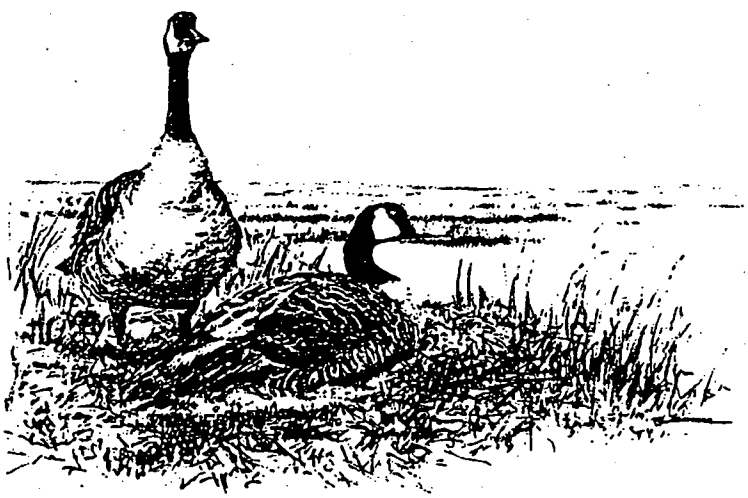
A BREEDING PAIR SURVEY OF CANADA GEESE IN NORTHERN QUEBEC - 1996



Prepared by:

William F. Harvey
Maryland DNR
Wildlife Division
and
Andre Bourget
Canadian Wildlife Service
Quebec Region

INTRODUCTION

Population status of Canada geese (Branta canadensis) in the Atlantic flyway is monitored mainly by trends in mid-winter surveys (Hindman and Ferrigno 1990). Mid-winter estimates of Canada geese in the Atlantic flyway peaked during the early 1980's, but have since declined to about 60% of their former levels. Resident (i.e., non-migratory) Canada geese have increased dramatically during this period. Breeding pair surveys in mid-Atlantic and northeast states suggest that resident Canada goose numbers nearly doubled between 1990 and 1994 (H. Heusman, Mass. Div. Of Fish and Wildl., pers. commun.). Therefore, increasing resident goose numbers are likely masking a more serious decline in the migrant population than indicated by mid-winter surveys. Concern for the migrant population has increased the need for breeding grounds surveys where estimates are not confounded by the presence of resident geese.

During the 1960's, aerial surveys identified the Ungava Peninsula in northern Quebec as the primary nesting area for Atlantic flyway Canada geese (Kaczynski and Chamberlain 1968). Malecki and Trost (1990) used a more quantitative approach to estimate the number of breeding pairs throughout the boreal forest and Ungava Peninsula regions of northern Quebec in 1988. Their findings confirmed that the highest densities were located along the coastal areas of Ungava Bay and Hudson Bay. In 1993, an annual survey was begun in northern Quebec using methods developed by Malecki and Trost (1990) (Bordage and Plante 1993). The objective of this survey was to monitor the status of the migrant population by estimating the number of breeding pairs. This report presents the results of the 1996 breeding grounds survey.

Acknowledgments: The 1996 breeding pair survey was cooperatively funded by the Canadian Wildlife Service (CWS), the U. S. Fish and Wildlife Service (USFWS), and the states of Delaware, Maine, Maryland, Massachusetts, New York, North Carolina, Pennsylvania, Vermont, Virginia, and West Virginia. Andre Bourget (CWS) and Bill Harvey (MD DNR) served as observers. Glen Cullingford (USFWS) served as pilot. The Makivik Corporation, and in particular, Stas Olpinski and Bill Doidge, provided logistical support. Andrew Novalinga (Povungnituk) served as an additional observer. Others assisting in various phases of the survey included: Bill Doidge (Makivik), Aliva Tulugak (Povungnituk), Daniel Bordage (CWS), Kathryn Dickson (CWS), Charles Drolet (CWS), Jerry Serie (USFWS), Rich Malecki (USFWS), and Larry Hindman (MD DNR).

STUDY AREA

The 1996 survey was conducted in northern Quebec, approximately north of 51° latitude and west of 67° longitude (Figure 1). The survey is stratified based on Malecki and Trost's (1990) modification of northern Quebec's ecoregions (Gilbert et al. 1985). The regions sampled in 1996 have been described by Malecki and Trost (1990) and Bordage and Plante (1993). Briefly, region 1 included the inland tundra, region 2 consisted mainly of flat coastal tundra, and region 3 is a transition zone between boreal forest and tundra (Figure 1). These 3 regions comprise the area known as the Ungava Peninsula. The northern tip of the coastal zone from Ivujivik, southeast to about 150 km north of Kangirsuk, was excluded (Figure 1). Exploratory transects flown in 1993 indicated that this mountainous area had few geese.

