

NOT

RAPTORS AND COLONIAL BIRDS
OF THE
YELLOWKNIFE AREA
AND
EAST ARM OF GREAT SLAVE LAKE, N.W.T.

by
D.Lynne Allen
and
David M. Ealey



QL
696
.F32
D53
1979
c.1

CANADIAN WILDLIFE SERVICE



MEMORANDUM

NOTE DE SERVICE

TO
A

M. R. Robertson
Regional Director
Canadian Wildlife Service
EDMONTON

FROM
DE

Chief, Migratory Birds Division
Canadian Wildlife Service
EDMONTON

SUBJECT
OBJET

Attached is the report "Raptors and Colonial Birds of the Yellowknife Area and East Arm of Great Slave Lake, N.W.T." by Lynne Allen and Dave Ealey. The purpose of the study was to assess the vulnerability of local populations of raptors and colonial birds to development in the Yellowknife area and east arm of Great Slave Lake. This was a preliminary investigation to determine whether further work should be done. The report includes brief descriptions of further studies needed, as well as recommendations to ameliorate the impact of development on the more sensitive raptors and colonial birds in the study area.

This was an internally funded project intended to augment the baseline data of the Canadian Wildlife Service. However, it may be constructive to distribute the report externally to assist other agencies in planning and policy-making.

S.E. Stephansson

Encl.

SECURITY - CLASSIFICATION - DE SÉCURITÉ
OUR FILE - N/RÉFÉRENCE 3527-1
YOUR FILE - V/RÉFÉRENCE
DATE November 26, 1979

ACKNOWLEDGMENTS

This study was financed by the Canadian Wildlife Service with logistical support from Northwest Lands and Forest, Fisheries and Marine Service and the Environmental Protection Service. Don Karasiuk was an observer for two of the aerial surveys, and Julie Burnford, Paul Panegyuk, and Dave Sutherland assisted in the surveys by canoe. The pilots for the aerial surveys were Duncan Bell of Ptarmigan Airways, and Rod Wood and Mike McNellis of Shirley Helicopters. The following people kindly contributed information on nests: Bob MacKillop, Vic Gillman, Nancy Cooper, Roy Thomas, George Calef, Norm Barachello, Russ Hall, Hugh Monaham, Leo Sabatta, Lee Harding, Len and Rose Blover, Dr. George Gibson, John Stephenson, Steff Stephansson, Russ Newmark and Larry Sharpiro. Susan Popowich drafted the figures and Lori Hanak typed the manuscript. Our editors were Don Karasiuk and Celia Camfield. We are very grateful to all of these individuals and services.

ENVIRONMENT CANADA
LIBRARY, NOVA COAST PLAZA
PO BOX 2310 5019-52 ST.
YELLOWKNIFE, NT X1A 2P7

RAPTORS AND COLONIAL BIRDS
OF THE
YELLOWKNIFE AREA
AND
EAST ARM OF GREAT SLAVE LAKE, N.W.T.

by

D. Lynne Allen

and

David M. Ealey

Canadian Wildlife Service

Edmonton, Alberta

July 1979

ABSTRACT

Surveys for nesting raptors and colonial waterbirds were conducted in the Yellowknife area and east arm of Great Slave Lake from June through September in 1978. Raptor nests found totalled 85 in the Yellowknife area and 136 in the east arm of Great Slave Lake. Most were Bald Eagle nests. The only colonial nesters sighted were Larids of which the Herring Gull and Arctic Tern were most numerous.

Of the 207 Bald Eagle nests recorded, 57% were on cliffs, 40% were in trees and the remainder were on the ground and utility poles. Over 90% were found within 100 m of water. We found 43 productive Bald Eagle nests and these nests contained an average of 1.6 eaglets. Eighty percent of the productive nests in the Yellowknife area were on islands. Bald Eagles initiated incubation in the second half of April and the young fledged during the first half of August.

In the east arm of Great Slave Lake the raptors and colonial birds remain relatively undisturbed. However, outdoor recreational activity and chemical pollution from gold mines may be detrimentally affecting raptor populations in the Yellowknife area. This report includes recommendations to ameliorate the impact of development on the raptors and colonial birds of the study area.

TABLE OF CONTENTS

	Page
LIST OF TABLES.....	iii
LIST OF FIGURES.....	iv
LIST OF APPENDICES.....	v
1. INTRODUCTION.....	1
2. STUDY AREA.....	2
3. REVIEW OF CURRENT STATE OF KNOWLEDGE.....	4
4. METHODS.....	5
4.1 Terminology.....	9
5. SURVEY RESULTS AND DISCUSSION.....	10
5.1 Raptor Nests.....	10
5.2 Colonial Waterbirds.....	13
5.3 Bald Eagle.....	19
5.3.1 Phenology.....	19
5.3.1.1 Spring Arrivals.....	19
5.3.1.2 Initiation of Incubation.....	19
5.3.1.3 Fledging.....	20
5.3.1.4 Fall Departure.....	20
5.3.2 Productivity.....	21
5.3.3 Immatures.....	26
5.3.4 Nesting Habitat.....	26
5.3.4.1 Substrate.....	28
5.3.4.2 Distance from Water.....	30
5.3.4.3 Tree Nests.....	32
5.3.4.4 Cliff Nests.....	34
5.3.4.5 Physiographic Location of Nests.....	34
6. IMPACT OF DEVELOPMENT.....	37
6.1 Mining.....	37

	Page
6.2 Hydro Power.....	40
6.3 Fishing.....	41
6.4 Recreation and Tourism.....	41
6.4.1 Detrimental Effects.....	41
6.4.2 Sensitivity of Birds.....	42
6.4.3 Current Impact.....	45
6.4.4 Potential Impact of Future Recreation and Tourism..	46
7. RECOMMENDATIONS.....	47
8. NEED FOR FURTHER STUDYES.....	50
LITERATURE CITED.....	52
APPENDICES.....	57

LIST OF TABLES

Table	Page
1. Colonial birds recorded in the east arm of Great Slave Lake during surveys conducted in 1978.....	17
2. Productivity of the Bald Eagle in the Yellowknife area and east arm of Great Slave Lake.....	22
3. Comparison of mean brood sizes for Bald Eagles in our study area with those in other parts of northern Canada and Alaska.....	24
4. Comparison of the percentage of Bald Eagle breeding territories that were occupied or productive in our study area with those in other parts of northern Canada.....	25
5. Comparison of the percentage of immature Bald Eagles in our study area with those in other parts of northern Canada and Alaska.....	27

LIST OF FIGURES

Figure	Page
1. Map of the study area.....	3
2. Areas near Yellowknife surveyed for raptor nests and colonies of nesting birds in 1978.....	6
3. Areas in the east arm of Great Slave Lake surveyed for raptor nests and colonies of nesting birds in 1978.....	7
4. Location of the large stick nests found during surveys of the Yellowknife area in 1978.....	11
5. Location of the small stick nests found during surveys in the Yellowknife area in 1978.....	12
6. Location of the large stick nests found during surveys of the east arm of Great Slave Lake in 1978. All of the birds seen in association with the nests were Bald Eagles...	14
7. Location of the small stick nests found during surveys of the east arm of Great Slave Lake in 1978.....	15
8. Location of the tern and gull nests, and flocks of 10 or more larids found during surveys of the east arm of Great Slave Lake.....	18
9. Substrate on which Bald Eagles built their nests in the Yellowknife area and the east arm of Great Slave Lake.....	29
10. Distance from Bald Eagle nests to nearest river or lake.....	31
11. Height of trees used by Bald Eagles for nesting.....	33
12. Height of Bald Eagle tree nests above the nearest body of water.....	33
13. Height of cliffs used by Bald Eagles for nesting.....	35
14. Height of Bald Eagle cliff nests above the nearest body of water.....	35
15. Physiographical location of Bald Eagle nests on the lakes near Yellowknife.....	36
16. Physiographical location of Bald Eagle nests in the east arm of Great Slave Lake.....	38

LIST OF APPENDICES

Appendix	Page
A. Bald Eagle nestlings banded in the east arm of Great Slave Lake.....	57
B. Comparison of 1978 monthly mean temperatures to the average monthly mean temperatures from 1941 to 1970.....	58

1. INTRODUCTION

When assessing the impact of development on wildlife, special attention should be given to raptors and colonial birds for they are unusually vulnerable to both pollution and human disturbance. Because these birds are at a high trophic level, environmental contaminants such as DDT, PCB's and trace metals concentrate in their tissues, and they are often among the first wildlife to decline in numbers due to pollution. During the early stages of nesting, several species of raptors and colonial birds are very sensitive to disturbance by man. The mere passing of a boat or short visit to a nest has caused birds to desert their nests (Fyfe and Olendorff 1976; Bergman in Vaisanen 1973). Colonial birds concentrate in one area to nest. Thus, if the colony is disturbed or if the nesting site is destroyed, a significant portion of the total local population of the species may be affected.

The drastic decline in numbers of several species of raptors and colonial birds over the past several decades in North America is tribute to the sensitivity of these birds to development. In Canada, the Peregrine Falcon subspecies *anatum* has been declared "endangered" and the subspecies *tundrius* "threatened" (Keith 1978). In the United States, the Southern Bald Eagle, and both the *anatum* and *tundrius* subspecies of the Peregrine Falcon have been declared "endangered" (Snow 1972; Snow 1973). Other species that are declining in North America, and hence on the Blue List include the Marsh Hawk, Osprey, Merlin, American Kestrel, Common Tern, and Short-eared Owl (Arbib 1978).

Except for gold mining in the immediate vicinity of Yellowknife, the land in the Yellowknife area and east arm of Great Slave Lake remains relatively undeveloped. However, human activity is increasing, with the development of industries such as mining, hydro power and tourism, and as more Yellowknifers use the countryside for outdoor recreation.

Although no systematic inventory had been done prior to this study, casual observations indicated that a substantial number of raptors and colonial gulls and terns inhabited the Yellowknife area and east arm of Great Slave Lake. Thus, in 1978 we initiated a study with the following objectives:

- 1) to locate the nests of raptors and colonial birds;
- 2) to define the habitat suitable for nesting raptors and colonial birds;
- 3) to obtain data on productivity and phenology; and
- 4) to assess the vulnerability of the nesting raptors and colonial birds to human activity.

This study was a preliminary investigation to determine whether further work should be done. However, the study results are also useful as baseline data for predicting, ameliorating and monitoring the impact of future development on raptors and colonial birds.

2. STUDY AREA

Two separate regions were studied; the area around Yellowknife, most influenced by recreationalists, and the east arm of Great Slave Lake. The boundaries of each study area are defined in Figure 1.

Yellowknife lies at the western edge of the Precambrian Shield. East and north of the city, the landscape is predominately rolling granite

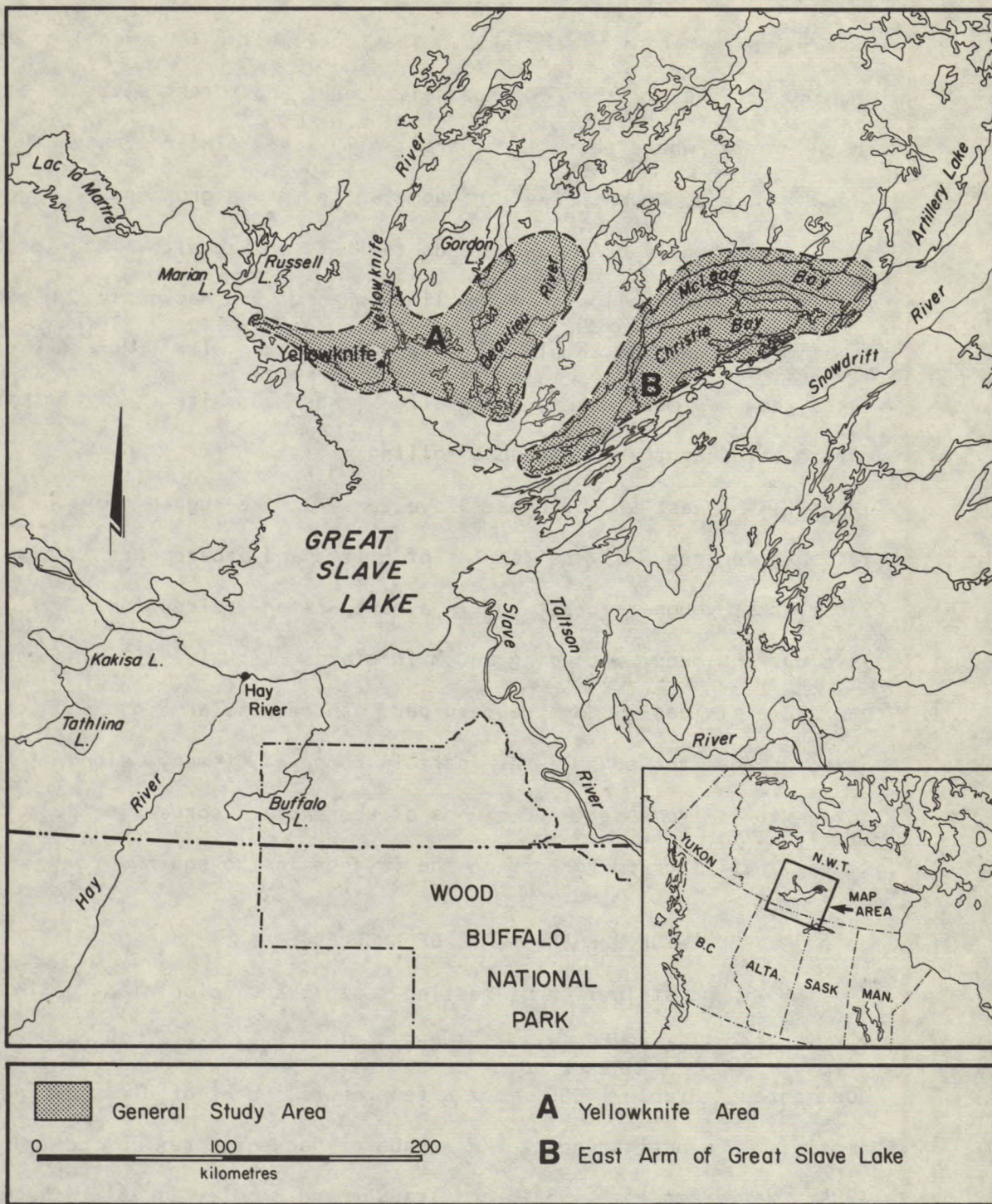


Figure 1. Map of the study area.

hills with numerous clear lakes. The local relief is generally less than 60 m. The hilltops are sparsely treed, and forest cover is thickest in the basins where there is mineral soil. Jack pine dominates the upper slopes. Birch, aspen, alder and some white spruce grow on the lower slopes. In poorly drained lowlands there is muskeg with black spruce and willow. West of Yellowknife the limestones of the Mackenzie Lowlands overlay the Canadian Shield. The land is flatter with fewer deep clear lakes, but has more muskeg and shallow lakes. Granite is present as outcrops rather than continuous rolling hills.

The east arm of Great Slave Lake is more rugged than the Yellowknife area. Several series of cliffs and escarpments as high as 240 m arc through the east arm in a northeasterly direction. The lake is clear and deep, exceeding 600 m in places (Beckel 1975). A long peninsula divides the northeastern part of the east arm into two large bays, whereas the southwestern part is composed of many islands. Forest cover varies from scattered clumps of short black spruce in the northeast to tall well stocked forests on the islands in the southwest.

