Breeding Distribution and Abundance of Trumpeter Swans *(Cygnus buccinator)* in British Columbia, Summer 2005

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Pacific and Yukon Region

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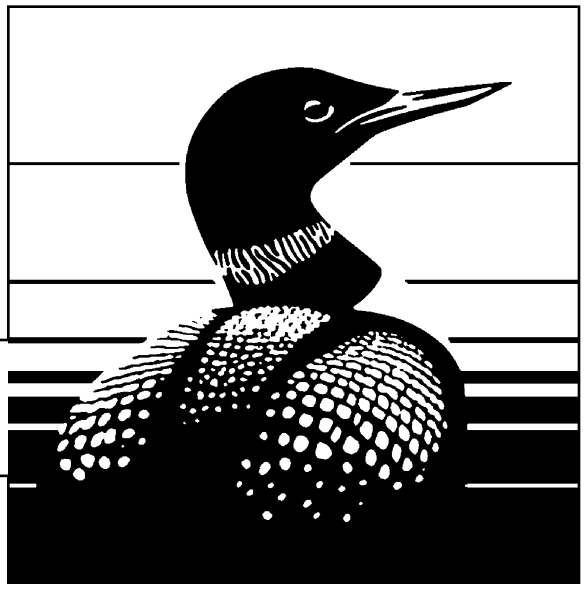

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Abstract

This report presents the results of the Trumpeter Swan (*Cygnus buccinator*) breeding survey conducted in British Columbia in 2005 and a summary of similar surveys conducted since 1985. Aerial (fixed-wing) surveys were conducted over the known breeding range of Trumpeter Swans in the province in mid-August 2005, to coincide with the brood-rearing period of flightless young. The population of Trumpeter Swans breeding in British Columbia was estimated at 1,126 birds (808 adults and 318 cygnets) in 2005, the highest recorded since 1985. Brood size averaged 2.66 young per brood. The Rocky Mountain population (905 birds in 2005) remains larger than the Pacific Coast population (221 birds in 2005). The breeding population of Trumpeter Swans in British Columbia has grown at an estimated (arithmetic) rate of annual increase (*r*) of 10.7% between 1985 and 2005. Range extension into previously unoccupied breeding areas accounts for much of this growth.

Résumé

Le présent rapport expose les résultats du relevé des cygnes trompettes (*Cygnus buccinator*) effectué en 2005 en Colombie-Britannique et inclut un résumé des relevés similaires effectués depuis 1985. Des relevés aériens (à partir d'avion) ont été effectués à la mi-août dans la province, au-dessus de l'aire de nidification connue des cygnes trompettes, au moment de l'élevage des poussins. La population des cygnes trompettes nichant en Colombie-Britannique a été estimée à 1 126 oiseaux (808 adultes et 318 jeunes cygnes), l'effectif le plus élevé depuis 1985. Les nichées abritaient en moyenne 2,66 poussins. La population des montagnes Rocheuses (905 oiseaux en 2005) reste plus importante que celle de la côte du Pacifique (221 oiseaux en 2005). Le taux (arithmétique) d'augmentation annuelle estimé de la population des cygnes trompettes nicheurs en Colombie-Britannique entre 1985 et 2005 est de 10,7 %. L'extension de l'aire de répartition dans des zones de nidification antérieurement inoccupées explique la plus grande partie de cette croissance.

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Introduction

The Trumpeter Swan (*Cygnus buccinator*) once nested from Alaska and northern Canada to areas south of the Great Lakes and along the St. Lawrence River. Large wintering populations were known from the central Atlantic coast of the United States, the Gulf of Mexico, the Ohio and Mississippi river valleys, and parts of the west coast (Mitchell 1994). Heavy hunting by European settlers, for their own use and for the swan skin trade, and possibly habitat changes associated with settlement, combined to eliminate the species from all but a small portion of its range.

By 1933, only 66 Trumpeter Swans could be located in the United States and one small remnant population was found near Grande Prairie, Alberta. Fear for the extinction of the species led to substantial conservation efforts based on law enforcement, public education and land acquisition (Banko 1960). Since then, North American populations of Trumpeter Swan have grown steadily and expanded their ranges (Mitchell 1994, Hawkings *et al*. 2002).

Biologists recognize three populations of Trumpeter Swans in North America: the Pacific Coast Population (PCP), the Rocky Mountain Population (RMP), and the Interior Population (see Appendix 1 for map and details). The first two populations developed primarily from remnant flocks that survived the historic decline while the latter population was created by transplanting wild birds from established flocks into promising habitat and by breeding swans in captivity and releasing the young to the wild. Trumpeter Swans breeding in northeastern British Columbia belong to the RMP while those breeding in northwestern British Columbia (i.e. Coast Mountains) belong to the PCP.

Continental efforts to determine the size of the three breeding populations of Trumpeter Swans were initiated in 1968 and range-wide surveys are now conducted at 5-year intervals. A total of 23,647 Trumpeter Swans were counted during the last continental breeding ground survey held in 2000 (Caithamer 2001). In 2000, the PCP and RMP supported respectively 74% and 15% (17,551 and 3,666 birds, respectively) of the continental population (Caithamer 2001).

This report summarizes the results from the 2005 Trumpeter Swan continental survey for British Columbia conducted by Ducks Unlimited Canada and the Canadian Wildlife Service of Environment Canada. Survey routes, flight dates, locations of swan sightings, productivity and general observations on habitat use and habitat conditions

are described. The 2005 results are also compared to previous survey results collected since 1985.

Methods

1. Survey

The 2005 aerial survey was conducted in mid-August, to coincide with the brood-rearing of flightless young. A Cessna 206 was flown at altitudes of up to 500m above ground to locate swans in areas of high wetland density. When swans were detected, passes were made at lower elevations to determine the number of adults, nests and cygnets or eggs.

The area surveyed covered the entire known breeding range of the species in British Columbia. For compilation purposes and to allow comparison with previous surveys, swan sightings are reported for 4 different geographical units that either support different populations (i.e. PCP or RMP) or were historically surveyed by different groups or with different methods (i.e. by crews from either the Yukon, Edmonton or Delta offices of CWS).

The geographic units used in this report are: Western Alberta Upland, Fort St. John-Fort Nelson, Taiga Plains and Coast Mountains (Table 1, Figure 1). In all areas, swan locations were recorded using a Global Positioning System (GPS) and the aircraft flight track was recorded with moving map software (ESRI Tracking Analyst).

The breeding range was surveyed during 11-25 August (Table 1) and the areas flown (as determined by on-board GPS) are shown in Appendices 2 to 5.

Table 1. Survey dates for the 2005 British Columbia Trumpeter Swan Survey.

Geographic Unit*	Survey Dates
Unit 1: Western Alberta Upland	13 to 25 August 2005
Unit 2: Fort St.John - Fort Nelson	15 to 18 August 2005
Unit 3: Taiga Plains	14 to 16 August 2005
Unit 4: Coast Mountains	11 to 14 August 2005

*see Figure 1 for delineation of the geographic units.

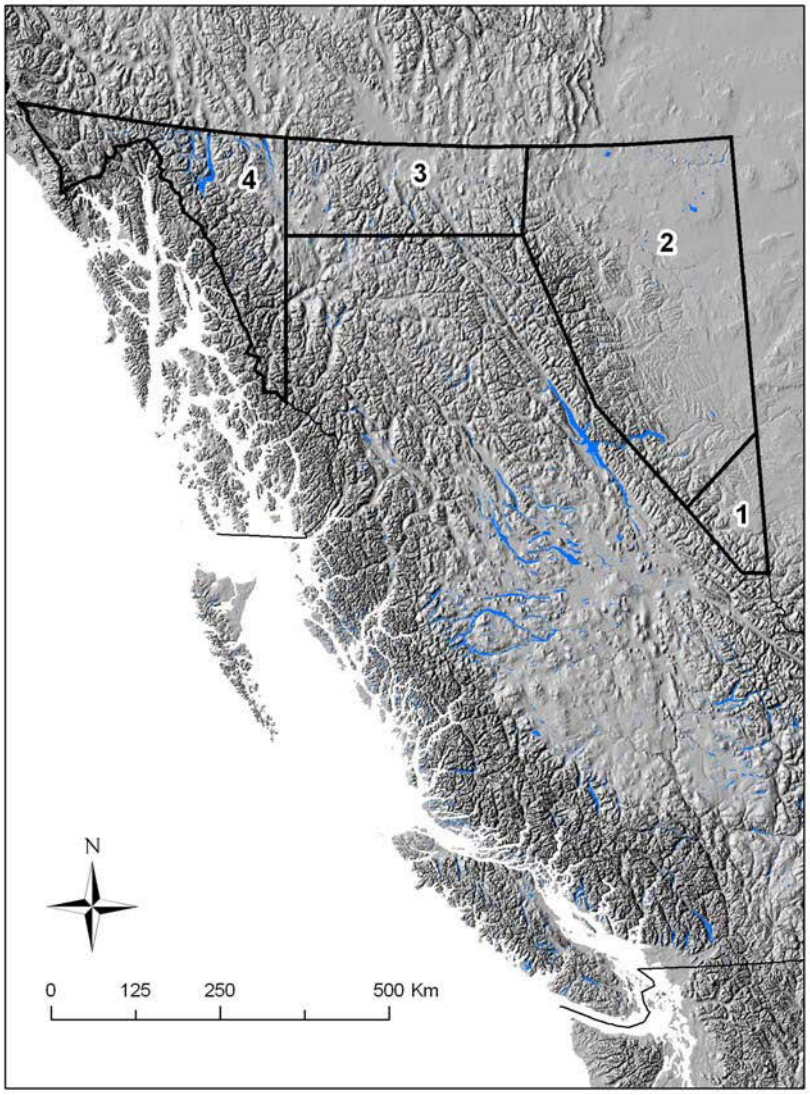

Figure 1. Geographic Units surveyed for breeding Trumpeter Swan in British Columbia in 2005. Numbered polygons represent: 1) Western Alberta Upland, 2) Fort St. John - Fort Nelson, 3) Taiga Plains, and 4) Coast Mountains.

For the Western Alberta Upland and Fort St. John – Fort Nelson (units 1 and 2, Figure 1), the survey involved a total count of all individuals. All known nesting locations identified in the course of earlier surveys (i.e. the 2000 Trumpeter Swan continental survey, CWS-USFWS 2003 breeding waterfowl survey and the Ducks Unlimited Canada Western Boreal Forest Initiative 2000-2005 Fort Nelson and 2001-2004 Peace River waterfowl surveys) were specifically visited to determine current use by breeding pairs. All other wetlands judged capable of supporting swans were also visited. The total number of swans observed is assumed to represent total swan use of these areas and no adjustments or extrapolations were made for unsurveyed areas.

For the Taiga Plains and Coast Mountains (units 3 and 4, Figure 1), the survey used a stratified random sampling procedure (Hawkings 2000) with total counts done within sample units (1:50,000 topographic maps) chosen at random within different density strata. Total swan use was calculated by projecting the observed number of swans across the remainder of the survey unit (see Hawkings 2000 for details).