The boreal forest (region 4), approximately bounded by 51° and 57° latitude, was included in the 1988 and 1993 surveys but was not surveyed in 1994 or 1995. This region has relatively low densities of nesting geese (Malecki and Trost 1990, Bordage and Plante 1993) and little annual variation in goose density (Reed 1994). We surveyed this region in 1996 and plan to resample this region every third year.

METHODS

The survey followed the methodology of Malecki and Trost (1990). Aerial transects were flown in a Partenavia twin engine at an altitude of 30 m and a ground speed of approximately 140 km/h. Observers recorded the number of geese observed as singles, pairs, or in groups (3 or more geese) within 200 m of each side of the plane. In addition to geese, observers also recorded similar information for other waterfowl species. Transect width was calibrated before the survey began. Transects were flown using a global positioning system (GPS) to assist with navigation.

We surveyed the same transects used in 1995 and 1994 and we plan to continue using these transects in the future. Using the same transects allows us to better detect differences between years and to plan in advance for aviation gas needs. The total length of transects to be sampled in each region was determined using variance estimates from the 1993 survey and a target of 10% coefficient of variation (Bordage and Plante 1994). Transects were randomly located within regions until the total length desired was reached. All transects were orientated along east-west lines.

The number of indicated breeding pairs on a given transect was the sum of the singles and pairs observed by both observers over the length of the transect. Density of breeding pairs

within regions was estimated using quotient estimators while the total population density was estimated using a separate stratified quotient estimator (Cochran 1977). Variances were estimated using the jack-knife procedure (Cochran 1977). The estimates presented in this report are not adjusted for visibility bias and thus represent an index to the population.

RESULTS

Habitat Conditions

Transects were sampled from June 17-25, similar to survey dates in 1993-95, but later than the 1988 survey (Table 1). In general, the spring thaw was late compared to conditions observed in 1993-95. Spring thaw was particularly late along Ungava Bay, where about 90% of the coastal zone was frozen or snow-covered at the time of this survey. Open water was evident only on portions of small ponds and only within about 15 km of the Ungava Bay coast. Ungava Bay was frozen at least 65 km from shore. Conditions were better along the Hudson Bay coast, with 30-40% of small ponds still frozen and fewer patches of snow. However, conditions in this area were also the latest observed while conducting the survey during 1993-96.

Breeding Pair and Total Population Estimates

Ungava Peninsula

The estimated number of breeding pairs on the Ungava Peninsula (regions 1,2, and 3) improved in 1996 (46,058 pairs) from the 1995 estimate of 29,302 pairs ($P = 0.004$) (Table 2). On the 36 transects surveyed in both 1996 and 1995, the number of indicated pairs recorded in 1996 increased on 24 transects, remained the same on 6 transects, and decreased on 6 transects compared to 1995. The 1996 estimate is similar to the number of pairs

estimated in 1994 (40,086 pairs, $P = 0.373$), but less than the 1993 (91,307 pairs) ($P < 0.001$) or 1988 estimates (118,031 pairs) ($P < 0.001$) (Table 2).

In region 1 (inland tundra), the number of breeding pairs in 1996 (14,941 pairs) was marginally less than the estimate for 1988 (35,016 pairs) ($P = 0.056$), but similar to the estimates for 1993 (18,185 pairs) ($P = 0.70$), 1994 (10,633 pairs) ($P = 0.358$), and 1995 (8,101 pairs) ($P = 0.11$) (Table 1). The breeding pair estimate for region 2 (coastal tundra) improved in 1996 (25,865 pairs) from 1995 (15,705 pairs) ($P = 0.003$) and was similar to the estimate for 1994 (20,917 pairs) ($P = 0.215$). However, the 1996 estimate for region 2 remained far below the estimates for 1993 (57,122 pairs) and 1988 (70,833 pairs) ($P < 0.001$). No difference in the number of breeding pairs was detected in region 3 (transition zone) between 1996 and any other year of the survey ($P > 0.112$) (Table 2).