3. REVIEW OF CURRENT STATE OF KNOWLEDGE

The distribution of nesting raptors and colonial birds in the Yellowknife area and east arm of Great Slave Lake has never been well documented. Preble (1908) made a few general notes of birds during a biological investigation of the Athabasca-Mackenzie region from 1901 to 1904. Weller *et al.* (1969), and Trauger and Bromley (1976) recorded the birds that nested on the West Mirage Islands in the north arm of Great Slave Lake. In 1970 and again in 1975, Fyfe *et al.* (1976) conducted surveys for nesting Peregrine Falcons throughout the Northwest Territories

including parts of the Yellowknife area and east arm of Great Slave Lake. The CWS also has on file casual sightings of raptor nests reported by some Yellowknife residents (R. Fyfe, pers. comm.).

4. METHODS

We used both aircraft and boats to search for raptor nests and nesting colonies. Most of the surveys were conducted along the shores of lakes and rivers. The major exception was an investigation of the inland cliffs and escarpments of Pethei and Douglas peninsulas in the east arm. We concentrated on shoreline, because it is the preferred nesting habitat of colonial waterbirds, Bald Eagles, Ospreys and Peregrine Falcons, and because future development (recreation, tourism, mining, hydro power and fishing) will probably have its greatest effect on waterways. Figures 2 and 3 show where we surveyed.

For the aerial surveys, we used a Cessna 185 fixed-wing on floats, Bell 206L helicopter and Allouette II helicopter. All aerial surveys were conducted at 110 to 120 kph at an altitude of 30 to 60 m. There were two observers; one for each side of the aircraft.

Timing of the surveys was as follows: June, late August and September in the Yellowknife area; July and the first week of August in the east arm.

We documented all large stick nests. The smaller stick nests built by Common Ravens were also recorded because several raptors including the Peregrine Falcon, Merlin, and Red-tailed Hawk commonly use raven nests (Bent 1937). Each nest or colony was marked on a 1:50,000 or 1:250,000 topographical map. We also mapped the location of all observations of raptors and flocks of colonial birds.

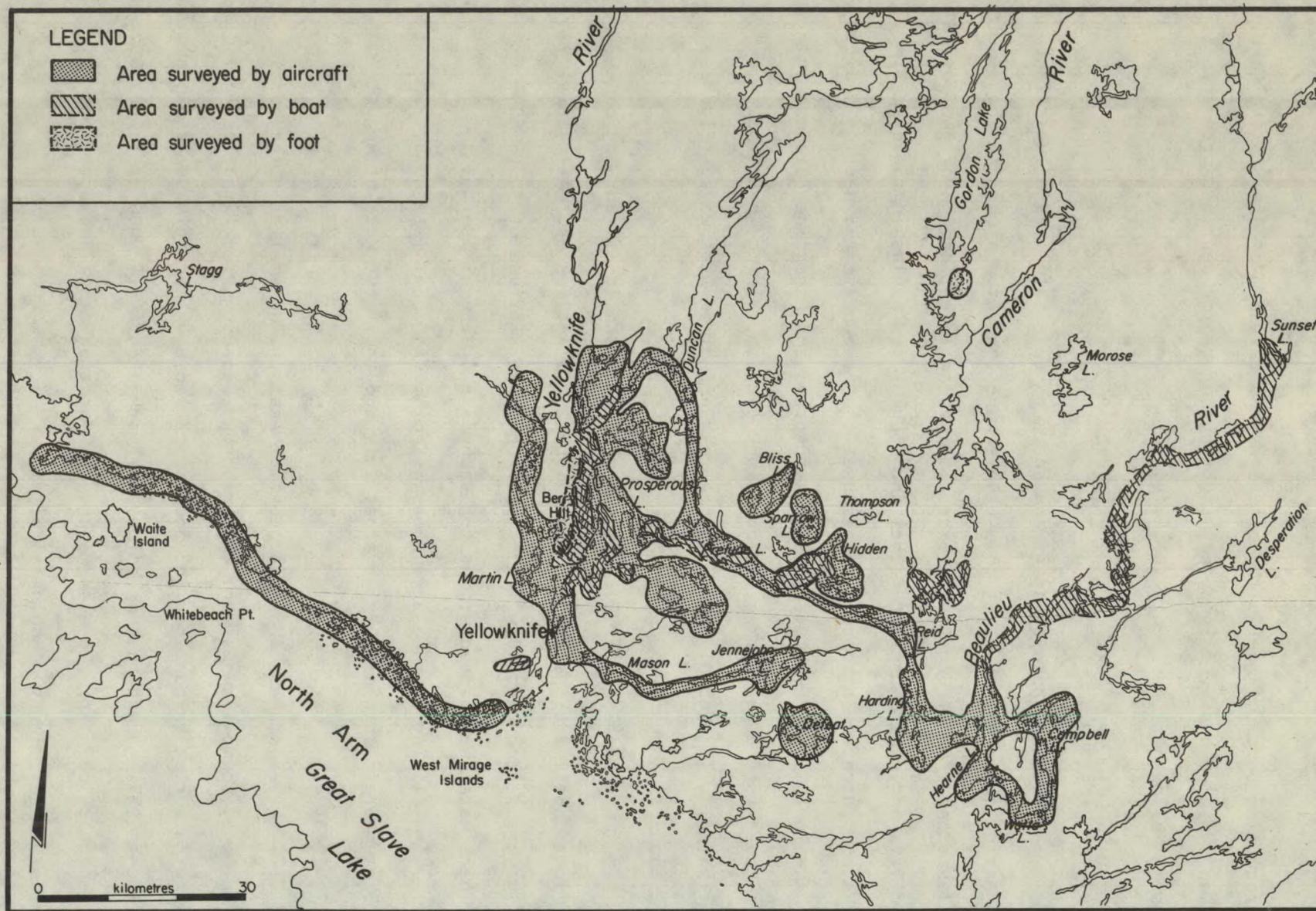


Figure 2. Areas near Yellowknife surveyed for raptor nests and colonies of nesting birds in 1978.

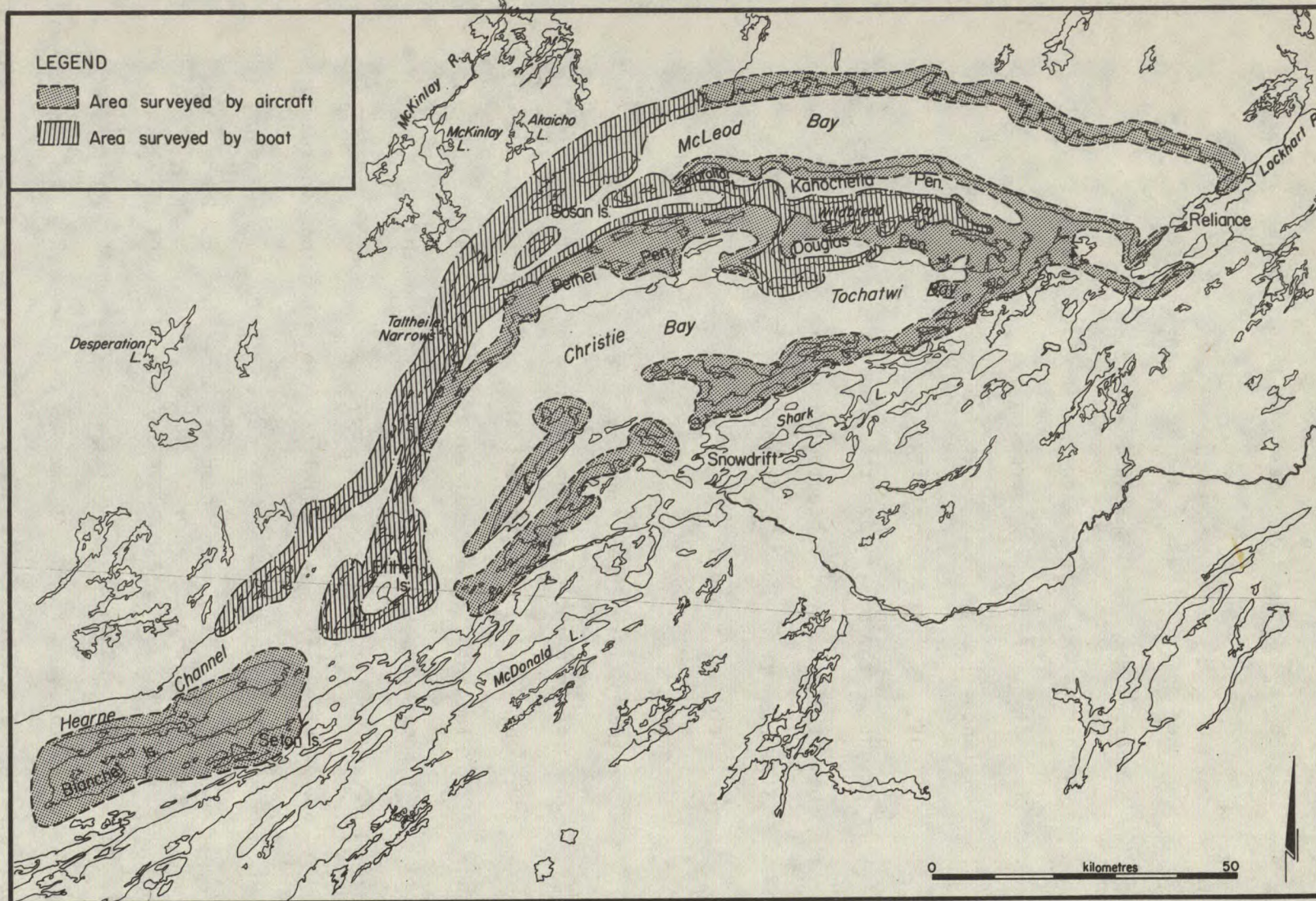


Figure 3. Areas in the east arm of Great Slave Lake surveyed for raptor nests and colonies of nesting birds in 1978.

For each raptor and raven nest, we recorded the following information:

- whether the nest was in a tree or on a cliff;
- number of eggs or young in the nest;
- whether adults were present, and if so, their behaviour (brooding, incubating, perching);
- distance from the nest to the nearest water body;
- height of the tree or cliff;
- height of the nest above the ground or the base of the cliff;
- height of the nest above the valley floor;
- direction that the nest faced;
- condition of the nest;
- size of the nest;
- presence of other nests nearby; and
- a brief description of the surrounding habitat.

If the nest was on a cliff, we also recorded whether or not there was an overhang and the length of rope required to reach the nest for banding the young. If the nest was in a tree, we recorded whether the tree was dead or alive and whether the tree was above, at, or below the forest canopy. Lack of time during the aerial surveys permitted consistent recording of only the first four items. For colonial birds, we recorded the number of nests or the number of adults and chicks during ground surveys, but only the approximate number of adults in the colony during aerial surveys. For subsequent identification, two photographs were taken of each raptor nest using 35 mm SLR cameras with 50 mm and 200 mm lenses. The nest descriptions, the maps and the slides of the nests are on file at the CWS Edmonton office as reference material for future studies.

Several Yellowknife residents contributed additional information on the location and history of a number of nests. This information was filed with the field study results, and the nests whose location we were able to verify were included in this report.

4.1 Terminology

The terminology used in raptor research is a source of confusion because it varies from one study to another. Although slightly different, our definitions which are listed below, are based on those of Postupalsky (1974).

Vacant nest is one that contains no eggs or young and has no bird attending it.

Occupied nest is one that is being used by a pair of Bald Eagles. Signs of occupancy are eggs, young, or an incubating adult in the nest, or an adult nearby (includes all productive nests).

Productive nest is one that will likely produce fledglings. Signs of productivity are eggs or young in the nest, or an adult sitting in the incubating posture.

Breeding territory is an area occupied by a pair of Bald Eagles during the nesting season. The breeding territory may have one or more nests, but only one occupied nest.

Alternate nest is an additional but vacant nest within the breeding territory of one pair of birds. There may be more than one alternate nest.

Mean brood size is the average number of young per productive nest.

5. SURVEY RESULTS AND DISCUSSION

5.1 Raptor Nests

In the Yellowknife area we recorded 85 raptor nests, specifically:

- 24 Bald Eagle nests,
- 1 Golden Eagle nest,
- 1 Osprey nest,
- 1 Merlin nest,
- 1 Goshawk nest,
- 5 Great Horned Owl nests, and
- 52 vacant large stick nests most of which were probably built by Bald Eagles.

Of the 52 vacant stick nests, 22 were sighted in late August and September after the birds had fledged, so that some of these nests may have been active earlier in the season. Besides the raptor nests, we found 16 vacant, and 3 productive Common Raven nests. The location of all nest sightings in the Yellowknife area is shown in Figures 4 and 5.

We saw numerous American Kestrels, several Red-tailed Hawks and Marsh Hawks and a Peregrine Falcon in the Yellowknife area, but we found none of these species nesting. R. MacKillop of the Northwest Lands and Forest Service, in Yellowknife, (pers. comm.) reported American Kestrels and Great Horned Owls nesting in the buildings and headframes of several abandoned mine sites.

In the east arm of Great Slave Lake, we recorded 136 raptor nests, specifically:

- 39 Bald Eagle nests,
- 2 Merlin nests,

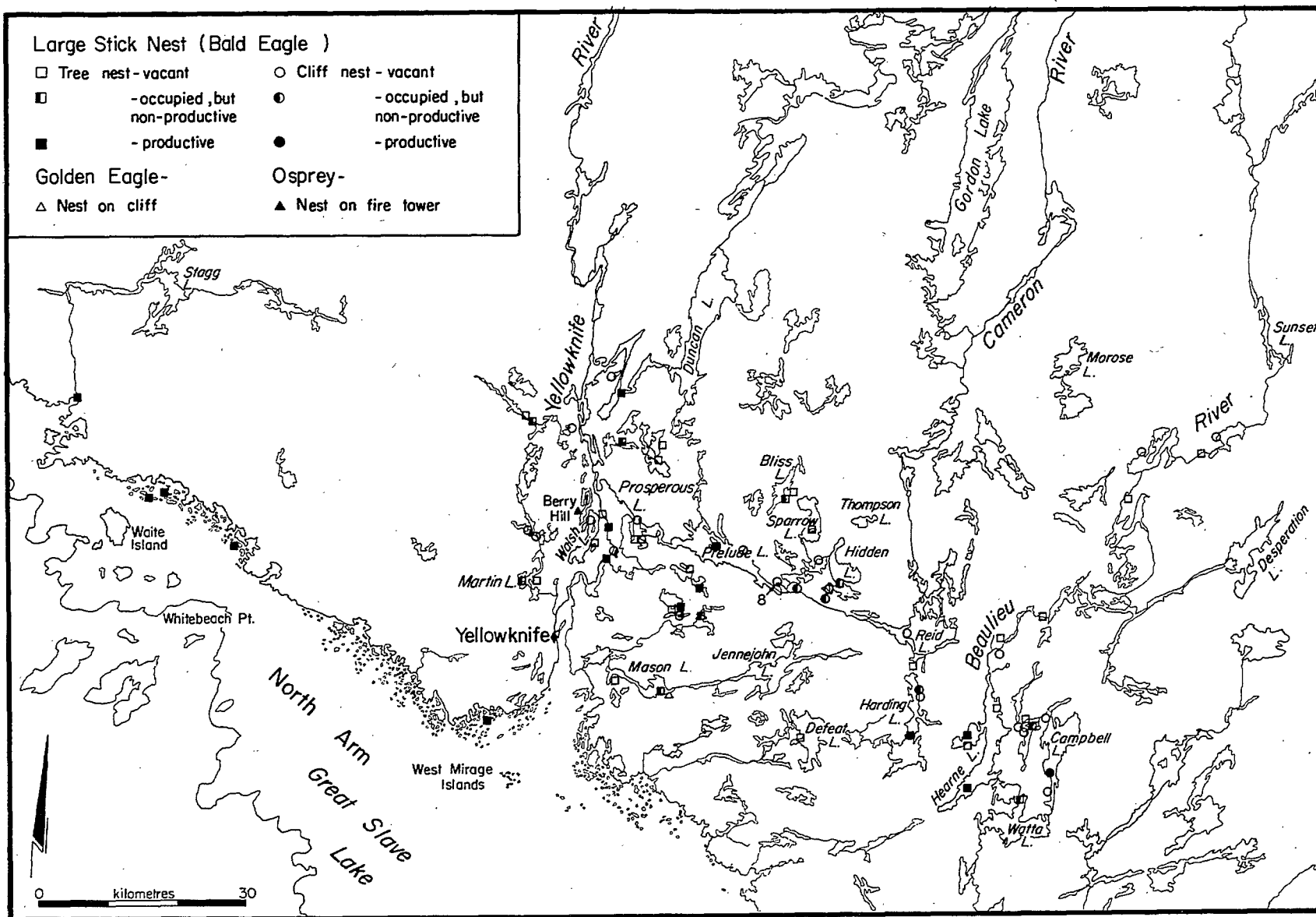


Figure 4. Location of the large stick nests found during surveys of the Yellowknife area in 1978.
 □ includes three nests on utility poles.
 ○ includes three nests on the ground.