2. Survey area physiography, vegetation and land use

Units 1 and 2 roughly correspond to the Great Plains physiographic region (Meidinger and Pojar 1991). Characterized by long cold winters and a short growing season, this flat to gently rolling area occupies the Boreal White and Black Spruce (BWBS) biogeoclimatic zone. The poorly drained lowlands in the northeast corner are a mosaic of black spruce (*Picea mariana*) forests, bogs and fens, commonly known as muskeg. The foothills and plateau areas in the west are dominated by mixed forests of trembling aspen, white spruce and lodgepole pine. Wetland vegetation is dominated by sedges, cattail and hydrophilic grasses.

Units 3 and 4 are part of the Northern Plateaus and Mountain physiographic region (Meidinger and Pojar 1991). Most of the swan breeding habitat in these units is found on the flat to rolling terrain of the Liard, Stikine and Yukon plateaus. These plateaus are primarily in the BWBS biogeoclimatic zone, and are dominated by mixed forests of trembling aspen (*Populus tremuloides*), white spruce (*Picea glauca*) and lodgepole pine (*Pinus contorta*) in drier sites. At higher elevations (e.g. >1000m) in the Spruce-Willow-Birch (SWB) zone, vegetation grades from forests of white spruce to subalpine fir (*Abies lasiocarpa*) to deciduous scrub. Wetlands at lower elevations are dominated by sedges (*Carex* spp.) and cattail (*Typha latifolium*), with relatively rich

swamps, sedge fens and marshes at higher elevations. Bogs are uncommon. Along the coast, swan breeding habitat is found primarily in the larger river valleys.

Oil and gas exploration and development are the predominant industrial activity in Units 1 and 2. The forest industry is active on well-drained sites at lower (BWBS) elevations in all units and there is agricultural activity in the lands around Fort St. John and Dawson Creek. Subalpine SWB areas have no forestry or agricultural values. Cattle range in aspen forests and there is hunting, trapping and fishing throughout all the units.

3. Calculating the rate of population increase

We quantified the rate of increase in Trumpeter Swan populations using the 5-year interval counts conducted between 1985 and 2005. The increase in the number of swans tightly fitted a geometric growth model where population was expressed as ln (population) (Figure 2). In a geometric growth model, the change in population size (N) over change in time (t) is equal to the population's growth rate times the population's size (r N):

$$\frac{d\,N}{d\,T} = r\,N$$

where d N = change in number
d T = change in time
r = the individual growth rate
N = the number of individuals in the population

When log-transformed, this equation makes the exponential growth linear and the slope of the equation can be interpreted as the average rate of increase (r) over the period covered.

For the 1985-2005 period, the intrinsic growth rate of Trumpeter Swans breeding in British Columbia was 10.18% per year (Figure 2). We used a similar method to calculate population growth rate in the Western Alberta Upland, Fort St. John-Fort Nelson, Taiga Plains and the Coast Mountains.

4. Assessing historic distribution and trends

Survey results for the 1985, 1990, 1995 and 2000 surveys were obtained from published reports (McKelvey *et al*. 1983, Beyersbergen and Shandruk 1994, Hawkings 2000, McKelvey 1986, McKelvey and Hawkings 1990, Norton and Beyersbergen 2000, Olson 2001, Conant *et al*. 2002) and from unpublished CWS survey results.

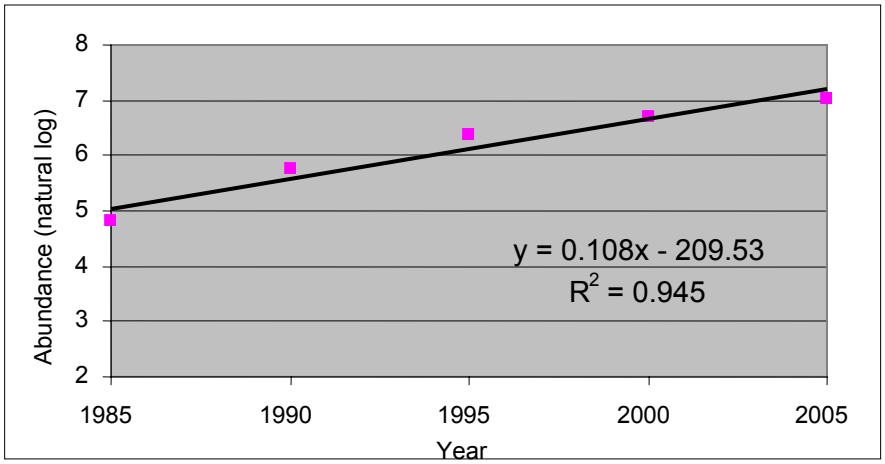

Figure 2. Log-transformed abundance of Trumpeter Swan in British Columbia, 1985-2005. Population data from Table 2.

Results and Discussion

1. *Total and regional population estimates for Trumpeter Swans breeding in British Columbia*

The number of Trumpeter Swans estimated to occur in northern British Columbia during the breeding season has continuously increased over the last 20 years, from 122 birds in 1985 to a historic-high of 1126 birds in 2005 (823% total increase) (Table 2, Figure 3). Compared to 1985, swan populations have grown in all breeding areas of the province (Table 2, Figure 3). Raw survey data are presented in Appendices 6-9.

The British Columbia portion of the Western Alberta Upland is adjacent to the Grande-Prairie - Valleyview area of Alberta, and the two have generally been surveyed together. The number of Trumpeter Swans counted in the British Columbia portion of the Western Alberta Upland increased from 36 in 1985 to 198 in 2005 (Table 2).

The Fort St. John - Fort Nelson geographic unit was first surveyed in 1981 (Olson 2001). Survey efforts in 1985 and 1990 (7.4 hours and 10 hours respectively) were less than in 1995, 2000 and 2005 (25+ hours each), with the increased coverage of the last surveys occurring primarily south, east and north of Fort Nelson. The number of swans observed in this unit grew from 66 in 1985 to 590 in 2005 (Table 2). This unit supported over half the swans found in British Columbia in 2005.

Table 2. Results of the 1985-2005 British Columbia Trumpeter Swan Population Surveys by population and geographic unit[a].

Population and geographic unit	Survey Design[b]		Estimate (SE) of Total Swans				
			1985	1990	1995	2000	2005
1. Rocky Mountain Population							
Western Alberta Upland	PC, TC[c]		*36*	*67*	*51*	*101*	*198*
Fort St. John, Fort Nelson	PC, TC[c]		*66*	*197*	*259*	*363*	*590*
Taiga Plains	PC, SRS, TC[c]		*11*	*24*	*122 (38)*	*260 (52)*	*117 (29)*
Population Total			113	288	432	724	905
2. Pacific Coast Population *(Northern Coast Mountains*)	PC, SRS,		9	24	145 (68)	91 (7)	221 (19)
Total			122	312	577	815	1126

[a] see methods for origin of past data; [b] TC=Total Count, SRS=Stratified Random Sample, PC=Partial Count, IO=Incidental observations; [c] for 2005 only

The Taiga Plain geographic unit (particularly the eastern part) has historically not been well surveyed because of its remoteness and of the small number of scattered pairs of swans it initially supported. From 1985 to 2000, the number of swans found there increased from 11 to 260 but only 117 swans were estimated to be present in 2005 (Table 2). There is no known cause for the swan decline between 2000 and 2005.

The Coast Mountains geographic unit, the only one to support Pacific Coast Population swans in the province, was poorly surveyed prior to 1995, primarily because there was little evidence that swans bred there. Up to 2000, surveys suggested that the northeastern part of the region was unoccupied and the increases were observed in areas closest to the coast. Swan numbers in the Coast Mountains have increased from 9 birds in 1985 to 221 birds in 2005 (Table 2).

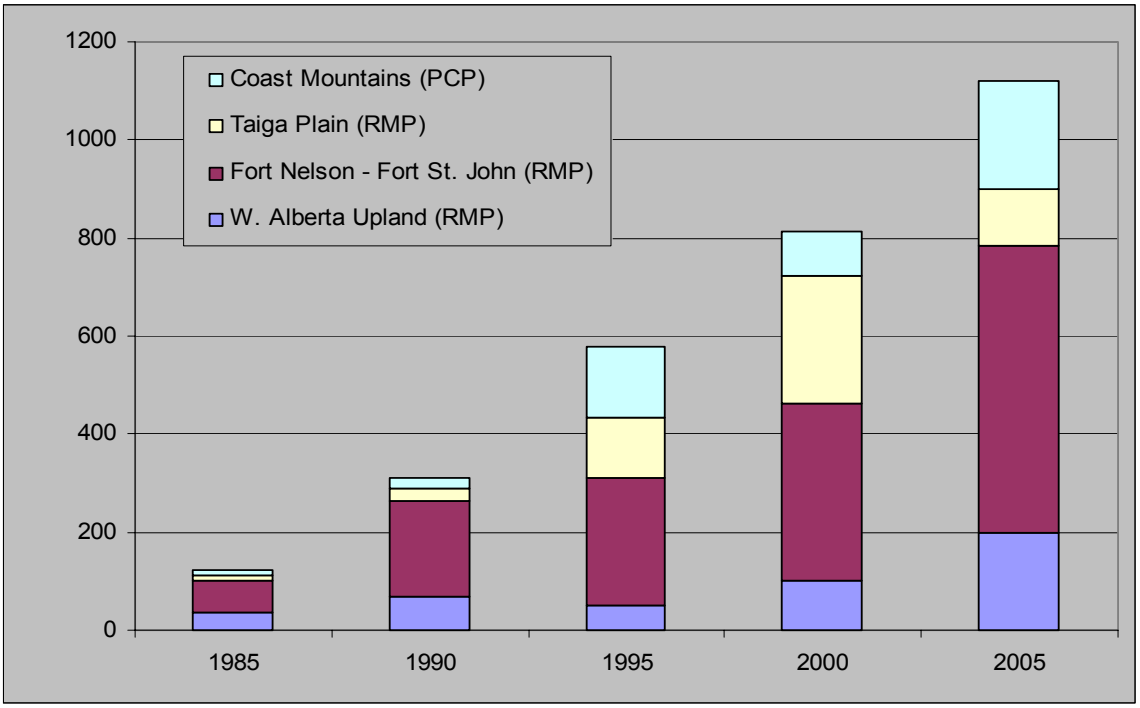

Figure 3. Trumpeter Swan abundance in the four geographic units of British Columbia 1985-2005. Data source is Table 2.

2. Rate of population increases in the breeding population.

The Trumpeter Swan population of British Columbia grew at an estimated annual rate of 10.8% (r) between 1985 and 2005 (Table 3, Figure 2). The rate of population increase was lower than average in the Western Alberta Upland (7.6%), near average in Fort St. John - Fort Nelson units (10.0%) and higher than average in the Taiga Plains and Northern Coast Mountains (14.4% and 15.5% per year, respectively) (Table 3, Figures 4, 5, 6 and 7).

