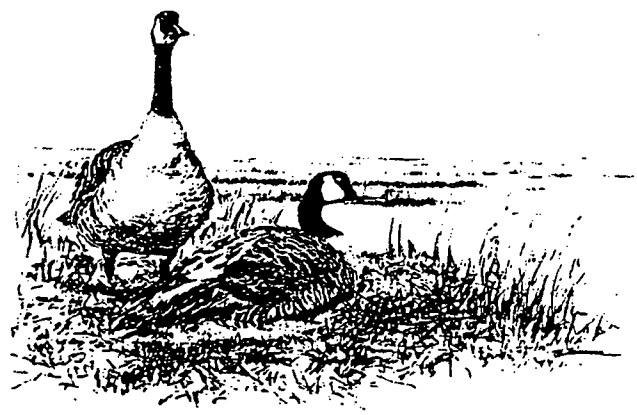
A BREEDING PAIR SURVEY OF CANADA GEESE IN NORTHERN QUEBEC - 1997



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INTRODUCTION

Status of Canada geese (Branta canadensis) in the Atlantic flyway has traditionally been monitored by mid-winter surveys (Hindman and Ferrigno 1990). Mid-winter estimates of Canada geese in Maryland (the primary wintering area for migrant Canada geese) peaked during the late 1970's and 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 throughout the Atlantic flyway. Population estimates of resident Canada geese during the breeding season have tripled since 1989 and now exceed 1,000,000 birds in the mid-Atlantic and northeast states (H. Heusman, Mass. Div. of Fish and Wildl., pers. commun.). Mixing of resident and migrant populations on wintering areas has seriously compromised the utility of mid-winter surveys to monitor status of these populations. Therefore, emphasis of population monitoring has shifted to surveys on breeding areas, where population affiliation is more obvious.

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 is to monitor the status of the migrant population by estimating the number of breeding pairs. This report presents the results of the 1997 breeding grounds survey.

Acknowledgments: The 1997 breeding pair survey was cooperatively funded by the Canadian Wildlife Service (CWS), the U. S. Fish and Wildlife Service (USFWS), and the Atlantic Flyway Council. Andre Bourget (CWS) and Bill Harvey (MD DNR) served as observers. Jim Goldsberry (USFWS) served as pilot. The Makivik Corporation, and in particular, Bill Doidge, provided logistical support. Alix Gordon (Makivik Corporation, Kuujjuaq) served as an additional observer. Others assisting in various phases of the survey included: Carol Peddicord (Wildlife Management Institute), Aliva Tulugak (Povungnituk), Kathryn Dickson (CWS), Austin Reed (CWS), Jerry Serie (USFWS), Rich Malecki (USFWS), and Larry Hindman (MD DNR).

STUDY AREA

The 1997 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 have been described by Malecki and Trost (1990) and Bordage and Plante (1993). Briefly, region 1 included 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 sampled in 1988, 1993, and 1996, but not in 1997. 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 and Hughes 1996). We 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 to assist with navigation.

Transects flown in 1997 were established in 1994 and repeated each year thereafter. Repeating transects allows differences between years to be detected more easily and aids in planning for aviation fuel needs. Total length of transects 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 desired length was reached. All transects were orientated along east-west lines (Figure 2).

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 21-26, similar to survey dates in 1993-96, but later than the 1988 survey (Table 1). Warmer spring temperatures and limited snowfall during winter contributed to an early spring in 1997. In coastal habitat, most ponds were ice-free and snow occurred only in drift areas. A number of shallow ponds along the Hudson Bay coast were dry or mostly dry, probably a result of little snow during winter. Inland areas were largely snow free and ice cover remained only on medium and large lakes and ponds. Leaves had emerged on deciduous shrubs along both coasts. However, grass and sedge growth was most evident on the Hudson Bay coast.

While habitat conditions in all areas were dramatically improved from 1996, the spring thaw appeared to be somewhat more advanced on the Hudson Bay coast and later along Ungava Bay. This difference has been evident in each year of the survey, dramatically different in some years (e.g., 1996) and slightly different in others (e.g., 1997).