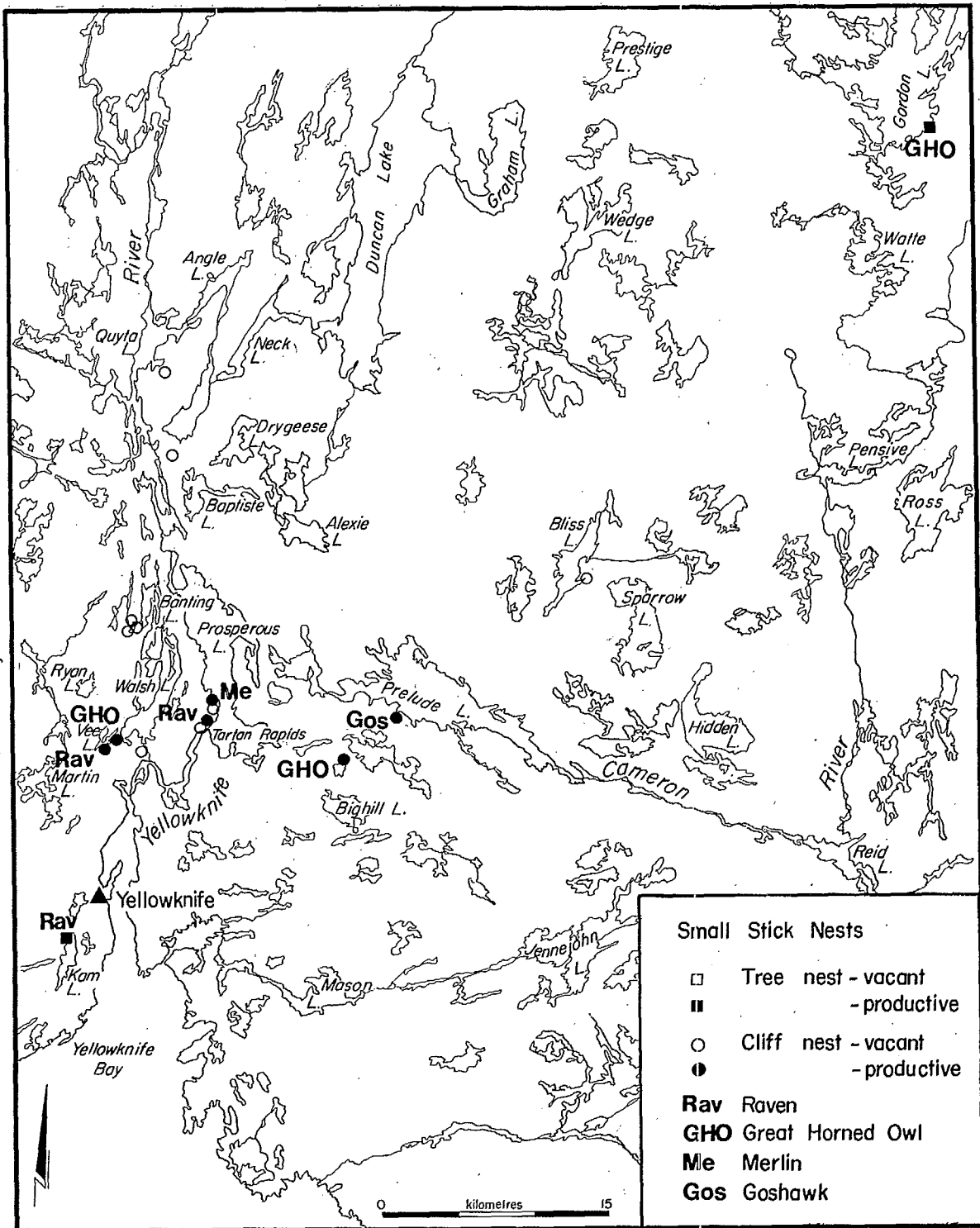


Figure 5. Location of the small stick nests found during surveys in the Yellowknife area in 1978.

- 2 falcon sp. nests,
- 1 Short-eared Owl nest, and
- 92 vacant large stick nests, most of which were probably built by Bald Eagles.

In addition, we found 70 vacant Common Raven nests. The location of all nests observed in the east arm is shown in Figures 6 and 7.

Adult Merlins were present at two nests, but extensive cliffs prevented us from determining whether there were young in the nests. At the base of a cliff near Taltheilei Narrows, we saw three recently fledged Merlin. We found no American Kestrel nests in the east arm, but we sighted American Kestrels twice near Taltheilei Narrows. Although past records indicate that the occasional Peregrine Falcon, Golden Eagle and Great Horned Owl nest in the east arm, we did not see any of these species. However, canoeists reported a pair of Peregrine Falcons occupying an eyrie in 1978 on Artillery Lake northeast of Great Slave Lake (L. Shapiro and R. Newmark, pers. comm.). Also, personnel at the weather station in Fort Reliance reported that a pair of Ospreys were nesting at the mouth of the Lockhart River (pers. comm.).

None of the raven and owl nests that we found in the east arm had young in the nest. However, copious amounts of fresh whitewash at several nest sites suggested that some of the nests had been used earlier in the year. The ravens and owls likely fledged before 6 July when we began surveying the east arm.

5.2. Colonial Waterbirds

We found only larids nesting colonially in both study areas. In the Yellowknife area we located two tern colonies: 60 terns on an island in the north arm of Great Slave Lake (map and mercator grid number 85 J/7 PV 0826), and 30 terns on a small rocky island in the middle of Hearne Lake

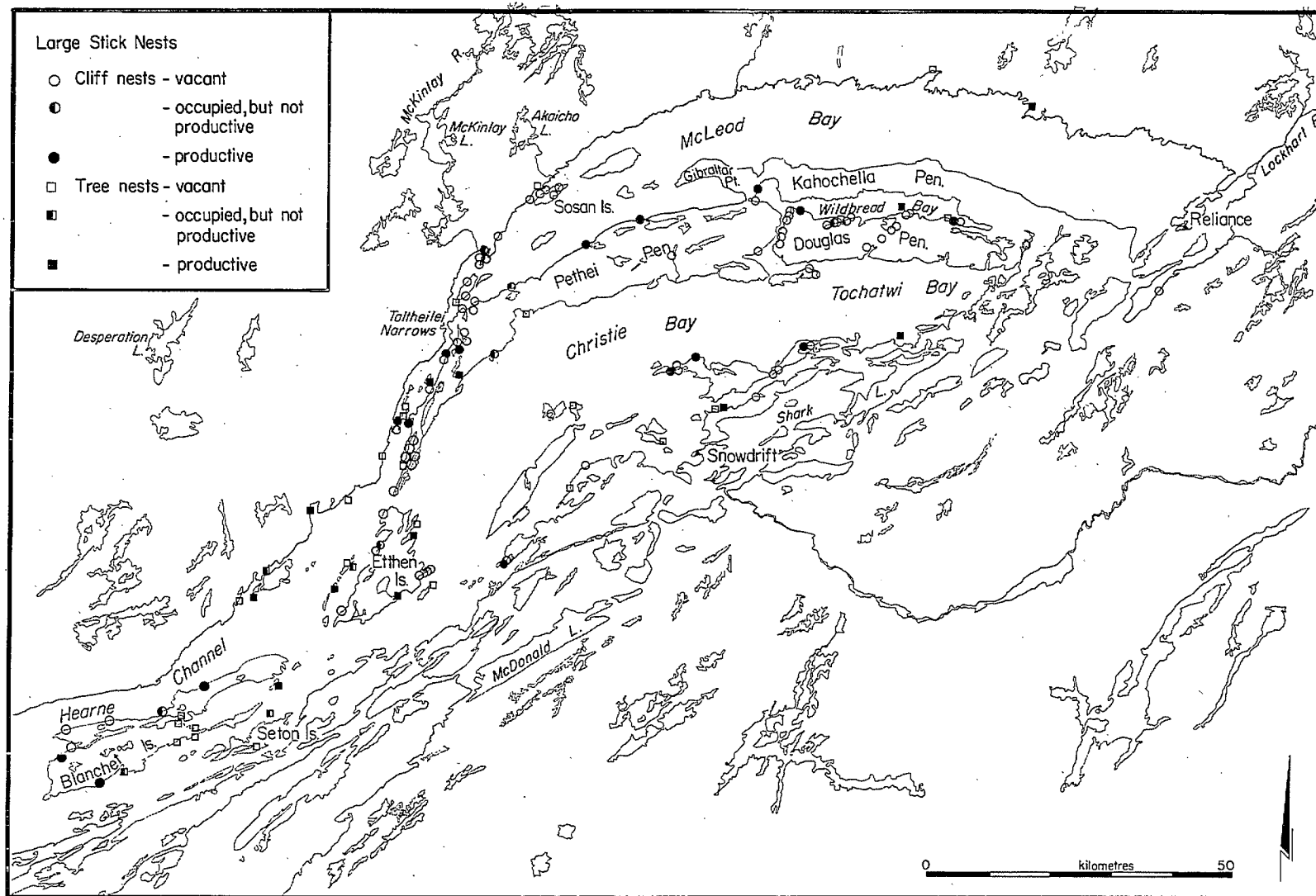


Figure 6. Location of the large stick nests found during surveys of the east arm of Great Slave Lake in 1978. All of the birds seen in association with the nests were Bald Eagles.

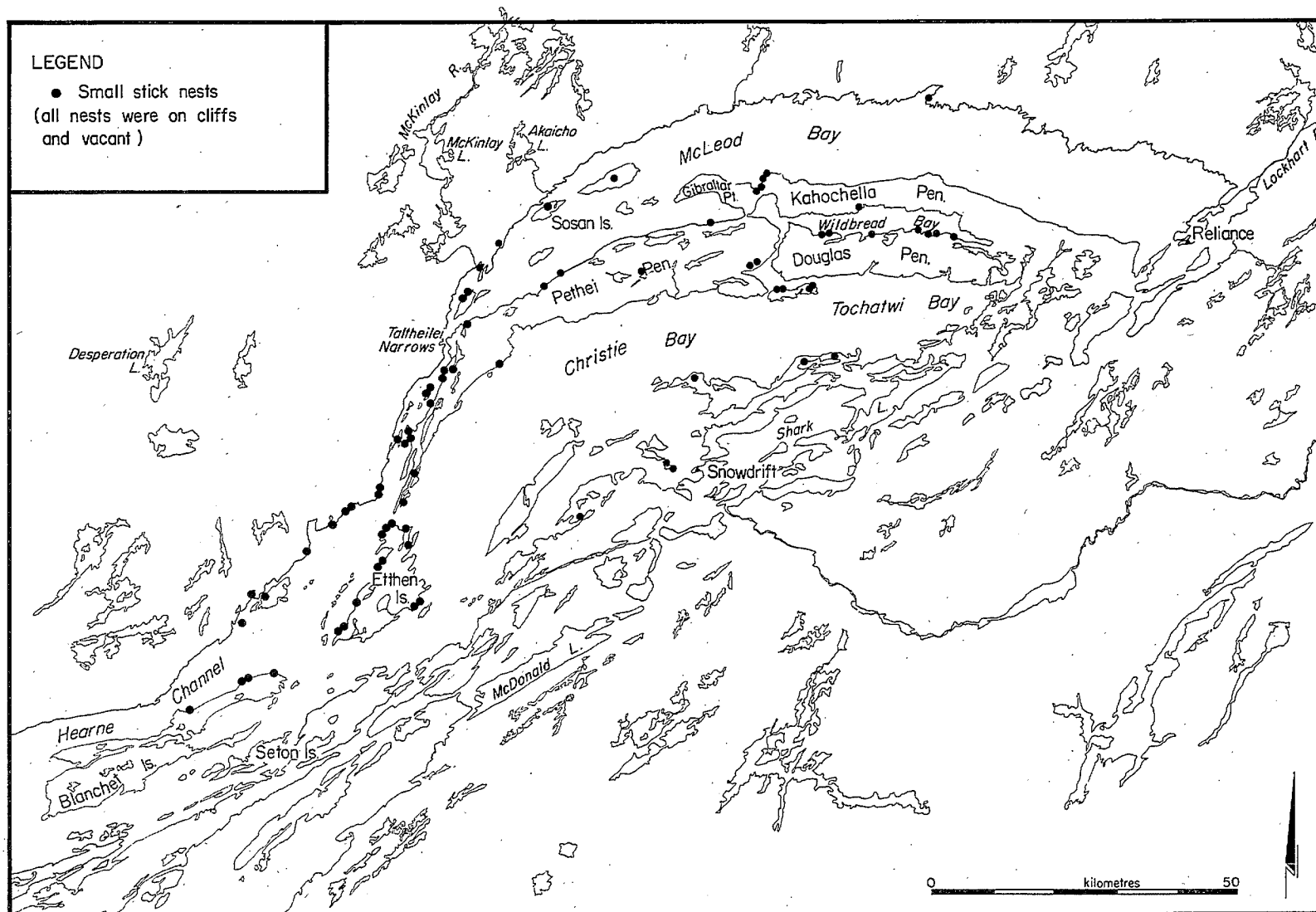


Figure 7. Location of the small stick nests found during surveys of the east arm of Great Slave Lake in 1978.

(map and mercator grid number 85 I UE 8810). Since both colonies were sighted during aerial surveys, we were unable to identify whether they were Arctic or Common Terns. However, all casual sightings from the ground in the Yellowknife area were of Arctic Terns and past nest records also indicate that the Arctic Tern is the more abundant species (Trauger and Bromley 1976).

We saw numerous Herring, Mew and California gulls and a few Bonaparte's Gulls in the Yellowknife area. While we found no nesting colonies, we did find a number of single nests of Herring, Mew and California gulls on small rocky islands on several lakes including Walsh, Jennejohn, Gordon and Kam lakes. We were unable to survey adequately the north arm of Great Slave Lake due to poor visibility when we were in that area. However, we suspect that the multitude of islands in the north arm provide excellent habitat for nesting colonies of larids. The only islands investigated to date are the West Mirage Islands where Trauger and Bromley (1976) reported numerous nesting larids including 150 to 200 pairs of California Gulls and 75 to 100 pairs of nesting Arctic Terns.