Table 3. Rate of population increase (r) in Trumpeter Swan breeding in four geographic units of northern British Columbia 1985-2005[a].

Geographic Unit	Pop Growth
	R
Western Alberta Upland	0.076
Fort St. John - Fort Nelson	0.100
Taiga Plains	0.144
Coast Mountains	0.155
Average for British Columbia	0.108

[a] see methods for origin of past data.

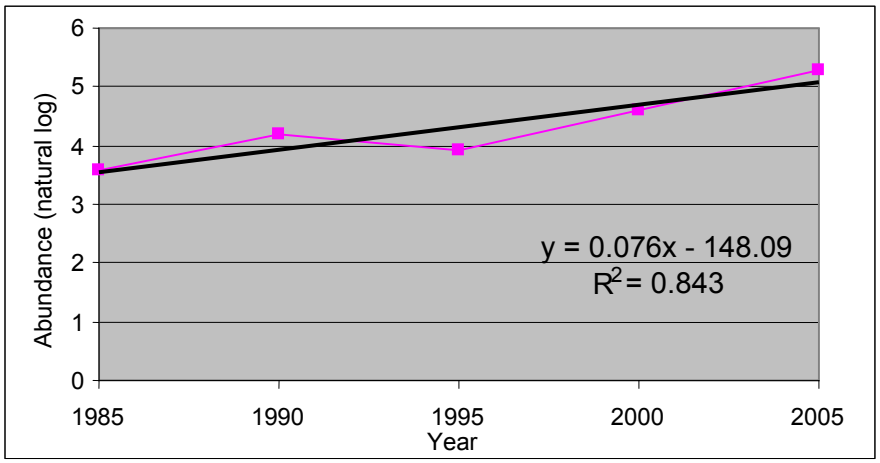

Figure 4. Log-transformed abundance of Trumpeter Swan in the Western Alberta Upland unit, 1985-2005. Population data from Table 2.

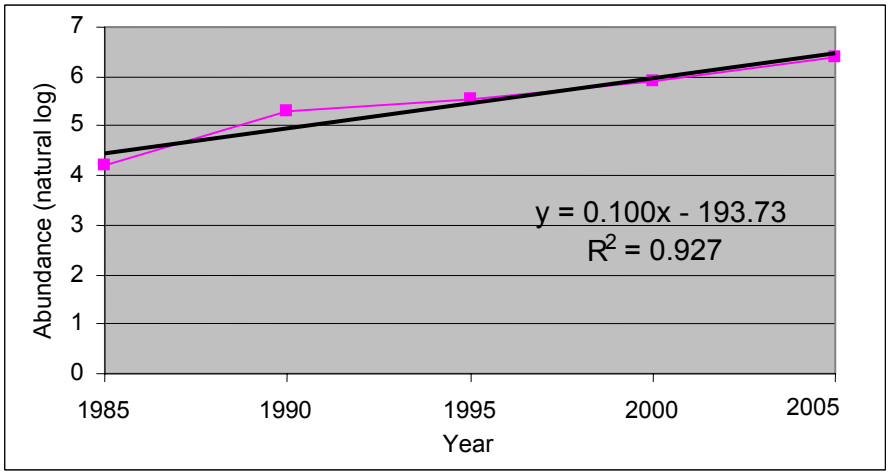

Figure 5. Log-transformed abundance of Trumpeter Swans in the Fort St. John – Fort Nelson unit, 1985-2005. Population data from Table 2.

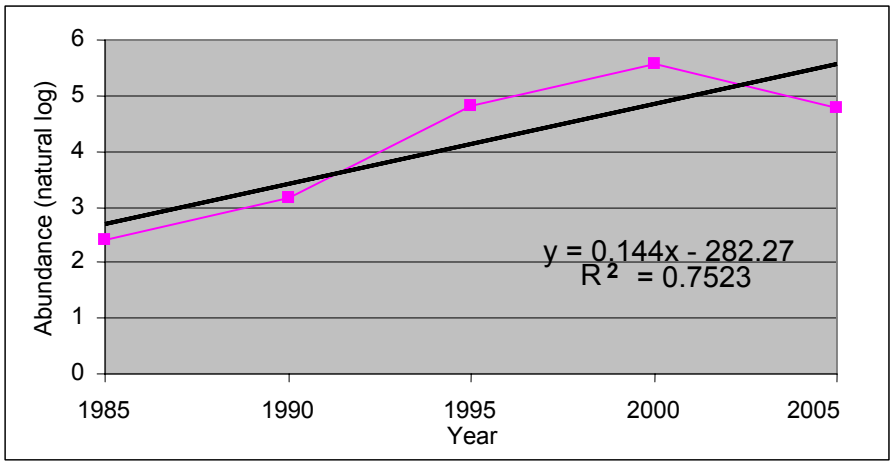

Figure 6. Log-transformed abundance of Trumpeter Swan in the Taiga Plains unit, 1985-2005. Population data from Table 2.

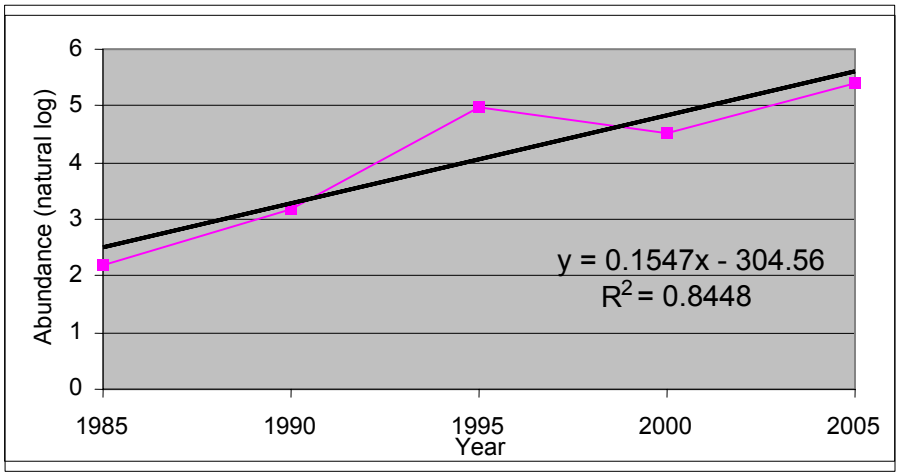

Figure 7. Log-transformed abundance of Trumpeter Swan in the Coast Mountains unit, 1985-2005. Population data from Table 2.

3. Productivity estimates for Trumpeter Swans breeding in British Columbia

Brood size averaged 2.66 young per brood in British Columbia in 2005 (Table 4). Brood size was lower than average in the Fort St. John – Fort Nelson unit (2.38 young/brood), near average in the Western Alberta Upland (2.68) and higher than average in the Taiga Plains and Coast Mountains (3.00 and 3.17 young/brood, respectively).

Table 4. Trumpeter Swan productivity in British Columbia in 2005[a].

Geographic Unit (Population)	Swan sightings			
	Adults[b]	Cygnets	Broods	Mean (SD) brood size
Western Alberta Upland (RMP	147	51	19	2.68 (1.63)
Fort St. John – Fort Nelson (RMP)	438	152	65	2.38 (1.20)
Taiga Plains (RMP)	75	42	14	3.00
Coast Mountains (PCP)	148	73	23	3.17
Total	808	318	119	2.66 (1.4)

[a] See methods for data source
[b] Includes adult and sub-adult

4. Distribution of breeding Trumpeter Swan in British Columbia

a) Western Alberta Upland

The Western Alberta Upland supported nearly 200 swans in 2005 (Table 2). Most of the breeding pairs with young were observed in the northern part of the unit and along the Alberta border, whereas non-breeding adults and subadults were more evenly and broadly distributed (Figure 8).

The core lowland regions on the center and east side of this unit have been fairly well covered by the 2005 survey (see flight track in Appendix 2), but there is likely additional suitable swan habitat available both to the south and west of the surveyed portion (i.e. in the foothills and large lakes/valleys associated with the Rocky Mountains).

b) Fort St. John – Fort Nelson

The Fort St. John – Fort Nelson geographic unit supported over 50% of all Trumpeter Swan sightings and over 60% of the RMP Trumpeter Swans found in the province in 2005 (Table 2). The highest concentration of swans occurred southwest of

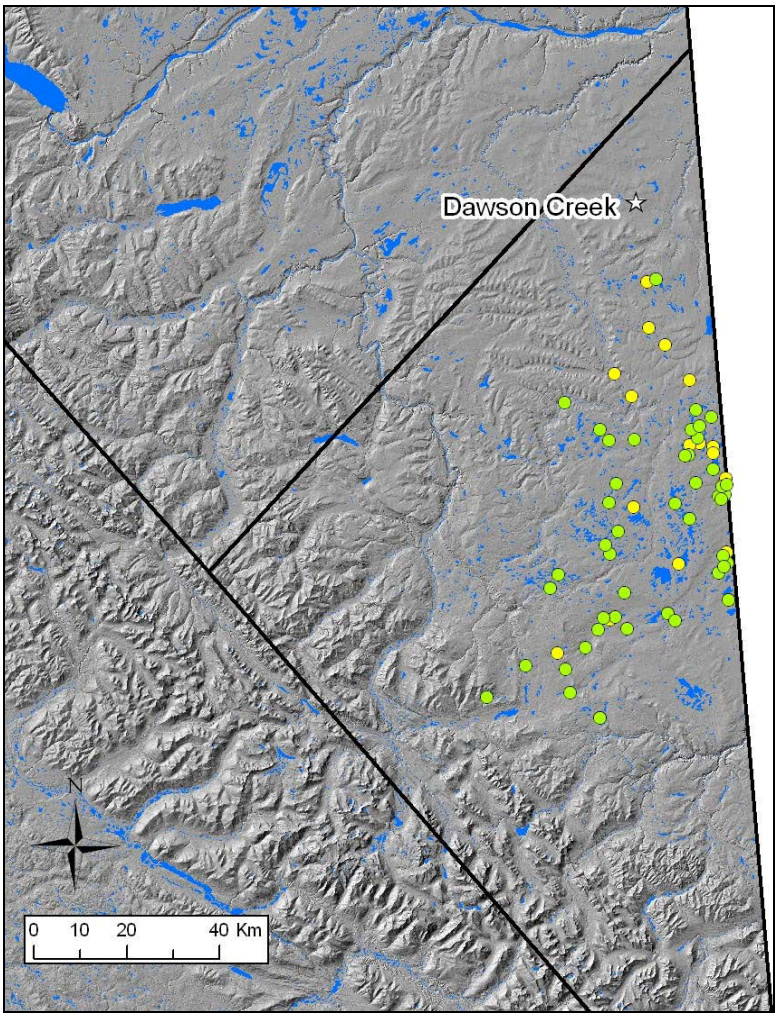

Figure 8. Sightings of Trumpeter Swan pairs with broods (yellow circles) and adults/subadults without young (green circles) in the Western Alberta Upland unit in 2005.