The total population estimate (breeding pairs + non-breeders) was similar between 1996 (251,094 individuals; SE = 22,038) and 1995 (238,706 individuals; SE = 30,568), 1994 (258,332 individuals; SE = 48,504), 1993 (241,407 individuals; SE = 30,599), and 1988 (348,950 individuals; SE = 69,879) ($P > 0.180$).

Boreal Forest

Previous surveys of Canada geese in the boreal forest of northern Quebec were conducted in 1988 and 1993. Results of the 1993 survey and comparison to 1988 estimates excluded a 92,200 km^2 section north of Labrador City because no transects were flown in the area (Bordage and Plante 1993). A comparison of transects flown in this area in 1988 and 1996 with other transects in the boreal forest indicated no gross differences in the density of Canada goose pairs (pairs/km^2 in excluded area: 1988 - 0.026, 1996 - 0.033; pairs/km^2 in

remainder of boreal forest: 1988 - 0.028, 1996 - 0.020). Therefore, the 92,200 km^2 section was included as part of the total area and the 1988 and 1993 estimates were recalculated.

The estimated number of breeding pairs in 1996 (11,062) was similar to estimates for 1993 (22,846 pairs) ($P = 0.089$) and 1988 (13,775 pairs) ($P = 0.327$) (Table 3). Likewise, the estimated total population in 1996 (51,623 individuals) was similar to estimates for 1993 (61,226 individuals) ($P = 0.70$) and 1988 (30,830 individuals) ($P = 0.332$) (Table 3).

Composition of Indicated Pairs

The number of indicated pairs observed includes birds recorded as pairs and singles. Single birds are likely to be males associated with an incubating female while pairs include some nesting birds as well as subadult or failed breeders. Therefore, composition of the indicated pairs (i.e., % indicated pairs observed as singles) may provide a more reliable indicator of the proportion of indicated pairs that are actually nesting. The percentage of indicated pairs observed as singles on the Ungava Peninsula averaged 53% (range = 44-59%) during 1993-96 (Figure 2). In 1993 and 1995, the percentage of indicated pairs observed as singles was similar in the coastal zone (region 2) along Ungava Bay and Hudson Bay (Figure 2). However, in 1994 and 1996, the percentage of indicated pairs observed as singles was lower on the Ungava Bay coast than along Hudson Bay (Figure 2).

Comparison of Hudson and Ungava Bay Coasts

During 1993-96, the Hudson Bay coast supported nearly 80% (range = 74-82%) of the breeding pairs estimated for the coastal zone (region 2) (Figure 3). Similarly, an average of 86% (range = 81-92%) of the total geese estimated for the coastal zone were along the Hudson Bay coast (Figure 3).

The proportion of total geese comprised of breeding pairs varied widely during 1993-96 in the Hudson and Ungava Bay portions of the coastal zone (Figure 4). However, in 3 of 4 years, a greater proportion of total geese were comprised of breeding pairs in the Ungava Bay portion of the coastal zone (Figure 4).

DISCUSSION

The number of Canada goose pairs on the Ungava Peninsula improved 57% between 1996 and 1995. The cause of the increase can not be definitively attributed to a specific source. For example, visibility of indicated pairs can be higher in years with low nest success because failed or nonbreeding pairs are more visible than nesting pairs (Bromley et al. 1995). However, the increase is consistent with an expected improvement in survival of adult and subadult geese following closure of sport hunting in 1995.

Habitat conditions indicated a relatively late spring thaw, particularly along Ungava Bay. The percentage of indicated pairs observed as singles (28%) was the lowest recorded between 1993-96 on the Ungava Bay coast. Conditions were less severe along the Hudson Bay coast and the percentage of indicated pairs observed as singles (50%) was near the 4-year average. Nest searches on the Ungava Bay and Hudson Bay coasts resulted in similar findings. Clutch sizes were relatively small ($\leq$ 3.5 eggs/nest) along both coasts. Nesting effort seemed to be low on the Ungava Bay coast but better along Hudson Bay (Reed and Hughes 1996).

