WALKER BAY,

N.W.T. WATERFOWL PROJECT - 1987

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GOVERNMENT OF THE NORTHWEST TERRITORIES

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ABSTRACT

A pilot study was conducted from 3 June to 1 August, 1987 on a study area in the central Canadian arctic. Objectives were to determine the feasibility of intensive work, use of the area for staging, nesting and moulting, and nesting chronology and reproductive success of White-fronted Geese, Canada Geese and Tundra Swans. Population estimates during spring were 870, 875 and 215 respectively, but these were considered underestimates. Moulting numbers were much larger.

The season was characterized by a late spring and very low reproductive success. Nesting densities on 21 km^2 were $1.1/km^2$, 0.7 and 0.1 respectively for white-fronts, Canadas and swans. Nest and hatching success (Mayfield) was 7% and 10% for white-fronts ; success of other species could not be quantified but was similarly low. The major direct cause of nest failure was predation by arctic fox.

Forty-six adult white-fronts were banded and neck collared, and 107 adult Canada Geese were banded. Many more birds were penned than were banded, but most escaped because of inadequate holding pens.

Intensive studies appear feasible, but work during a year of good reproduction is needed. A large sample of marked individuals are needed to improve the value of intensive studies.

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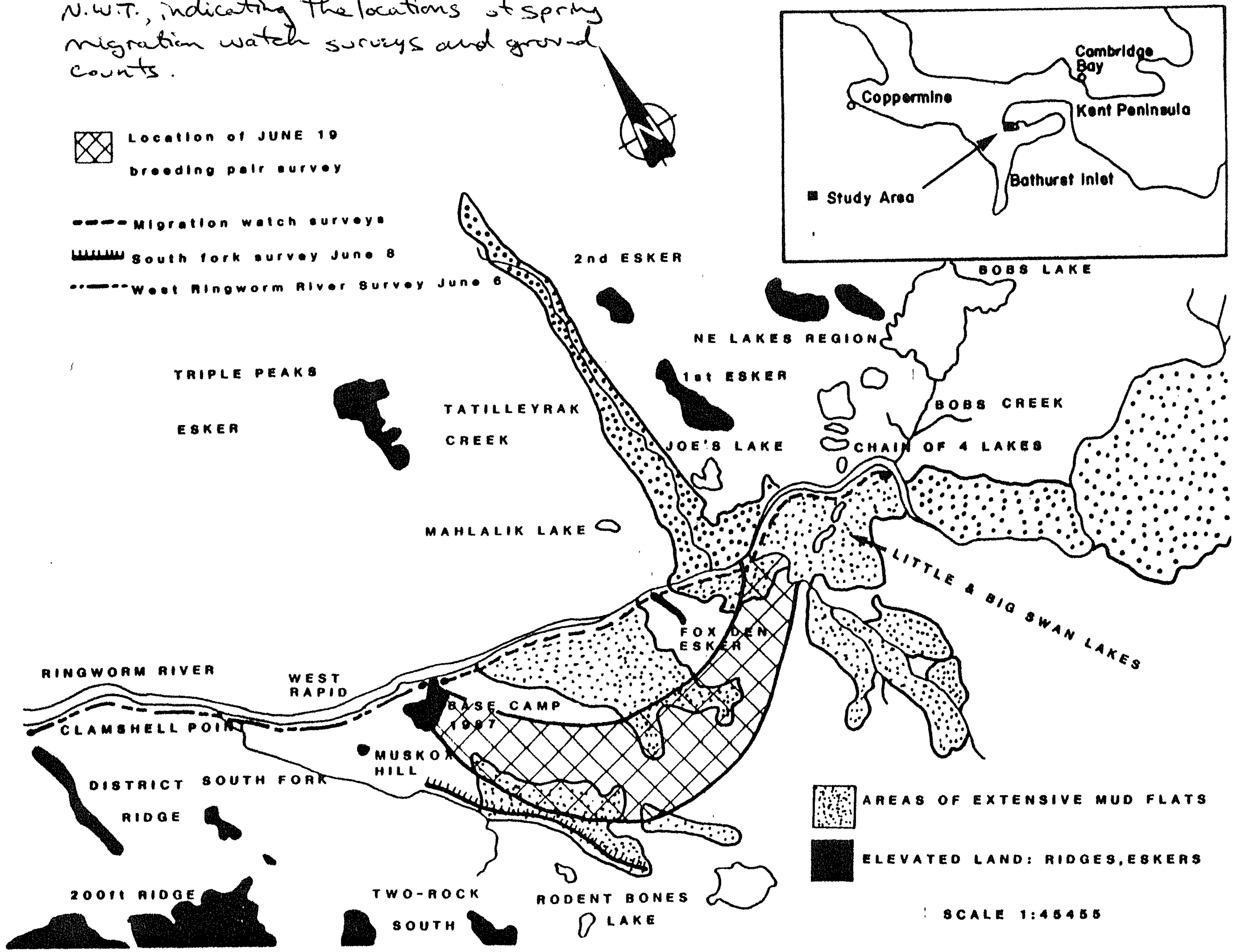
INTRODUCTION

Very few intensive studies have been conducted on the nesting grounds of the mid-continent (M-C) population of White-fronted Geese (WFG), (Barry 1967, Simpson 1984), and even incidental studies are rare (Kuyt 1962, McLaren et al. 1976, Barry et al. 1981). WFG are particularly difficult to study during the reproductive season because of their ground-like colouration and their tendency to disperse our vast remote areas. Similarly, few intensive studies of Short Grass Prairie (SGP) Canada Geese (CG) have been conducted on nesting grounds (CFC 1982a). While there is increasing interest in hunting the eastern population of Tundra Swans (TS), little is known about their productivity, survival and geographic affiliations (Ad Hoc TS Committee 1987).

This report details a pilot study of WFG, CG and TS on the Kent Peninsula, Northwest Territories in 1987. Large numbers of geese and swans were observed on the west end of the Kent Peninsula during a waterfowl reconnaissance flight in June 1986. An impromptu aerial survey on 80 km^2 (Figure 1) provided an estimate of 1030 WFG, 965 CG and 1215 TS (Bromley, unpubl. data). Little nesting was observed at the time, probably due to a late spring.

WFG of the Kent Peninsula presumably belong to the eastern M-C population (EM-C) (CFC 1982b), although, with a lack of banding and band recoveries east of Paulatuk, NWT the division of M-C WFG into eastern and western components remains obscure (Miller et al. 1968). The two subpopulations have also proven difficult to separate on the wintering grounds where WFG are

Figure 1. Map of the Walker Bay Study Area, N.W.T., indicating the locations of spring migration watch surveys and ground counts.



traditionally counted. The M-C population of WFC is the only international waterfowl population for which Canada accounts for up to 50% of the continent recreational harvest; in most cases Canada accounts for 20 to 25% only (NAWMP 1986). But annual continental harvest estimates are often almost as large as the mid-winter population estimates of EM-C WFG (CFC 1982b). Subsistence harvest levels are unknown. The paucity of knowledge about M-C WFG is of increasing concern, given the high popularity of the species among recreational and subsistence hunters and the increasingly specific management needs on the wintering grounds.

The Kent Peninsula lies on the eastern edge of the range of the SGP population of CG and near the western edge of TGP CG (CFC 1982b, 1985). Thus, CG found there may belong to either population. Both populations are very poorly known on their summer range, and remain difficult to separate on staging and wintering areas.

Research needs highlighted (CFC 1982b, 1985) for SGP CG , and likely applicable also to TGP CG, include delineation of breeding, moulting and migration distributions, determination of the breeding area derivation and subspecific composition of populations on the wintering range; determination of the productivity of geese in relation to nesting habitat, weather and physical condition; definition of the breeding range and determination of nesting densities; documentation of moulting areas and determination of the feasibility of banding geese on breeding areas, and measurement of the subsistence harvest.

TS residing in the Northwest Territories belong to the eastern population. Although this population has not been recreationally hunted in the recent past, its' numbers and patterns of winter habitat use have changed to the point where some population control is necessary to minimize crop damage. As a result, an increasing number of states in the United States are permitting a recreational hunt of TS. As of 1987, swan hunts within the range of the eastern population have been authorized in Montana, South Dakota, North Dakota and South Carolina. Requests for authorization have been submitted by Alaska, Maryland, Virginia, Delaware and New Jersey (Ad Hoc TS Committee 1987). The existing quota for the Atlantic Flyway is 6000 TS.