Fort St. John, although adults and subadults and pairs with cygnets were broadly distributed throughout the entire area (Figure 9).

The lowlands comprising the majority of this region have been fairly well surveyed (see flight track in Appendix 3) but there is likely unsurveyed suitable swan habitat in the western portion of this unit (i.e. foothills and large lakes/valleys in the Rocky Mountains).

c) Taiga Plains

The Taiga Plains unit supported an estimated 117 Trumpeter Swans in 2005 (Table 2). The few records of breeding and non-breeding Trumpeter Swans collected in the Taiga Plains in 2005 suggest that swans are primarily associated with the Coal, Liard, Kechika and Dease River drainages (Figure 10). The entire Trumpeter Swan breeding and non-breeding range has yet to be characterized in the Taiga Plains.

d) Coast Mountains

The Coast Mountains unit supported an estimated 221 Trumpeter Swans in 2005 (Table 2). The two major breeding and non-breeding areas were the Tatshenshini (top left) and Taku River (middle right) drainages (Figure 11). Our estimates of wetland availability suggest that these drainages are likely the best swan nesting habitat in this unit. However, the entire breeding and non-breeding range of Trumpeter Swans has yet to be characterized in the Coast Mountains.

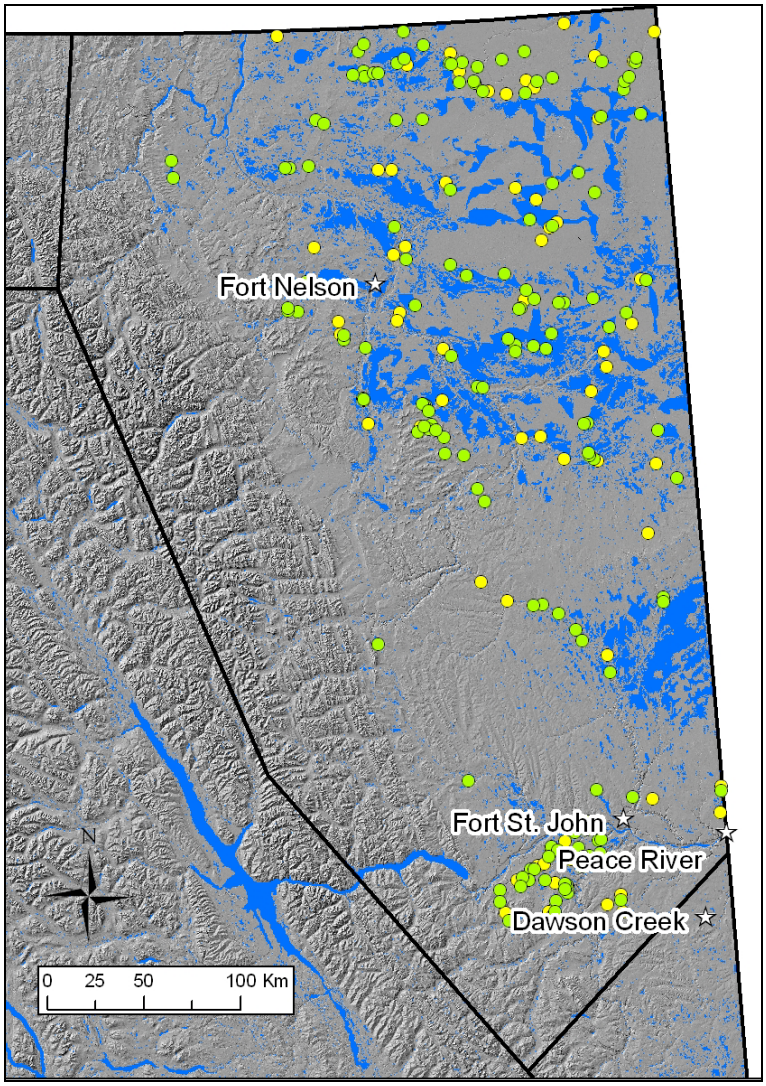

Figure 9. Sightings of Trumpeter Swan pairs with broods (yellow circles) and adults/subadults without young (green circles) in the Fort St. John – Fort Nelson geographic unit in 2005.

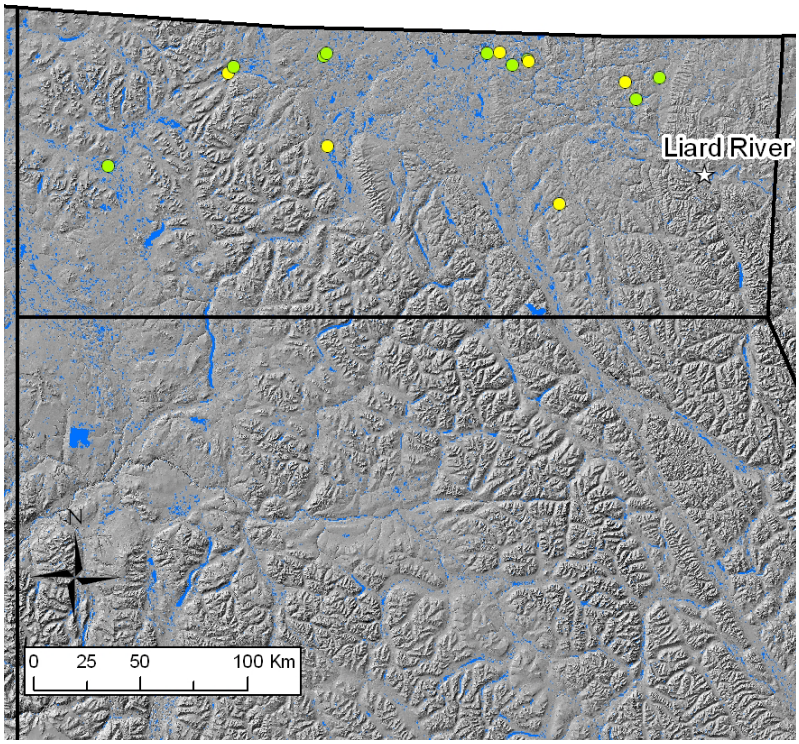

Figure 10. Sightings of Trumpeter Swan pairs with broods (yellow circles) and adults/subadults without young (green circles) in the Taiga Plains unit in 2005.

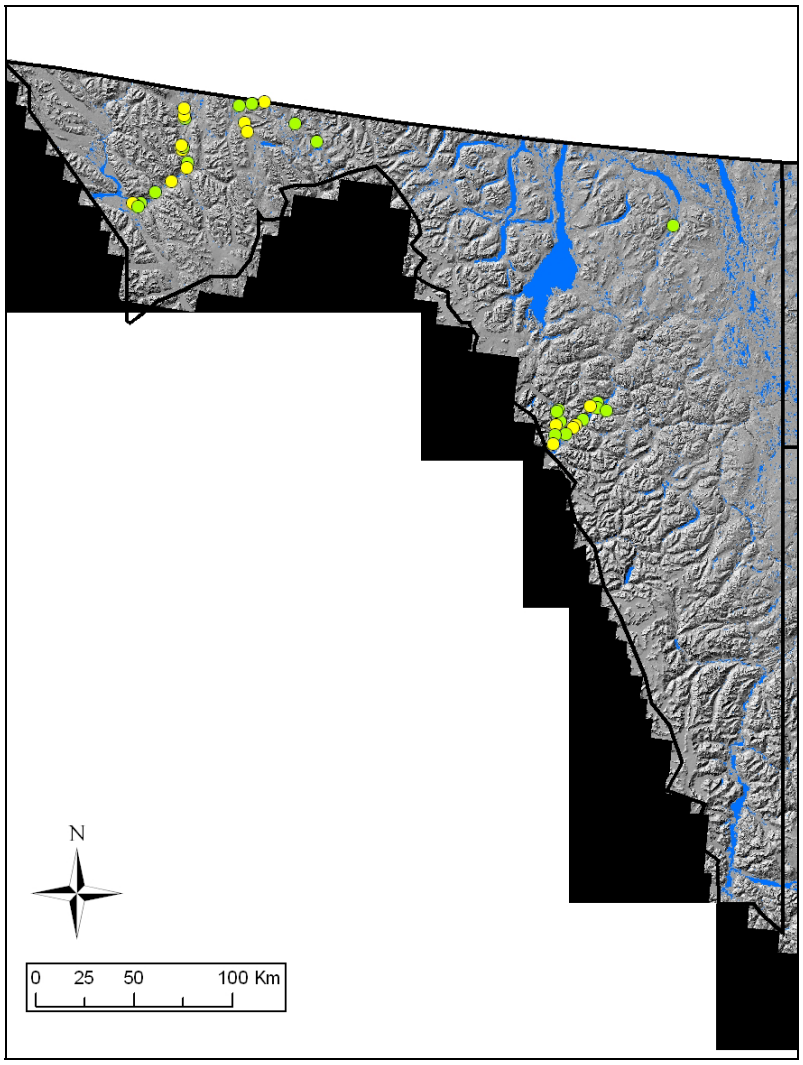

Figure 11. Sightings of Trumpeter Swan pairs with broods (yellow circles) and adults/subadults without young (green circles) in the Coast Mountains in 2005.

Conclusion

Thirty years ago, breeding Trumpeter Swans were rare in Western Canada and surveys were sufficient to delineate breeding range, provide a minimum estimate of numbers and characterize population growth (Hawkings *et al*. 2002).

In British Columbia, as elsewhere in their range, Trumpeter Swans have become more abundant and dispersed, making surveys more difficult. In some places (e.g. Alaska, Yukon, Coast Mountains and Taiga Plains), the total count has been replaced with a stratified sampling protocol, while in other regions (e.g. Fort St. John - Fort Nelson and the Western Alberta Upland), efforts are still undertaken to deliver a complete survey of all suitable habitats.

Breeding survey data indicate that both the Rocky Mountain and the Pacific Coast populations of Trumpeter Swans have consistently grown in abundance and distribution over the last twenty years in British Columbia. This growth took place to a large extent into previously unoccupied areas, similar to the well-documented pattern of growth in Alaska (Conant *et al*. 2002) also suspected to have occurred in the Yukon and Northwest Territories (Hawkings *et al*. 2002).

The productivity of Trumpeter Swans in British Columbia is within the range observed in 2000 and 2005 in other North American Trumpeter Swan populations (Caithamer 2001, Moser 2006) and the population growth rates observed in all 4 units in British Columbia do not appear unreasonably high compared to the 21% reported for Alaska over a 5-year period (Conant *et al*. 2002).

Acknowledgements

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Appendices

Appendix 1. Distribution of the three populations of Trumpeter Swans breeding in North America.

There are three populations of Trumpeter Swans breeding in North America: the Pacific Coast Population (PCP), the Rocky Mountain Population (RMP) and the Interior Population (IP). The PCP and RMP birds are descended from the historical populations and from restoration efforts in the Rocky Mountains. The IP birds are the result of reintroduction programs.