The coastal habitat bordering Hudson Bay and Ungava Bay is well known for the high density of breeding Atlantic Population Canada geese it supports (Malecki and Trost 1990). However, separate analyses of the goose populations associated with each coast illustrate that Hudson Bay supports a much larger breeding population than Ungava Bay. The smaller

breeding population along the Ungava Bay coast is primarily a function of less land area (Ungava Bay: 9,700 km^2; Hudson Bay: 33,800 km^2) and a somewhat lower density of breeding pairs. The particularly late thaw along Ungava Bay in 1996 indicates that habitat conditions (and presumably gosling production) can vary considerably between the Hudson and Ungava Bay coasts in some years. Furthermore, our limited experience also suggests that late spring thaws may occur more frequently along the Ungava Bay coast. The Hudson Bay coast is noted for "on-shore" winds that frequently produce fog but may also tend to moderate temperatures.

Recovery distributions of geese banded on the Hudson Bay and Ungava Bay coasts indicate most geese winter in the Chesapeake Bay region but may have different migration corridors (J. Hestbeck, Mass. Coop. Fish and Wildl. Res. Unit, unpubl. data). Given the small population associated with Ungava Bay, the potential for different (and perhaps lower) recruitment rates in some years, and the possibility of different migration (and therefore harvest) patterns, it may be necessary to monitor productivity and population size in this area separately.

Although breeding population estimates have declined dramatically on the Ungava Peninsula since 1988, total population estimates have changed little, particularly between 1993 and 1996 (a large change between 1988: 348,950 and 1993: 241,407, was not statistically significant). Total population estimates include breeding pairs, non-breeders (i.e., those not of breeding age), failed breeders, and molt migrants from other areas. Flightless geese banded along Hudson Bay are frequently recovered in the Mississippi flyway (Malecki and Trost 1990). Interpreting the results of the total population estimate is difficult without knowing the

number, timing, and annual variation of molt migrants from other populations entering the surveyed area. Slight differences in survey timing or the arrival of molting geese may result in large variation in the population estimates. For example, the 1988 survey was conducted in late May - early June (Table 1), well before molt migrants generally arrive. In contrast, the 1994 and 1995 surveys were completed in late June and many flocks of (presumably) molt migrants were arriving along the Hudson Bay coast. The 1996 survey was completed within a day of the 1995 survey, but only a few flocks of molt migrants were observed, probably because of the late spring. Inuit hunters confirmed that arrival of molt migrants was delayed in 1996.

Although the estimated number of breeding pairs in the boreal forest region in 1996 was only about half as large as the estimate for 1993, it was not significantly different. Total population estimates for the boreal region were also similar between 1996 and 1993. Other sources of information on Canada geese nesting in the boreal forest also indicate low densities and little annual variation (Reed and Hughes 1996, D. Bordage, pers. comm.).

Variances on all boreal forest estimates from this survey are large (SE > 20%) (Table 3). If surveys are to be continued in this region, sample sizes should be increased to obtain more useful estimates.

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Table 1. Dates of Canada goose pair surveys conducted in northern Quebec[1] in 1988 and 1993-96.

Year	Survey Dates
1988	23 May - 3 June
1993	11-21 June
1994	21 June - 1 July
1995	18-24 June
1996	17-25 June

[1] In 1988, 1993, and 1996, the boreal forest was surveyed prior to the Ungava Peninsula.

Table 2. Number of Canada goose breeding pairs estimated for the Ungava Peninsula of northern Quebec.

REGION[a]	YEAR[b]	TOTAL AREA (KM^2)	AREA SAMPLED (KM^2)	n[c]	PAIRS /KM^2 (SE)	TOTAL PAIRS (SE)
1	1988	116000	285	6	0.30 (0.084)	35016 (9744)
	1993	116000	242	4	0.16 (0.063)	18185 (7308)
	1994	116000	458	11	0.09 (0.022)	10633 (2542)
	1995	116000	458	11	0.07 (0.014)	8101 (1635)
	1996	116000	458	11	0.13 (0.034)	14941 (3956)
2	1988	43500	119	7	1.63 (0.245)	70833 (10658)
	1993	43500	420	25	1.31 (0.166)	57122 (7221)
	1994	43500	491	21	0.48 (0.062)	20917 (2692)
	1995	43500	488	21	0.36 (0.041)	15705 (1799)
	1996	43500	488	21	0.60 (0.067)	25865 (2928)
3	1988	63200	171	3	0.18 (0.067)	11491 (4253)
	1993	63200	176	6	0.26 (0.110)	16432 (6952)
	1994	63200	265	4	0.13 (0.038)	8124 (2421)
	1995	63200	265	4	0.09 (0.027)	5496 (1702)
	1996	63200	265	4	0.08 (0.018)	5258 (1165)
1,2,3	1988	222700	575	16	0.53 (0.068)	118031 (15144)
	1993	222700	838	35	0.41 (0.056)	91307 (12471)
	1994	222700	1214	36	0.18 (0.020)	40086 (4454)
	1995	222700	1211	36	0.13 (0.013)	29302 (2967)
	1996	222700	1211	36	0.21 (0.023)	46058 (5052)

[a] Region 1 - inland tundra; Region 2 - coastal tundra; Region 3 - transition zone between boreal forest and tundra.

