DISTRIBUTION AND ABUNDANCE
OF BLACK SCOTERS AND SURF SCOTERS IN NORTHERN QUEBEC

by

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INTRODUCTION

Black Scoters (Melanitta nigra) and Surf Scoters (M. perspicillata) are the least known waterfowl of North America (Johnsgard 1975, Palmer 1976, Godfrey 1986). The few studies on these species have focused mainly on courtship (Myres 1959a, b; McKinney 1959, Palmer 1976) wintering ecology (Stott and Olson 1973, 1974; Vermeer 1981, Vermeer & Bourne 1984) or general distribution (Bellrose 1976, Palmer 1976, Godfrey 1986). No breeding studies have been published to date on the north American populations (Godfrey 1986) although a few studies have been conducted on the breeding ecology of the European Black Scoter (Bengtson 1966, 1970, 1971). Godfrey (1986) in his revised edition of Birds of Canada confirmed the lack of data on the breeding density and behaviour of Black and Surf Scoters in North America.

Between 1975 to 1980, Hydro-Québec commissioned several studies to assess waterfowl breeding densities near their proposed northern hydro-electric developments (Bider and Lamothe 1982). These studies provided important information on the distribution and abundance of Black and Surf Scoters in Northern Québec. Unfortunately this information is contained in various consultant reports written in French and not readily accessible (see appendix 1).

To facilitate decimation of that information, we present here data we collected in 1976 during such commissioned study (Savard 1977) and briefly review some of the published and unpublished reports containing data on Black and Surf Scoter breeding densities in Eastern Canada.

STUDY AREA

The area surveyed include the watersheds of Great Whale River, Little Whale River and coastal areas from the mouth of Great Whale River to the Richmond Gulf (Fig. 1). The focal point of the study area was Lake Bienville with 1 049 km of transects. Three smaller areas were sampled:

1° The Vaujours area, to the north-west of Lake Bienville which include the lakes Vaujours, Saindon and Mollet and which differ from the lake Bienville area by a more mountainous terrain and the absence of large networks of string bogs. A total of 438 km of transects were surveyed in this sector.

2° The Caniapiscau area to the east of Lake Bienville which, like the Vaujours area, has a more mountainous terrain. This sector was covered by 231 km of transects.

3° The Hudson plateau which comprise an inland sector near the Coast bordered to the south by the Great Whale River, to the north by the Boutin River and to the east by the Coast River. Fifty small lakes were surveyed in this sector along a transect of 88 km. Lakes of this sector were on old marine deposits and tended to have more aquatic vegetation than the lakes of other sectors.

METHODS

Aerial surveys were conducted from an helicopter (Bell 206 Jet Ranger) at a speed of 100 to 145 km/hour and a height ranging between 60 and 90 m. The Crew was composed of a pilot, a navigator and two observers. Each sector was surveyed along series of parallel flight lines located from 4 to 10 km apart. Flight lines were followed until birds were spotted, then the helicopter left the flight line to approach the birds so that proper identification could be made and numbers counted. Usually, the navigator made the identification and the other counted the birds. Following identification the flight line was resumed until other birds were detected.

This type of procedure, facilitated by the low density of birds and their clumped distribution, permitted to identify accurately over 95% of the birds spotted. Transect width was not fixed but varied with weather and habitat. However, we estimate the average width covered at 0.5 km. All bird observations were assigned a number on a 1:250,000 scale topographic map and observations details recorded on tape cassettes. Most flights were conducted during calm weather.

To obtain a more realistic estimate of brood density, we combined the results of two surveys using a mapping technique. During each survey, broods were localized on a map and the number of young and their age recorded , so that it was possible to determine wether the same or a different brood had been observed. We assumed from daily observations on some lakes, overland brood movements to be negligeable.

Broods were aged following the criteria of Gollop & Marshall (In Bellrose 1976). Because of the absence of data for plumage growth of scoters, we used data of the Lesser Scaup to extrapolate nest initiation and brood hatching dates (Taber 1971). Incubation was assumed to last 30 days for both species of scoters (Cramp and Simmons 1977).

Brood behaviour was studied on a small lake harboring five scoter broods. Two broods were followed for 2 1/2 days using focal sampling and the behaviour of the females and young were recorded as swimming, sleeping, preening (regrouped as resting for analysis), feeding, and watching (for female only). Because of frequent brood mixing the composition of each brood under observation ranged between 8 and 28 young.

RESULTS

Scoters were the dominant species of waterfowl breeding within the study area (Table 1). Only one brood of white-winged scoter was observed whereas Black Scoters were more abundant than Surf Scoters.

Seasonal abundance of scoters

Slightly larger numbers of scoters were seen in early June than in July and August for all sectors, but the coast (Tables 2-3). Along coastal transects, large numbers of Black Scoters were recorded in August (Table 2) whereas large numbers of Surf Scoters occurred in September (Table 3). Spring concentration of Black Scoters were observed on the coast and on the rivers but spring concentration of Surf Scoters were only seen on rivers. Few scoters were observed on rivers during the summer, indicating that rivers are seldom used as breeding habitat.