The size or importance of the TS harvest in the spring hunt of northern Canada is unknown. As a result, harvest strategies are being established in the states without specifically accounting for a subsistence harvest component. However, in a draft report entitled "Eastern Population TS Hunting Plan" it is recognized that "the actual determination of allowable harvest is complicated by the lack of any precise estimate of subsistence harvest and further, by the absence of survival rate information."

Because there is an increasing take of TS in the continental United States, and because TS may be locally important in the subsistence kill in Canada, it is important to determine and monitor the survival rate of the species on nesting grounds, and relate survival to both the recreational and subsistence harvest.

OBJECTIVES

Short Term (one to three years)

1. Determine the feasibility of intensive studies of waterfowl in the Ringworm River area of the Kent Peninsula.
2. Determine the use of the area for staging, nesting, summering and molting by WFG, CG and TS.
3. Determine annual reproductive parameters for the 3 species, including nesting chronology, clutch size, and nest success.

Long Term (four to seven years)

4. Determine factors affecting production.
5. Determine population delineation, including affinities to specific staging and wintering areas, and
6. Determine survival rates for each of the 3 species.

higher ground. In some areas of the flat lowlands there are complexes of poorly defined wetlands of an ephemeral to semipermanent nature, usually less than 1 m deep. On the eastern and southern fringes of the study area are small deeper lakes up to 40 ha in size. Some of the wetlands and most of the lakes have small islands less that 10 m across. A few dry, rocky outcrops are dispersed through the study area, rising 10 to 20 m above surrounding terrain.

The WBSA is bordered by dolomite formations interbedded with sandstone and shale to the south and east, and by basalt to the northeast (Fraser 1964, Campbell 1979). After deglaciation more than 9000 years ago, the area was inundated by the sea. Since that time uplift has exposed the area, leaving behind an extensive deposit of silt (Blake 1963). Elevation is less that 40 m.

The area is used for winter trapping and hunting by Eskimos of Parry Bay and the Bathurst region. No subsistence waterfowl hunting is known to occur due to poor accessibility in spring.

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METHODS

Migration Watch Survey

Observers were present on the WBSA from 3 June to 15 July and 29 July to 1 August, 1987. Migration watch surveys were conducted on June 5, 7, 9 and 12 to determine the chronology of migration and arrival. Surveys were by foot, following the Ringworm River east from base camp to it's confluence with Bob's Creek, a distance of 4 miles (Figure 1). Birds were counted on the hike east only, with adjustments to account for "roll-up" (the practice of birds to flush and move ahead of the observer and thus be enumerated on repeated observations). Adjustment for roll-up is a subjective process and thus observer dependant. For this reason enumeration was consistently undertaken by the same observer. Surveys were conducted until migration was judged to have concluded.

Nest Searching

Portions of the study area were systematically searched for nests. Because of the large areal extent and limited manpower the entire study area was not covered. Some nests were located opportunistically during traverses across the study area.

From 2 to 4 people conducted coordinated searches maintaining a distance of approximately 30 m between adjacent observers. A set of flags were positioned approximately equal distances apart along an outside edge of the transect, to be picked up when returning along the adjacent transect. This method resulted in thorough coverage and avoidance of duplication on subsequent transects.

Nest locations were marked with two orange flags placed 40 paces north of the actual nest to avoid discovery by predators. From the position of the flags two compass bearings were taken to familiar landmarks: the base camp location and the projection of land known as "Two Rock South" (see Figure 1). These bearings were used for relocation of nests via compass triangulation.

Each nest of a given species was assigned a number according to order of discovery. Species, nest number, amount of down in the nest, and flushing distances of adult birds were recorded. Eggs were numbered using permanent marking pens and their lengths and widths were recorded.

Aerial Survey

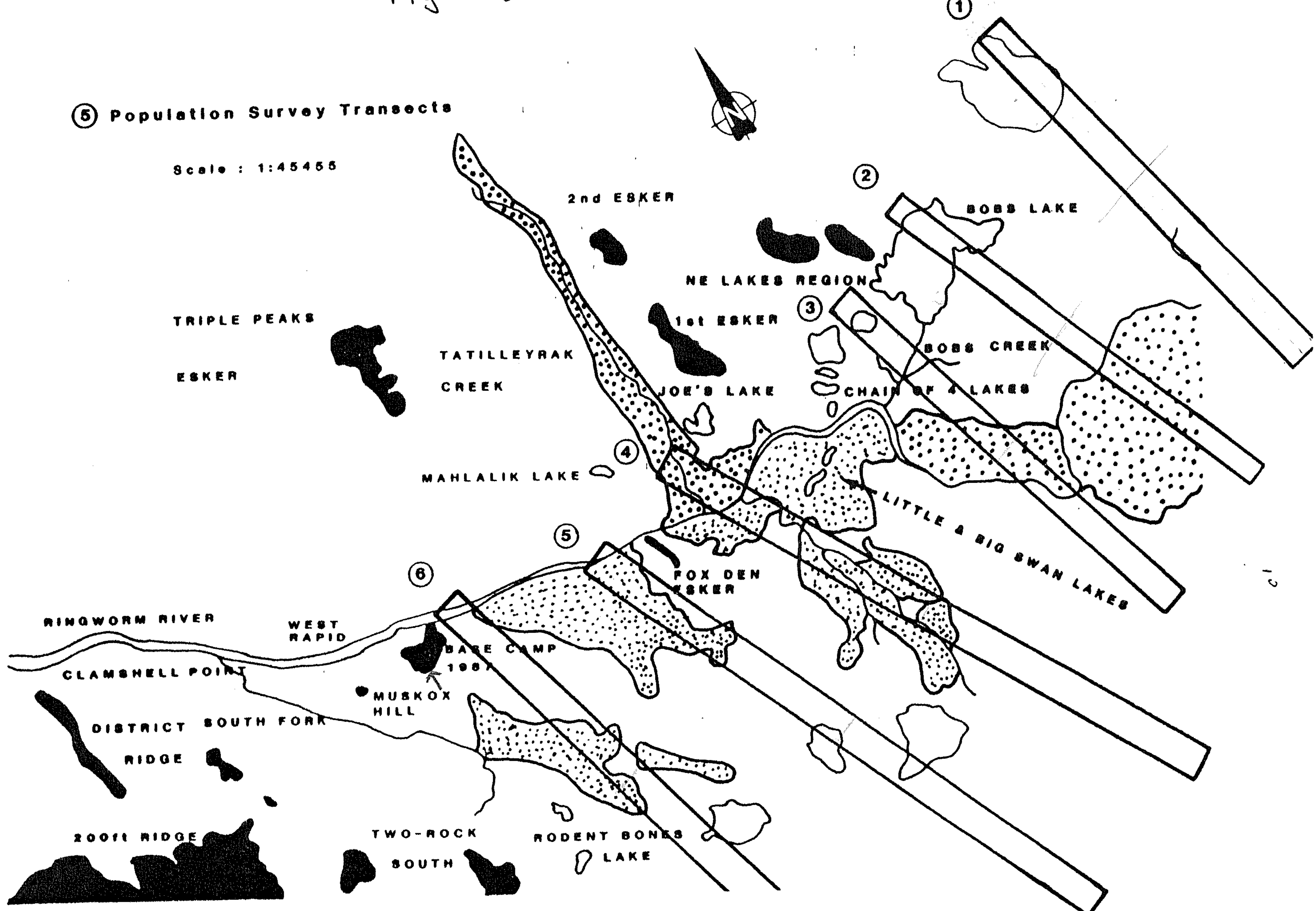
An aerial survey of the WBSA was conducted in a Bell 206B Jet Ranger helicopter on June 21. A navigator sat in the front with one observer on each side in the rear seats. The helicopter maintained an air speed of 96 kph. and an altitude of about 100 m throughout the survey.