[b] 1988 (Malecki and Trost 1990); 1993 (Bordage and Plante 1993); 1994 (Harvey 1994); 1995 (Harvey and Bourget 1995); 1996 (this report).

[c] Number of transects.

Table 3. Total population and number of breeding pairs of Canada geese estimated for the boreal forest region of northern Quebec.

YEAR[a]	TOTAL AREA (km^2)	AREA SAMPLED (km^2)	n[b]	TOTAL PAIRS (SE)	TOTAL GEESE (SE)
1988	508100	775	11	13775 (1184)	30830 (5836)
1993	508100	556	8	22846 (6450)	61226 (12980)
1996	508100	551	8	11062 (2504)	51623 (20710)

[a] 1988 (Malecki and Trost 1990); 1993 (Bordage and Plante 1993); 1996 (this report).

[b] Number of transects.

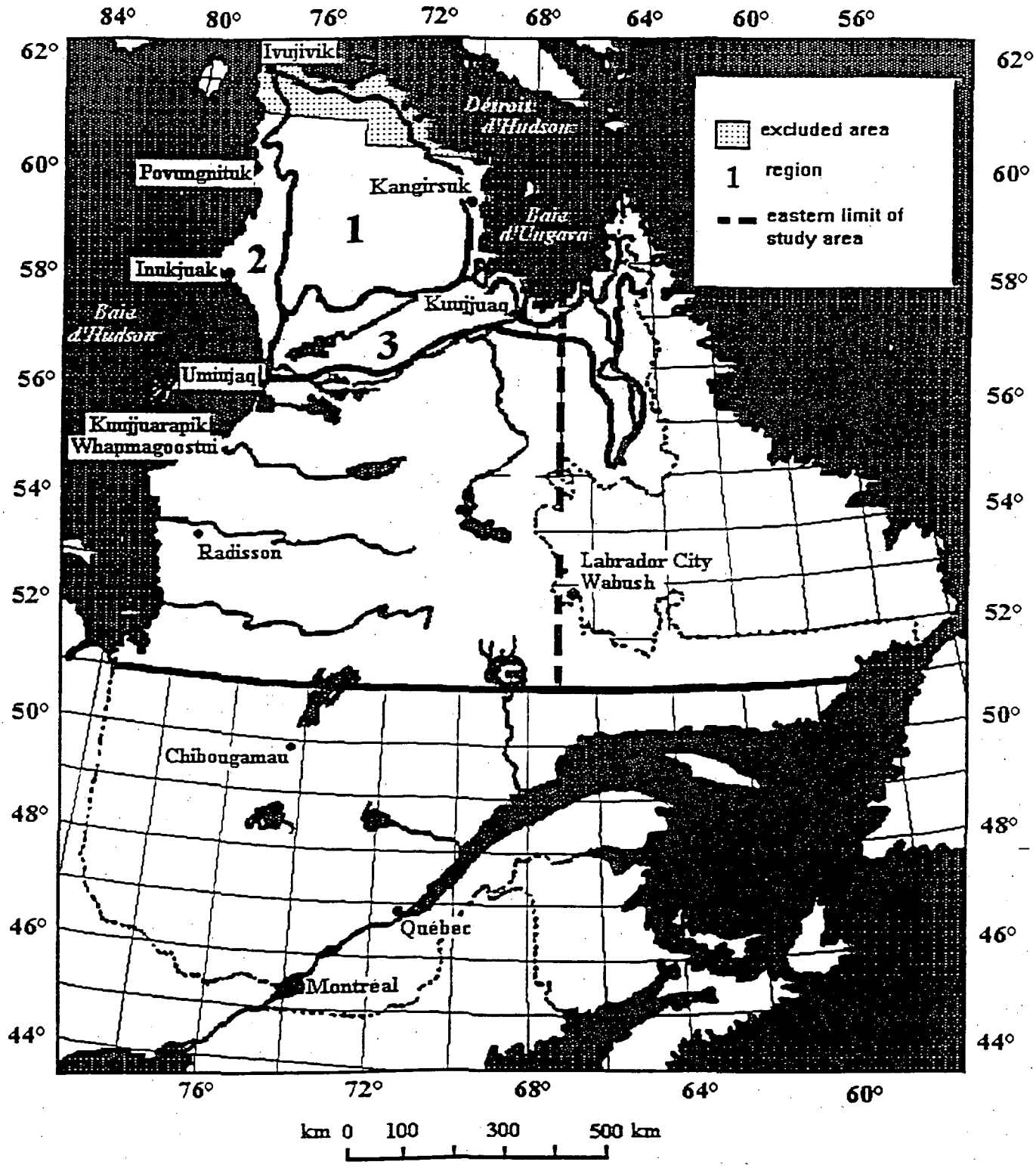

Figure 1. Study area for 1996 breeding pair survey in northern Quebec.

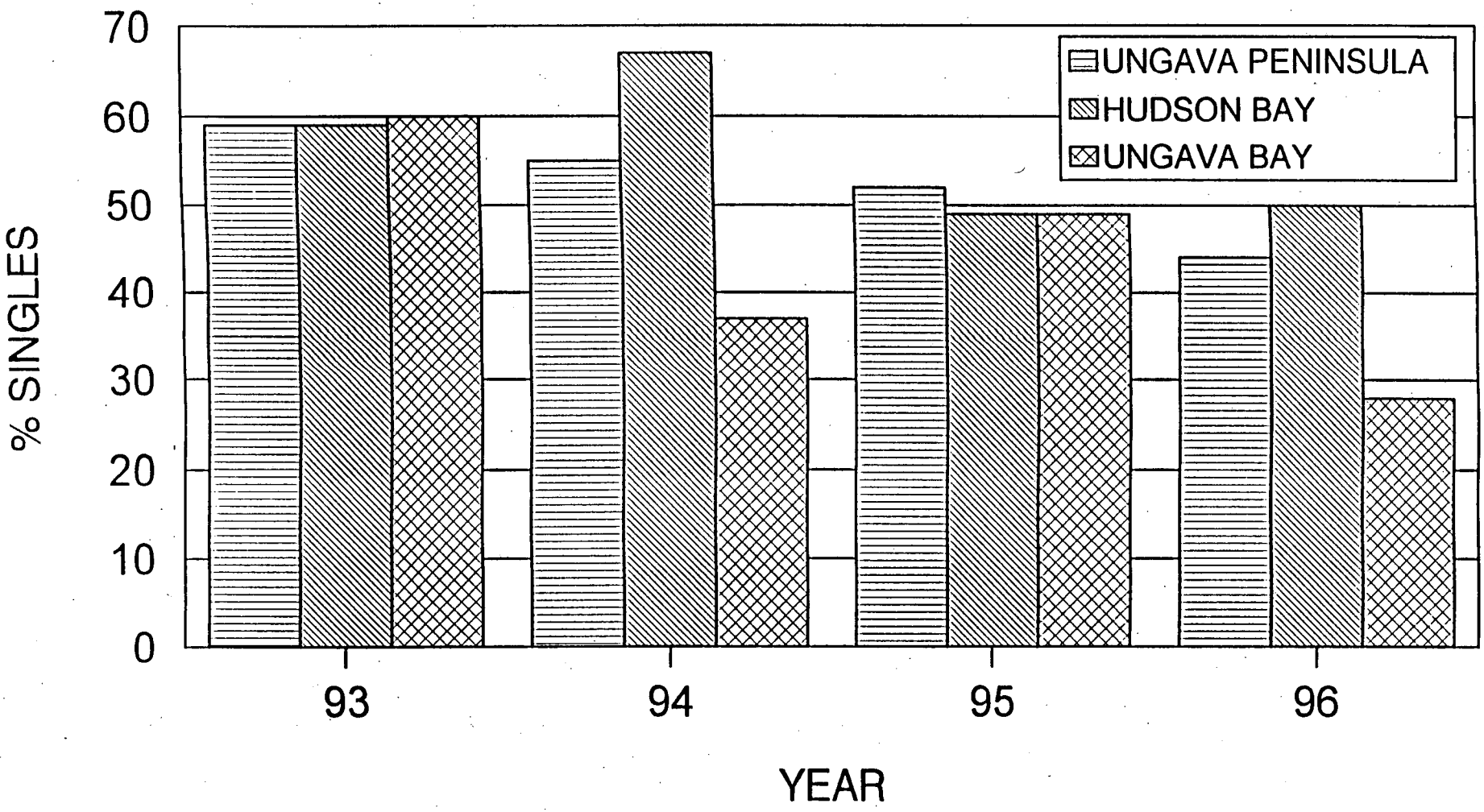

Figure 2. Percent of indicated Canada goose pairs (i.e., singles and pairs) that were observed as singles on the Ungava Peninsula and the coastal zone along Ungava Bay and Hudson Bay in 1993-96.