Breeding densities

Black Scoter bred in higher densities than Surf Scoter in the three main inland sectors (Bienville, Vaujours and Caniapiscau). On Hudson Plateau, the high relative number of unidentified broods does not permit to determine the dominant species. Densities of Black Scoters ranged from 2 broods per 100 km^2 on the Hudson Plateau to 11 per 100 km^2 in the Caniapiscau area (Table 4). Densities of Surf Scoters ranged from 2 per 100 km^2 in the Vaujours area to 6 per 100 km^2 in the Caniapiscau area. No broods were seen on coastal transects and very few on rivers.

In the lake Bienville area, 24 plots of 3.25 km^2 placed at random along the flight lines were also surveyed (Table 5). These produced a density estimate of 4 Surf Scoter broods/100 km^2 and of 13 Black Scoter broods/100 km^2, confirming the high densities of scoters in the area and the greater abundance of Black Scoter.

Density estimates derived from single surveys are nearly half those derived from repeated survey of an area. In the lake Bienville area, the section with the most intensive sampling, the July survey yielded 28 scoter broods, and the August survey yielded 30 scoter broods. However, aging and mapping of broods along the surveyed route indicated that most broods observed during the two surveys were different. Also, a survey of plots in the same area yielded 10 more broods in the area covered by transects for a total of 68 different broods in the surveyed area ~~for~~ and a density estimate of 13.0 broods/ 100 km^2 (Table 4).

Breeding phenology

Five Surf Scoter pairs and one Black Scoter pair were observed daily on a small lake near Lake Bienville. Lone males were first recorded on June 11, and by June 15 most males were alone on the lake indicating that females had started incubating (fig. 2). On July 13, three newly hatched broods were seen on the lake. Assuming an incubation period of 30 days, incubation was initiated on June 13 which correspond to the observation of lone males on the lake.

Results based on aging broods from the air are more crude but permit a comparison between species (Table 6). Black Ducks were the earliest breeders followed by Canada Geese. Greater Scaups, scoters and mergansers initiated their nest in the 2nd week of June, 2-3 weeks after Black Ducks. The first brood of Black Duck was observed in the 3rd week of June whereas that of scoters in the second week of July. Thus, it is likely that the July survey missed late hatching Scoter broods while the August survey may have missed early fledging broods and broods that died prior to fledging.

Brood ecology

Four of the five pairs observed on a small lake near lake Bienville hatched a brood. No broods were observed on the lake on July 11 but 3 broods of Surf Scoters were seen on July 13 containing 6, 11 and 13 young respectively. On July 15 there was only two broods on the lake, one with 8 young and the other with 20 young indicating that brood amalgamation occurred. One lone female was present on the lake. On July 23, only one female was seen with 9 young and 15 young were scattered on the lake without any attending female. On July 26, a newly hatched brood of Black Scoter with 5 young was seen on the lake. Two days later the female Black Scoter was alone on the lake and there was only 10 young Surf Scoters scattered on the lake. A survey of neighbouring lakes did not yield any scoters. On the same lake, a female scaup was seen on the lake with 8 young on July 21 and sucessfully fledged 7 of those. The low degree of attentiveness of scoter females and the high mortality observed contrasted with the close bound of the brood of Greater Scaup present on the lake. Five lakes known to have scoter broods were surveyed first in July and again in mid- August. Results suggest again heavy mortality among scoters (Table 7). The unusual cold weather and heavy rain recorded during the first week of August may have contributed to this high mortality.

Two newly hatched Surf Scoter broods alternated feeding and resting periods throughout the day but not simultaneously. Young spent 60% of their time feeding compared to only 30% for females who spent most of their time (40%) watching over their young (fig. 3). Young feeding periods average 36.7 min and ranged between 4 and 88 min and resting periods averaged 21.9 min ranging between 3 and 122 min (Table 8). Resting periods were longest in the afternoon and shorter in the evening than in the morning. Feeding periods were more constant during the day (Table 8). Broods rested on water and along the edge of ponds. Resting periods on water averaged 15.4 min. (n = 15) and those on land 31.0 min. (n = 16). All broods fed intensively just after sun rise and prior to sundown.

DISCUSSION

1. Seasonal abundance of scoters

The decrease in abundance of scoters in summer is due to the departure of males for moulting areas. Conversely, high numbers observed on the coast in July and August are due to males concentrating there to moult. The coastal areas of James Bay and Hudson Bay seem to be used extensively for moulting by scoters: Bordage and Aubry (1982) counted 800 Black Scoters on July 2 and 300 on July 5 1982 at the mouth of Eastmain River. Over 90% of the birds were males. Bourget (1973) counted over 7,000 scoters along the shore and around the islands of James Bay in the summer of 1972. Ross (1983) estimated the number of moulting Black Scoters near 90,000 in the James Bay area. Small number of scoters also spend the summer in the St. Lawrence Estuary (David 1980). Lamothe et Dubé (1978) report sightings of rafts of several hundred males Surf and Black Scoters (mostly Black Scoters), on the north side of the St. Lawrence river, in early September between Havre-Saint-Pierre and the Moisy River. The origin of these birds is unknown but they may represent birds breeding in Labrador (Gillespie & Wetmore 1974, Goudie & Whitman 1987). It is undetermined wether these birds were early migrants or moulting birds.