The Pacific Coast Population (PCP): The PCP consists of the Trumpeter Swans breeding primarily within Alaska and wintering along coastal areas of British Columbia, Washington State, Oregon and California.

The Rocky Mountain Population (RMP): The RMP is home to two groups of swans. The first group consists of migratory birds nesting in western Canada (Alberta, British Columbia, the Northwest Territories, Yukon, and southern Saskatchewan) and wintering in the Tri-state (Idaho, Montana and Wyoming) area. The second group consists of non-migratory swans that remain in the Tri-state area on a year-round basis and of small restored flocks in eastern Nevada and southern Oregon.

Interior Population: The IP comprises various re-introduced flocks in central and eastern North America.

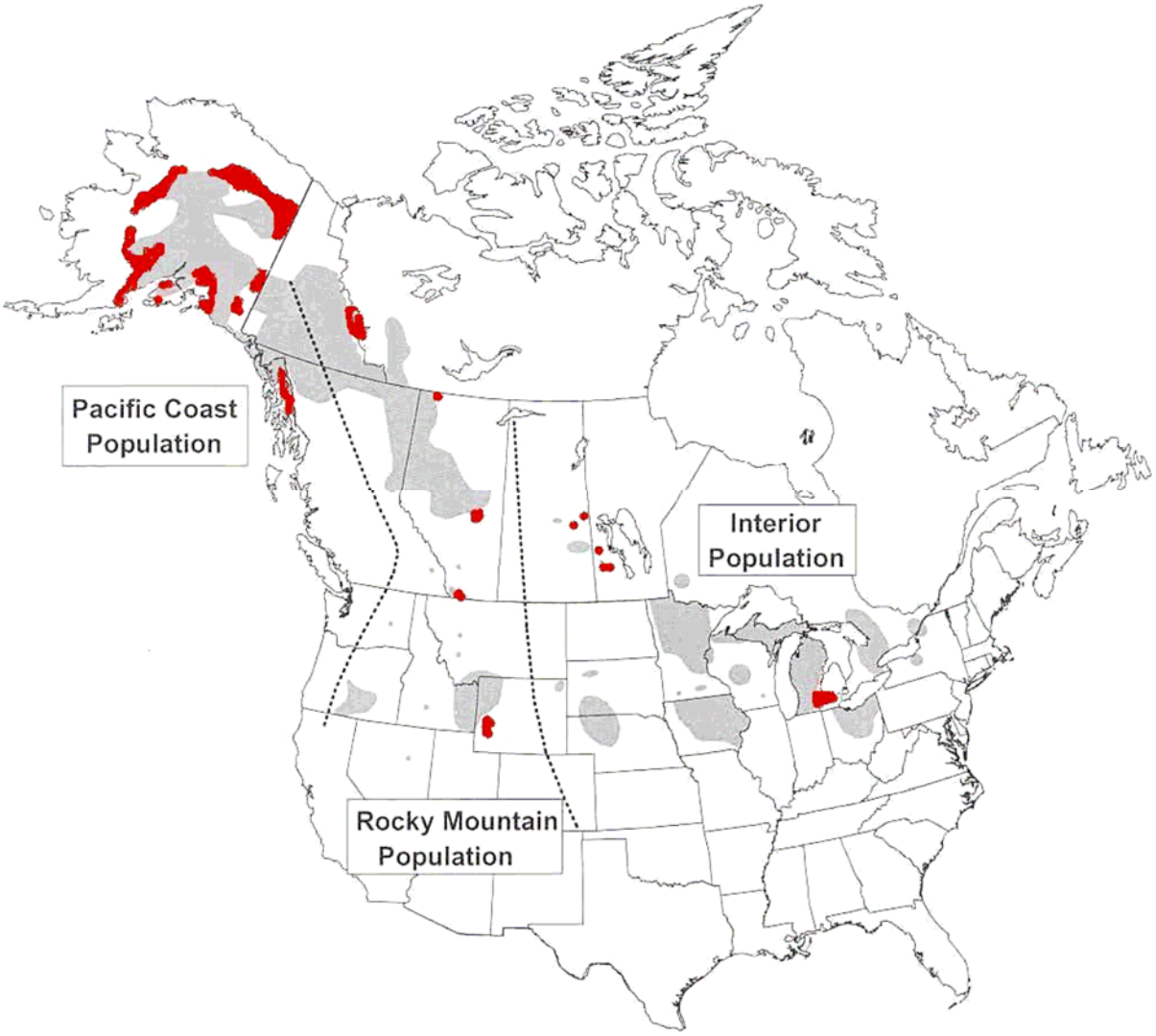
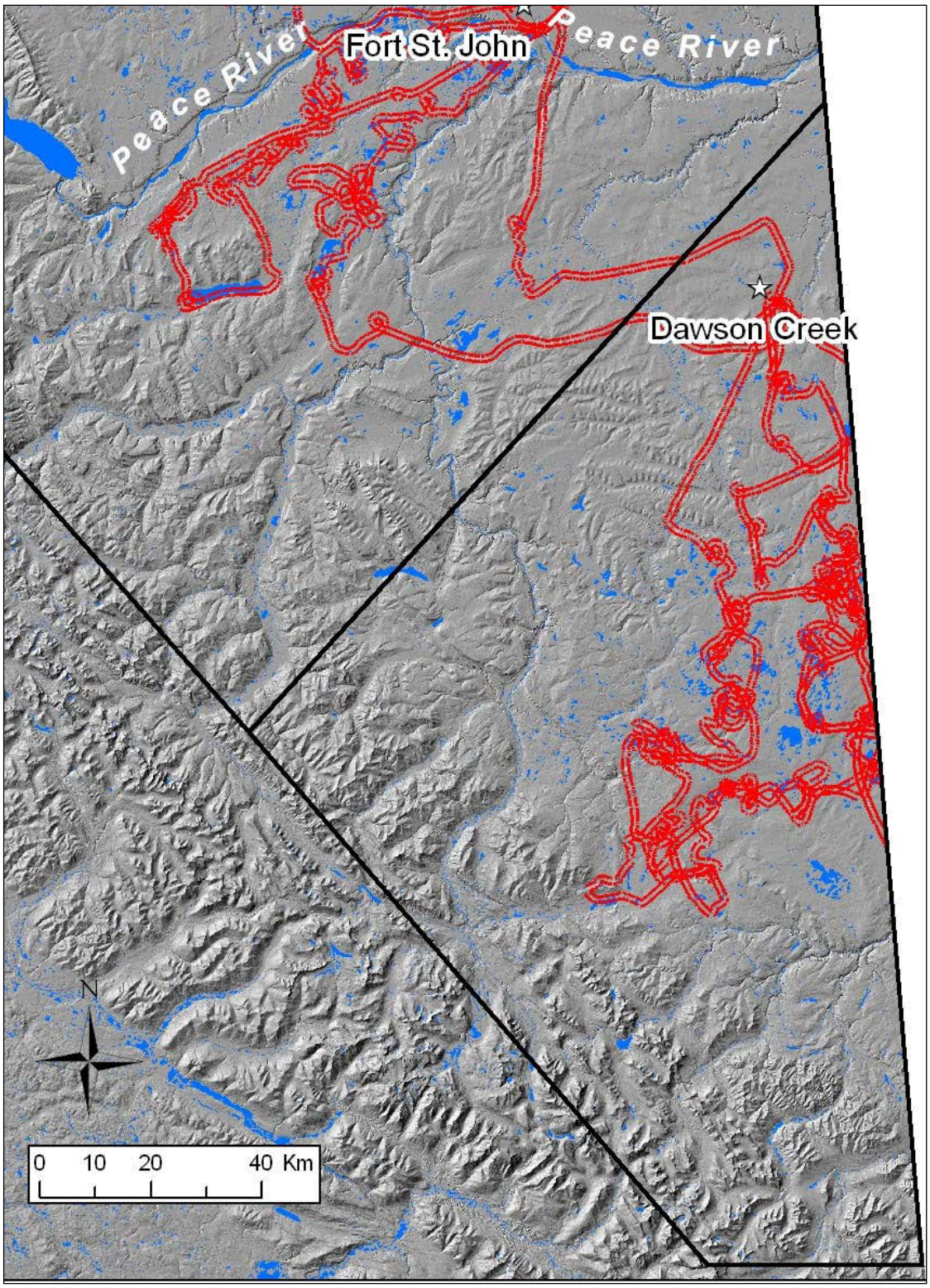
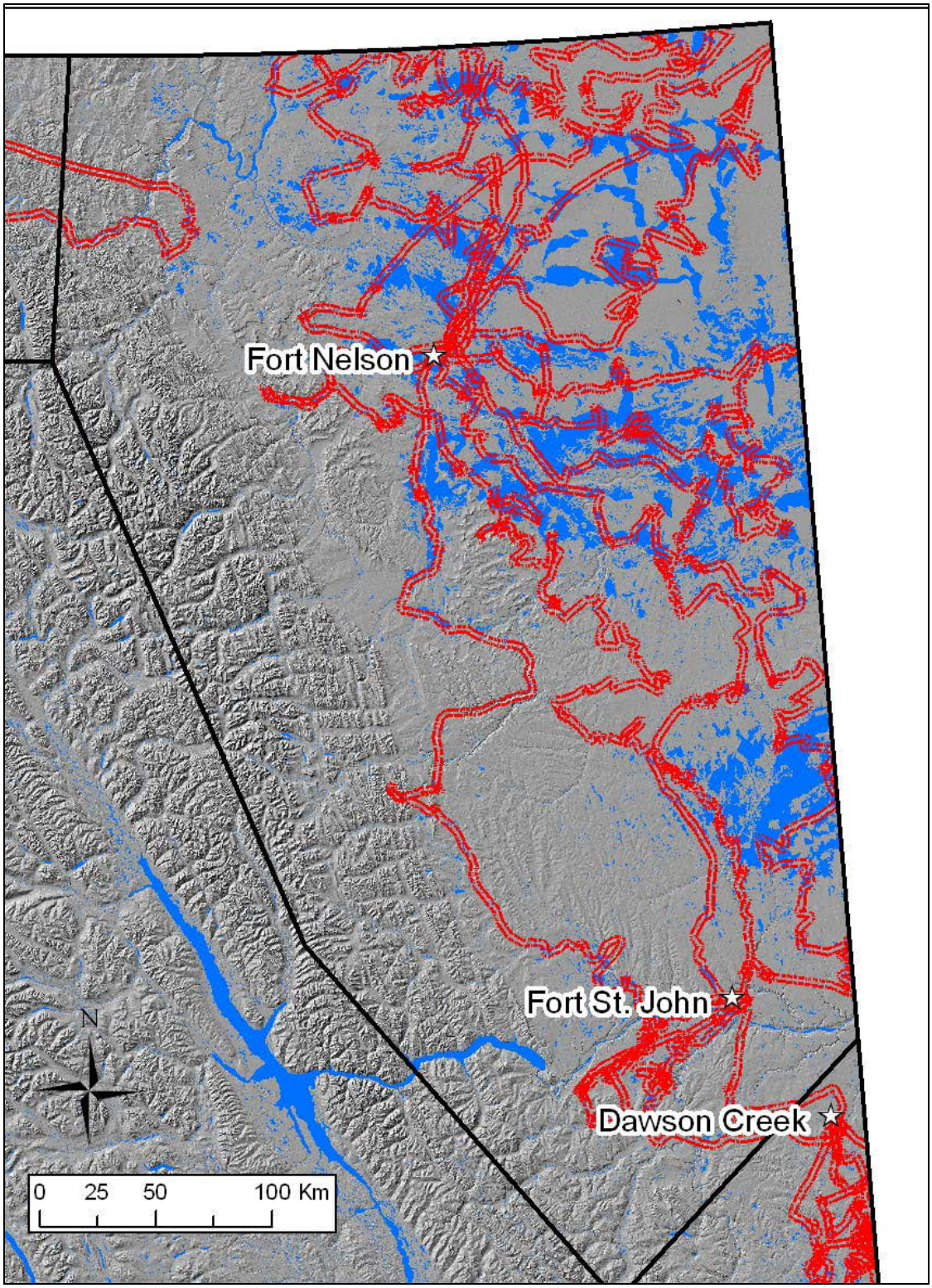


Fig. 1. Approximate breeding range of Pacific Coast, Rocky Mountain, and Interior populations of Trumpeter Swans. Trumpeter swan range expansion reported by survey biologists during the 2005 North American trumpeter swan survey is shown in red (from Moser, T.J. 2006).