A total of six east/west transects were surveyed for a total transect length of 40 km (Appendix A). Observations were made within a strip extending 200 m on either side of the helicopter. Total area surveyed represents 20% of the study area (Figure 2).

Time Budget Study

Pairs of WFG were observed in order to determine behavioural activity budgets during the early parts of the reproductive

Figure 2



5 Population Survey Transects
Scale : 1:45455
1
2
3
4
5
6
BOBS LAKE
2nd ESKER
NE LAKES REGION
1st ESKER
BOBS CREEK
TRIPLE PEAKS
ESKER
TATILLEYRAK
CREEK
JOE'S LAKE
CHAIN OF 4 LAKES
MAHLALIK LAKE
LITTLE & BIG SWAN LAKES
FOX DEN
ESKER
RINGWORM RIVER
WEST
RAPID
BASE CAMP
1987
CLAMSHELL POINT
MUSKOX
HILL
DISTRICT
RIDGE
SOUTH FORK
200ft RIDGE
TWO-ROCK
SOUTH
RODENT BONES
LAKE

season. Only time budget sessions lasting a minimum of 30 minutes were included for analysis, with activities recorded at 30 second intervals throughout the session (Altmann 1974, Ely et al. 1985). Two people took part in each session, one as observer, and another as timekeeper and recorder. Activities were assigned to one of ten categories including: feed, alert, alarm, walk, swim, fly, comfort, social, sleep, and unobserved.

Drive Trapping/Banding

A banding and marking program was initiated to investigate survival and homing rates. Banding began on July 29 and concluded on August 1 at the Walker Bay Study Area.

Concentrations of moulting, flightless geese were located by helicopter. Two or three people were then dropped off to set up the trap and net lead system. Two net leads approximately 30 m in length and 1.3 m in height were placed in a funnel shaped configuration narrowing to an opening of 0.7 m. At the opening a circular trap/holding pen was placed. The helicopter hovered in position, holding the birds in the area, until completion of the trap. The helicopter was then used to drive the birds into the trap. Once the birds were inside, the entrance of the pen was closed. Banding commenced after a period of rest and adjustment for the birds. WFG were marked with blue neck collars engraved with a white series of one alpha and two numeric symbols.

RESULTS

Spring Phenology

The 1987 season was characterized as a late spring, with snowmelt retarded by at least a week. Climatological data from 2 weather stations located 75 km NW (Byron Bay) and 140 km NE (Cambridge Bay) of the WBSA indicate that May and June were much cooler than normal, and June and July were much wetter than normal (Table 1, Environment Canada 1987). Snow cover was extensive on the study area until 10 June, when rapid snowmelt began (Figure 3). Frequent rains in mid June expedited this process.

Phenological events were recorded (Table 2) for comparison with subsequent field seasons.

Arrival and Nest Initiation

Geese and swans were present on the study area upon our arrival on 3 June (Appendix A). Surveys by foot indicated that migration to and through the study area peaked on or before 5 June for TS, on or just after 12 June for WFG, and on 7 June for CG (Fig. 1, Table 3, 4). A major influx of waterfowl and other species occurred on 7 June (Table 3). Few yearling WFG were observed either during or after migration. CG were the most abundant waterfowl during the migratory period of early June.

Between the migration surveys (Table 3) and counts on different parts of the study area (Fig. 1, Table 4), we determined that although birds dispersed across the study area earlier in June, they did not break up into territorial pairs

Table 1. Comparison of mean monthly temperatures, and precipitation for Cambridge Bay, and Byron Bay, N.W.T., April through July 1986 and 1987 with long term averages.

	1986 April	1986 May	1986 June	1986 July	1987 April	1987 May	1987 June	1987 July
Cambridge Bay Departure from normal (°C)	-0.3	+0.1	-1.9	-0.8	-1.2	-4.3	-1.8	-0.3
Byron Bay Departure from normal (°C)	+0.2	-0.6	-2.7	-0.6	-1.3	-4.6	-2.2	+0.1
Cambridge Bay Precipitation (% of normal)	158	239	28	60	91	66	227	234
Byron Bay Precipitation (% of normal)	144	280	61	89	237	63*	133*	105*

* Missing data for 1 to 4 days per month.

Figure 3

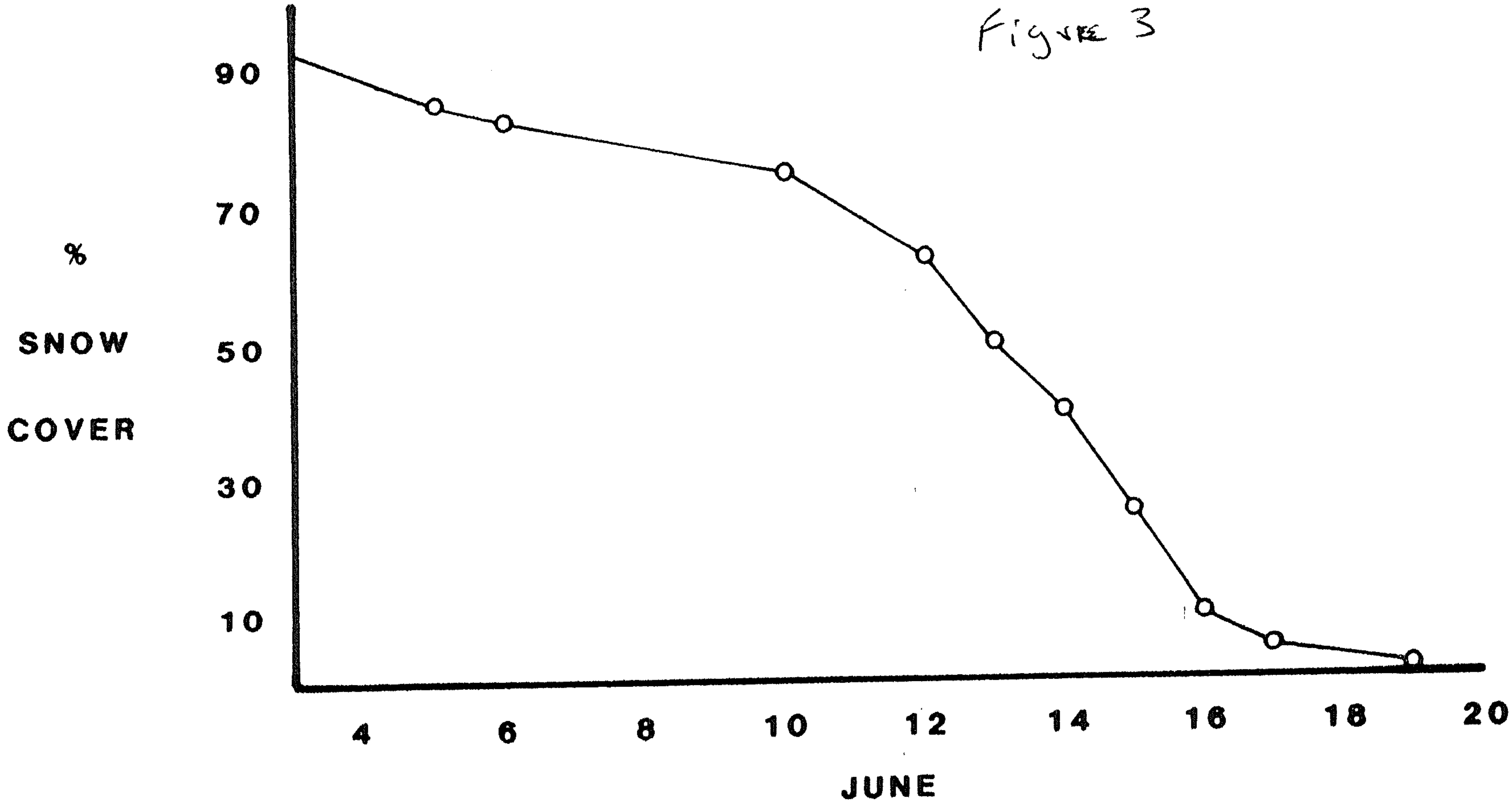


Table 2. Phenological events on the Walker Bay study area, N.W.T. in 1987.

Chronology of Events - Walker Bay 1987.