2. Breeding density of scoters

Both Black and Surf Scoters bred in high densities in the lake Bienville area. White-winged Scoters were occasionally observed but only 1 brood was seen over 4 years of studies (Bider & Lamothe 1982).

Review of other density estimates for scoters point to lake Bienville as the area of highest breeding densities (appendices 2-3-4). In Labrador, few scoters breed along the coast but densities increased in the Churchill area (Gillespie & Wetmore 1974, Goudie & Whitman 1987). Similarly, few breeding scoters have been recorded in the inland area adjacent to James Bay (Lehoux & Rosa 1973). Intensive surveys in the boreal forest between 48° and 51° latitude indicated low densities of breeding scoters and a gradiant of higher density as latitude increase (Bordage 1987, 1988). All estimates of brood density found in the litterature were based on single counts and thus greatly underestimate real density. In the lake Bienville area, single counts recorded less than half of the actual brood density because of visibility and hatching chronology. Bordage (1985) compared simultaneous helicopter and ground surveys in an area just south of our study area and found a visibility index of 40% for scoter pairs and 66% for scoter broods. Goudie and Whitman (1987) measured the efectiveness of aerial surveys compared to ground coverage of the same areas in Labrador and obtained for scoters a visibility index for pair surveyed from the air ranging between 30 and 50%. However, Haapanan and Nilsson (1979) report an efficiency of 80% for pairs of Black Scoters in Sweden. It seems that efficiency of aerial surveys can vary drastically and more research is needed to understand the reasons. However, it is likely that the pair estimates presented in appendix 2 are under-estimates ranging possibly between 20 and 70%.

Density of Black Scoters was nearly 12 pairs per 100 km^2 and those of Surf Scoters nearly 7 pairs/100 km^2 in the Lake Bienville area. Those are the highest breeding densities of scoters ever reported. This at least suggest that the area is prime nesting habitat for these two species of scoters. The zone of high nesting densities of Black and Surf Scoters correspond roughly to the Hemiarctic zone (Rousseau 1952, Ducruc et al. 1976) whereas their general breeding area would be enclosed in the forest and tundra region found in Hosie (1952). Further south in the boreal forest, Black Ducks become the dominant species with breeding densities ranging between 10 to 24 pairs per 100 km^2 (Bordage 1987, Ross 1987) and scoter densities are lower (2 pairs/ 100 km^2, Bordage 1987). However, Bordage's surveys were conducted early in the season for Black Ducks and may have underestimated scoter density. DesGranges & Houde (1988) found Black Scoters only in on lakes of the Taiga and Musked area and none within the boreal forest. However, the number of lakes they surveyed was small.

3. Breeding phenology and brood ecology

Scoters were late breeders compared to Canada Geese and Black Ducks. They were not uniformely distributed over the area but were clumped. Such distribution may reflect habitat availability. Scoters seemed to prefer shallow and rocky lakes and avoid rivers and large deep lakes. DesGranges & Houde (1977) indicated that Black Scoter preferred productive lakes of the Taiga. More research is needed to identify the factors influencing scoter distribution on their breeding areas. Time budgets of female Surf Scoter with young were similar to those measured in Barrow's Goldeneye (Savard 1988) as females spent less time feeding than young but more time watching. Young broods rested often an land, behaviour that may account for their low detectability from the air. Evening surveys would locate more broods than afternoon surveys as resting periods are three times shorter in the evening. Such behaviour should be considered in the planning of surveys. The high duckling mortality and the low attentiveness of females towards brood deserve further studies. Greater understanding of the ecology of breeding scoter is essential for proper management of the species especially in the light of impending hydroelectric development in the center of their breeding range.

4. Other aspects of scoter ecology in Québec

One aspect of scoter ecology which has not been studied yet is their staging ecology. Each fall and spring large numbers of the three species of scoters, but especially Surf and Black spend several months in the St. Lawrence Estuary (David 1980, Bédard et al. 1987). Besides their lenght of stay, nothing is known of their ecology at this time.

Much remain to be known about the Surf and Black Scoters in North America. We hope this brief paper will stimulate further research on these still mysterious birds.