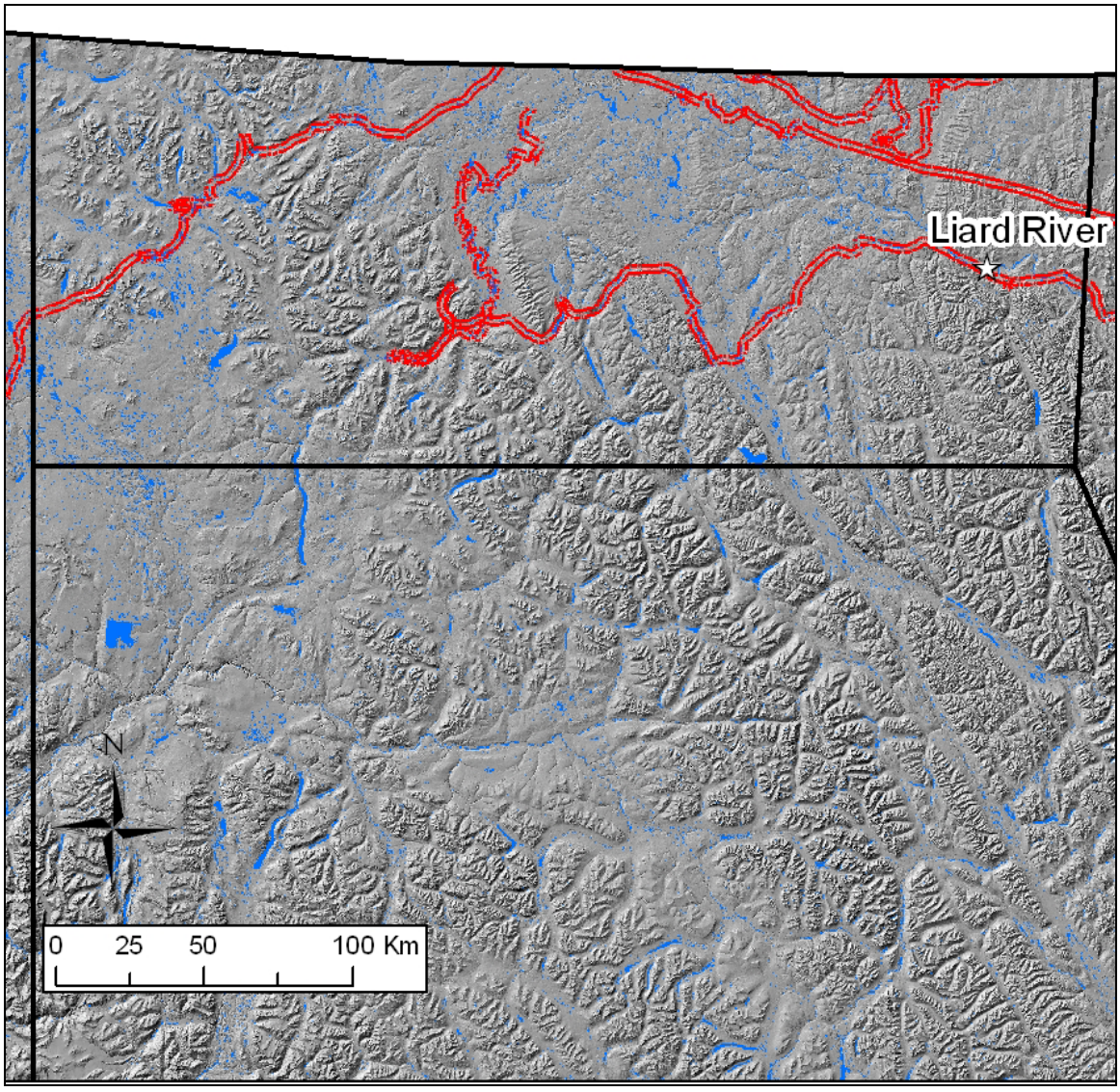
Appendix 2. Flight route (in red) showing survey effort for the 2005 Trumpeter Swan breeding survey in the Western Alberta Upland (Unit 1).



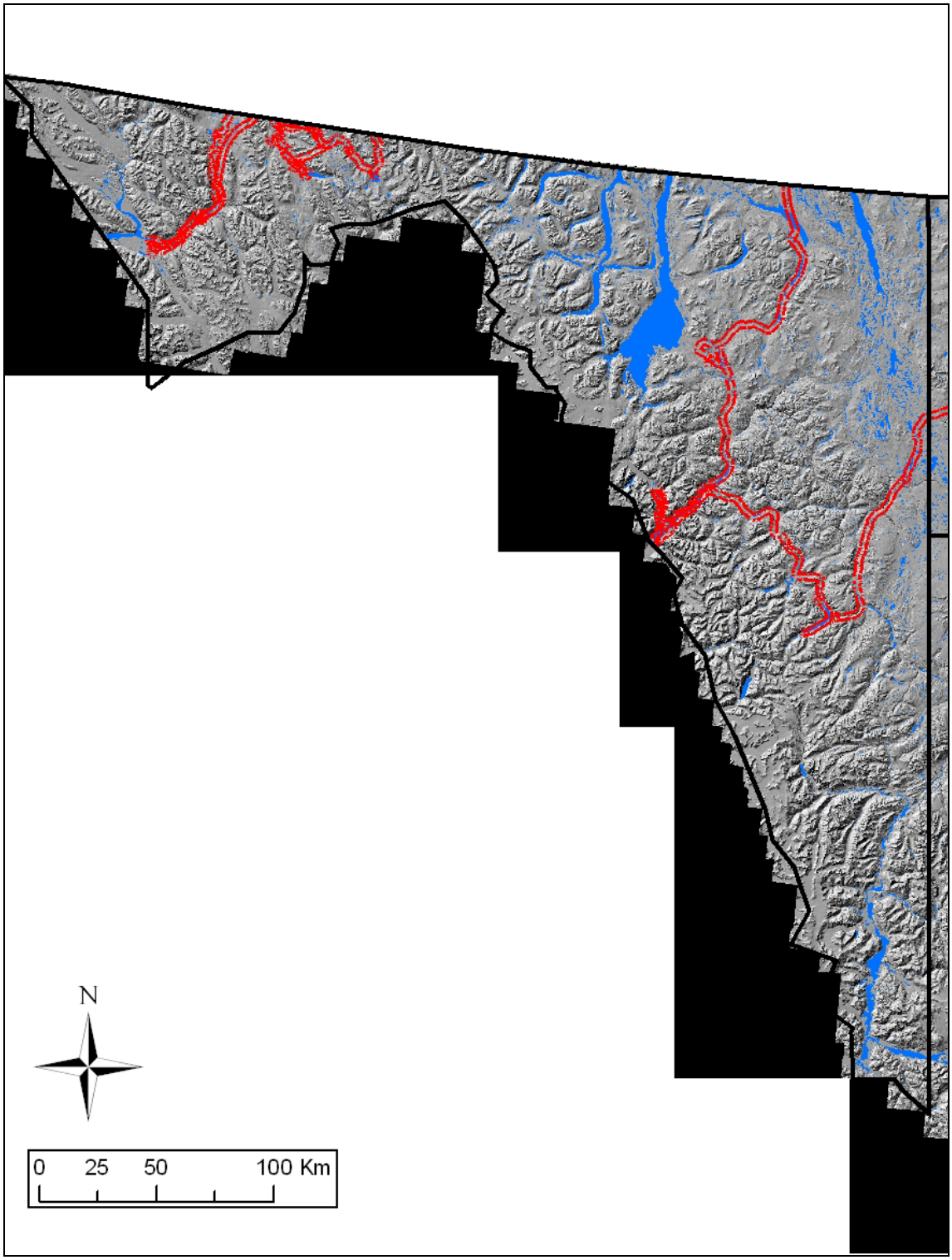
Appendix 3. Flight route (in red) showing survey effort for the 2005 Trumpeter Swan breeding survey in the Fort St. John – Fort Nelson area (Unit 2).



Appendix 4. Flight route (in red) showing survey effort for the 2005 Trumpeter Swan breeding survey in the Taiga Plains (Unit 3).



Appendix 5. Flight route (in red) showing survey effort for the 2005 Trumpeter Swan breeding survey in the Coast Mountains (Unit 4).



Appendix 6. Field sightings of Trumpeter Swans in the Western Alberta Upland in August 2005.