In the east arm of Great Slave Lake, we found 31 nesting colonies of Herring Gulls, Mew Gulls, California Gulls and Arctic Terns. For a summary of the birds and colonies recorded, refer to Table 1, and for the location of the colonies, refer to Figure 8. The most abundant species was the Herring Gull. A number of Herring and Mew gulls nested singly and in small groups rather than in colonies. We found two mixed colonies of Herring, Mew and California gulls. All nests were on small rocky islands.

Table 1. Colonial birds recorded in the east arm of Great Slave Lake during surveys conducted in 1978.

	Herring Gull	California Gull	Mew Gull	Unidentified Gull	Arctic Tern
Total number of birds recorded	477	59	87	86	111
Number of birds in nesting colonies	179	20	58	75	51
Number of nesting colonies with 10 or more birds	5	1	2	3	2
Number of nesting colonies with less than 10 birds	12	0	4	0	2

The numbers presented in this table are intended for comparison only. They do not represent the absolute number of each species in the east arm because we surveyed only a portion of that area. Furthermore, due to time restraints during the aerial surveys, only the larger colonies and flocks of larids were recorded.

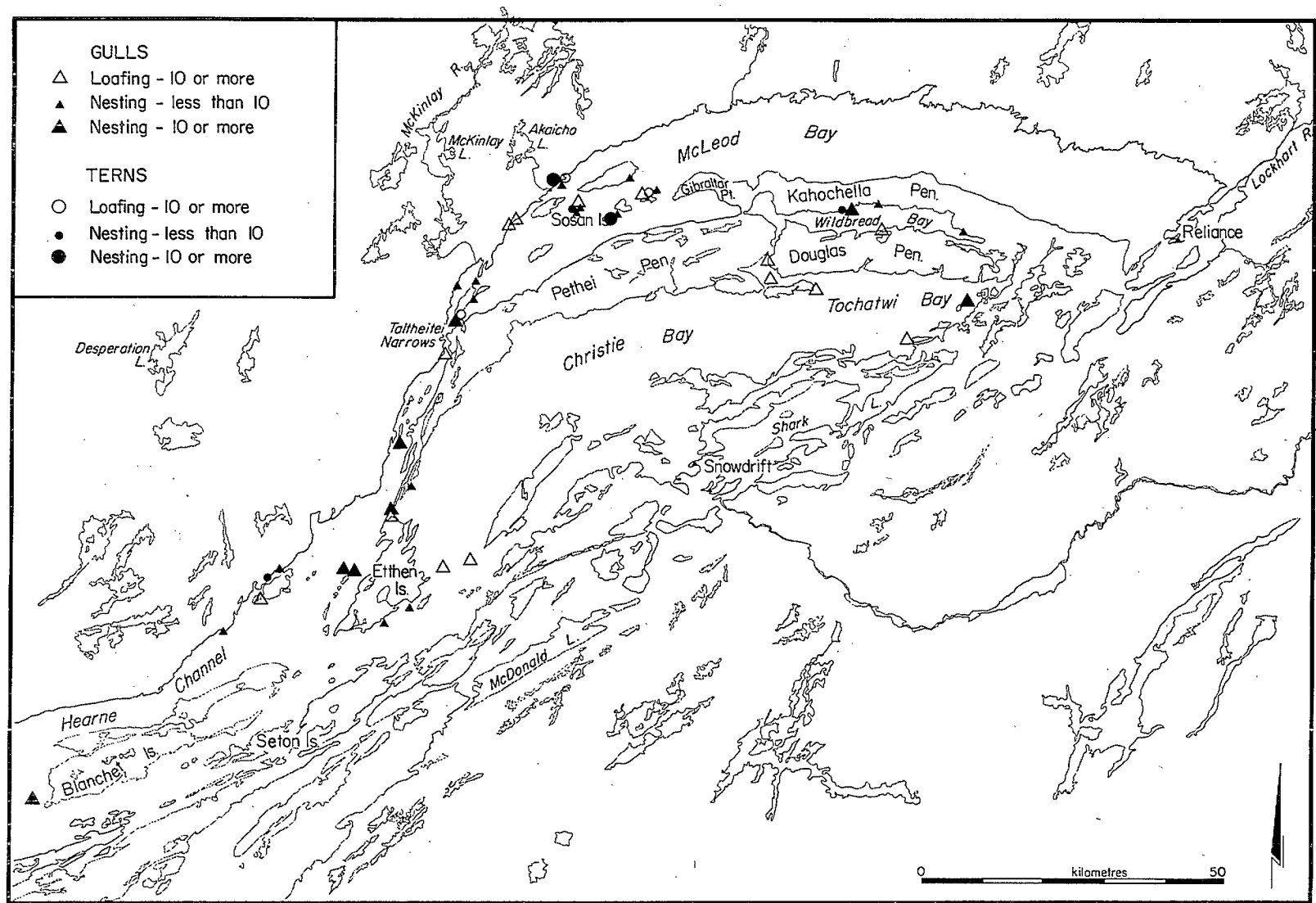


Figure 8. Location of the tern and gull nests, and flocks of 10 or more larids found during surveys of the east arm of Great Slave Lake in 1978.

5.3 Bald Eagle

The Bald Eagle was the most abundant raptor in the study area. We found 43 productive nests and recorded over 230 individuals. Due to the abundance of the Bald Eagle, we were able to comment on its phenology, productivity and nest site as follows.

5.3.1 Phenology

5.3.1.1 Spring Arrivals

We lack data on the timing of spring arrivals because the study began after the onset of incubation. However, we have two records for the Yellowknife area: one adult Bald Eagle on 7 April at Boundary Creek about 32 km east of Yellowknife (D. Karasiuk, pers. comm.), and another on 20 April over Yellowknife.

5.3.1.2 Initiation of Incubation

To obtain the date at which the Bald Eagles laid their eggs, we back-dated from the age estimations made of the nestlings visited during the summer. We based our age estimations on the descriptions of developing eaglets by Bent (1937) and Gabrielson *et al.* (1959 in Snow 1973a), and assumed an incubation period of 34 to 35 days (Hensel and Troyer 1964). From this, we estimated that eggs were laid in the Yellowknife area between 17 and 29 April, and in the east arm of Great Slave Lake between 18 April and 5 May. The later egg-laying date for the east arm corresponded with the lower mean monthly temperatures and delayed break-up for the region. Fort Reliance which is at the extreme eastern end of the study area is generally 3° to 4° cooler than Yellowknife (Appendix B).

The date of initiation of egg-laying may vary a few weeks from year to year. Grubb (1976) observed nearly a month's variation during

the two years that he studied Bald Eagles in the State of Washington. Thus, to accurately assess when the eggs are laid in our study area, we need several more years of data. However, we believe that our estimations represent an average year because temperatures in the spring of 1978 were near normal (Appendix B).

Our estimations concurred with other studies. To the north, along the lower Mackenzie River, Campbell and Davies (1973) estimated that Bald Eagles laid their eggs in late April. To the south, in northeastern Alberta, (Ealey (1978b) they laid their eggs between 5 and 19 April.

5.3.1.3 Fledging

In the east arm, young eagles began to leave the nest in the first week of August. Between 4 and 6 August, the young of three of seven nests could fly. We estimated that these young eagles were 9 to 10 weeks old. In comparison, Campbell and Davies (1973) reported that the young Bald Eagles along the lower Mackenzie River fledged in early August at an estimated 10 to 11 weeks of age. Gerrard *et al.* (1973) estimated that the eaglets in northern Saskatchewan and Manitoba fledged at 9 to 12 weeks.

5.3.1.4 Fall Departure

We left the east arm of Great Slave Lake on 9 August, and so we have no data on when Bald Eagles depart from that area. However, there were still eagles near Yellowknife at the end of September. Karasiuk (1979) sighted 40 Bald Eagles during a survey of Mills and Beaver lakes about 200 km southwest of Yellowknife on 6 October 1979. These birds were probably migrants, since the average count of Bald Eagles in comparable surveys of the area in August was only 15. We suspect that most of the Bald Eagles in our study area departed in the first half of October. Campbell and Davies (1973) reported that Bald Eagles left the lower Mackenzie River by early October.

5.3.2 Productivity

Of the 76 nests in the Yellowknife area that we classed as Bald Eagle nests, 15 were productive and 25 were of an unknown status because we found them after fledging. In the east arm, 28 of the 131 Bald Eagle nests were productive. The average number of young per productive nest was 1.8 at Yellowknife and 1.5 in the east arm.

Bald Eagles often have more than one nest within their breeding territory. The extra nests are referred to as alternates and they are not available for other nesting pairs. Therefore, to determine what percentage of the habitat is being used for raising young in a given year and region, it is more accurate to consider territories than individual nests. To delineate the breeding territories, we adopted the method used by Whitfield *et al.* (1974), Grier (1973) and Grubb (1976). Nests that were within 1 km of each other were considered to be in the same breeding territory. However, there were about a dozen exceptions where we designated nests which were 1 to 2 km apart as in the same territory due to local physical features. For example, nests on the same bay or on the same small lake were put in the same breeding territory. Although most of the occupied nests were more than 2 km apart, there was one situation where two occupied nests were within 1 km of each other. Thus, our method of delineating breeding territories is only approximate. For a more accurate analysis, intensive ground work is required.

Using the method just described, we delineated 51 breeding territories in the Yellowknife area and 78 breeding territories in the east arm. At Yellowknife, of the 35 breeding territories surveyed before fledging, 60% were occupied and 43% were productive. In the east arm, 51% of the breeding territories were occupied and 36% were productive (Table 2).

Table 2. Productivity of the Bald Eagle in the Yellowknife area and east arm of Great Slave Lake in 1978.

	Yellowknife area	East Arm of Great Slave Lake
Timing of surveys	10 June-1 July	4 July-6 August
Number of nests	51 (76)*	131
Number of occupied nests	21	40
Number of productive nests	15	28
Number of breeding territories	35 (51)*	78
% occupied breeding territories	60%	51%
% productive breeding territories	43%	36%
Number of young per productive nest	1.8	1.5

*Values in brackets based on August-September surveys as well as June-July surveys.

Our data suggests that productivity was lower in the east arm than in the Yellowknife area. The east arm had both smaller brood sizes and a lower percentage of breeding territories with productive nests. This discrepancy arose partially or wholly because we collected the data on productivity in the Yellowknife area in June, earlier in the nesting season than July and the beginning of August when we surveyed the east arm. Other studies have shown that as the breeding season progresses, eaglets die and failed nesters vacate their breeding territory. Whitfield (1974), for example, found that 22% of the 51 nests active in May were empty in July. Similarly, Sherrod *et al.* (1977) found that in one month the number of nestlings decreased by 20%. Thus, for a meaningful comparison of productivity values, all data should be collected at the same time during the nesting season.

Because there has been little conformity in the methods used for gathering and analyzing data on Bald Eagles, it is often misleading to compare productivity values between studies. However, for rough comparisons, we have presented some values from other studies in Tables 3 and 4. The mean brood sizes that we found were comparable to other studies in northern Canada and Alaska (Table 3). However, our values for the percentage of either occupied or productive breeding territories were much lower than those reported in other studies (Table 4). Possible reasons for this discrepancy are as follows:

- 1) The Bald Eagle population in our study area may be declining. Increased human disturbance, depletion of the food supply, or environmental contamination are possible reasons for the decline. This seems unlikely, particularly in the east arm where human activity has been limited.

Table 3. Comparison of mean brood sizes for Bald Eagles in our study area to those in other parts of northern Canada and Alaska.

Average Number of Young per Productive Nest	Study Area	Source
1.8	Yellowknife area	this study
1.5	East arm of Great Slave Lake	this study
1.5	Northwestern Ontario	Grier (1973)
1.7-1.9	Central Saskatchewan and Manitoba	Whitfield <i>et al.</i> (1974)
1.56-1.62	Besnard Lake, Saskatchewan	Bortolotti <i>et al.</i> (1977)
1.53	Northern Alberta	Ealey (1978a)
1.67	Alaska	Sherrod <i>et al.</i> (1977)

Table 4. Comparison of the percentage of Bald Eagle breeding territories that were occupied or productive in our study area with those in other parts of northern Canada.

Breeding Territories Occupied %	Breeding Territories Productive %	Study Area	Source	Comment
63	43	Yellowknife area	this study	based on June survey
50	36	East arm of Great Slave Lake	this study	surveys in July & early August
87		Northwestern Ontario	Grier (1973)	
83-86	56	Central Manitoba and Saskatchewan	Whitfield <i>et al.</i> (1974)	May survey
72-81	54.7-59.0	Besnard Lake, Saskatchewan	Bortolotti <i>et al.</i> (1977)	

- 2) We may have overestimated the number of breeding territories. Our study area is near the northern limit of the breeding range for the Bald Eagle. Hence, the breeding territories may be larger than in areas to the south.
- 3) Nest failure in early spring may be higher in our study area, because it is the northern limit of the breeding range for Bald Eagles. Unfortunately, we did not start to survey until June in the Yellowknife area and July in the east arm, so that we do not know how many nests were occupied and then vacated early in the nesting season.

5.3.3 Immatures

We recorded all Bald Eagles sighted during the surveys. Excluding the young of the year, 12% of the Bald Eagles in the Yellowknife area and 20% in the east arm were immature. Our estimates are probably low because the immature which lacks a white head and tail is more difficult to see than the adult.

Table 5 compares our values with those of other Bald Eagle populations in northern Canada and Alaska. Our values were low; however, most authors did not specify whether they included the young of the year in their calculations.

5.3.4 Nesting Habitat

On the 64 large stick nests that were occupied by birds, all but two nests had Bald Eagles. We assumed, therefore, that most of the large vacant stick nests were probably also Bald Eagle nests, and included the vacant nests in the following analysis of Bald Eagle nesting habitat.

Table 5. Comparison of the percentage of immature Bald Eagles in our study area with those in other parts of northern Canada and Alaska.

% Immatures	Sample Size	Study Area	Source	Comment
12	73	Yellowknife area	this study	Excluding young of year
20	100	East arm of Great Slave Lake	this study	Excluding young of year
16	307	Central Saskatchewan and Manitoba	Whitfield <i>et al.</i> (1974)	Excluding young of year
37		Besnard Lake, Saskatchewan	Bortolotti (1977)	
28.6	100	Southern NWT and northern Alberta	LGL Ltd. (1972)	
36	215	Amchitka Island, Alaska	Sherrod <i>et al.</i> (1977)	may be high due to garbage dump
11.3	505	Southeastern Alberta	King <i>et al.</i> (1972)	

5.3.4.1 Substrate

We found Bald Eagle nests in trees, on cliffs, on utility poles and on the ground. In the east arm, nearly 70% of the nests were on cliffs and the remainder were in trees. In the Yellowknife area, 55% of the nests were in trees, 37% were on cliffs and the remainder were on the ground and on utility poles (Figure 9).