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Appendix 2 - Breeding pair density of scoters in various area of Québec and Labrador (See Appendix 4)

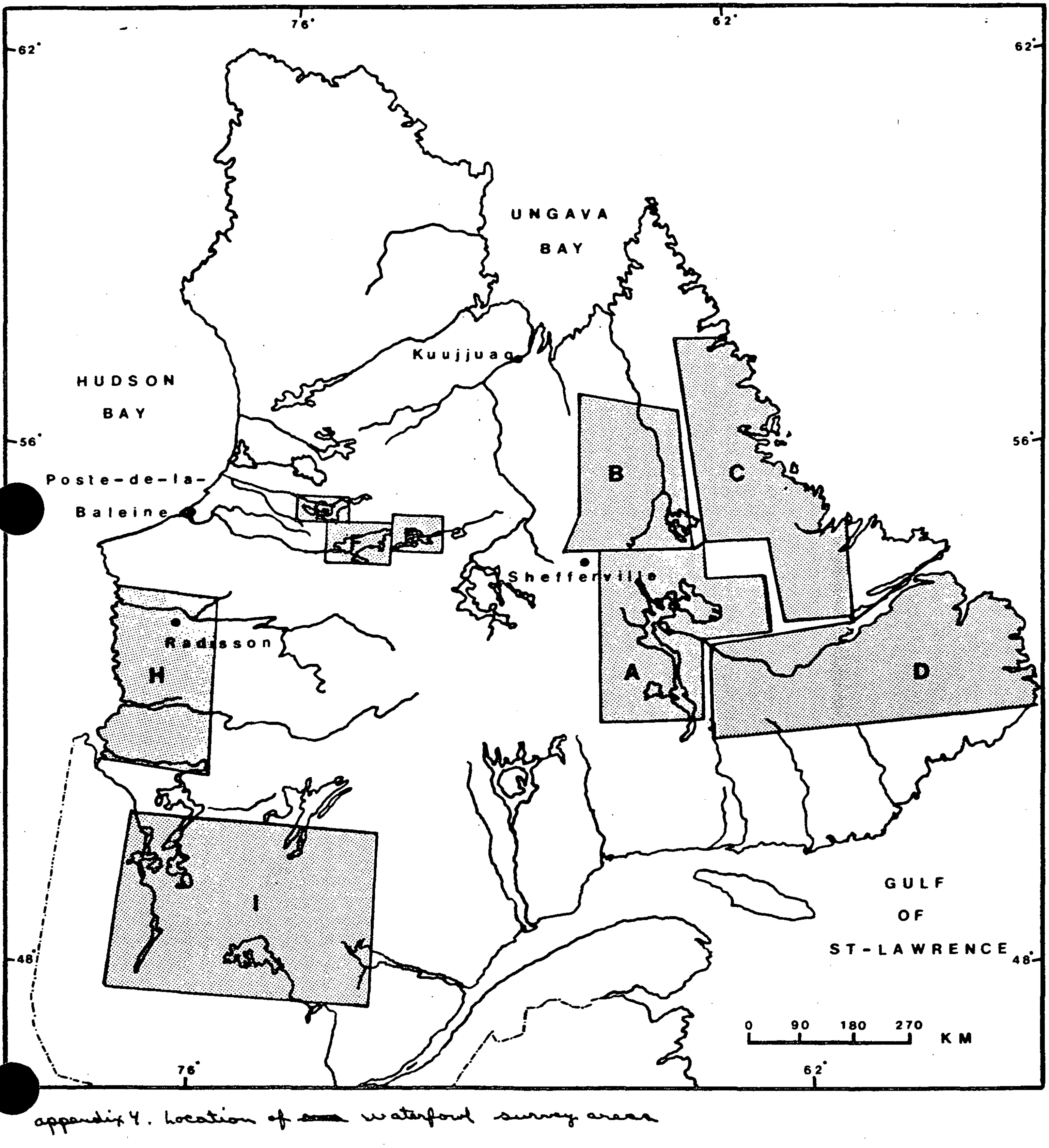
Area	(Source)	Area surveyed (km^2)	Date	Density (pairs/100km^2)
A	(Gillespie & Wetmore 1974)	1396	June 6-11, 1970	1.9[1]
A	(Gillespie & Wetmore 1974)	1134	June 6-11, 1970	1.9[1]
A	(Gillespie & Wetmore 1974)	1021	May 28-31, 1971	0.3
A	(Gillespie & Wetmore 1974)	1021	June 8-11, 1972	0.9
A	(Goudie & Whitman 1987)	1200	June 3-11, 1980	2.6[2]
A	(Goudie & Whitman 1987)	1100	June 3-11, 1980	2.2[2]
B	(Gillespie & Wetmore 1974)	?	June 6-9, 1970	0.4
C	(Gillespie & Wetmore 1974)	?	June 15-30, 1970	0.0
D	(Goudie & Whitman 1987)	1900	June 12-21, 1980	1.0[2]
F	(Savard 1977)	523	June 4-7, 1976	18.0[3]
H	(Lehoux & Rosa 1973)	1508	July, 1972	0.1
i	(Bordage 1987)	5000	May 11-26, 1985	1.9[4]
i	(Bordage 1988)	5000	May 12-27, 1986	0.1[5]

1 Report a ratio of 10 Surf Scoters for 1 Black
2 Report a ratio of 3 Surf Scoters for 1 Black
3 11.6 pairs of Black Scoter and 6.3 pairs of Surf Scoter
4 0.7 pair of Black Scoter and 1.2 pair of Surf Scoter
5 only Surf Scoter