LOCATION (degree.decimal degree)		SURVEY DATE		BREEDING STATUS	SWANS	
LATITUDE	LONGITUDE	MONTH	DAY		ADULTS	CYGNETS
55.1770	-120.3250	August	13	Pair with young	2	1
55.3920	-120.3000	August	13	Pair with young	2	1
55.4380	-120.3500	August	13	Pair with young	2	1
55.5210	-120.2220	August	13	Pair with young	2	1
55.4856	-120.1711	August	13	Pair with young	2	1
55.2814	-120.0383	August	24	Pair with young	2	1
54.9827	-120.0306	August	24	Pair with young	2	2
54.7756	-120.4937	August	24	Pair with young	2	2
55.2697	-120.0407	August	24	Pair with young	2	2
54.9631	-120.4336	August	24	Pair with young	2	3
55.2899	-120.0814	August	24	Pair with young	2	3
55.4141	-120.0979	August	24	Pair with young	2	4
55.6109	-120.2136	August	24	Pair with young	2	4
54.9066	-120.6182	August	24	Pair with young	2	5
55.2117	-120.0069	August	24	Pair with young	2	5
55.2887	-120.1181	August	24	Pair with young	2	5
55.0758	-120.0210	August	25	Pair with young	2	1
55.0610	-120.1861	August	25	Pair with young	2	4
55.2179	-120.0029	August	25	Pair with young	2	5
55.0130	-120.3770	August	13	Adult(s) without young	1	0
55.3100	-120.3880	August	13	Adult(s) without young	2	0
55.3320	-120.4170	August	13	Adult(s) without young	2	0
55.3900	-120.5280	August	13	Adult(s) without young	2	0
55.3079	-120.3022	August	13	Adult(s) without young	2	0
54.9827	-120.0306	August	24	Adult(s) without young	2	0
54.9678	-120.2364	August	24	Adult(s) without young	2	0
54.9678	-120.2364	August	24	Adult(s) without young	2	0
54.9439	-120.3771	August	24	Adult(s) without young	4	0
54.9681	-120.4130	August	24	Adult(s) without young	2	0
54.7756	-120.4937	August	24	Adult(s) without young	2	0
54.8314	-120.8667	August	24	Adult(s) without young	2	0
54.8747	-120.5951	August	24	Adult(s) without young	2	0
54.8287	-120.5870	August	24	Adult(s) without young	2	0
55.3005	-120.0885	August	24	Adult(s) without young	10	0
55.2691	-120.1218	August	24	Adult(s) without young	2	0
55.2692	-120.1363	August	24	Adult(s) without young	2	0
55.2380	-120.0445	August	24	Adult(s) without young	2	0
55.2246	-120.3745	August	24	Adult(s) without young	2	0
55.1897	-120.4052	August	24	Adult(s) without young	2	0
55.0907	-120.4152	August	24	Adult(s) without young	1	0
55.0337	-120.6245	August	24	Adult(s) without young	2	0

LOCATION (degree.decimal degree)		SURVEY DATE		BREEDING STATUS	SWANS	
LATITUDE	LONGITUDE	MONTH	DAY		ADULTS	CYGNETS
54.8880	-120.7260	August	24	Adult(s) without young	2	0
54.9137	-120.5230	August	24	Adult(s) without young	1	0
54.9462	-120.4766	August	24	Adult(s) without young	4	0
54.9674	-120.4532	August	24	Adult(s) without young	2	0
54.9521	-120.2156	August	24	Adult(s) without young	3	0
55.1872	-120.0106	August	24	Adult(s) without young	2	0
55.0590	-120.5935	August	24	Adult(s) without young	2	0
55.1095	-120.4289	August	24	Adult(s) without young	2	0
55.1337	-120.3834	August	24	Adult(s) without young	2	0
55.3171	-120.1050	August	24	Adult(s) without young	2	0
55.3228	-120.0778	August	24	Adult(s) without young	2	0
55.3562	-120.0848	August	24	Adult(s) without young	2	0
55.3397	-120.0355	August	24	Adult(s) without young	4	0
55.6139	-120.1848	August	24	Adult(s) without young	2	0
55.0374	-120.0560	August	25	Adult(s) without young	2	0
55.0543	-120.0209	August	25	Adult(s) without young	2	0
55.0693	-120.0355	August	25	Adult(s) without young	2	0
55.2143	-120.1073	August	25	Adult(s) without young	2	0
55.1847	-120.0333	August	25	Adult(s) without young	2	0
55.2041	-120.0184	August	25	Adult(s) without young	5	0
55.2056	-120.0039	August	25	Adult(s) without young	2	0
55.1791	-120.0250	August	25	Adult(s) without young	2	0
55.1787	-120.1810	August	25	Adult(s) without young	2	0
55.1462	-120.1378	August	25	Adult(s) without young	2	0
55.0485	-120.0367	August	25	Adult(s) without young	2	0

Appendix 7. Field sightings of Trumpeter Swans in the Fort St. John – Fort Nelson area in August 2005.

LOCATION (degree.decimal degree)		SURVEY DATE		BREEDING STATUS	SWANS	
LATITUDE	LONGITUDE	MONTH	DAY		ADULTS	CYGNETS
59.966	-123.517	August	17	Pair with young	2	2
58.975	-123.252	August	18	Pair with young	2	2
58.628	-123.057	August	16	Pair with young	2	3
58.566	-123.049	August	16	Pair with young	2	1
58.256	-122.862	August	18	Pair with young	2	6
58.147	-122.833	August	18	Pair with young	2	3
59.323	-122.638	August	17	Pair with young	2	3
58.926	-122.534	August	17	Pair with young	2	3
58.620	-122.533	August	15	Pair with young	2	3
59.323	-122.513	August	17	Pair with young	2	1
58.654	-122.504	August	15	Pair with young	2	1
58.961	-122.430	August	17	Pair with young	2	1
58.124	-122.376	August	16	Pair with young	2	1
59.806	-122.329	August	17	Pair with young	2	2
58.119	-122.296	August	16	Pair with young	2	3
58.238	-122.169	August	16	Pair with young	2	1
58.476	-122.137	August	15	Pair with young	2	2
59.249	-122.028	August	17	Pair with young	2	2
59.847	-121.925	August	18	Pair with young	2	3
57.385	-121.920	August	16	Pair with young	2	2
55.848	-121.880	August	14	Pair with young	2	2
59.760	-121.848	August	18	Pair with young	2	2
55.996	-121.760	August	14	Pair with young	2	2
57.293	-121.702	August	16	Pair with young	2	2
59.660	-121.592	August	18	Pair with young	2	3
56.058	-121.584	August	14	Pair with young	2	3
56.062	-121.530	August	14	Pair with young	2	4
55.838	-121.515	August	13	Pair with young	2	3
58.040	-121.493	August	15	Pair with young	2	1
56.129	-121.463	August	14	Pair with young	2	1
55.973	-121.451	August	13	Pair with young	2	5
59.644	-121.433	August	18	Pair with young	2	1
59.206	-121.401	August	17	Pair with young	2	2
58.681	-121.386	August	16	Pair with young	2	2
56.161	-121.347	August	14	Pair with young	4	3
58.046	-121.327	August	15	Pair with young	2	2
56.076	-121.303	August	13	Pair with young	2	2
59.700	-121.240	August	18	Pair with young	2	1
59.145	-121.223	August	17	Pair with young	2	3
58.951	-121.200	August	17	Pair with young	2	3
59.663	-121.172	August	18	Pair with young	2	1
57.932	-121.135	August	15	Pair with young	2	2
59.009	-121.119	August	17	Pair with young	2	2

LOCATION (degree.decimal degree)		SURVEY DATE		BREEDING STATUS	SWANS	
LATITUDE	LONGITUDE	MONTH	DAY		ADULTS	CYGNETS
59.032	-121.053	August	17	Pair with young	2	1
55.855	-121.028	August	13	Pair with young	2	4
55.815	-120.907	August	13	Pair with young	2	4
55.898	-120.906	August	13	Pair with young	2	2
57.009	-120.882	August	15	Pair with young	2	1
59.952	-120.857	August	18	Pair with young	2	1
58.238	-120.853	August	15	Pair with young	2	2
57.912	-120.839	August	15	Pair with young	2	3
58.418	-120.716	August	16	Pair with young	2	1
58.345	-120.701	August	16	Pair with young	2	1
59.499	-120.609	August	17	Pair with young	2	4
59.790	-120.599	August	17	Pair with young	2	4
58.538	-120.451	August	16	Pair with young	2	2
57.559	-120.448	August	15	Pair with young	2	3
58.737	-120.334	August	16	Pair with young	2	5
57.879	-120.332	August	15	Pair with young	4	2
59.753	-120.246	August	17	Pair with young	2	4
59.882	-120.028	August	17	Pair with young	2	1
56.241	-120.027	August	15	Pair with young	2	3
56.363	-120.003	August	15	Pair with young	2	5
58.688	-123.506	August	16	Adult(s) without young	2	0
58.699	-123.502	August	16	Adult(s) without young	3	0
59.351	-123.485	August	17	Adult(s) without young	2	0
59.349	-123.444	August	17	Adult(s) without young	2	0
58.679	-123.413	August	16	Adult(s) without young	2	0
58.816	-123.333	August	16	Adult(s) without young	2	0
59.353	-123.268	August	17	Adult(s) without young	2	0
59.566	-123.187	August	17	Adult(s) without young	2	0
59.550	-123.114	August	17	Adult(s) without young	2	0
58.543	-123.019	August	16	Adult(s) without young	1	0
58.563	-123.015	August	16	Adult(s) without young	2	0
58.267	-122.867	August	18	Adult(s) without young	2	0
58.262	-122.865	August	18	Adult(s) without young	4	0
57.122	-122.830	August	18	Adult(s) without young	2	0
59.770	-122.828	August	17	Adult(s) without young	2	0
58.500	-122.828	August	18	Adult(s) without young	2	0
59.877	-122.772	August	17	Adult(s) without young	2	0
59.787	-122.726	August	17	Adult(s) without young	2	0
59.760	-122.724	August	17	Adult(s) without young	2	0
59.910	-122.719	August	17	Adult(s) without young	2	0
59.775	-122.634	August	17	Adult(s) without young	2	0
59.775	-122.599	August	17	Adult(s) without young	2	0
59.055	-122.515	August	17	Adult(s) without young	5	0
59.553	-122.449	August	17	Adult(s) without young	1	0
58.903	-122.426	August	17	Adult(s) without young	2	0
59.815	-122.418	August	17	Adult(s) without young	2	0
58.098	-122.397	August	16	Adult(s) without young	1	0