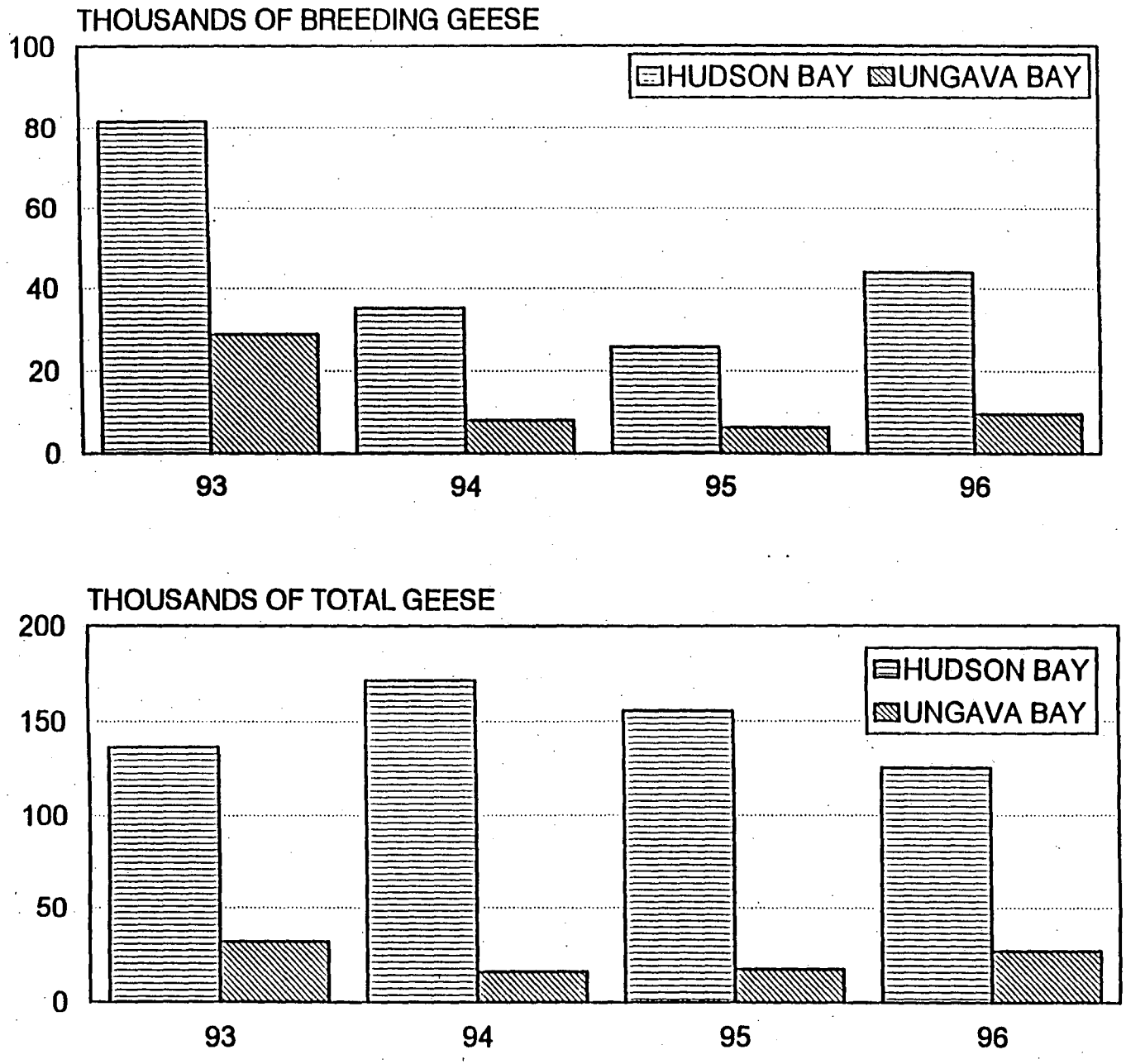

Figure 3. Estimated number of total Canada geese (breeding pairs and groups) and total Canada geese in breeding pairs in the coastal zones along Hudson Bay and Ungava Bay in 1993-96.