Appendix 3 - Brood density of scoters in various areas of Québec
(See Appendix 4)

Area	(Source)	Area surveyed (km^2)	Date	Density (broods/100km^2)
A	(Gillespie & Wetmore 1974)	1160	July 20-27, 1970	0.3[1]
A	(Gillespie & Wetmore 1974)	2055	July 26-Aug 1, 1971	0.4[1]
E	(Savard 1977)	116	July 29, 1976	11.0[2]
E	(Savard 1977)	116	August 18, 1976	6.0[3]
E	(St-Louis 1982a)	91	August 16-24, 1977	1.1
F	(Plante 1975)	440	August 4, 1975	4.8
F	(Savard 1977)	523	July 24-26, 1976	5.4[4]
F	(Savard 1977)	523	August 14-16, 1976	5.4[5]
F	(St-Louis 1982a)	421	August 16-24, 1977	2.6
F	(St-Louis 1982b)	397	July 22-29, 1978	5.3
G	(Savard 1977)	219	July 28, 1976	4.6[6]
G	(Savard 1977)	219	August 17, 1976	2.3[7]
G	(St-Louis 1982a)	174	August 16-24, 1977	0.6

1 Report Surf more abundant than Black
2 Surf Scoters 4.3/100 km^2; Black Scoter 6.9/100 km^2
3 Surf Scoter 0.9/100 km^2; Black Scoter 5.2/100 km^2
4 Surf Scoter 2.5/100 km^2; Black Scoter 2.9/100 km^2
5 Surf Scoter 1.9/100 km^2; Black Scoter 2.9/100 km^2; unknown 0.6/100 km^2
6 Surf Scoter 1.4/100 km^2; Black Scoter 2.7/100 km^2; white-winged Scoter 0.5/100 km^2



appendix 4. Location of waterfowl survey areas

Appendix 4 - Location of waterfowl survey area.

Table 1 - Number of Waterfowl observed during 1830 km of transects in Northern Québec in 1976

	25-29 July			14-21 August		
	No. of adults	No. of broods	No. of young	No. of adults	No. of broods	No. of young
Common Loon	28	7	9	34	9	10
Red-throated Loon	13	3	3	7	3	3
Canada Goose	451	20	73	291	46	157
Mallard	2	1	4	1	1	6
Black Duck	31	3	18	56	1	9
Pintail	1	–	–	21	–	–
Green-winged Teal	–	–	–	45	–	–
Scaup sp.	8	2	19	11	9	55
Common Goldeneye	7	–	–	9	–	–
White-winged Scoter	1	1	4	1	1	4
Surf Scoter	34	19	101	18	17	71
Black Scoter	49	29	151	29	25	117
Scoter sp.	3	3	12	2	2	23
Hooded Merganser	68	–	–	86	–	–
Merganser sp.[1]	233	14	105	311	43	236
Duck sp.	11	–	–	9	–	–

1 Common Merganser and Red-breasted Merganser.

Table 2 - Seasonal abundance of Black Scoters in 1976
(Number of adults seen)

Area	June 4-7	July 25-28	August 15-18	Sept. 5-7	Sept. 12-14	Sept. 19-21	Sept. 24-27
Bienville	90	66	55	47	63	24	14
Hudson Plateau	13	0	3	0	3	1	0
Hudson Coast	134	0	639	60	10	10	70
Great Whale River	180	0	0	0	1	12	7
Coast River	39	1	0	0	0	2	5
TOTAL	456	67	697	107	77	49	96

Table 3 - Seasonal abundance of Surf Scoters in 1976
(Number of adults seen)

	June 4-7	July 25-28	August 15-18	Sept. 5-7	Sept. 12-14	Sept. 19-21	Sept. 24-27
Bienville	43	25	25	18	9	9	31
Hudson Plateau	32	7	16	24	29	21	5
Hudson Coast	7	0	25	37	6	305	202
Great Whale River	65	0	0	0	19	15	32
Coast River	5	0	5	0	14	17	5
TOTAL	152	32	71	79	77	367	275

Table 4 - Scoter brood density in various sectors of Northern Québec in 1976 (Transect width = 0.5 km; based on 2 surveys July 24-26 and August 14-16)

	Transect Length (km) (area km^2)	Surf Scoter No. broods; No. young (Brood/ $100km^2$)	Black Scoter No. broods; No. young	Scoter sp. No. broods; No. young	Total No. young
Bienville	1 047 (524)	26;121 (5.0)	38;194 (7.3)	4;14 (0.8)	68;329 (13.0)
Vaujours	438 (219)	4;14 (1.8)	9;42 (4.1)	0;0	13;56 (6.0)
Caniapiscau	231 (116)	6;26 (5.2)	13;56 (11.2)	2;6 (1.7)	21;88 (18.1)
Hudson plateau	115 (57)	2;14 (3.5)	1;2 (1.8)	2;8 (3.5)	5;24 (8.8)
Hudson coast	68	0;0	0;0	0;0	0;0
Great Whale River	364	0;0	0;0	0;0	0;0
Coast river	99	1;4	0;0	0;0	1;4