Bald Eagles generally nest in trees (Campbell and Davies 1972; Ealey 1978b; Grier 1977; Grubb 1976; Snow 1973a); however, their adaptability to nesting elsewhere has been well documented. Amchitka Island has no trees and there the eagles nest on sea stacks, ridges, islets and hillsides (Sherrod *et al.* 1977). Troyer and Hensel (1965) reported that some of the nests on Kodiak Island, Alaska were on cliffs. Gerrard *et al.* (1975) found that two out of 290 nests in northern Saskatchewan and Manitoba were on cliffs. Ground nests, although rare, have been reported by Bendire (1892 in Shrerrod *et al.* 1977), Bromley and Trauger (1974), Fyfe (pers. comm.), Sharrit (1939 in Sherrod *et al.* 1977) and Sherrod *et al.* (1977). Few reports document Bald Eagles nesting on man-made structures such as utility poles, but Postupalsky (1977) described six instances in which three different pairs of Bald Eagles nested on man-made platforms in Michigan. He also mentioned two other accounts in the literature.

In regions that are well treed, Bald Eagles select the tallest, strongest species of tree to build a nest (Gerrard *et al.* 1975; Grubb 1976; Snow 1973a). Similarly, in our study area they tended to build nests on the tallest, most prominent structures available. In the eastern part of the east arm, the trees are small and scattered, but the cliffs are high,

YELLOWKNIFE AREA

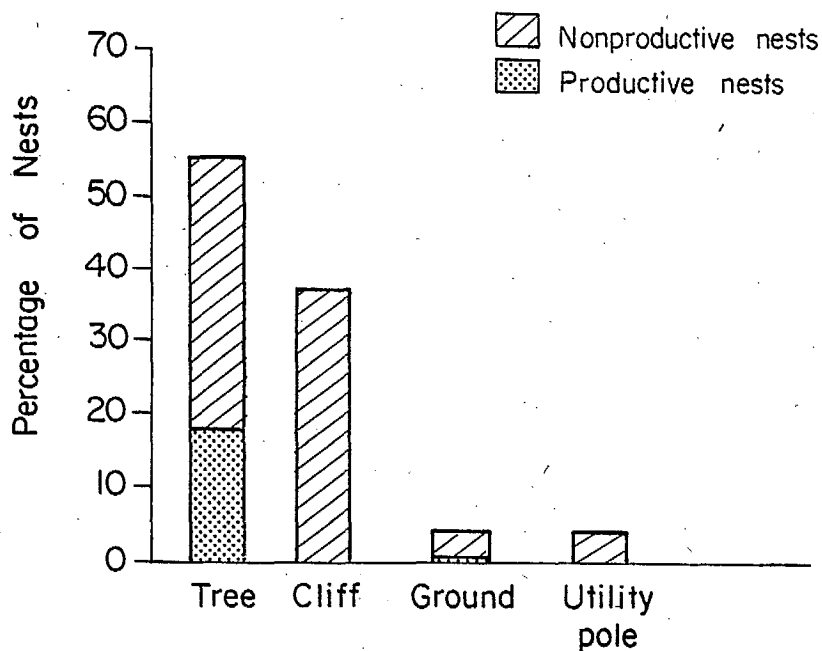
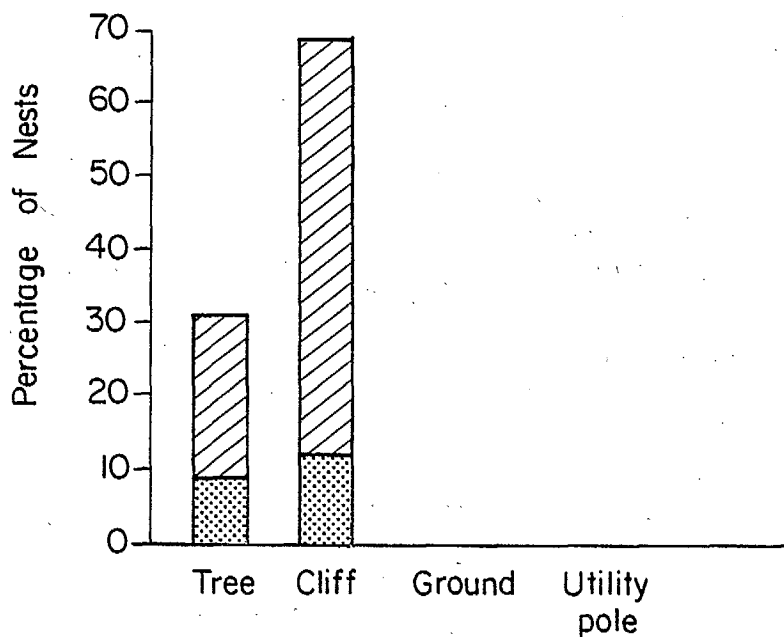
EAST ARM OF
GREAT SLAVE LAKE

Figure 9. Substrate on which Bald Eagles built their nests in the Yellowknife area and the east arm of Great Slave Lake.

vertical and extensive. There, most of the nests were on cliffs. In the Yellowknife area, the trees are taller and more numerous, whereas the cliffs are lower and more rounded. There, more than half of the nests were in trees. In between the two extremes of landscape, along Hearne Channel, Etthen Island and Blanchet Island, where there are both large trees and extensive high cliffs, 54% of the nests were on cliffs and the remainder were in trees.

Tree nests were proportionally more productive than cliff nests, even where cliff nests were more common. Thirty-three percent of the tree nests in the Yellowknife area were productive. In the same region, none of the cliff nests were productive. In the east arm, 29% of the tree nests and only 18% of the cliff nests, were productive. Of the cliff nests, those built on pinnacles were most productive. Six of the 16 nests that we found on pinnacles in the east arm had eaglets. Cliff nests may have been less productive because many of them, particularly in the Yellowknife area, were more accessible to predators such as the red fox, wolverine and lynx. Sherrod *et al.* (1977) suggested that fox predation strongly influenced nest-site selection by eagles on Amchitka Island.

5.3.4.2 Distance from Water

Over 90% of all Bald Eagle nests were within 100 m of a lake or river. More than half of the nests were within 25 m of shoreline, and no nest was more than 500 m from shore (Figure 10). Other studies have documented the Bald Eagle's preference for nesting near water. Renewable Resources (1978) reported that almost every nest was within 100 m of the Mackenzie River. Ealey (1978b) reported that 80% of the nests in north-eastern Alberta were less than 50 m from water. In central Saskatchewan

YELLOWKNIFE AREA

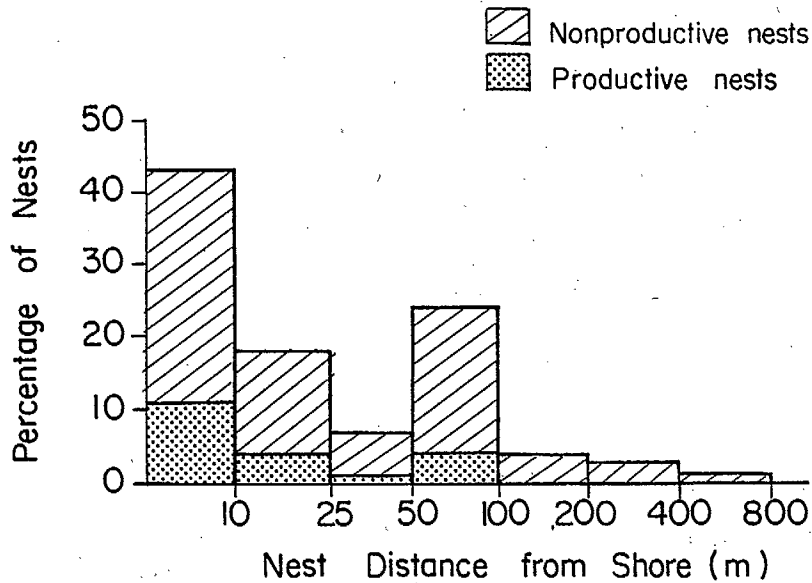
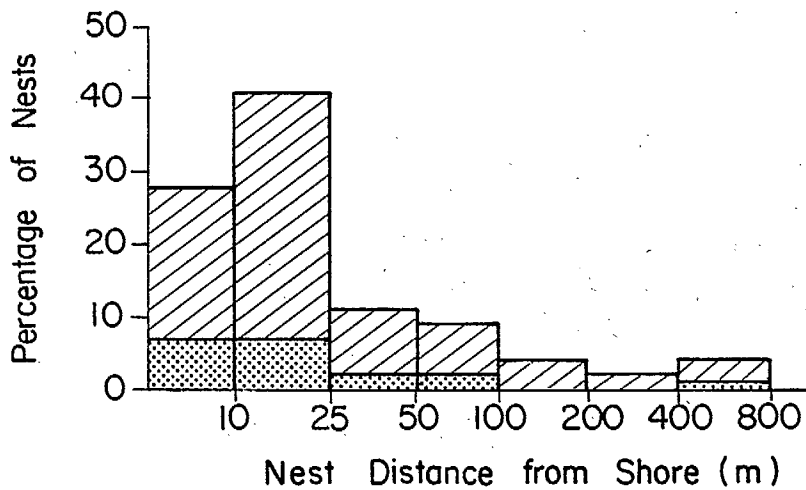
EAST ARM OF
GREAT SLAVE LAKE

Figure 10. Distance from Bald Eagle nests to nearest river or lake.

and Manitoba, 90% of the nests were within 180 m of water (Whitfield *et al.* 1974), and in Washington State, 92% were less than 180 m from water (Grubb 1976).

5.3.4.3 Tree Nests

In the Yellowknife area, 45% of the tree nests were in jack pine (*Pinus banksiana*) and 55% were in spruce (*Picea* sp.). Of the trees with nests, only one of the spruce, but 42% of the jack pines, were dead. In the east arm, all nests were in spruce and 15% of these trees were dead. Our results concurred with Grubb (1976), Snow (1973a) and Gerrard *et al.* (1975) who stated that the Bald Eagle nests in the dominant, tallest and strongest species of tree in an area. In the east arm, the spruce is the predominant tree; in the Yellowknife area black spruce dominates the moister habitat, whereas jack pine dominates the drier uplands. Some of the tree species used elsewhere in North America are: in Washington State, the Douglas fir (*Pseudotsuga menziesii*) (Grubb 1976); in northwestern Ontario, trembling aspen (*Populus tremuloides*) (Grier 1973); in Minnesota, red pine (*Pinus resinosa*) and white pine (*P. strobus*) (Frenzel *et al.* 1973); and on Kodiak Island, Alaska, cottonwood (*Populus* sp.) (Troyer and Hensel 1965).

The height of tree used to nest reflected the size of the trees available in each part of the study area. At Yellowknife, the trees used for nesting were 6 to 18 m high, and 45% of the nests were in trees 12 to 15 m high. In the east arm where the trees are smaller, all nest trees were 5.5 to 12 m high, and 50% of the nests were in trees 9 to 12 m high (Figure 11). The vertical distance from the nests to the nearest river or lake was 4.5 to 43 m (Figure 12).

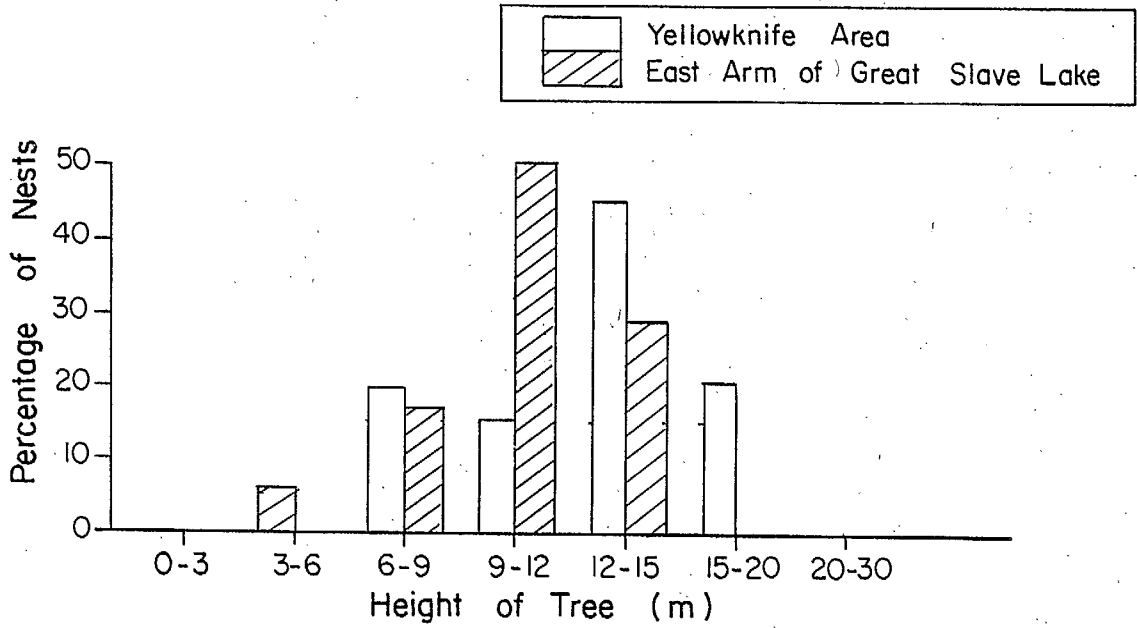


Figure 11. Height of trees used by Bald Eagles for nesting.

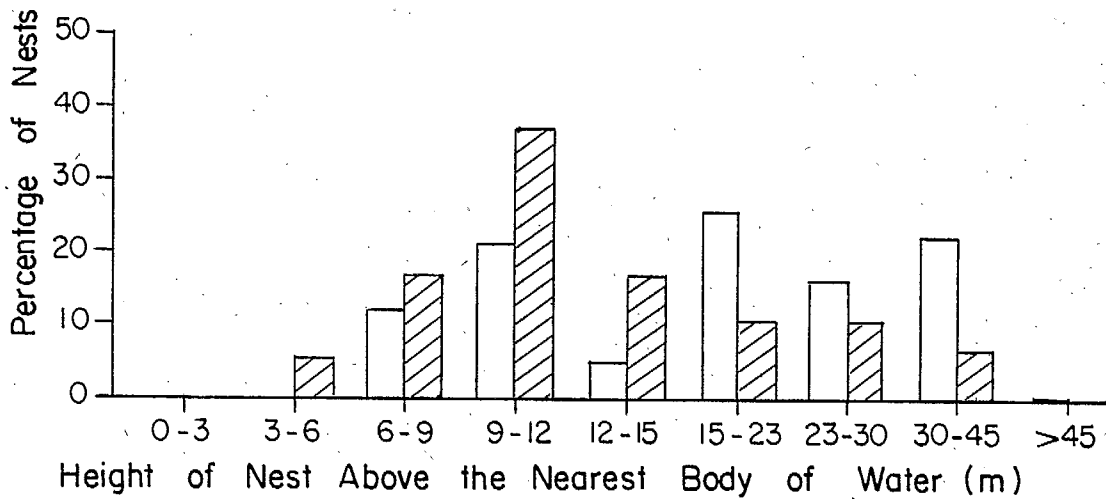


Figure 12. Height of Bald Eagle tree nests above the nearest body of water.

Throughout both parts of the study area all nests were in the top half of the tree and more than 75% of the nests were in the top quarter of the tree. In the east arm, 50% of the nests and in Yellowknife 28% were at the very top of the tree. Many of the trees with nests on top were spruce with broken crowns.

5.3.4.4 Cliff Nests

In the Yellowknife area, cliffs with nests were from 9 to 30 m high (Figure 13). One nest was at the top of a cliff, 53% of the nests were on the top quarter of a cliff and all but one nest were within the top half of the cliff. The vertical distance from the nest to the nearest river or lake was 9 to 50 m (Figure 14).