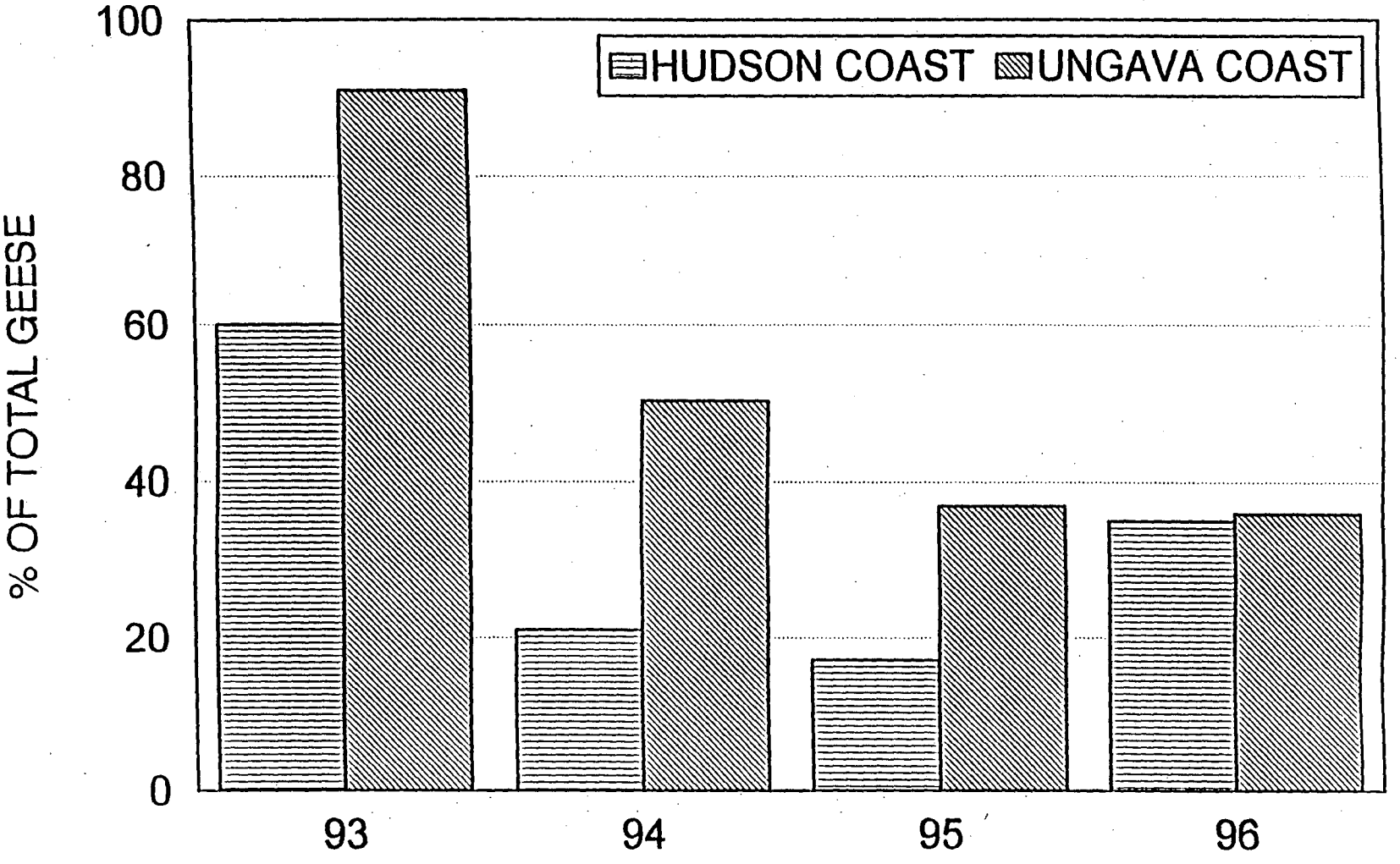

Figure 4. Percent of total Canada geese estimated for the coastal zone along Ungava Bay and Hudson Bay that were breeding pairs in 1993-96.