Table 5 - Number of Scoter brood observed (No. of broods; No. of young) in 1976 in the sector of Bienville Lake as derived from surveys of 24 3,25 km^2 sampled plots (Total area = 78 km^2)

	July 24-26	August 14-16
Surf Scoter	2;4 (2.6)[1]	3;11 (3.9)
Black Scoter	6;29 (7.7)	10;33 (12.8)
TOTAL	8;33 (10.3)	13;44 (16.7)

1 Brood density (brood/100 km^2)

Table 6 - Number of broods classified in the various age groups in 1976 during the 26-28 July survey (regular numbers) and the 14-18 August survey (Number in parentheses)

	AGE CLASS					
	I			II		
	A	B	C	A	B	C
Canada Goose	-	7	38	(12)	(22)	-
Black Duck	-	-	-	3	-	(1)
Greater Scaup	1	1(2)	(1)	(2)	-	-
Surf Scoter	1	8	5(5)	(8)	(1)	-
Black Scoter	3	13	3(6)	(15)	(2)	-
Merganser	10	8(9)	(13)	(8)	-	-

Table 7 - Comparison of brood counts on five lakes surveyed in July and in August

	July Count		August Count	
	No. of broods	No. of Young	No. of broods	No. of Young
Greater Scaup	1	8	1	8
Surf Scoter	6	53	3	8
Black Scoter	8	40	1	1
TOTAL	15	101	5	17

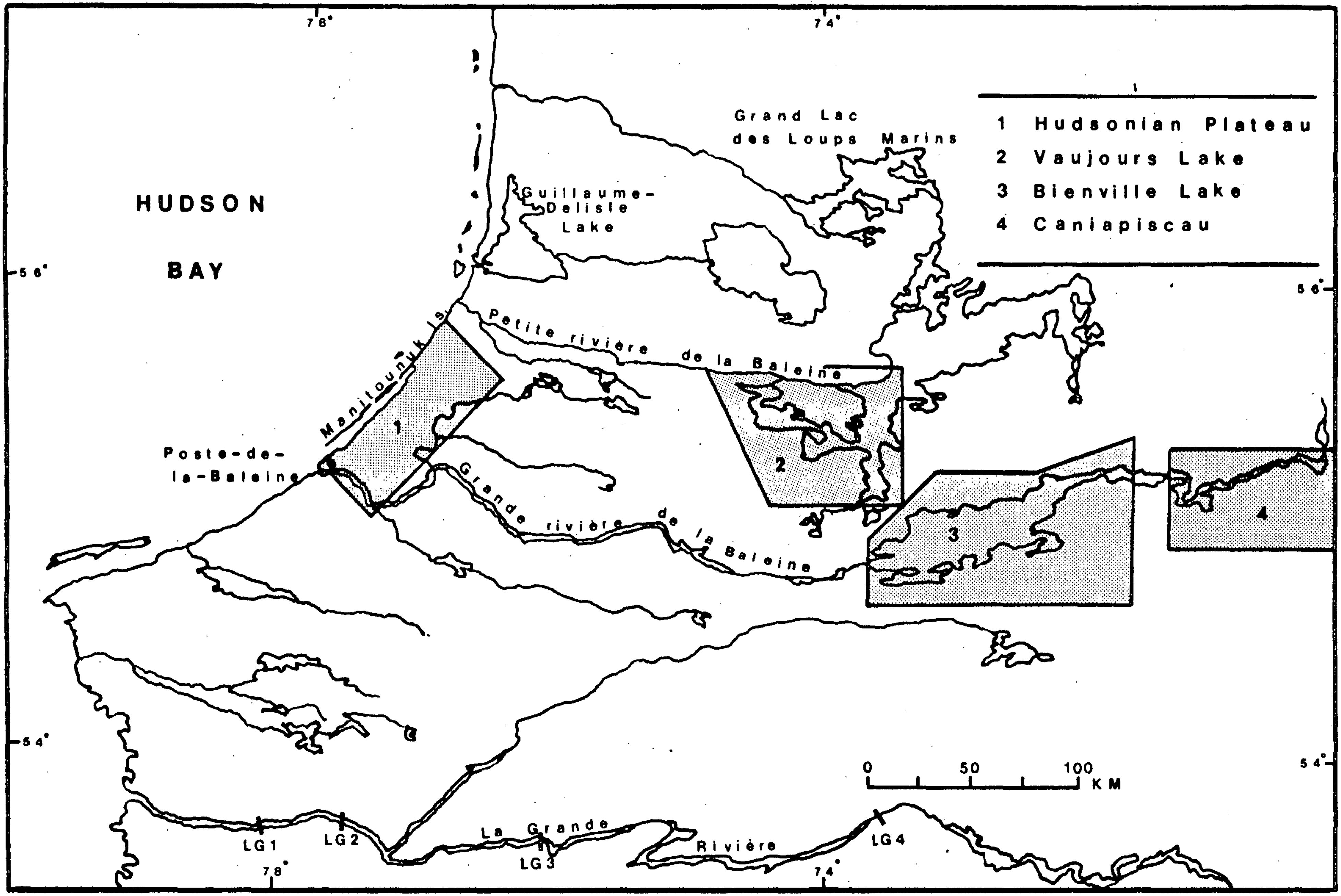
Table 8 - Average length of feeding and resting periods (in min.) at different period of the day ($\bar{X}$ ± S.E.)