Breeding Pair and Total Population Estimates

The estimated number of breeding pairs on the Ungava Peninsula (regions 1,2, and 3) improved in 1997 (63,216 pairs) from the 1996 estimate of 46,058 pairs ($P = 0.032$) (Table 2, Figure 3) . The number of indicated pairs recorded in 1997 increased on 23 transects, remained the same on 3 transects, and decreased on 10 transects compared to 1996. The 1997 estimate is greater than the number of pairs estimated in 1995 (29,302 pairs, $P < 0.0001$) and 1994 (40,086 pairs, $P = 0.002$), but less than the 1993 (91,307 pairs) ($P = 0.043$) or 1988 estimates (118,031 pairs) ($P < 0.001$) (Table 2).

In region 1 (inland tundra), the number of breeding pairs in 1997 (21,772 pairs) was greater than estimates for 1995 (8,101 pairs, $P < 0.0001$) and 1994 (10,633 pairs, $P = 0.009$), but similar to estimates for 1996 (14,941 pairs, $P = 0.194$), 1993 (18,185 pairs) ($P = 0.653$), and 1988 (35,016 pairs) ($P = 0.20$) (Table 2). The breeding pair estimate for region 2 (coastal tundra) was similar in 1997 (32,301 pairs) to 1996 (25,865 pairs, $P = 0.215$), but greater than 1995 (15,705 pairs, $P = 0.0004$) and 1994 (20,917 pairs) ($P = 0.0244$). However, the 1997 estimate for region 2 remained below estimates for 1993 (57,122 pairs, $P = 0.003$) and 1988 (70,833 pairs, $P = 0.001$). No difference in the number of breeding pairs was detected in region 3 (transition zone) between 1997 and any other year of the survey ($P > 0.20$) (Table 2).

The total population estimate (breeding pairs + non-breeders) was greater in 1997 (392,956 individuals, SE = 52,112) than in all years (1996: 251,094 individuals, SE = 22,038; 1995: 238,706 individuals, SE = 30,568; 1994: 258,332 individuals, SE = 48,504; 1993: 241,407 individuals; SE = 30,599) ($P < 0.06$), except 1988, when the estimates were statistically similar (348,950 individuals; SE = 69,879) ($P = 0.61$) (Figure 3).

Composition of Indicated Pairs

The number of indicated pairs 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 was 60% in 1997, the highest level recorded

during 1993-97 (mean = 54%, range = 44-60%) (Figure 4). In 1993 and 1995, the percentage of indicated pairs observed as singles was similar in the coastal zones (region 2) along Ungava Bay and Hudson Bay (Figure 4). However, in 3 of 5 years (1994, 1996, and 1997) the percentage of indicated pairs observed as singles was lower on the Ungava Bay coast than along Hudson Bay (Figure 4).

Comparison of Hudson and Ungava Bay Coasts

During 1993-97, the Hudson Bay coast supported an average of 80% (range = 74-83%) of the breeding pairs estimated for the coastal zone (region 2) (Figure 5). In 1997, the estimated number of breeding pairs increased 28% along Hudson Bay and 17% on the Ungava Bay coast compared to 1996 (Figure 5). An average of 91% (range = 82-95%) of the nonbreeding geese estimated for the coastal zone were located along the Hudson Bay coast during 1993-97 (Figure 5). The estimated number of nonbreeding geese nearly doubled between 1996 (80,944 birds) and 1997 (155,069 birds) on the Hudson Bay coast but declined 24% along Ungava Bay (1996: 17,288 birds; 1997: 13,063 birds) (Figure 5). In 1997, total Canada geese decreased by 10% along the Ungava Bay coast but increased 69% along the Hudson Bay coast compared to 1996.

The proportion of total geese comprised of breeding pairs varied widely during 1993-97 in the Hudson and Ungava Bay portions of the coastal zone (Figure 6). However, in 4 of 5 years, a greater proportion of total geese were comprised of breeding pairs in the Ungava Bay portion of the coastal zone (Figure 6).

