NORTHERN ALASKA

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ABSTRACT

The Colville River Delta supports one of northern Alaska's most dense concentrations of breeding Tundra Swans (Cygnus columbianus columbianus). The need to understand the relative importance of the Delta's various habitats to wildlife has been elevated by the discovery of oil on the Delta and the risks of subsequent development. The purposes of this study were 1) to investigate Tundra Swan use of terrestrial habitats along lake perimeters, 2) to assess the use of lakes in relation to lake size, type (discrete, tapped or drained), and availability of good perimeter habitat, 3) to examine use of lakes and river channels in relation to the availability of sheathed pondweed (Potamogeton vaginatus) and 4) to quantify Tundra Swan diet.

Analyses were based on extensive aerial surveys, which covered the entire Delta, and intensive aerial surveys, which were flown at a lower altitude and which covered about one-third of the Delta. Extensive surveys were flown twice each summer, 1982-89, by the Alaska Department of Fish and Game. Intensive surveys, which were flown as a part of my dissertation project, were flown on the same day as extensive surveys in 1987-89. We used a habitat classification scheme based on one developed by C. Markon. Feces were collected during 1987-90 field seasons and pondweed was sampled during 1989.

Swan densities were substantially higher in five of the nine lake perimeter habitats than in the others. The five most preferred lake perimeter habitats included three of four polygonal pond habitats, one of three wet meadow habitats and only one of six upland habitats. Lakes with larger proportions of the five good perimeter habitats had more swan sightings on and within 150 m of the lake. Swan sightings per lake also increased with lake size and were higher on tapped lakes (i.e., those connected to river channels) and partially-drained lakes (i.e., those having some open water and >30% of their basin comprised of wet meadows) than discrete lakes.

Sheathed pondweed, which occurred only in tapped lakes and river channels, was an important component of Tundra Swan habitat use. Sites in tapped lakes and river channels that were often used by swans were significantly more likely to have sheathed pondweed than were unused sites (pondweed present in 90% of used vs. 17% of unused sites in tapped lakes, and in 58% of used vs. 19% of unused sites in river channels). Microhistological analyses of fecal samples indicated that sedges (Carex spp.), sheathed pondweed and algae (Nostoc sp.) were the major components of Tundra Swan diet.

BEHAVIORAL RESPONSES OF NESTING TUNDRA SWANS TO HUMAN DISTURBANCE AND IMPLICATIONS FOR NEST PREDATION ON THE ARCTIC NATIONAL WILDLIFE REFUGE

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ABSTRACT

Tundra Swan (Cygnus columbianus) populations have not declined as observed for Trumpeter Swans (C. buccinator) in the past 120 years, partly due to the remoteness of their arctic breeding grounds. Arctic remoteness is being lost with the exploitation of natural resources. With increased human activities on Tundra Swan nesting areas associated with the petroleum industry, an assessment of the vulnerability of nesting swans to human disturbance is needed. During our study of Tundra Swans on the Arctic National Wildlife Refuge, we found that swans were particularly sensitive to human disturbance during incubation. Swans frequently departed from their nests when observers were >500 m away. Swans did not cover eggs with nest material prior to departure, leaving the eggs more vulnerable to thermal stress and avian predation. Swans did not return to their nests while we were within view of the nest (often >2 km for >30 minutes). Over our 3-year study, avian predators (Glaucous Gulls [Larus hyperboreus] and Jaeger spp. [Stercorarius spp.]) were suspected of seven total-clutch losses and 13 partial-clutch losses. The frequency of avian predation on nests and the absence of egg covering suggests that disturbance during incubation may have a negative impact on swan reproduction. Possible mammalian predators on the study areas were foxes (Alopex lagopus and Vulpes fulva) and brown bears (Ursus arctos). Foxes were not suspected of causing nest predation, but five of 13 nests on one study area were destroyed by bears in 1988. The bear (only one suspected) apparently developed a search image for swan nest mounds. The ease of observing incubating swans from great distances, and the unlikelihood of nest defense in a bear encounter, may have influenced the development of long distance nest desertion behavior by swans in response to potential predators.

MODIFICATION OF TUNDRA SWAN HABITAT BY REPEATED USE OF NESTING TERRITORIES

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ABSTRACT

The same nesting and brood rearing areas are often used by Tundra Swans (Cygnus columbianus) for many years. This traditional use may enhance the habitat for swans by improving nest sites and foraging areas. Each year the size of nests increases as swans add more nest material. These nest mounds are free of snow and above melt water earlier than surrounding areas. This allows swans to initiate laying when most of the tundra is covered by snow and water. Swan productivity on the Arctic National Wildlife Refuge is restricted by time, and early nesting is often essential to allow enough time to fledge cygnets. Nest mounds are subjected to the erosive forces of shifting ice, spring runoff and wind. We collected data on simulated nest mounds to investigate factors influencing the persistence of nest mounds. These mounds were stabilized by the formation of permafrost cores, vegetation growth and the accumulation of nitrogen-rich waste from many animal species. Within swan territories, there are discrete foraging areas that are revisited within and among years. We initiated an experiment using a factorial design to evaluate the effects of swan grazing and fertilization from swan feces on above ground biomass production and plant species composition. Repeated use of foraging areas increased biomass production and graminoid species tolerant of grazing. Protecting swan nesting areas is important, because displaced swans lose the benefits developed from traditional use.

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