	Period of the day				
Activity	0500-0900h.	0900-1200h.	1400-1800h.	1900-2100h.	(0500-2100h.)
Feeding	39.4 ± 8.3 n = 5	25.8 ± 5.6 n = 5	41.1 ± 5.1 n = 10	38.5 ± 9.3 n = 8	36.7 ± 3.7 n = 28
Resting	18.4 ± 3.7 n = 5	19.6 ± 5.2 n = 5	30.9 ± 7.5 n = 14	8.0 ± 1.7 n = 7	21.9 ± 3.8 n = 31

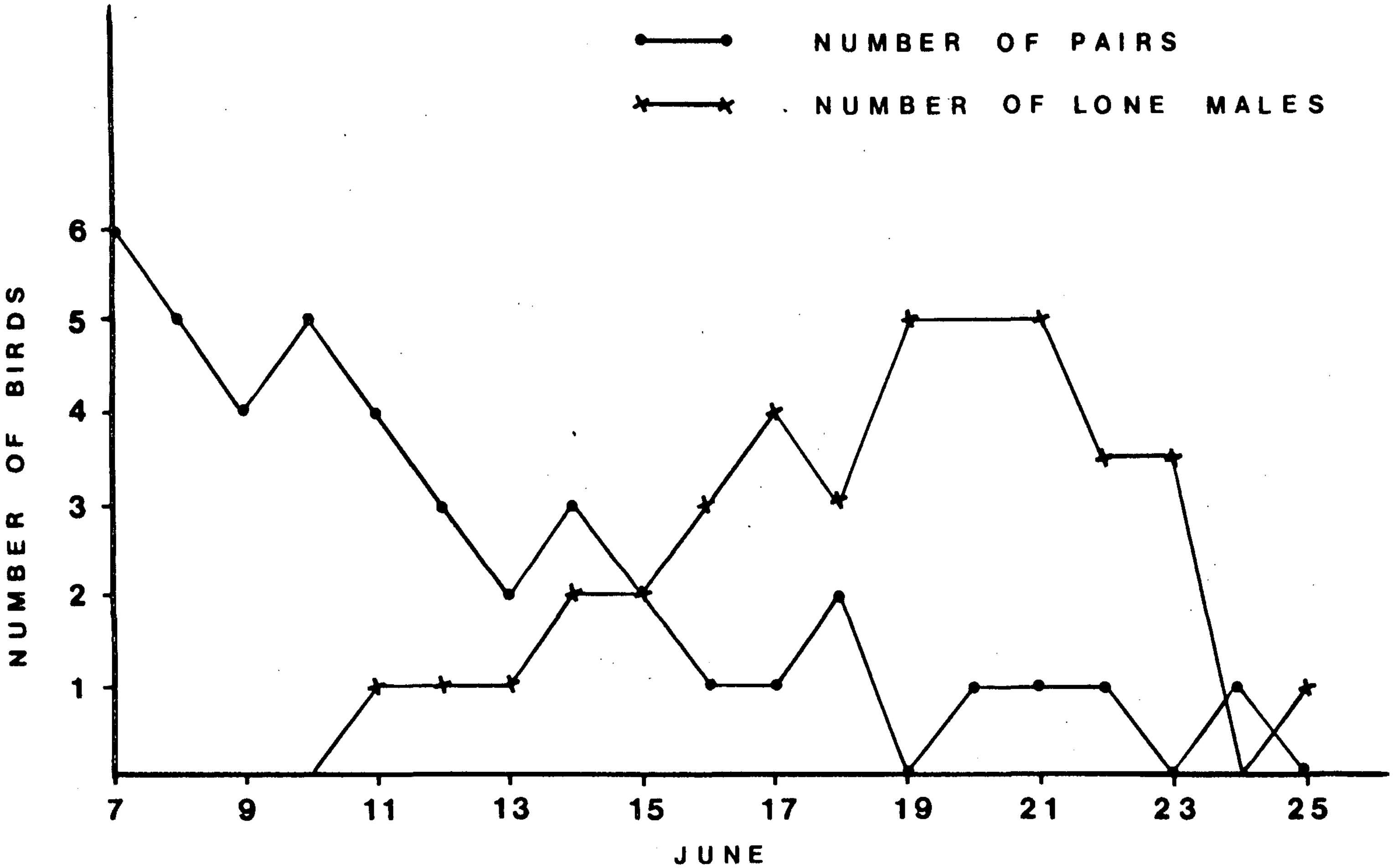
Fig. 1 - Location of the study area in Northern Quebec.

Fig. 2 - Breeding phenology of scoter: relative number of pairs and lone males observed on a small lake.