In the east arm which has greater local relief than the Yellowknife area, the nests were on higher cliffs that were 12 to 67 m high (Figure 13). Of these nests, 18% were on top of pinnacles and 52% were within the top quarter of the cliff. Unlike Yellowknife, 18% of the nests were situated on the lower half of the cliffs, probably because the cliffs in the east arm were higher. The vertical distance from the nest to the nearest river or lake was 15 to 120 m, but most nests were 15 to 60 m above the water (Figure 14).

5.3.4.5 Physiographic Location of Nests

All of the Bald Eagle nests in the Yellowknife area were near either a lake or a river with clear deep water suitable for fish. We found no nests by shallow marshy ponds. On the lakes most nests were on islands and in bays (Figure 15). Points were generally rocky, with a few scattered, small trees, and had few nests. Eighty percent of the productive nests in the Yellowknife area were on islands.

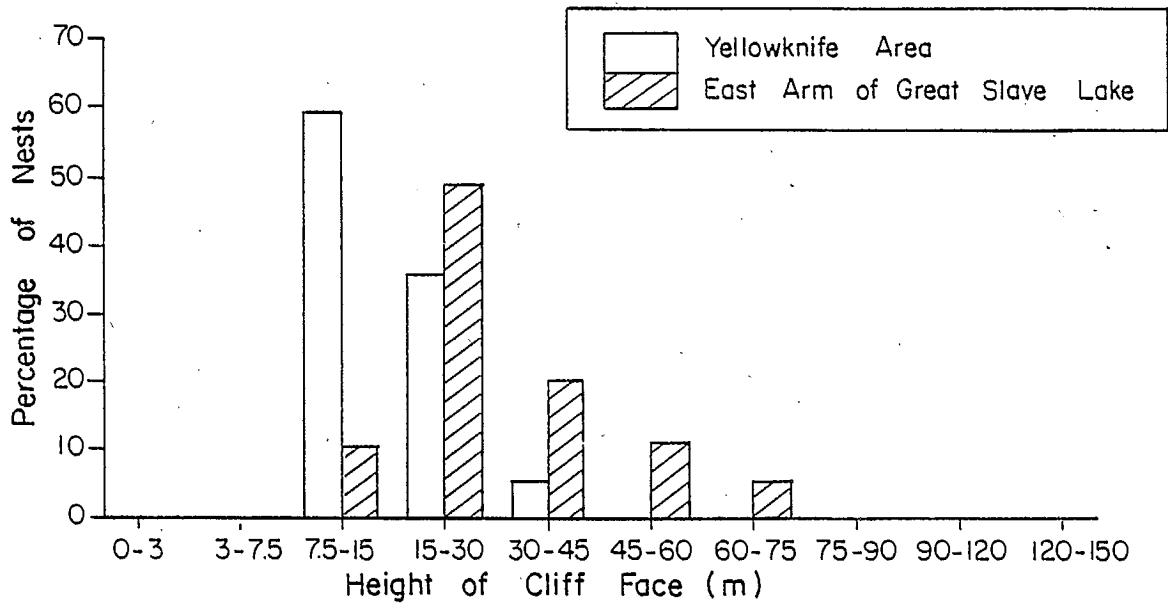


Figure 13. Height of cliffs used by Bald Eagles for nesting.

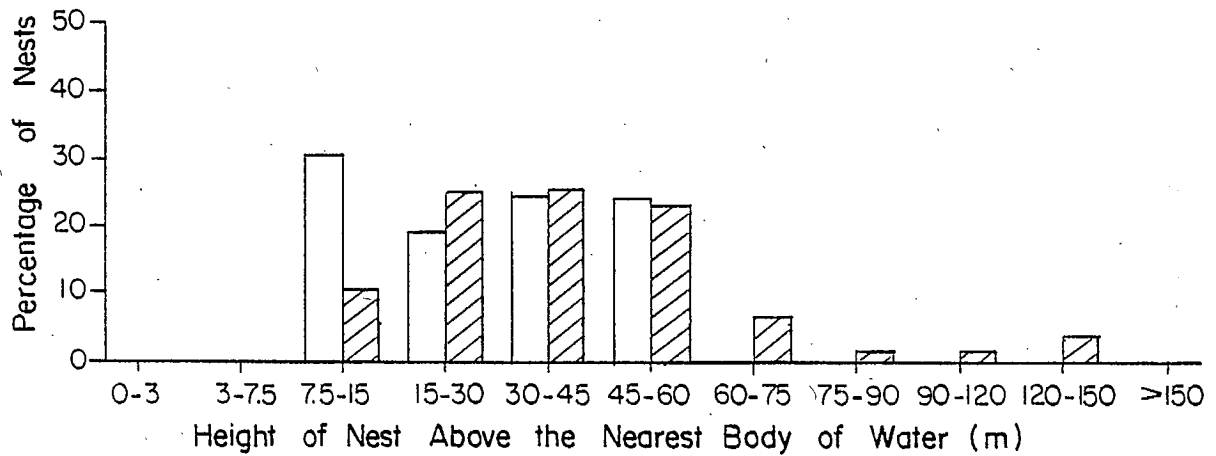
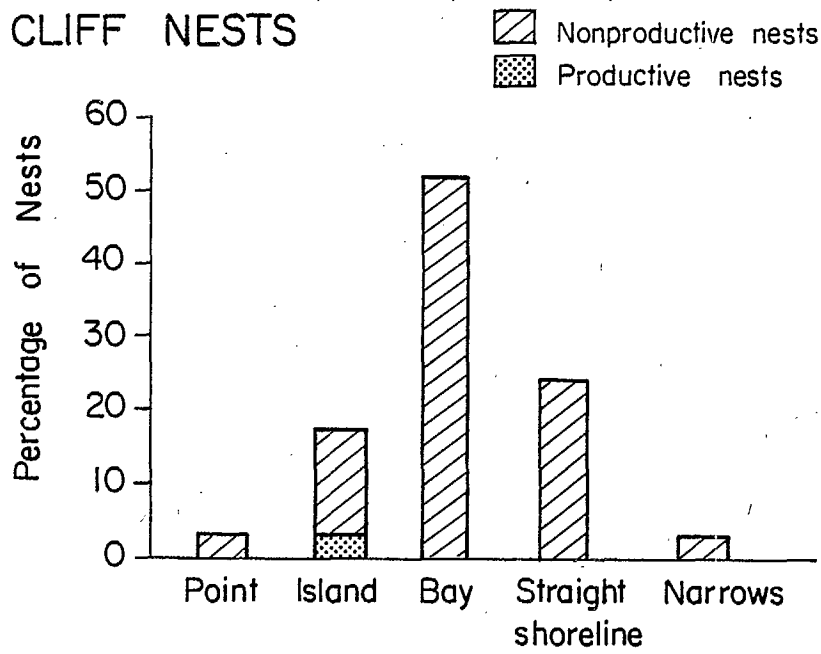


Figure 14. Height of Bald Eagle cliff nests above the nearest body of water.

CLIFF NESTS



TREE NESTS

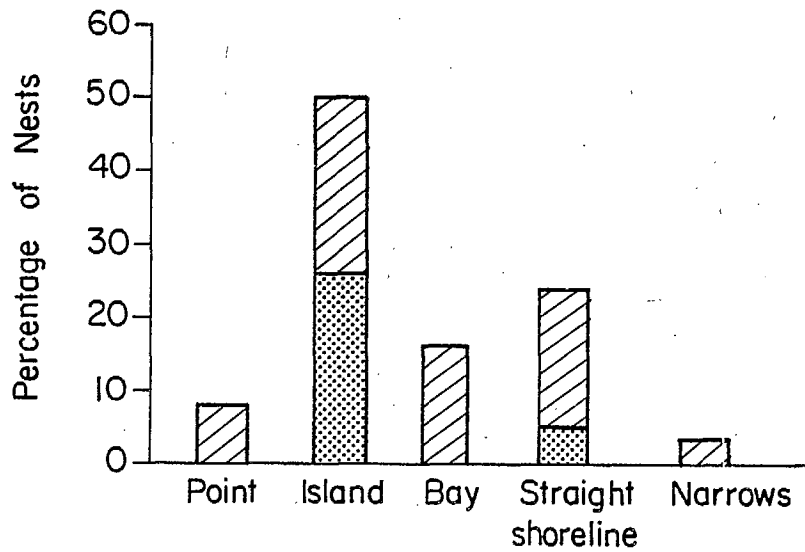


Figure 15. Physiographical location of Bald Eagle nests on the lakes near Yellowknife.

In the east arm of Great Slave Lake, many of the cliff nests, including 11 of the 16 productive ones, were on the extensive cliffs that form long straight stretches of shoreline (Figure 16). Most of the tree nests were along more sheltered and undulating shoreline where the trees were taller. Most of the productive tree nests were on islands (58%) or points (25%).

Several authors noted that the Bald Eagle preferred to nest along broken shoreline, on points, and on islets rather than along continuous shoreline (Gerrard *et al.* 1975; Ealey 1978b; King *et al.* 1972; Troyer and Hensel 1965). Except for the nests along the extensive cliffs in the east arm, our results concurred with this.

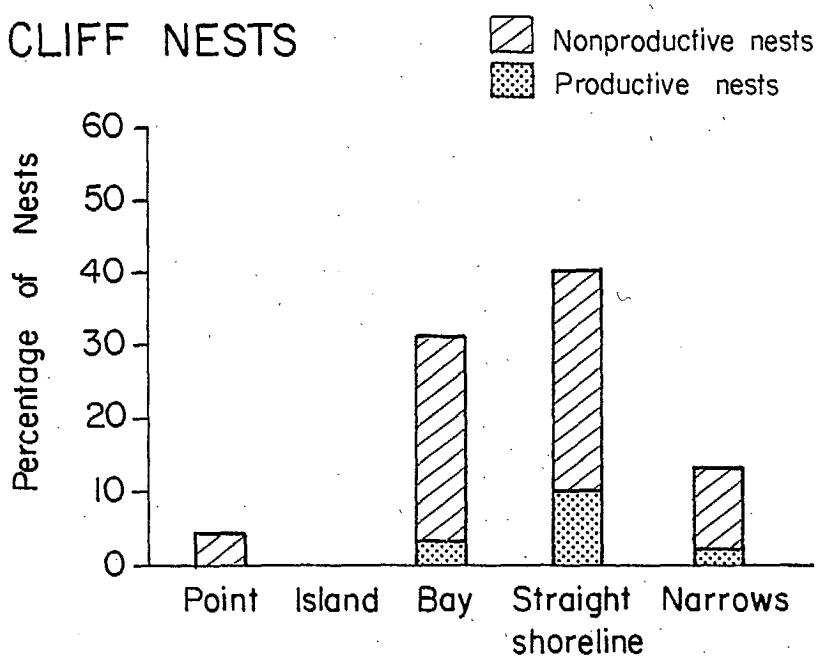
6. IMPACT OF DEVELOPMENT

The economic potential of the Yellowknife area and east arm of Great Slave Lake lies primarily in mining, hydro power, fishing, recreation and tourism.

6.1 Mining

Gold has been mined in the Yellowknife area since the early 1930's and today the two major active mines are Con and Giant. Studies have indicated that both the active and abandoned mines are contaminating the Yellowknife area. Falk *et al.* (1973) reported that fish in the water bodies near Con and Giant mines had unusually high concentrations of arsenic, zinc, copper, lead, cadmium and nickel. Hazra and Prokopuk (1977) reported that Con and Giant mines were also polluting the air, particularly with arsenic. The fish and sediments in the lakes adjacent to the tailings ponds of several abandoned mines are highly contaminated with mercury. The tissue of Lake Trout near the abandoned Discovery Mine,

CLIFF NESTS



TREE NESTS

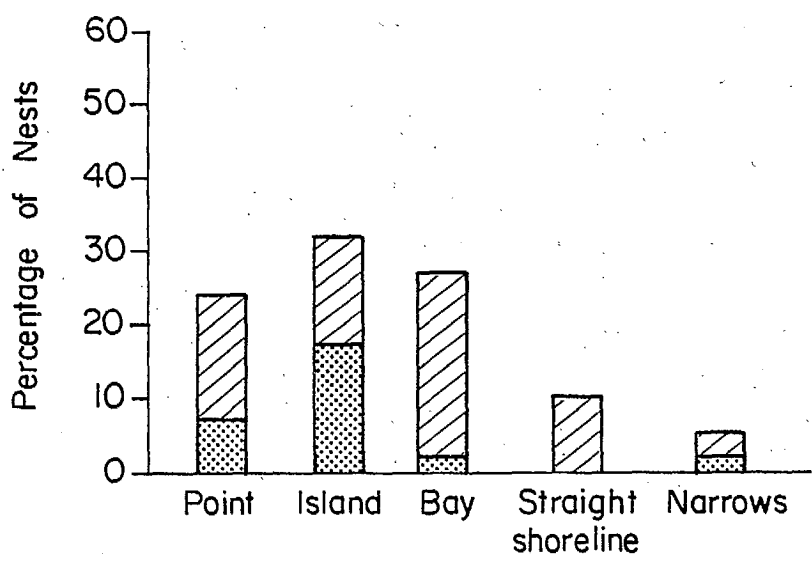


Figure 16. Physiographical location of Bald Eagle nests in the east arm of Great Slave Lake.

for example, contained as much as 12.30 mg/kg of mercury which far exceeds 0.5 mg/kg, the maximum safe limit recommended by National Health and Welfare (Moore *et al.* 1978).

No studies have been done to determine if chemical pollution from the mines in the Yellowknife area is affecting the local populations of raptors and colonial birds. However, studies elsewhere have shown that chemical pollutants tend to concentrate in raptors, terns and gulls, because these birds are at a high trophic level. For example, Fimreite *et al.* (1971) found that fish-eating birds contained higher levels of mercury in their tissues than did the fish that they ate. Furthermore, many researchers have attributed the decline of certain populations of raptors and colonial birds to chemical pollution (Peakall 1976; Grier 1974; Cook 1973; Hickey and Anderson 1969). Borg *et al.* (1969) in Sweden and Henriksson *et al.* (1966) in Finland both found high levels of mercury in tissues of the White-tailed Eagle (*Haliaeetus albicilla*), and suggested that this species is declining in numbers due to mercury contamination. Thus chemical pollution from mining operations in the Yellowknife area may already be affecting the birds that eat fish and other birds.

Several mining companies are presently prospecting for gold in the Yellowknife area. Hence more gold mines will likely open in the future. Interest in prospecting for other minerals has been low; however, there are small deposits of lithium, tin, tungsten and beryl east of Yellowknife which may some day be marketable (W. Padgham, pers. comm.).

Although several small mines once operated in the east arm of Great Slave Lake, presently there is very little mining activity. Mineral exploration is low-keyed. This is partly because a large portion of the

east arm has been set aside as a potential National Park, with claim staking prohibited in that area. However, outside these boundaries several mining companies prospected for uranium in 1978 (Padgham 1979), and geologists say that the east arm has potential for mining, including lead/zinc, uranium, native silver and cobalt/copper mining (W. Padgham, pers. comm.).

6.2 Hydro Power

The only hydroelectric development within the study area is a small power station north of Yellowknife at Bluefish Lake that supplies Con Mine. The major source of power for the city of Yellowknife is a hydroelectric scheme to the west of the study area on the Snare River system. There are no plans for further hydroelectric development near Yellowknife, but two new dams have been proposed for the Snare River system. Several rivers in the east arm of Great Slave Lake have good potential for hydro power, but they remain undeveloped to date.