June 3	- arrival at study area 1:30 p.m. - snow cover 90 - 95%
June 5	- snow cover 85% - mud sticks to boots in some areas for first time
June 6	- snow cover 80 - 85% - puddles beginning to form in rock depressions and in low areas along river
June 7	- arrival of shorebirds and influx of waterfowl
June 10	- snow cover 75%
June 12	- snow cover 60 - 65% - small streams trickling into river in many locations - water beginning to accumulate in river basins
June 13	- snow cover 50% - river beginning to swell
June 14	- snow cover 40%
June 15	- snow cover 30% a.m. - 20% p.m. - river rising quickly, several feet in six hours - majority of birds have now left congregations along the river and are found in pairs and small groups along the edges of emerging ponds
June 16	- snow cover 10 - 15% a.m. - 5% p.m. - tundra heavily flooded, water running to rivers - river up approximately 3 feet again
June 17	- snow cover 5% - rise of river slowed - 6 inch increase approximately - patches of green sedge to a height of 1/2 to 3/4 inch - green shoots and erupting buds on creeping willows - first WFG nest found
June 18	- river level now declining, little flowing water on tundra - standing water in relatively well defined tundra ponds now predominant - first shorebird nest, Baird's Sandpiper - first Bumble Bee
June 19	- snow cover less than 2%
June 20	- first Canada Goose nest
June 22	- first Lapland Longspur eggs
June 23	- first King Eider eggs
June 24	- leaves of creeping willows erupting - many green sedge plants approximately 1 inch tall
June 25	- 2 inches of snow on ground in morning, snow all day
June 26	- snow in morning, melted by evening
June 28	- first mosquito
July 4	- 3 flightless Canada Geese along river - no longer observe WFG "tollers"
July 5	- flightless Pintail hen _ Lapland Longspur nest hatched, 5 chicks

Table 2. Continued

	- Mountain Sorrel, Marsh Marigold, Northern Birdsfoot, Buttercup, Moss Campion, Wolly Lousewort all in bloom
July 6	- Arctic Avens in bloom
July 8	- Arctic Oxytrope in bloom
	- capture 2 moulting Pintail drakes by hand
	- Silvery Oxytrope in bloom
	- Arctic Poppy in bloom
	- flock of 50 to 60 flightless WFG sighted
July 10	- tundra pond teeming with amphipods
July 12	- 70 to 80 moulting geese, probably Canada Geese, at Walker Bay near mouth of east channel of river

Table 3. Birds observed during migration watch surveys on the Walker Bay Study Area, N.W.T., in June, 1987.

Species	June 5	June 7	June 9	June 12
Arctic Loon	0/0	0/0	0/0	0/17
Tundra Swans (ad.)	7/246	3/169	2/65	0/64
Tundra Swans (imm.)	0/0	0/0	0/0	0/0
White-fronted Goose (ad.)	1/4	4/97	1/62	1/122
White-fronted Goose (imm.)	0/0	0/2	0/0	0/1
Lesser Snow Goose	0/0	0/4	0/1	0/4
Brant	0/2	0/0	0/0	0/7
Canada Goose	1/96	2/450	0/363	1/125
Northern Pintail	0/0	2/11	3/4	9/5
Common Eider	0/0	0/0	0/0	1/0
King Eider	0/0	0/14	0/3	5/0
Eider spp.	0/60	0/100	0/0	0/0
Rough-legged Hawk	0/0	0/0	0/1	0/2
Peregrine Falcon	0/0	0/0	0/1	0/0
Willow Ptarmigan	0/0	0/0	0/2	0/0
Rock Ptarmigan	0/146	0/0	0/0	0/2
Sandhill Crane	2/68	5/6	3/0	0/3
Black-bellied Plover	0/0	0/0	0/0	0/1
Lesser Golden Plover	0/0	0/3	0/6	0/1
Plover (?)	0/0	0/0	0/5	0/0
Semi-palmated Sandpiper	0/0	0/0	0/0	0/2
Sandpiper (Peeps)	0/0	0/0	0/9	0/7
Stilt Sandpiper	0/0	0/3	0/0	0/4
Red Phalarope	0/0	0/0	0/0	0/2
Parasitic Jaeger	0/0	0/0	0/0	0/1
Long-tailed Jaeger	0/0	0/2	0/0	0/2
Thayer's Gull	0/2	0/0	0/0	0/0
Glaucous Gull	0/11	0/3	0/8	0/10
Sabine's Gull	0/0	0/0	0/0	0/8
Snowy Owl	0/1	0/2	0/0	0/0
Horned Lark	0/1	0/0	0/many	0/many
Lapland Longspur	0/0	0/0	0/many	0/many
Hoary Redpoll	0/0	0/0	0/0	0/2

#/# Represents number of pairs and number of birds as singles or groups.

Table 4. Results of ground counts of selected species on the Walker Bay Study Area, N.W.T. in June, 1987[a].

Species	June 6	June 8	June 19
Tundra Swans (ad.)	8/0[b]	1/1	6/2
White-fronted Goose (ad.)	1/1	5/24	30/21
White-fronted Goose (imm.)	0/0	0/2	0/1
Black Brant	0/0	0/0	2/0
Canada Goose	1/27	2/36	27/2
Northern Pintail	0/0	0/0	3/4 (male)
Oldsquaw	0/0	0/0	2/0
King Eider	0/1	0/0	12/2 (male)
Eiders (?)	0/20	0/0	0/0
Sandhill Crane	2/6	2/1	2/3

a See map (Fig. 1) for location of ground counts

b #/# represents number of pairs and number of birds as singles or groups.

until 10 to 19 June. This was consistent with the few known dates of nest initiation.

Few dates of nest initiation (Table 5) were determined because of extremely high predation of eggs (see nest success). Those that were obtained indicated that nest initiation by geese occurred about 17 - 24 June. No dates were obtained for swans.

Time Budget Analysis of Behaviour

Four male and 4 female WFG, in pairs, were observed for 5.8 and 5.3 h respectively, from 16 to 20 June. Females spent considerably more time feeding during observations than did males, while males were much more alert than females (Table 6). Other behaviours were similar between the sexes.

Breeding Population Estimates

An aerial survey of the WBSA was conducted on 21 June from 12:00 to 13:00 under partly cloudy skies with winds of 35-40 kph. The survey coincided with the period of nest initiation for geese, so that most birds were well dispersed and on territory. During the survey 80 WFG, 90 CG, 172 unidentified geese, and 43 TS were enumerated (Table 7, Figure 2). Applying a ratio of observed WFG to CG to the unidentified geese, and extrapolating for the entire study area by multiplying by 5 (20% of the area was surveyed) (Appendix B), we estimated the WBSA supported 870 WFG (10.9/km^2), and 875 CG (10.9/km^2). The estimate for TS was 215 (2.7/km^2). Since production of geese was negligible in 1986, the 1987 estimate is essentially for adult (2 yr old +) geese. These figures are not significantly different from 1986 estimates (for WFG, $t = 0.68$, $p > 0.5$; for CG, $t = 0.38$, $p > 0.5$; for TS,

Table 5. Dates of nest initiation for White-fronted Geese, Canada Geese and King Eiders on the Walker Bay Study Area, N.W.T., in 1987.

Nest No.	Date Found	Eggs	Initiation Date
WF - 1	17 June	1	17 June
2	18 June	1	18 June
3	19 June	2	18 June
CG - 14	20 June	1	20 June
CG - 15	20 June	1	20 June
CG - 1	24 June	1	24 June
KE - 1	23 June	2	22 June
2	22 June	2	21 June
4	4 July	2	3 July

Table 6. Time budget analysis of the behaviour of four male and four female adult-plumaged White-fronted Geese in pairs prior to incubation on the Walker Bay Study Area, N.W.T., in 1987.

	Males		Females	
	No. observations	%	No. observations	%
Feed	208	29.9	338	53.2
Alert	195	28.0	59	9.3
Walk	92	13.2	76	12.0
Swim	5	0.7	5	0.8
Fly	2	0.3	2	0.3
Comfort	21	3.0	12	1.9
Social	9	1.3	1	0.2
Sleep	73	10.5	85	13.4
Unobserved	91	13.1	57	9.0
Total Observations	696	100.0	635	100.1
Total Time	348 min. 5.8 h.		318 min. 5.3 h.	