Fig. 3 - Time budget of newly hatched Surf Scoter broods. (n = 42 h of observations distributed equally on 2 broods over 2.5 days).

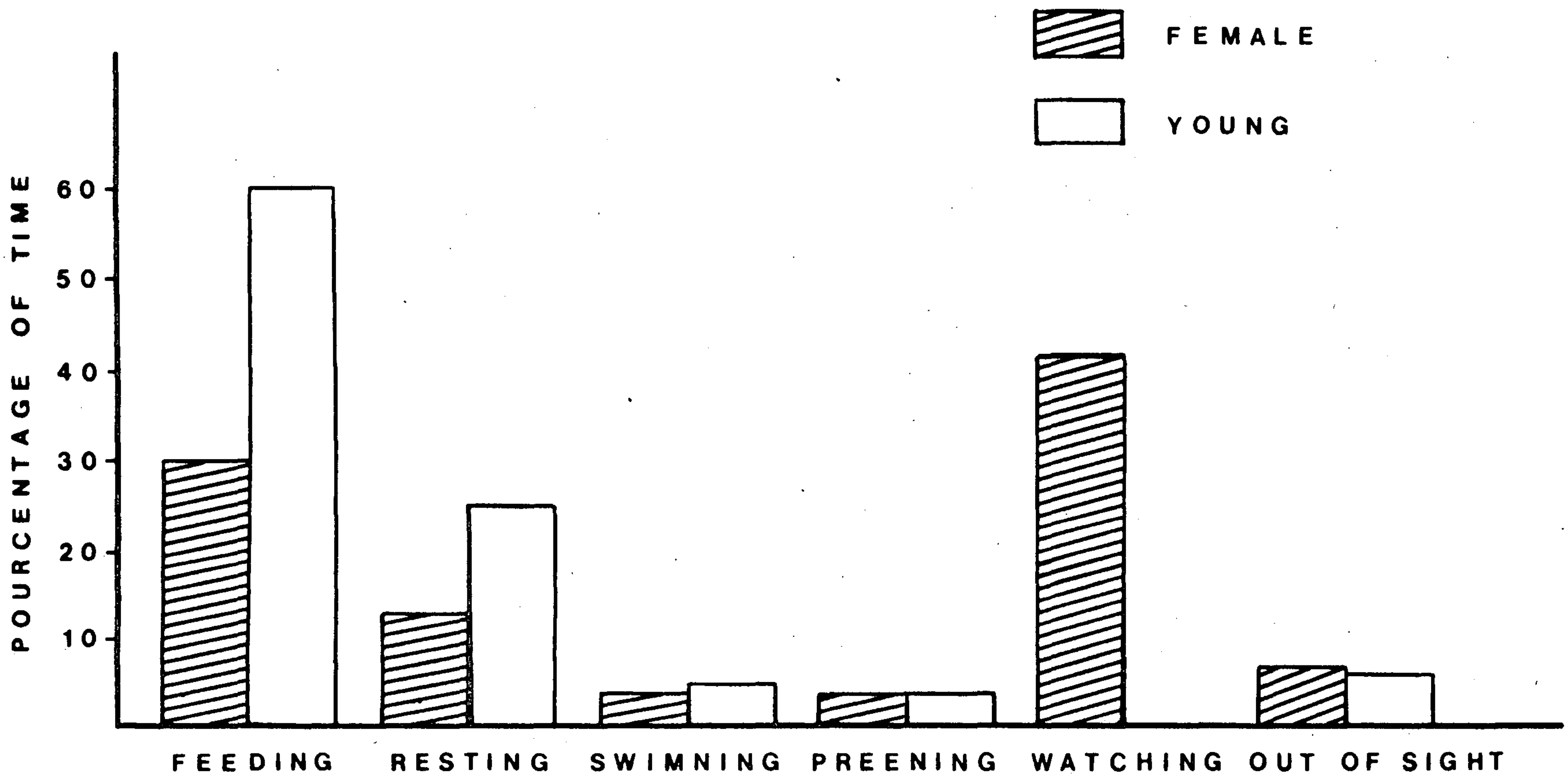


78°
74°
HUDSON
BAY
56°
54°
Grand Lac
des Loups Marins
1 Hudsonian Plateau
2 Vaujours Lake
3 Bienville Lake
4 Caniapiscau
Guillaume-
Delisle
Lake
Manitounuk Is.
Petite rivière de la Baleine
Poste-de-
la-Baleine
Grande rivière de la Baleine
1
2
3
4
0
50
100
KM
La Grande
Rivière
LG1
LG2
LG3
LG4



NUMBER OF PAIRS
NUMBER OF LONE MALES
NUMBER OF BIRDS
6
5
4
3
2
1
7
9
11
13
15
17
19
21
23
25
JUNE

Fig 2


FEMALE
YOUNG
POURCENTAGE OF TIME
60
50
40
30
20
10
FEEDING
RESTING
SWIMNING
PREENING
WATCHING
OUT OF SIGHT

3