Although the hydroelectric industry has probably had very little effect on the raptors and colonial birds of our study area, the industry has the potential to expand and could be harmful in the following ways:

- 1) Raised water levels caused by a dam may flood nests; lowered water levels may enable predators to reach nests that were previously inaccessible. Terns and gulls are particularly vulnerable to fluctuations in water levels, because most of these birds nest on the ground near water level and escape predation by nesting on islands.
- 2) Damming a river may cause fish populations to decline, thus reducing the primary food source of the Osprey and Bald Eagle.

- 3) Large raptors are sometimes electrocuted when they perch or nest on power poles (Nelson and Nelson 1976). In Idaho, in one year, 22 dead Golden Eagles were found along a 26 mile stretch of powerline (White 1974). In the Yellowknife area, electrocutions could become a frequent problem because the power poles are generally taller than the surrounding trees, and hence attractive perch and nest sites. We found three nests on power poles near Yellowknife.

6.3 Fishing

Overharvesting by the commercial fishery could harm fish-eating birds. According to the Federal Department of Fisheries and Oceans, the fisheries resource is presently stable in the Yellowknife area (pers. com.). Commercial fishing is restricted to only certain parts of Great Slave Lake and certain inland lakes and rivers. Also, in recent years, the high cost of transporting fish to market has reduced commercial fishing to a minimum on lakes north of Great Slave Lake. However, should the demand for fish rise in the future, harvesting must be carefully monitored not only for the benefit of the fisheries resource, but also fish-eating birds.

6.4 Recreation and Tourism

6.4.1 Detrimental Effects

Perhaps the worst immediate threat to the raptors and colonial nesters of our study areas is the increasing number of outdoor recreationists and tourists. The city of Yellowknife is steadily growing, as is the tourist industry. Thus, each year more people use the surrounding countryside for recreation, and the probability of people either accidentally or intentionally disturbing nesting birds increases. Nesting raptors and colonial birds are particularly vulnerable because they are conspicuous

and hence readily attract the attention of curious people, vandals and poachers. Critical bird habitat may be lost and nesting birds displaced, as facilities such as cottages, campgrounds, picnic grounds and boat launching sites are built to accommodate the recreationalist and tourist. To avoid blackflies or mosquitoes, people often camp or build cottages on islands. This is unfortunate because many of the productive Bald Eagle nests that we found were on islands. Sport fishermen may put an additional strain on the birds by displacing them from their preferred fishing areas.

6.4.2 Sensitivity of Birds

Few studies have attempted to experimentally define the distance at which disturbance affects the reproductive success of raptors or colonial birds. Juenemann *et al.* (1972 in Snow 1973a) demonstrated that disturbance within 1500 m of the nest lowered the reproductive success of Bald Eagles. Windsor (1977) observed that nesting Peregrine Falcons responded to a hiker as far away as 1500 m. Ealey (1978b) noted that Bald Eagles flushed whenever a boat passed within 200 m. These studies suggest that recreational activity within 1500 m of a nesting raptor is a potential threat to its nesting success. However, the sensitivity of nesting birds to human disturbance varies considerably with the nature of the human activity, time of year, species of bird and even the individual bird involved.

A nesting colony or raptor may become habituated to boat, car or even foot traffic. However, if directly approached, a nesting bird will react (Beebe 1974).

Both raptors and colonial birds are most sensitive to disturbance during the early stages of nesting. Their tendency to desert an area, if disturbed, is greatest while they are establishing their nesting territories, laying eggs and first incubating. A motor boat, merely passing a Caspian Tern colony during the early stages of breeding, has caused the entire colony to desert (Bergman in Vaisanen 1973). Likewise, raptors have deserted following a single short visit to the nest (Fyfe and Olendorff 1976). Gulls and terns that have been disturbed early in the nesting season may move to another site, but will probably fail to produce any offspring that year (Buckley and Buckley 1976). Once the eggs have hatched, it is uncommon for raptors or colonial birds to abandon their nests (Fyfe and Olendorff 1976; Buckley and Buckley 1976).

Eggs and newly hatched young are vulnerable to disturbance. If the parent bird is frightened off the nest, it may trample the eggs or young, or knock them out of the nest as it leaves (Fyfe and Olendorff 1976). Left unattended, the eggs or newly hatched young may die of exposure or be taken by predators. Gulls must protect their eggs not only from alien predators, but also from neighbouring gulls. Occasionally an excited gull will even destroy its own eggs (R. Beaver, pers. comm.). The greatest source of mortality for both gull and tern chicks when disturbed, is attacks from neighbouring adult birds on the frightened chicks as they scatter into neighbouring territories (Robert and Ralph 1975).

As the newly hatched birds grow, disturbance results in fewer mortalities. Gillet *et al.* (1975) reported that 55% of deaths of Glaucous-winged Gull chicks due to disturbance occurred within a week of hatching.

A study by Grier (1969) concluded that climbing to Bald Eagle nests after the eaglets were two weeks old caused no significant reduction in productivity. Similarly, Mathisen (1968) found that fishing, boating, water skiing and hiking which occurred after the young were half grown had no effect on the nesting success of Bald Eagles.

Although raptors and colonial nesters seldom desert when young are in the nest, some researchers suspect that they remember disturbance and thus may not nest in the area again the following year (Beebe 1974; R. Fyfe, pers. comm.). The results of a recent study by Conover and Miller (1978) concurred with this hypothesis. They found that Ring-billed Gulls did not return to nest in those parts of a colony which had been disturbed the previous year. Thus, disturbance during the late phases of nesting may not affect productivity that year. However, it may affect local bird populations in subsequent years because the birds do not re-nest in the area.

Certain species of birds are more sensitive to people than others. The Golden Eagle is very shy (Fyfe and Olendorff 1976; Beebe 1974; Snow 1973b). Human disturbance appears to be a major factor in nesting failure for Golden Eagles in the United States (Snow 1973b). Murphy (1973 in Snow 1973b) noted that where there was extensive human activity, Golden Eagles had completely abandoned their nesting territories. Bald Eagles are also sensitive to disturbance. However, they seem to be able to adapt to human activity such as passing boats and cars, that is not directed towards them (Beebe 1974). Ospreys and Great Horned Owls are more tolerant of people. According to Fyfe and Olendorff (1976), they are the least likely of all raptors to desert if disturbed during the early phases of nesting. The

Merlin has adapted well to man. An estimated twenty pairs nested in the city of Edmonton in 1978. One of these nests was in a school yard (Smith 1978). Of the colonial nesters, the Caspian Tern is very sensitive to the presence of people (Bergman in Vaisanen 1973).

Tolerance to human activities varies not only with the species but with the individual bird (Smith and Murphy 1973 in Fyfe and Olendorff 1976; Grubb 1976; Windsor 1977; Buckley and Buckley 1976). For instance, Peregrine Falcons have deserted their eyries following a single short visit by people. In contrast, a pair of Peregrine Falcons successfully reared young for many years on top of an office building in downtown Montreal.

6.4.3 Current Impact

There are a number of indications that the present level of recreation and tourism in our study area has already had a deleterious effect on nesting raptors. In 1977, a pair of Bald Eagles occupied a nest on Pontoon Lake in June, but disappeared in July (B. MacKillop, pers. comm.). This nest abandonment coincided with the construction of a cottage and a road in the same bay. Walsh Lake, which has become one of the most popular lakes in the Yellowknife area for recreation, had no nesting Bald Eagles in 1978. Yet the remains of two old nests indicated that Bald Eagles used to nest on the lake. Each nest was within 100 m of a cottage. On a cliff at the south end of Hidden Lake, Bald Eagles produced two young in 1977. Several Yellowknifers recounted how they had climbed to the nest to see the young that year. When we visited the nest in June of 1978, there was an eagle nearby, but the nest was empty. A beaten path leading from the waters edge was evidence that numerous people

had investigated this nest. In late May 1978, a pair of Ospreys were repairing a nest on top of the fire tower on Berry Hill. By 27 June, the Ospreys were gone. Diamond drillers and canoe-campers had been present on Berry Hill. We also suspect that three Great Horned Owls on Vee Lake fledged early due to heavy week-end boat traffic. Bromley and Trauger (1974) recounted how some campers on the West Mirage Islands used a Bald Eagle nest for firewood. Furthermore, there are several historical accounts of fishermen destroying Bald Eagle nests because they regarded the birds as competitors (Bromley and Trauger 1974; V. Gillman, pers. comm.). Several Peregrine Falcon eyries were recorded in the Yellowknife area in the past, including a productive eyrie in 1975 (R. Fyfe, pers. comm.). We found no nesting Peregrine Falcons in 1978, and the historically active eyries that we checked were either vacant or occupied by Common Ravens. However, the Peregrine's absence may be due not only to local disturbance, but also to the continent-wide decline of the *anatum* subspecies.

It is more difficult to determine what impact recreation has had on colonial nesters, because few colonies have been documented in the past and abandoned nests on the ground soon become difficult to detect. Thus, we have very little information with which to compare our present survey data. However, the gulls seemed to be benefitting from the fishing lodges, as we saw large flocks of Herring, California and Mew gulls scavenging at the offal depots and garbage dumps.

6.4.4 Potential Impact of Future Recreation and Tourism

As the city of Yellowknife grows, so does the usage of the surrounding countryside for recreation. In a survey by Dallard Runge Consulting Limited (1978), Yellowknifers expressed a need for over 500

more cottages. They also requested improved roads, and road access, improved hiking trails and portage routes, more picnic grounds, camp grounds and more sites for camper trailers. The recreational activities that will have the greatest impact on nesting raptors and colonial birds are cottaging, fishing, canoe-camping and boating. Each of these activities occurs during the nesting season, affects a large area and is centered on the lakes and rivers where most of the nests were found.

Aircraft considerably enlarge the area affected by recreational activity, by enabling people to fish, camp or build on lakes that would otherwise be inaccessible. Some fly-in fishing, camping and cottaging occurs already, but more will likely occur in the future. According to the survey by Dallard Runge (1978), Yellowknifers preferred private, isolated lake frontage for a cottage, and 25% wanted no road access. Thus, there is a potential market for fly-in cottages and eventually every lake in the Yellowknife area could be occupied. Because cottaging is an intense activity, particularly during construction, this could detrimentally affect a large portion of the local raptor populations.

7. RECOMMENDATIONS

- 1) Whenever feasible, a known nest site of any species of raptor that is sensitive to disturbance (Bald Eagle, Golden Eagle, Peregrine Falcon) should be protected. Any of the larger nesting colonies in the area should also be protected. If an active eyrie of the endangered Peregrine Falcon *anatum* is discovered, special efforts should be made to protect it. The local people may also be interested in protecting the Caspian Tern which is rare in the Northwest Territories.
- 2) According to Postupalsky (1978), the Osprey, and to a certain extent, the Bald Eagle, can be manipulated to nest on a man-made platform.

Thus, if development can not be avoided near a Bald Eagle or Osprey nest, the nest should be moved away from the disturbance to an artificial nesting platform. If the platform is within the breeding territory of the birds and is a close replica of the original nest site (e.g. distance from water, height above ground), the displaced birds may nest there.

- 3) The following recommendations should ameliorate the impact of outdoor recreational activities on raptors and colonial birds. These recommendations need only apply to the sensitive species of raptors (Bald Eagle, Golden Eagle, Peregrine Falcon) and the larger nesting colonies in the area.
 - a) Establish a public education program. Issue a press release in April just before the birds return to nest. Discuss interesting aspects of the life history of two or three species, but emphasize the importance of staying away from raptor nests and nesting colonies in the spring when the birds are establishing their nesting territories, laying eggs and incubating.
 - b) Land within 1.6 km (1 mi) of a known raptor nest or nesting colony should not be leased for cottages. The CWS should consult anyone that leases land for a cottage within 3 km (2 mi) of a nest or colony.
 - c) Locate outdoor recreational facilities such as picnic grounds, camp grounds, boat launching sites, recreational vehicle camps and roads at least 1.6 km (1 mi) from known nests.
 - d) Trails and portage that are within 200 m (650 ft) of raptor nests or nesting colonies should be either rerouted or abandoned. Establish campsites for hikers and canoeists at least 1.6 km (1 mi) from known nests.

- e) Prohibit overnight camping within 200 m of raptor nests and nesting colonies between April 1 and August 15.
 - f) At nest sites that people visit frequently (for example, the Bald Eagle nest on the cliff on the south shore of Hidden Lake, the Bald Eagle nest at Tartan Rapids, the Goshawk nest in the Prelude Lake campground) post a sign explaining that disturbance harms the birds and requesting that they please keep away. The signs should be posted April 1 and taken down in late August. If the nest is abandoned or no bird uses it that year, the sign should be taken down in late June. Because signs attract attention, they should only be posted near nests whose location is already known. Nest sites should not be publicized.
 - g) Some lakes and portions of Great Slave Lake should be left undeveloped. This means no cottages, no resorts, no access roads and no improved trails or portages.
 - h) Monitor the impact of outdoor recreational activities on nesting raptors and colonial birds.
- 4) Ensure the future protection of fish - a major food source for Ospreys and Bald Eagles.
- 5) Mining companies should be made legally responsible for ensuring that toxic substances do not escape from their tailings ponds after shut down as well as during operation of the mine.
- 6) If land is transferred from federal to territorial or private ownership, provisions to protect raptor and colonial bird habitat should be included in the transfer agreement.
- 7) Man-made structures such as headframes at old mine sites should be left standing to provide nest sites for Ospreys, Gyrfalcons, American Kestrels and Great Horned Owls.

- 8) Prohibit the use of chlorinated pesticides.
- 9) In areas where raptors use powerlines for perching or nesting, the lines should be altered to prevent electrocutions. For example, construct platforms on the utility poles that already have nests. In areas of good raptor habitat, new powerlines should be constructed according to the specifications described by Miller *et al.* (1975) to reduce raptor electrocutions. These measures may also benefit the hydro company by decreasing costly power failures.

8. NEED FOR FURTHER STUDIES

The raptor and colonial bird study conducted in 1978 was intended as a preliminary investigation to determine whether further work was necessary. In view of the substantial number of nesting raptors and colonial birds that we found, and the prospects for mining, hydroelectric and recreational development in the Yellowknife area, we feel that the following further investigations are warranted.

- 1) The baseline inventory should be expanded. The preliminary investigations indicated that both the north arm of Great Slave Lake and the Simpson Islands may be very important to nesting raptors and colonial birds. These two areas should be more thoroughly surveyed to identify critical areas. This information will also enable a more accurate assessment of the regional significance to these birds of the area in the immediate vicinity of Yellowknife.
- 2) The Yellowknife area offers an excellent opportunity to study the impact of outdoor recreational development on raptors, particularly the Bald Eagle. Most raptor disturbance studies have dealt with populations that were already disturbed. At Yellowknife only a few nests close to town have been disturbed to date. Thus, we have the opportunity to gather information both before and after much

disturbance has occurred. To obtain the maximum information, the impact study should include two sets of aerial surveys: one following the establishment of nesting territories and one just prior to fledging. The rationale for this is explained by Postupalsky (1974). During our preliminary study in 1978, we conducted only one set of surveys, some of which occurred after the young had fledged. Thus to properly assess the "pre-development" situation, another year of surveys should be done. A study such as this which assesses the raptor populations both before and after development would enable us to predict more accurately the impact of future development proposals on raptors.

- 3) To adequately protect and manage the raptors and colonial birds of the Yellowknife area, more information is required about the phenology and behaviour of the birds. Knowledge of the breeding events enables us to specify the time of year when the birds are most sensitive to disturbance. Foraging and loafing areas must be identified as well as nest sites to ensure that all habitat requirements are protected.