Table 7. Aerial survey results for the Walker Bay Study Area, N.W.T. on 21 June, 1987.

Transect	White-fronted Geese	Canada Geese	Unident. Geese	Tundra[a] Swan
I	0/3[b]	3/1	7/19	2/3
II	6/8	3/2	1/1	2/0
III	0/7	6/0	8/14	4/1
IV	2/7	7/4	13/20	3/1
V	3/4	10/1	6/16	4/1
VI	11/7	12/7	3/26	3/3

a A large concentration of about 80 swans occurred just off one transect, so that swans are likely under-estimated.

b #/# represent number of pairs and number of birds as singles or groups.

$t = 1.57$, $p > 0.10$) (Bromley, unpubl. data). Population estimates for TS were widely disparate (1215 in 1986 and 225 in 1987) because concentrations of non-breeding swans occurred just off transect in 1987, and on transect in 1986.

Reproductive Parameters

Nesting Densities

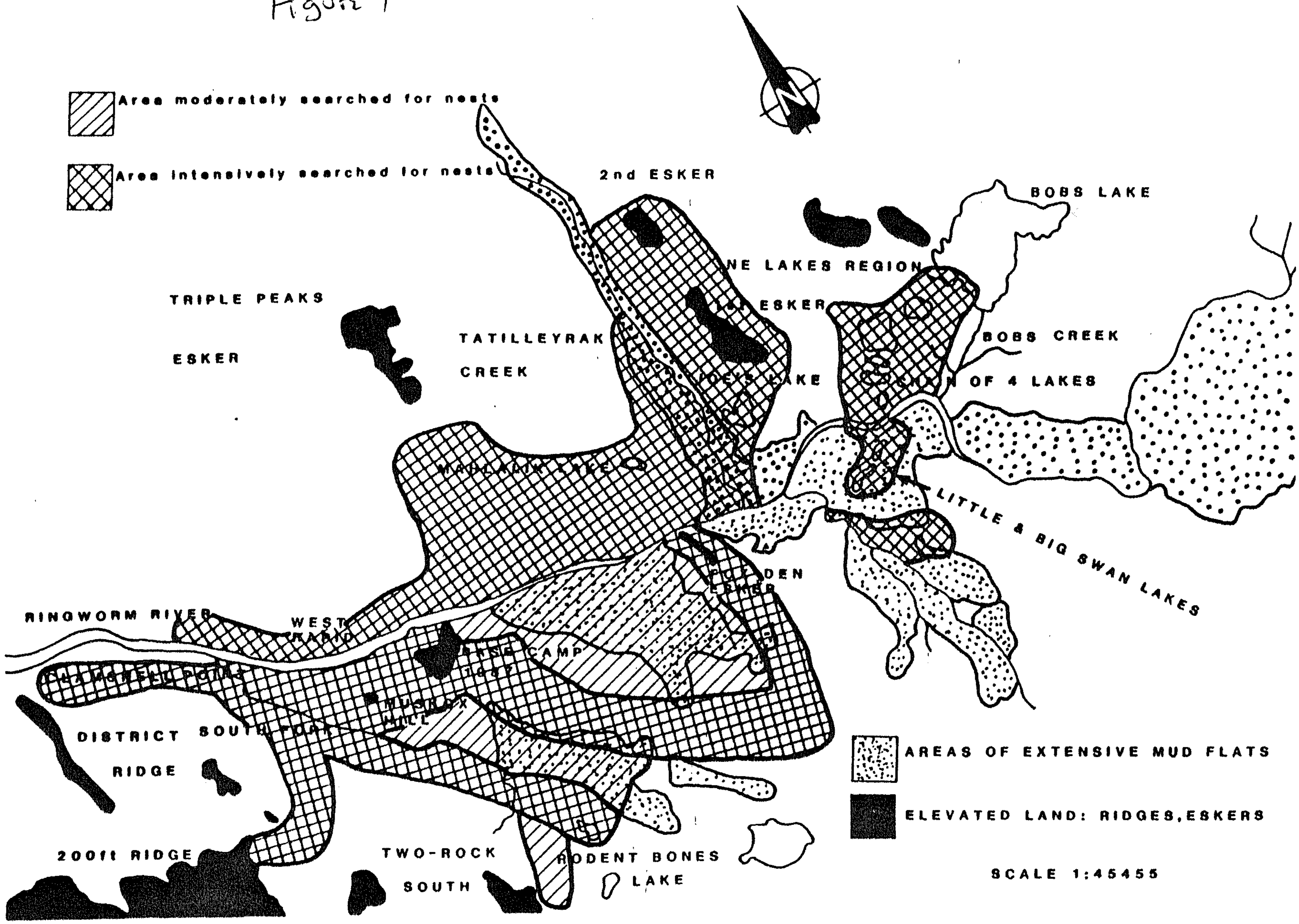
Nest searching was conducted from 17 June to 9 July (Figure 4). During 174 person hours of search, 21 WFG (1 nest/8.3 h.), 15 CG (1/11.6 h.) and 2 TS (1/87.0 h.) nests were located (Figure 5). In addition, 5 King Eider (1/34.8 h.) nests and 10 Sandhill Crane (1/17.4 h.) nests were found. Areas searched very intensively totalled 16.8 km^2 and with moderate intensity, 4.0 km^2, for a total of 20.8 km^2. Thus, nesting densities overall were 1 nest/km^2 for WFG, 0.7 nest/km^2 for CG, 0.1 nest/km^2 for TS, 0.2 nest/km^2 for KE and 0.5 nest/km^2 for SC. On intensively searched areas WFG averaged 1.1 nests/km^2, CG 0.9 nest/km^2 and KE 0.3 nest/km^2.

Clutch and Egg Size

Most nests were destroyed before clutch size could be determined. Eight completed WFG nests averaged 4.1 eggs (SD = 1.1) each, CG averaged 3.0 ($n = 3$), 2 KE nests had 3 and 4 eggs, 1 swan nest had 1 egg and 8 SC nests averaged 1.4 eggs (SD = 0.5).

Egg measurements are summarized in Table 8 and detailed in Appendix C.

Figure 4



Area moderately searched for nests
Area intensively searched for nests
2nd ESKER
BOBS LAKE
TRIPLE PEAKS
ESKER
TATILLEYRAK
CREEK
ESKER
BOBS CREEK
OF 4 LAKES
LITTLE & BIG SWAN LAKES
RINGWORM RIVER
WEST
DISTRICT
RIDGE
200ft RIDGE
TWO-ROCK
SOUTH
ODENT BONES
LAKE
AREAS OF EXTENSIVE MUD FLATS
ELEVATED LAND: RIDGES, ESKERS
SCALE 1:45455