DISCUSSION

The estimated number of Canada goose pairs on the Ungava Peninsula increased 37% between 1996 and 1997 and 117% between 1995 and 1997. The increase in breeding pairs is consistent with an expected improvement in survival of adult and subadult geese following closure of sport hunting in 1995. However, given the poor production of recent years, it seems unlikely that the number of geese of breeding age has increased at this rate. The increase may be partly a function of improved habitat conditions that allowed more pairs of breeding age to attempt nesting. We believe the number of breeding pairs estimated by this survey in a given year is influenced by climatic conditions as well as the number of geese of breeding age. Survey results may also be affected by differential detection probabilities when survey timing varies relative to hatching dates or in years with low nest success when failed or nonbreeding pairs are more visible than breeding pairs (Bromley et al. 1995).

Habitat conditions at the time of the survey were among the most favorable observed since 1993. The percentage of indicated pairs observed as singles (60%) was the highest recorded during 1993-97, indicating that a high proportion of the indicated pairs were likely attending nests. Data from field studies along Hudson and Ungava Bays also indicate higher densities of breeding birds, earlier nest initiation, and larger clutch sizes than were observed in 1996 (Reed and Hughes 1997).

The coastal habitat bordering Hudson Bay and Ungava Bay is well known for its high density of breeding Canada geese (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. In 3 of 5 years, the percentage of indicated pairs observed as singles has been higher along the Hudson Bay coast compared to Ungava Bay, indicating that productivity may also vary between these areas. 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 may 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 declined from 1988 until 1995, total population estimates changed little, particularly between 1993 and 1996. However, the total population estimate increased 57% in 1997 compared to 1996 and was statistically greater than in all years except 1988 (Figure 3). 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). Band recoveries by Cree hunters during the spring hunt along eastern James Bay include geese banded during summer on Akiminski Island and other sites in

southern James Bay as well as southern Ontario, Michigan, and Ohio (Hughes et al. 1997). Morphological measurements from geese killed near Povungnituk on the Hudson Bay coast suggest that resident geese may comprise a substantial portion of the geese harvested in this area (Hughes et al. 1997). Clearly, geese molting along the Hudson Bay coast are likely to include birds from several populations.

In contrast, preliminary information suggests that few geese shot by Inuit hunters near Kuujjuaq (southern Ungava Bay) are large enough to be considered resident birds (Hughes et al. 1997). Furthermore, recoveries of birds banded in this area have all been in the Atlantic flyway. At this time, we have no information to indicate that geese utilizing this area include populations other than the Atlantic Population.

Interpreting the results of the total population estimate is difficult given the large gaps in our knowledge regarding 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), before molt migrants generally arrive. In contrast, the 1994 and 1995 surveys were completed in late June. During our stay in Povungnituk and Inukjuak (Hudson Bay coast), we observed (from the ground) the arrival of many flocks of molt migrants. The 1996 survey was completed within a day of the 1995 survey, but only a few flocks of arriving molt migrants were observed during our activities on the ground. Inuit hunters confirmed that few molt migrants were seen in 1996. In contrast, we observed numerous flocks of molt migrants arriving in the Povungnituk area in 1997.

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Table 1. Dates of Canada goose pair surveys conducted in northern Quebec[1] in 1988 and 1993-97.

Year	Survey Date	Peak Hatch Date - Hudson Bay[2]	Peak Hatch Date - Ungava Bay[2]
1988	23 May - 3 June		
1993	11-21 June		
1994	21 June - 1 July		
1995	18-24 June		
1996	17-25 June	7 July	2 July
1997	21-26 June	29 June	23 June

[1] In 1988, 1993, and 1996, the boreal forest was surveyed prior to the Ungava Peninsula.
[2] Peak hatching dates on Ungava Peninsula from Reed and Hughes (1996) and Reed and Hughes (1997).

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)
	1997	116000	458	11	0.19 (0.029)	21772 (3398)
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)
	1997	43500	491	21	0.74 (0.099)	32301 (4298)
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)
	1997	63200	290	4	0.15 (0.046)	9144 (2906)
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)
	1997	222700	1239	36	0.28 (0.028)	63216 (6201)

[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 (Harvey and Bordage 1996); 1997 (this report).