LITERATURE CITED

- Arbib, R. 1978. The blue list for 1979. *American Birds*. 32(6):1106-1113.
- Beckel, D.K.B. 1975. IBP ecological sites in subarctic Canada. Univ. of Lethbridge, Lethbridge, Alberta. 163 pp.
- Beebe, F.L. 1974. Field studies of the falconiformes of British Columbia. Occ. Paper No. 17, B.C. Prov. Museum, Victoria. 163 pp.
- Bent, A.C. 1937. Life histories of North American birds of prey. Dover Publications Inc., New York. 2 parts. 891 pp.
- Borg, K., H. Wannorp, K. Erne, and E. Hanko. 1969. Alkyl mercury poisoning in terrestrial Swedish wildlife. *Viltrevy* 6:301-379.
- Bortolotti, G.R.A., K.J. Szuba, J.E. Daly, S.E. Daly, P.N. Gerrard, J.M. Gerrard, and D.W.A. Whitfield. 1977. Bald Eagle studies at Besnard Lake, Saskatchewan. Annual unpubl. rep. 1976. 41 pp.
- Bromley, R.G. and D.L. Trauger. 1974. Ground nesting of Bald Eagles near Yellowknife, NWT. *Can. Field-Nat.* 88:73-75.
- Buckley, P.A. and F.G. Buckley. 1976. Guidelines for the protection and management of colonially nesting waterbirds. Nat. Park Serv., Boston, Massachusetts. 49 pp.
- Campbell, R.W. and B. Davies. 1973. Nesting raptor survey in the western Canadian Arctic, 1972. *In*: Toward an environmental impact assessment of the portion of the Mackenzie gas pipeline from Alaska to Alberta. Environmental Protection Board, Winnipeg, Manitoba. 46 pp.
- Conover, M.R. and D.E. Miller. 1978. Reaction of Ring-billed Gulls to predators and human disturbance at their breeding colonies. Unpubl. Presented at a meeting of the Colonial Waterbird Group, Oct. 20-23, 1978, New York.
- Cook, A.S. 1973. Shell thinning in avian eggs by environmental pollutants. *Environ. Pollut.* (4):85-152.
- Dallard Runge Consulting Ltd. 1978. Outdoor recreational land use and activities survey of Yellowknife residents. Unpubl. rep., Department of Indian and Northern Affairs, Yellowknife. 37 pp.
- Ealey, D. 1978a. Surveys of rare, potentially endangered and sensitive birds in the oil sands and adjacent areas of northeastern Alberta. Unpubl. rep., Can. Wildl. Serv., Edmonton. 19 pp.
- Ealey, D. 1978b. Ecological and behavioural aspects of breeding and foraging Bald Eagles in northeastern Alberta. Unpubl. rep., Can. Wildl. Serv., Edmonton. 26 pp.

- Falk, M.R., M.D. Miller, and S.J.M. Kostiuk. 1973. Biological effects of mining wastes in the Northwest Territories. Fisheries and Marine Service, Tech. rep. ser. no. CEN/T-73-10, Winnipeg. 89 pp.
- Fimreite, N., W.N. Holsworth, J.A. Keith, P.A. Pearce, and I.M. Gruchy. 1971. Mercury in fish and fish-eating birds, near sites of industrial contamination in Canada. *Can. Field-Nat.* 83(3):211-220.
- Frenzel, L.D., G. Juenemann, and J. Kussman. 1973. Behavioural aspects of Eagle nest surveys. *In:* C.R. Madsen [ed.], Notes of a Bald Eagle nest survey workshop. U.S. Fish and Wildl. Serv. p. 33-36.
- Fyfe, R.W. and R.R. Olendorff. 1976. Minimizing the dangers of nesting studies to raptors and other sensitive species. *Can. Wildl. Serv., Occ. Paper No. 23*, Edmonton, Alberta. 15 pp.
- Fyfe, R.W., S.A. Temple, and Tom Cade. 1976. The 1975 North American Peregrine Falcon survey. *Can. Field-Nat.* 90(3):228-273.
- Gerrard, J.M., P.N. Gerrard, D.W.A. Whitfield and W.J. Maher. 1973. Bald Eagle behavior study. Part II. Unpubl. rep., Can. Wildl. Serv., Edmonton. 90 pp.
- Gerrard, J.M., P. Gerrard, W.J. Maher, and D.W.A. Whitfield. 1975. Factors influencing nest site selection of Bald Eagles in northern Saskatchewan and Manitoba. *Blue Jay* 33(3):169-176.
- Gillet, W.H., J.L. Hayward Jr. and J.F. Stout. 1975. Effects of human activity on egg and chick mortality in a Glaucous-winged Gull colony. *Condor.* 77(4):492-495.
- Grier, J.W. 1969. Bald Eagle behaviour and productivity responses to climbing to nests. *Jour. of Wildl. Manage.* 33(4):962-966.
- Grier, J.W. 1973. Aerial eagle census techniques as experienced in Ontario and Manitoba. *In:* C.R. Madsen [ed.], Notes on a Bald Eagle nest survey workshop. U.S. Fish and Wildl. Serv. p. 11-20.
- Grier, J.W. 1974. Reproduction, Organochlorines, and Mercury in North-western Ontario Bald Eagles. *Can. Field-Nat.* 88:469-475.
- Grier, J.W. 1977. Quadrat sampling of a nesting population of Bald Eagles. *Jour. of Wildl. Manage.* 41(3):438-443.
- Grubb, T.G. 1976. A survey and analysis of Bald Eagles nesting in western Washington. M.S. Thesis, Univ. of Washington, 79 pp.
- Hazra, A.K. and R. Prokopuk. 1977. A report on air quality in Yellowknife, Northwest Territories. Environmental Protection Service, Surveillance Rep. EPS-5-NW-77-7, Edmonton. 85 pp.
- Henriksson, K., E. Karppanen, and M. Helminen. 1966. High residue of mercury in Finnish White-tailed Eagle. *Ornis Fennica* 43:38-45.

- Hensel, R.J. and W.A. Troyer. 1964. Nesting studies of the Bald Eagle in Alaska. *Condor* 66(4):282-286.
- Hickey, J.J. and D.W. Anderson. 1969. The Peregrine Falcon; life history and population literature. *In*: J.J. Hickey [ed.], *Peregrine Falcon populations, their biology and decline*. Univ. of Wisconsin Press, Madison Wisc. p. 3-42.
- Juenemann, B.G. and L.D. Frenzel. 1972. Habitat evaluations of selected Bald Eagle nest sites on the Chippewa National Forest. Unpubl. Presented at the 34th Annual Midwest Fish and Wildlife Conference, Dec. 10-13, 1972, Des Moines, Iowa.
- Karasiuk, D. 1979. Dredging the Mackenzie River at Mills Lake and Beaver Lake, NWT - An Environmental Assessment. Unpubl. rep., Can. Wildl. Serv., Yellowknife.
- Keith, J.A. 1978. Committee on the status of endangered wildlife in Canada. *In*: *Transactions of the forty second Federal-Provincial Wildlife Conference*. Can. Wildl. Serv., Ottawa. p. 84-88
- King, J.G., F.C. Robards, and C.J. Lensink. 1972. Census of the Bald Eagle breeding population in southeast Alaska. *Jour. of Wildl. Manage.* 36:1292-1295.
- L.G.L. Limited. 1972. Bald Eagle surveys in southern Mackenzie District and northern Alberta, May, July, August, 1972. Unpubl. rep. prepared for Northern Engineering Services Ltd. 12 pp.
- Mathisen, J.E. 1968. Effects of human disturbance on nesting of Bald Eagles. *Jour. of Wildl. Manage.* 32:1-6.
- Miller, D., E.L. Boeker, R.S. Thorsell, and R.R. Olendorff. 1975. Suggested practices for raptor protection on powerlines. Raptor Research Foundation. 3 pp.
- Moore, J.W., D.J. Sutherland, S.J. Wheeler, and V.A. Beaubien. 1978. The effects of abandoned metal mines on aquatic ecosystems in the Northwest Territories I. Discovery Mine. Environmental Protection Service, Rep. EPS-5-NW-78-7. 75 pp.
- Nelson, M.W. and P. Nelson. 1976. Powerlines and birds of prey. *Idaho Wildl. Rev.* Mar-Apr: 1-5.
- Padgham, W.A. 1979. Mineral exploration, Northwest Territories, 1978. Unpubl. rep., Department of Indian and Northern Affairs, Yellowknife. 7 pp.
- Peakall, D.B. 1976. The Peregrine Falcon (*Falco peregrinus*) and pesticides. *Can. Field-Nat.* 90(3):301-307.

- Postupalsky, S. 1974. Raptor reproductive success; some problems with methods, criteria and terminology. *In*: J.N. Hamerstrom Jr., B.E. Harrell, and R.R. Olendorff, Management of Raptors, Raptor Research Foundation Inc., Raptor Research Report No. 2, Vermilion, South Dakota. p. 21-31
- Postupalsky, S. 1978. Artificial nesting platforms for Ospreys and Bald Eagles. *In*: S.A. Temple [ed.], Endangered Birds. Univ. of Wisconsin Press, Madison. p. 35-45.
- Preble, E.A. 1908. A biological investigation of the Athabasca-Mackenzie region. U.S. Bureau Biological Survey, North American Fauna 27. 574 pp.
- Renewable Resources Consulting Service Ltd. 1978. Environmental review and assessment. Proposed Mackenzie River dredging project. Prepared for Public Works Canada and Department of Transport. Vol. 2, Part 7. p. 567-686.
- Robert, H.C. and C.S. Ralph. 1975. Effects of human disturbance on the breeding success of gulls. *Condor* 77:495-499.
- Sherrod, S.K., C.M. White, and F.S.L. Williamson. 1977. Biology of the Bald Eagle on Amchitka Island, Alaska. *The Living Bird*. Cornell, 15th Annual 1976. p. 143-182.
- Smith, A.R. 1978. The Merlins of Edmonton. *Alberta Naturalist*. 8(4):188-191.
- Snow, C. 1972. American Peregrine Falcon and Arctic Peregrine Falcon. Habitat management series for endangered species. Technical Note. Rep. no. 1. U.S. Dept. Inter. Bur. Land Manage. 35 pp.
- Snow, C. 1973a. Bald Eagle. Habitat management series for endangered species. Technical Note. Rep. no. 5. U.S. Dept. Inter. Bur. Land Manage. 58 pp.
- Snow, C. 1973b. Golden Eagle. Habitat management series for endangered species. Technical Note. Rep. no. 7. U.S. Dept. Inter. Bur. Land Manage. 52 pp.
- Trauger, D.L. and R.G. Bromley. 1976. Additional bird observations on the West Mirage Islands, Great Slave Lake, NWT. *Can. Field-Nat.* 90(2):144-148.
- Troyer, W.A. and R.J. Hensel. 1965. Nesting and productivity of Bald Eagles on the Kodiak National Wildlife Refuge, Alaska. *The Auk* 82(4):636-638.
- Weller, M.W., D.L. Trauger, and G.L. Krapu. 1969. Breeding birds of the West Mirage Islands, Great Slave Lake, NWT. *Can. Field-Nat.* 83:345-360.

White, C.M. 1974. Current problems and techniques in raptor management and conservation. Trans. 39th North Am. Wildl. Nat. Resource Conf. 39:345-312.

Whitefield, D.W.A., J.M. Gerrard, W.J. Maher, and D.W. Davies. 1974. Bald Eagle nesting habitat, density and reproduction in Central Saskatchewan and Manitoba. Can. Field-Nat. 88:399-407.

Windsor, J. 1977. The response of Peregrine Falcons to aircraft and human disturbance. Unpubl. rep., Can. Wildl. Serv., Edmonton. 87 pp.

Vaisanen, R.A. 1973. Establishment of colonies of Caspian Tern (*Hydroprogne caspia*) by deserting flights in the northern Gulf of Bothnia. Ornis. Scand. 4:47-53.

APPENDIX A. Bald Eagle nestlings banded in the east arm of Great Slave Lake.

Band Number	Nest Name and Location	Age	Date Banded	Lat.-Long.
629-009 51	Cabin Bay Nest 75L5/VE/51.2x11.4	?	8 July '78	62°20'/112°57'
52	Cabin Bay Nest 75L5/VE/51.2x11.4	?	8 July '78	62°20'/112°57'
53	Cabin Bay Nest 75L5/VE/51.2x11.4	?	8 July '78	62°20'/112°57'
54	Horseshoe Bay Lip Nest 75L5/VE/67.3x25.4	7 wks	14 July '78	62°28'/111°38'
55	Going Home Nest 75L5/VE/65.8x25.1	7 wks	14 July '78	62°28'/111°40'
56	Moss Burns Island Nest 75L12/VE/70.8x31.4	8 wks	15 July '78	62°31'/111°34'
57	Moss Burns Island Nest 75L12/VE/70.8x31.4	8 wks	15 July '78	62°31'/111°34'
58	Lodgeview I Nest 75L12/VE/74.0x37.0	6 wks	16 July '78	62°34'/111°30'
59	Lynne's Nest 75L16/WE/31.4x58.7	7 wks	22 July '78	62°46'/110°23'
60	Lynne's Nest 75L12/WE/31.4x58.7	7 wks	22 July '78	62°46'/110°23'
61	Wildbread Bay Revisited 75K12/WE/57.1x56.3	7 wks	23 July '78	62°44'/109°53'
62	Wildbread Bay Revisited 75K12/WE/57.1x56.3	7 wks	23 July '78	62°44'/109°53'
63	Wildbread Bay Is. Nest 75L16/WE/48.8x58.4	7-8 wks	23 July '78	62°45'/110°03'
64	Wildbread Bay Is. Nest 75L16/WE/48.8x58.4	7-8 wks	23 July '78	62°45'/110°03'
65	Wildbread Showers Again Nest 75L15/WE/24.8x62.3	5-6 wks	23 July '78	62°47'/110°31'
66	Wildbread Showers Again Nest 75L15/WE/24.8x62.3	5-6 wks	23 July '78	62°47'/110°31'
67	Across the Bay 75L5/VE/67.7x06.6	8 wks	4 Aug. '78	62°18'/111°37'
68	Middle of Island Chain 75L4/VD/55.1x98.9	7-8 wks	4 Aug. '78	62°13'/111°52'

APPENDIX B. Comparison of 1978 monthly mean temperatures to the average monthly mean temperatures from 1941 to 1970.

	Mean Temperature (°C)			
	Yellowknife		Fort Reliance	
	ave. over 29 years	1978	ave. over 29 years	1978
April	- 7.8	- 7.6	-10.2	-11.6
May	4.0	4.1	- 0.9	1.4
June	12.2	12.1	8.7	8.1
July	16.0	13.3	13.3	11.0
August	14.1	12.7	12.8	11.7
September	6.8		6.2	6.4
October	- 1.2		- 2.0	

Data from Atmospheric Environment Service, Yellowknife.

QL Raptors and colonial birds
696 of the Yellowknife area and
.F32 East Arm of Great Slave
D53 Lake, N.W.T. / by D. Lynne
1979 4003728

QL Raptors and colonial birds
696 of the Yellowknife area and
.F32 East Arm of Great Slave
D53 Lake, N.W.T. / by D. Lynne
1979 4003728

ENVIRONMENT CANADA
LIBRARY, NOVA COAST PLAZA
PO BOX 2310 5019-52 ST.
YELLOWKNIFE, NT X1A 2P7

ENVIRONMENT CANADA LIBRARY
YELLOWKNIFE



4003728