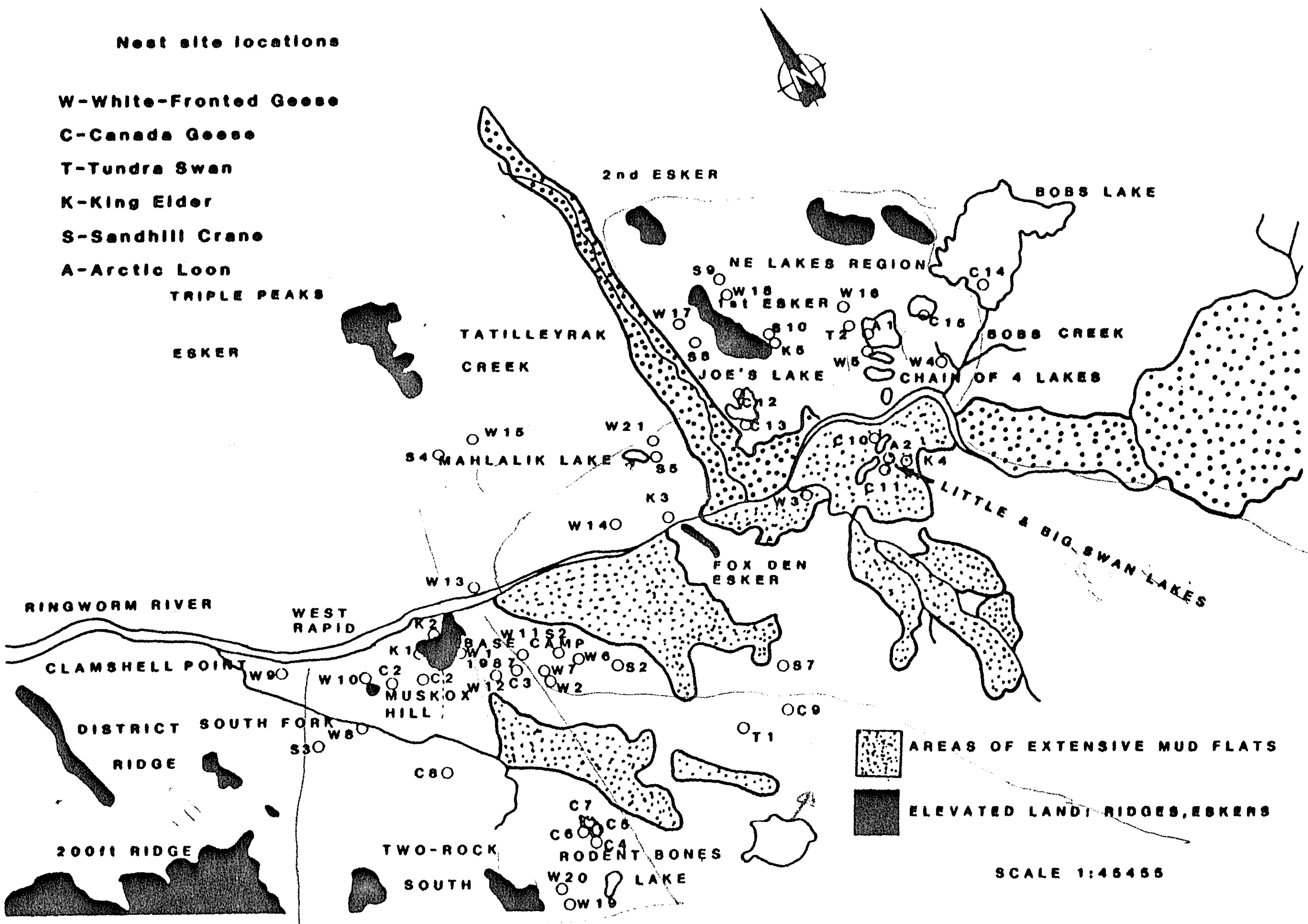

Nest site locations
W-White-Fronted Geese
C-Canada Geese
T-Tundra Swan
K-King Elder
S-Sandhill Crane
A-Arctic Loon
TRIPLE PEAKS
ESKER
2nd ESKER
BOBS LAKE
NE LAKES REGION
1st ESKER
TATILLEYRAK
CREEK
JOE'S LAKE
BOBS CREEK
CHAIN OF 4 LAKES
MAHLALIK LAKE
LITTLE & BIG SWAN LAKES
FOX DEN
ESKER
RINGWORM RIVER
WEST
RAPID
BASE CAMP
1987
CLAMSHELL POINT
MUSKOX
HILL
DISTRICT
RIDGE
SOUTH FORK
200ft RIDGE
TWO-ROCK
SOUTH
RODENT BONES
LAKE
AREAS OF EXTENSIVE MUD FLATS
ELEVATED LAND: RIDGES, ESKERS
SCALE 1:45455

Figure 5

Nest Success

Nest and hatching success was estimated according to the method of Mayfield (1975) for WFG (7.3% and 10.0% respectively), SC (60.9% and 72.6%, respectively) and KE (0.2% and 0.1%, respectively). These parameters could not be determined for CG and TS. Eight of 15 CG nests were already destroyed when found; one nest found at initiation of laying was destroyed when checked 6 days later, 3 nests were located but not rechecked, and 2 nests were found, rechecked and still active between 2 and 10 July. From these limited observations we concluded that success rates of CG nests and eggs were similar to those of WFG. Of two swan nests located, one was found after being predated, and a nest with one egg was still active at our last visit on 2 July. Nest record summaries are provided for all species (Appendix D).

In summary, reproductive success to hatching was negligible for all species except SC, which had fairly good success.

The arctic fox was the major egg predator on the WBSA in 1987. One occupied den was centrally situated on the study area, and contained 12 kits about 1/4 grown on 29 June. Adult foxes were observed harassing WFG, SC, and Shorteared Owls at known or suspected nest sites. Most predated nests were simply empty of eggs, indicating that the eggs had been removed from the vicinity. Foxes were seen or heard almost daily, and were often within sight of observers for several hours as they very thoroughly worked the area for food. On one occasion, during a recheck of nest WFG - 3, the nest was found predated, with one WFG wing lying nearby. We immediately checked the fox den, and found the nearly intact, but headless, carcass in the entrance to

Table 8. Egg measurements by species for the Walker Bay Study Area, N.W.T., 1987.

Species	n	Measurements	
		Length(mm) x (SE)	Width (mm) x(SE)
WFG	41	82.1 (0.41)	53.1 (0.27)
Canada Geese	11	77.4 (0.65)	52.1 (0.25)
King Eider	12	68.4 (0.89)	44.3 (0.32)
Sandhill Crane	12	87.9 (0.94)	55.4 (0.41)
Tundra Swan	1	101.2	67.5

one of the burrows. A hard shelled egg (the last of the clutch of 5), was found in the bird's oviduct.

The tracks of one grizzly bear, and later those of another adult and 2 cubs, were observed on 23 June and 2 July, respectively. Upon checking the fox den after seeing the first track, we found the bear had dug up the den in an attempt to get the pups and prey remains. The foxes had, however, managed to "out fox" the bear, and all 12 pups were settled in another den about 150 m away.

Ermine were frequently observed on the study area, as were Glaucous and Herring Gulls and Long-tailed Jaeger. Pomarine and Parasitic Jaegers, and Common Ravens were less frequently observed. We recorded no evidence of predation by these species, except for the raven. On 29 July an individual was observed flying and carrying an egg in its bill.

Banding and Marking

From 29 July to 1 August, 107 adult CG and 46 adult WFG were banded. The WFG were also marked with blue neck collars engraved with the symbols E01 to E47; collar E33 was not used. One banded CG, 1117-46497, was recaptured. Only 2 of the WFG were yearlings, aged by the almost complete lack of black splotching on the belly.

Many more birds were penned than were banded, but due to inadequate support of the pen nets, most escaped. Flocks of up to 1000 geese were observed, usually containing roughly equal mixes of CG and WFG. WFG were the most difficult to drive with the helicopter. The potential for banding large numbers of geese and swans is considerable.

Few broods were observed; all young were downies. Two swan broods contained 2 cygnets each. Two WFG brood, observed from the helicopter had 2 and 3 young. No CG broods were observed.

DISCUSSION

The late spring of 1987 on the WBSA is the second consecutive year of delayed spring phenology with concomitantly negligible reproduction by waterfowl. In 1986, extraordinary amounts of snowfall fell in April and May, while in 1987 precipitation was considerably above normal in June and July. Cooler temperatures then normal prevailed in both years, but particularly in May and June 1987. Thus, high spring snow accumulation in 1986, and cool temperatures in 1987 apparently caused delayed snow melt. Both situations appear to have had similar effects on waterfowl.

We suspect nest initiation in 1987 was delayed beyond average dates, although we do not have baseline data for comparison between years for this area. Nest initiation of WFG on the Colville River Delta of the Alaskan north slope, peaked on 8 and 10 June in 1982 and 1983 respectively (Simpson 1984). In the Yukon-Kuskokwim Delta, Alaska a more maritime location, Pacific WFG initiated nests from 22 May - 7 June and 12 May - 2 June in 1977 and 1978 respectively (Ely 1979). CG on Victoria Island began laying in early to mid June in 1960 and 1962, and most had initiated nests prior to 24 June on Jenny Lind Island (Parmalee et. al. 1962). Nest initiation of CG at Albert Edward Bay on Victoria Island occurred from 15 - 27 June, and peaked on 21 and 22 June, 1987 (Bromley and O'Brien in prep.). These later dates were similar to those of the WBSA.