LOCATION (degree.decimal degree)		SURVEY DATE		BREEDING STATUS	SWANS	
LATITUDE	LONGITUDE	MONTH	DAY		ADULTS	CYGNETS
58.684	-122.368	August	15	Adult(s) without young	2	0
58.226	-122.347	August	16	Adult(s) without young	2	0
59.835	-122.347	August	17	Adult(s) without young	2	0
59.961	-122.345	August	17	Adult(s) without young	2	0
58.121	-122.339	August	16	Adult(s) without young	2	0
58.224	-122.334	August	16	Adult(s) without young	2	0
58.216	-122.316	August	16	Adult(s) without young	2	0
58.110	-122.304	August	16	Adult(s) without young	2	0
58.193	-122.295	August	16	Adult(s) without young	2	0
58.130	-122.276	August	16	Adult(s) without young	2	0
58.102	-122.241	August	16	Adult(s) without young	5	0
59.547	-122.212	August	17	Adult(s) without young	2	0
57.990	-122.172	August	16	Adult(s) without young	2	0
58.065	-122.172	August	16	Adult(s) without young	2	0
59.892	-122.172	August	18	Adult(s) without young	2	0
56.469	-122.125	August	18	Adult(s) without young	1	0
58.444	-122.068	August	15	Adult(s) without young	2	0
58.866	-122.032	August	16	Adult(s) without young	2	0
57.977	-122.004	August	16	Adult(s) without young	2	0
59.214	-121.992	August	17	Adult(s) without young	2	0
59.803	-121.940	August	18	Adult(s) without young	2	0
59.798	-121.919	August	18	Adult(s) without young	3	0
55.901	-121.914	August	14	Adult(s) without young	2	0
55.955	-121.907	August	14	Adult(s) without young	1	0
57.820	-121.905	August	16	Adult(s) without young	3	0
58.812	-121.888	August	16	Adult(s) without young	2	0
58.294	-121.854	August	15	Adult(s) without young	1	0
55.810	-121.851	August	14	Adult(s) without young	6	0
59.713	-121.851	August	18	Adult(s) without young	2	0
57.760	-121.848	August	16	Adult(s) without young	2	0
59.803	-121.820	August	18	Adult(s) without young	2	0
58.285	-121.806	August	15	Adult(s) without young	5	0
55.964	-121.736	August	14	Adult(s) without young	3	0
59.712	-121.719	August	18	Adult(s) without young	5	0
56.007	-121.717	August	14	Adult(s) without young	2	0
59.705	-121.711	August	18	Adult(s) without young	2	0
56.288	-121.704	August	18	Adult(s) without young	2	0
59.778	-121.679	August	18	Adult(s) without young	2	0
55.992	-121.669	August	14	Adult(s) without young	2	0
56.044	-121.646	August	14	Adult(s) without young	1	0
59.663	-121.644	August	18	Adult(s) without young	2	0
56.040	-121.617	August	14	Adult(s) without young	2	0
58.506	-121.556	August	16	Adult(s) without young	3	0
58.810	-121.554	August	17	Adult(s) without young	1	0
55.986	-121.528	August	13	Adult(s) without young	2	0
58.446	-121.497	August	16	Adult(s) without young	2	0
58.473	-121.494	August	16	Adult(s) without young	1	0

LOCATION (degree.decimal degree)		SURVEY DATE		BREEDING STATUS	SWANS	
LATITUDE	LONGITUDE	MONTH	DAY		ADULTS	CYGNETS
56.095	-121.488	August	14	Adult(s) without young	2	0
55.816	-121.488	August	13	Adult(s) without young	1	0
57.264	-121.481	August	16	Adult(s) without young	2	0
55.837	-121.468	August	13	Adult(s) without young	3	0
56.142	-121.463	August	14	Adult(s) without young	1	0
55.890	-121.455	August	13	Adult(s) without young	2	0
59.804	-121.454	August	18	Adult(s) without young	2	0
58.643	-121.442	August	16	Adult(s) without young	2	0
58.643	-121.423	August	16	Adult(s) without young	2	0
56.122	-121.406	August	14	Adult(s) without young	1	0
57.263	-121.404	August	16	Adult(s) without young	1	0
55.940	-121.372	August	13	Adult(s) without young	2	0
55.963	-121.367	August	13	Adult(s) without young	2	0
58.726	-121.367	August	16	Adult(s) without young	2	0
55.961	-121.356	August	13	Adult(s) without young	2	0
55.922	-121.352	August	13	Adult(s) without young	1	0
55.951	-121.350	August	13	Adult(s) without young	2	0
58.465	-121.334	August	16	Adult(s) without young	2	0
55.765	-121.323	August	13	Adult(s) without young	2	0
58.682	-121.302	August	16	Adult(s) without young	2	0
59.054	-121.297	August	17	Adult(s) without young	3	0
57.216	-121.274	August	15	Adult(s) without young	2	0
59.643	-121.257	August	18	Adult(s) without young	2	0
56.202	-121.255	August	14	Adult(s) without young	2	0
59.835	-121.239	August	18	Adult(s) without young	2	0
56.126	-121.236	August	14	Adult(s) without young	2	0
58.450	-121.226	August	16	Adult(s) without young	2	0
56.040	-121.216	August	13	Adult(s) without young	1	0
56.085	-121.203	August	13	Adult(s) without young	2	0
56.071	-121.202	August	13	Adult(s) without young	2	0
58.516	-121.167	August	16	Adult(s) without young	2	0
56.087	-121.148	August	13	Adult(s) without young	2	0
56.208	-121.147	August	14	Adult(s) without young	1	0
59.694	-121.142	August	18	Adult(s) without young	2	0
56.245	-121.141	August	18	Adult(s) without young	2	0
57.139	-121.135	August	15	Adult(s) without young	2	0
59.015	-121.096	August	17	Adult(s) without young	1	0
58.660	-121.085	August	16	Adult(s) without young	2	0
57.086	-121.082	August	15	Adult(s) without young	2	0
56.216	-121.081	August	14	Adult(s) without young	2	0
59.214	-121.067	August	17	Adult(s) without young	2	0
56.154	-121.062	August	14	Adult(s) without young	1	0
56.095	-121.059	August	13	Adult(s) without young	4	0
56.389	-121.055	August	16	Adult(s) without young	1	0
56.160	-121.039	August	14	Adult(s) without young	2	0
58.657	-121.033	August	16	Adult(s) without young	2	0
59.704	-120.999	August	17	Adult(s) without young	2	0

LOCATION (degree.decimal degree)		SURVEY DATE		BREEDING STATUS	SWANS	
LATITUDE	LONGITUDE	MONTH	DAY		ADULTS	CYGNETS
58.089	-120.940	August	15	Adult(s) without young	2	0
57.952	-120.920	August	15	Adult(s) without young	2	0
55.874	-120.911	August	13	Adult(s) without young	2	0
57.939	-120.910	August	15	Adult(s) without young	2	0
58.090	-120.908	August	15	Adult(s) without young	1	0
57.920	-120.871	August	15	Adult(s) without young	1	0
56.931	-120.866	August	15	Adult(s) without young	2	0
59.255	-120.823	August	17	Adult(s) without young	2	0
58.669	-120.773	August	16	Adult(s) without young	2	0
56.344	-120.750	August	15	Adult(s) without young	3	0
59.158	-120.690	August	17	Adult(s) without young	2	0
58.527	-120.651	August	16	Adult(s) without young	2	0
59.508	-120.580	August	17	Adult(s) without young	1	0
59.761	-120.531	August	17	Adult(s) without young	2	0
58.589	-120.488	August	16	Adult(s) without young	2	0
57.235	-120.368	August	15	Adult(s) without young	2	0
57.257	-120.359	August	15	Adult(s) without young	1	0
59.624	-120.356	August	17	Adult(s) without young	2	0
59.664	-120.343	August	17	Adult(s) without young	2	0
59.681	-120.300	August	17	Adult(s) without young	2	0
58.034	-120.293	August	16	Adult(s) without young	2	0
58.732	-120.290	August	16	Adult(s) without young	1	0
59.745	-120.232	August	17	Adult(s) without young	2	0
59.767	-120.217	August	17	Adult(s) without young	2	0
59.504	-120.214	August	17	Adult(s) without young	4	0
57.805	-120.164	August	15	Adult(s) without young	2	0
56.340	-120.004	August	15	Adult(s) without young	2	0
59.398	-124.520	August	16	Adult(s) without young	2	0
59.318	-124.502	August	16	Adult(s) without young	2	0

Appendix 8. Field sightings of Trumpeter Swans in the Taiga Plains in August 2005.

LOCATION (degree.decimal degree)		SURVEY DATE		BREEDING STATUS	SWANS	
LATITUDE	LONGITUDE	MONTH	DAY		ADULTS	CYGNETS
59.7833	-130.0455	August	14	Pair with young	2	4
59.8026	-126.7398	August	15	Pair with young	2	3
59.9180	-127.7879	August	16	Pair with young	2	4
59.8823	-127.5426	August	16	Pair with young	1	4
59.2853	-127.2698	August	16	Pair with young	2	1
59.4960	-129.1883	August	16	Pair with young	2	3
59.3612	-130.9831	August	14	Adult(s) without young	2	0
59.8110	-129.9993	August	14	Adult(s) without young	2	0
59.8745	-129.2538	August	14	Adult(s) without young	2	0
59.8866	-129.2314	August	14	Adult(s) without young	2	0
59.8230	-126.4530	August	15	Adult(s) without young	2	0
59.9143	-127.8947	August	16	Adult(s) without young	5	0
59.8656	-127.6777	August	16	Adult(s) without young	2	0
59.8886	-127.5535	August	16	Adult(s) without young	2	0
59.7310	-126.6455	August	16	Adult(s) without young	2	0

Appendix 9. Field sightings of Trumpeter Swans in the Coast Mountains in August 2005.

LOCATION (degree.decimal degree)		SURVEY DATE		BREEDING STATUS	SWANS	
LATITUDE	LONGITUDE	MONTH	DAY		ADULTS	CYGNETS
59.6425	-137.1774	August	11	Pair with young	2	5
59.5696	-137.2942	August	11	Pair with young	2	4
59.4452	-137.6082	August	11	Pair with young	2	2
59.7208	-137.2454	August	11	Pair with young	2	5
59.7404	-137.2603	August	11	Pair with young	2	2
59.8787	-137.2770	August	11	Pair with young	2	4
59.9090	-137.2868	August	11	Pair with young	2	3
59.8896	-136.7280	August	11	Pair with young	2	2
59.8483	-136.6851	August	11	Pair with young	2	4
59.9961	-136.5734	August	11	Pair with young	2	4
58.8052	-133.3427	August	14	Pair with young	2	4
58.7089	-133.4465	August	14	Pair with young	2	3
58.6974	-133.4741	August	14	Pair with young	2	3
58.7020	-133.6223	August	14	Pair with young	2	2
58.6142	-133.6279	August	14	Pair with young	2	4
59.6673	-137.1789	August	11	Adult(s) without young	1	0
59.5121	-137.4290	August	11	Adult(s) without young	2	0
59.4510	-137.5369	August	11	Adult(s) without young	3	0
59.4369	-137.5825	August	11	Adult(s) without young	2	0
59.4321	-137.5520	August	11	Adult(s) without young	2	0
59.7344	-137.2381	August	11	Adult(s) without young	4	0
59.8672	-137.2689	August	11	Adult(s) without young	2	0
59.9629	-136.7995	August	11	Adult(s) without young	2	0
59.9818	-136.6784	August	11	Adult(s) without young	2	0
59.9792	-136.6867	August	11	Adult(s) without young	3	0
59.9198	-136.2716	August	11	Adult(s) without young	2	0
59.8524	-136.0580	August	11	Adult(s) without young	2	0
59.6613	-132.7618	August	14	Adult(s) without young	2	0
58.8231	-133.2795	August	14	Adult(s) without young	2	0
58.7992	-133.2741	August	14	Adult(s) without young	2	0
58.7397	-133.3918	August	14	Adult(s) without young	2	0
58.6665	-133.5283	August	14	Adult(s) without young	2	0
58.7196	-133.5874	August	14	Adult(s) without young	2	0
58.7704	-133.6170	August	14	Adult(s) without young	2	0
58.7642	-133.6286	August	14	Adult(s) without young	2	0
58.6543	-133.6234	August	14	Adult(s) without young	2	0
58.7921	-133.1965	August	14	Adult(s) without young	2	0