Besides late initiation of nests, we suspect there were large segments of the populations which did not breed. Given the lack of production in 1986, almost all geese were 2 years old or older. We compared number of geese nesting on areas intensively searched (2.2 WFG/km^2 and 1.8 CG/km^2) to total population densities from the aerial survey (10.9 WFG and 10.9 CG/km^2) to derive estimates of the non-breeding population segments. We estimated that 79.8% and 83% of the WFG and CG respectively were non-breeding birds. Undoubtedly, given the extremely high rate of nest predation, some of these birds were failed breeders; however, based upon the number and density of nests located, there is a clear indication of a large non-breeding component for each of the species, the majority of which should be breeding-age birds.

Given the poor conditions for nesting in 1987, we suspect that nesting densities were low compared to long term averages. Nesting densities of Pacific WFG on the Y-K Delta in Alaska averaged 3.0 to 4.7 nests/km^2 in 1977 and 1978 (Ely 1979), roughly 3 to 4 times that of the WBSA. Nesting densities of CG on the WBSA were considerably less than those on the Albert Edward Bay study area on Victoria Island (5.6 nests/km^2, Bromley and O'Brien in prep.). Data from subsequent years will help put the 1987 season into proper perspective.

Those geese that did nest had extremely poor success. Directly, this was caused by predation on eggs and adults by arctic foxes. We did not consider ourselves a factor in leading foxes to nests because we were finding large numbers of predated nests which were not previously known to us. Indirectly, low nest success may have been related to a late, wet and cool nesting season and to a decline in alternate prey for foxes. The unseasonal weather during May and June may have caused added stress to the energy budget of nesting birds. Geese tend to spend more time attending nests during incubation when poor weather prevails, possibly to their detriment if energy reserves become depleted. Nest abandonment by geese, or simply more time away from nests, results in increased vulnerability of eggs to predators.

During our initial weeks on the WBSA, collared lemmings were abundant. By the end of June, however, they were less so, possibly due to excessive flooding during snowmelt in mid-to late June. Thus, by the time nests were being initiated, arctic foxes were likely taking advantage of other prey to supplement their main diet of lemmings. The presence of a pair of adult arctic foxes with 12 healthy-appearing kits attested to their ability to exploit prey resources of the study area.

There may be a relationship between reproductive success of geese, and lemming numbers. When Brant Geese (Branta b. bernicla) have particularly low reproductive success on the Taimyr Peninsula, it has been found that there was usually a lemming crash during the previous year (see Greenwood 1987 for review). Apparently, lemming predators readily switch to alternate prey such as the eggs of waterfowl and other birds, during lemming lows. Possibly this also occurs within a season, explaining the situation we observed on the WBSA.

Foxes were observed interacting with nesting WFG and CG, and with SC. For geese, these interactions were potentially fatal, as evidenced by the adult female WFG found at a fox den. During interactions geese would eventually give way to foxes while cranes would not. This was reflected in the fairly high reproductive success of cranes, at least to hatching, compared to geese.

Egg sizes of WFG from the WBSA (Table 8), were compared to a sample from western Alaska (Ely 1979:49). Eggs were found to be of similar width (53.1 mm and 53.5 mm respectively), but eggs from the WBSA averaged 2 mm longer than those from Alaska (82.1 mm versus 80.1 mm, t=3.49, 352 df. P < 0.001). Further monitoring will be done with morphological measurements of adults for comparison.

Based on small samples, female WFG spent much of their time feeding (53%) as was observed in northern and western Alaska (61 to 71%, Simpson 1984; 67%, Ely 1979). Although food habits were not determined, geese were often observed probing the ground for food, and browsing on the buds of low bushy willows (Salix spp.). The role of food versus reserves in the energy budget of WFG in spring is poorly understood, and deserves further attention. Male WFG fed only 30% of the time while spending much more time being alert (28%) than did females (9%).

Population estimates derived from the aerial survey indicated no population changes, although we expected a slight decline of WFG and CG due to minimal reproduction in 1986. The sensitivity of the survey, however, requires refinement. The transect width has not been fully standardized between observers by marking guidelines on the helicopter to indicate the transect boundaries. Transects will be increased in number to minimize variances of estimates. Also, ability to distinguish CG from WFG and simply to identify geese to species undoubtedly varies. It seems that observers are more certain of CG whose white cheek patches are more apparent than any particular markings of WFG. This would cause more WFG to be assigned to the unidentified category, resulting in an overestimate of CG and underestimate of WFG. The divergent estimates for TS in 1986 and 1987 are a result of the tendency for non-breeding swans to form concentrations of about 15 to 80 birds per group. In 1986, several concentrations occurred on transect, while none did in 1987. In future surveys, a count of concentrations of TS, which are highly visible relative to geese, will be used to supplement the transect counts of dispersed birds. Our subjective estimate is that about 500 TS consistently use the area.

Geese and swans used the WBSA for nesting, brood rearing and molting. In particular, however, use of the area by molting birds was exceptional. Several thousand WFG and several thousand CG were observed in mixed flocks of up to 1000 birds. Apparently the WBSA draws geese from a large part of the Kent Peninsula and adjacent mainland coast, at least during years of poor production. These flightless geese concentrated on the larger lakes along the southwest and northeast boundaries of the study area. Flightless swans were more dispersed throughout the study area during molt, although groups of 5 to 10 birds were common.

FUTURE WORK

Two consecutive springs of poor reproductive success have prevented full assessment of the WBSA as a waterfowl production area. Further work is warranted to complete the assessment. In particular, work should be concentrated on measuring nesting effort and success, population size and use of the area for moulting. A concentrated effort to individually mark and band a large number of individuals in 1988 would put us in a better position to evaluate reproductive success and survival of individuals, fidelity to nesting and moulting areas and factors affecting reproduction in subsequent years. Marked individuals will contribute to our understanding of population delineation and distribution in other parts of their range.

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Appendix A. Birds and mammals of the Walker Bay Study Area, N.W.T. in 1987, with arrival dates for birds, and relative abundance for both.

Species - Birds	First Seen	Status	Abundance
Red-throated Loon	June 15	-	O
Yellow-billed Loon	July 29	-	R
Arctic Loon	June 11	B	FC
Tundra Swan (ad.)	June 3	B	FC
Tundra Swan (imm.)	-	-	-
Greater White-fronted Goose (ad.)	June 3	B	C
Greater White-fronted Goose (imm.)	June 7	-	R
Lesser Snow Goose	June 3	-	O
Black Brant	June 5	B	O
Canada Goose	June 3	B	C
Northern Pintail	June 7	-	FC
American Wigeon	June 19	-	R
Green-winged Teal	June 22	-	R
Oldsquaw	June 11	-	FC
Common Eider	June 6	-	FC
King Eider	June 5	B	FC
Eider (?)	June 5	-	-
Greater Scaup	June 16	-	R
Red-breasted Merganser	June 13	-	R
Golden Eagle	July 6	-	R
Rough-legged Hawk	June 7	-	FC
Peregrine Falcon	June 9	-	O
Willow Ptarmigan	June 5	-	O
Rock Ptarmigan	June 3	B	C
Sandhill Crane	June 3	B	FC
Black-bellied Plover	June 12	-	FC
Lesser Golden Plover	June 7	-	FC
Semi-palmated Plover	June 10	B	O
Plover (?)	June 7	-	-
Ruddy Turnstone	June 13	-	O
Semi-palmated Sandpiper	June 7	B	C
White-rumped Sandpiper	June 14	-	O
Baird's Sandpiper	June 13	B	FC
Peeps (?)	June 7	-	-
Pectoral Sandpiper	June 8	-	FC
Dunlin	June 14	-	R
Stilt Sandpiper	June 7	-	O
Common Snipe	June 23	-	R
Red-necked Phalarope	June 13	B	C
Red Phalarope	June 12	B	C
Pomarine Jaeger	June 15	-	R
Parasitic Jaeger	June 12	-	R
Long-tailed Jaeger	June 7	B	O
Herring Gull	June 13	-	O
Thayer's Gull	June 5	-	FC
Glaucous Gull	June 5	B	FC

Appendix A Continued ...

Species - Birds	First Seen	Status	Abundance
Sabine's Gull	June 8	-	O
Arctic Tern	June 13	-	O
Snowy Owl	June 5	-	O
Short-eared Owl	June 11	B	FC
Horned Lark	June 5	B	C
Common Raven	June 5	-	R
Water Pipit	June 11	-	R
Savannah Sparrow	June 8	B	FC
Lapland Longspur	June 7	B	C
Snow Bunting	June 3	-	O
Common Redpoll	June 8	-	O
Hoary Redpoll	June 8	B	FC

Species - Mammals	First Seen	Status	Abundance
Arctic Fox	June 3	Resident	Common
Barren-ground Caribou	June 4	Transient	Common
Arctic Ground Squirrel	June 7	Resident	Occasional
Ermine	June 13	Resident	Common
Collared Lemming (?)	June 3	Resident	Abundant
Muskox	July 9	Transient	Occasional
Barren-ground Grizzly	-	Transient	Occasional

Appendix B Method of population estimation from aerial survey results for geese and swans on the Walker Bay Study Area, N.W.T, 21 June, 1987.

	Transect	Length (km)
Transect Length:	1	5.9
	2	5.9
	3	5.9
	4	7.0
	5	7.0
	6	8.3
	Total	40 km

Transect Width: 200 m on each side of aircraft = 0.4 km

Transect Area: 16 km^2

WBSA: = 80 km^2

Proportion of WBSA: = 16 km^2/80 km^2 = 20%

1. Birds enumerated: WFG - 22 pairs, 36 as singles and flocks
   CG - 41 pairs, 16 as singles and flocks
   Unidentified
   Geese - 38 pairs, 96 as singles and flocks
   TS - 18 pairs, 9 as singles and flocks

2. Assigning unidentified geese to species.
   Total identified geese = 53 pairs, 51 as singles and flocks
   Proportion that are WFG = 0.35 pairs, 0.71 as singles and flocks
   Proportion that are CG = 0.65 pairs, 0.29 as singles and flocks
   Unidentified geese assigned to WFG = 38 pairs (0.35) = 13 pairs; 96 others (0.71) = 68 others
   Unidentified geese assigned to CG = 38 pairs (0.65) = 25 pairs; 96 others (0.29) = 28 others

3. Total WFG on transect = 35 pairs, 104 others = 174
   Total CG on transect = 66 pairs, 43 others = 175

4. Estimates of total population:
   Transect area = 16 km^2 (20%)
   WBSA = 80 km^2
   WFG = 174 (5) = 870
   CG = 175 (5) = 875
   TS = 45 (5) = 225

Appendix C Individual egg measurements for selected species on the Walker Bay Study Area, N.W.T., in 1987.

Species	Nest No.	Date Measured	Egg No.	Length	Width	Weight
Canada Goose	1	June 30	1	77.0	50.0	111
	9	July 2	1	75.6	52.1	107
			2	74.7	51.9	105
	10	July 4	1	82.0	51.1	108
	12	July 10	1	74.3	52.4	108
			2	77.6	52.0	108
			3	77.4	52.2	105
	13	July 9	1	80.6	52.9	111
			2	77.7	52.7	113
			3	77.2	52.8	105
			4	77.2	52.8	111
White-fronted Goose	1	June 23	1	86.1	51.6	-
			2	83.5	51.8	-
	6	June 23	1	82.4	53.1	123
			2	77.6	54.3	121
	7	June 23	1	82.0	50.2	110
			2	79.8	50.4	112
	8	June 23	1	81.6	54.9	136
			2	80.6	54.7	133
			3	85.1	52.9	128
			4	82.5	54.2	135
	9	June 24	1	79.7	52.1	114
			2	80.7	52.3	119
			3	82.7	52.3	121
	12	June 27	1	80.0	51.2	115
			2	83.2	51.5	123
			3	82.2	50.9	119
	13	June 27	1	79.8	51.5	113
			2	81.2	52.2	119
			3	79.5	50.2	107
			4	78.6	52.7	114
			5	78.2	51.0	109
	14	June 29	1	77.8	54.0	123
			2	80.5	54.2	128
	15	July 1	1	78.4	52.8	116
			2	83.4	50.8	113
			3	82.8	51.4	117
			4	83.0	51.1	117
			5	83.5	51.4	118
	16	July 4	1	78.3	56.2	128
			2	80.4	55.5	128
			3	83.2	55.8	132
			4	80.4	55.8	127
	17	July 8	1	86.1	54.0	130
			2	86.8	54.5	136
			3	87.2	54.8	138
			4	86.6	53.9	124

Appendix C Continued ...

Species	Nest No.	Date Measured	Egg No.	Length	Width	Weight
White-fronted Goose	17	July 8	5	86.7	54.2	132
	18	July 8	1	83.9	54.1	128
			2	84.5	54.5	129
			3	82.4	55.0	124
			4	81.3	55.2	126
Sandhill Crane	1	June 23	1	87.8	56.8	143
	2	June 23	1	82.5	54.2	121
			2	86.4	53.2	118
	3	June 23	1	88.1	55.8	142
	4	June 27	1	87.6	54.6	132
	5	June 29	1	89.2	55.4	149
			2	90.0	56.1	151
	7	July 2	1	87.7	57.7	143
			2	89.5	56.6	146
	8	July 8	1	89.0	52.7	122
	9	July 8	1	82.1	56.1	130
	10	July 8	1	95.2	55.8	141
King Eider	1	June 24	1	68.2	43.0	68
			2	66.6	43.4	68
			3	67.4	42.7	67
	2	June 24	1	66.6	45.3	73
			2	66.6	45.7	74
			3	65.3	46.0	74
			4	64.3	45.3	71
	3	June 29	1	72.4	42.7	74
			2	73.8	43.8	78
			3	73.9	44.2	79
	4	July 4	1	67.7	44.6	74
			2	68.2	44.7	75
Tundra Swan	1	July 2	1	101.2	67.5	227
Arctic Loon	1	July 4	1	79.9	48.8	104
			2	78.4	48.7	101
	2	July 4	1	72.1	48.6	90
			2	71.2	48.1	89

Appendix D Nest record summaries for selected species on the Walker Bay Study Area, N.W.T., in 1987.

Species	Nest No.	Date Found	Status	Final Egg No.
Canada Goose	1	June 24	laying	1
	2	June 26	destroyed	0
	3	June 30	destroyed	0
	4	June 30	destroyed	0
	5	June 30	destroyed	0
	6	June 30	destroyed	0
	7	June 30	destroyed	0
	8	June 30	destroyed	0
	9	July 2	incubation	2
	10	July 4	incubation	0
	11	July 4	destroyed	0
	12	July 8	incubation	4
	13	July 8	incubation	4
White-fronted Goose	1	June 17	laying	2
	2	June 18	laying	1
	3	June 19	laying	2
	4	June 20	incubation ?	4
	5	June 22	incubation ?	4
	6	June 23	laying ?	2
	7	June 23	incubation ?	2
	8	June 23	incubation ?	4
	9	June 24	incubation	3
	10	June 24	destroyed	0
	11	June 27	destroyed	0
	12	June 27	incubation ?	3
	13	June 27	incubation	5
	14	June 29	incubation ?	2
	15	July 1	incubation	5
	16	July 4	incubation	4
	17	July 8	incubation	5
	18	July 8	incubation	4
	19	July 9	destroyed	0
	20	July 9	destroyed	0
	21	July 10	destroyed	0
Sandhill Crane	1	June 23	laying ?	1
	2	June 23	incubation	2
	3	June 23	laying ?	1
	4	June 27	incubation ?	1
	5	June 29	incubation	2
	6	June 22	laying ?	1
	7	July 2	incubation	2
	8	July 8	incubation	1
	9	July 8	incubation	1
	10	July 8	incubation	1

Appendix D Continued ...

Species	Nest No.	Date Found	Status	Final Egg No.
King Eider	1	June 23	laying	4
	2	June 22	laying	4
	3	June 29	laying ?	3
	4	July 4	laying	2
	5	July 8	destroyed	0
Tundra Swan	1	July 2	incubation	1
	2	July 4	destroyed	0