[c] Number of transects.

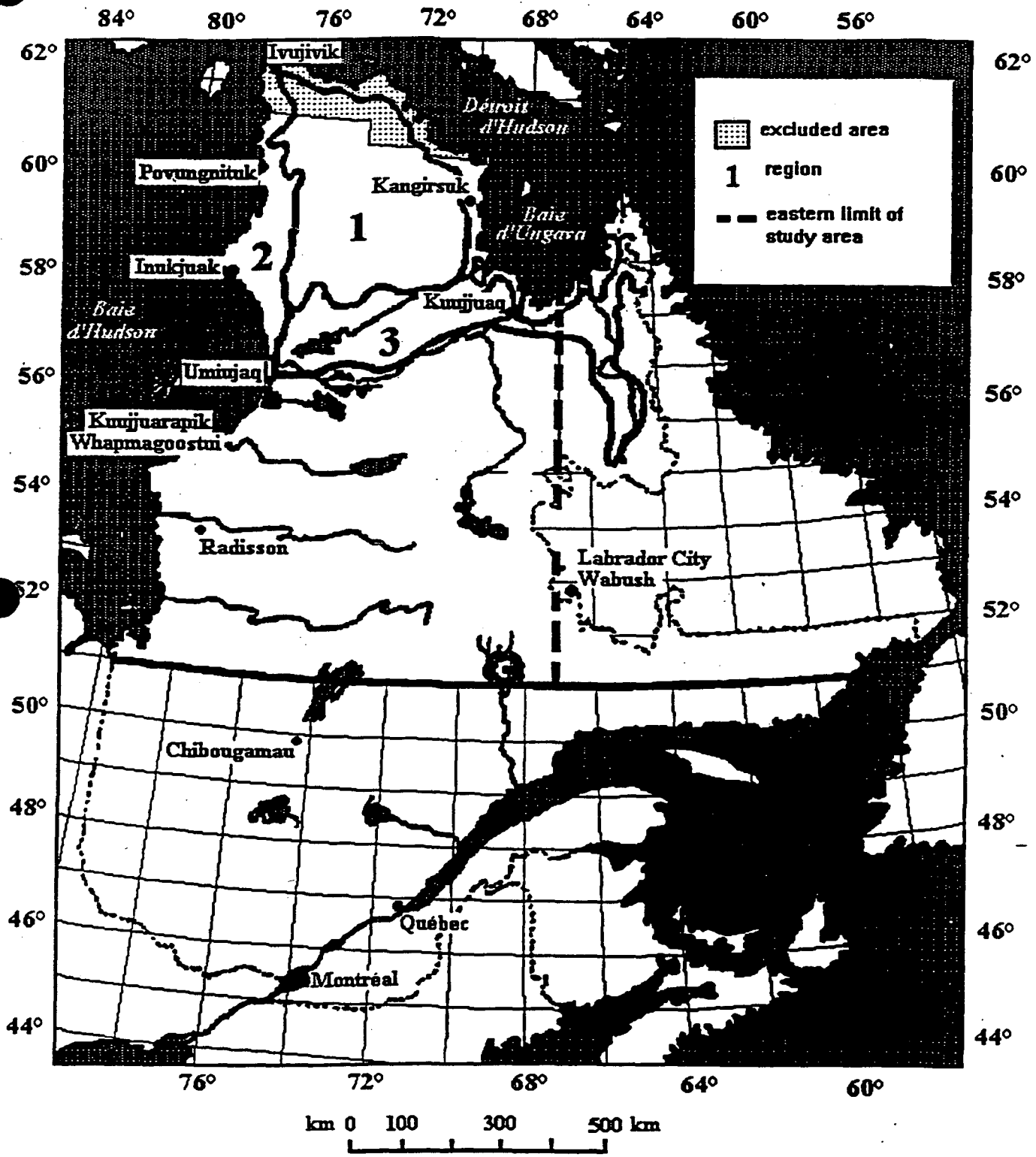

Figure 1. Study area for 1996 breeding pair survey in northern Quebec.

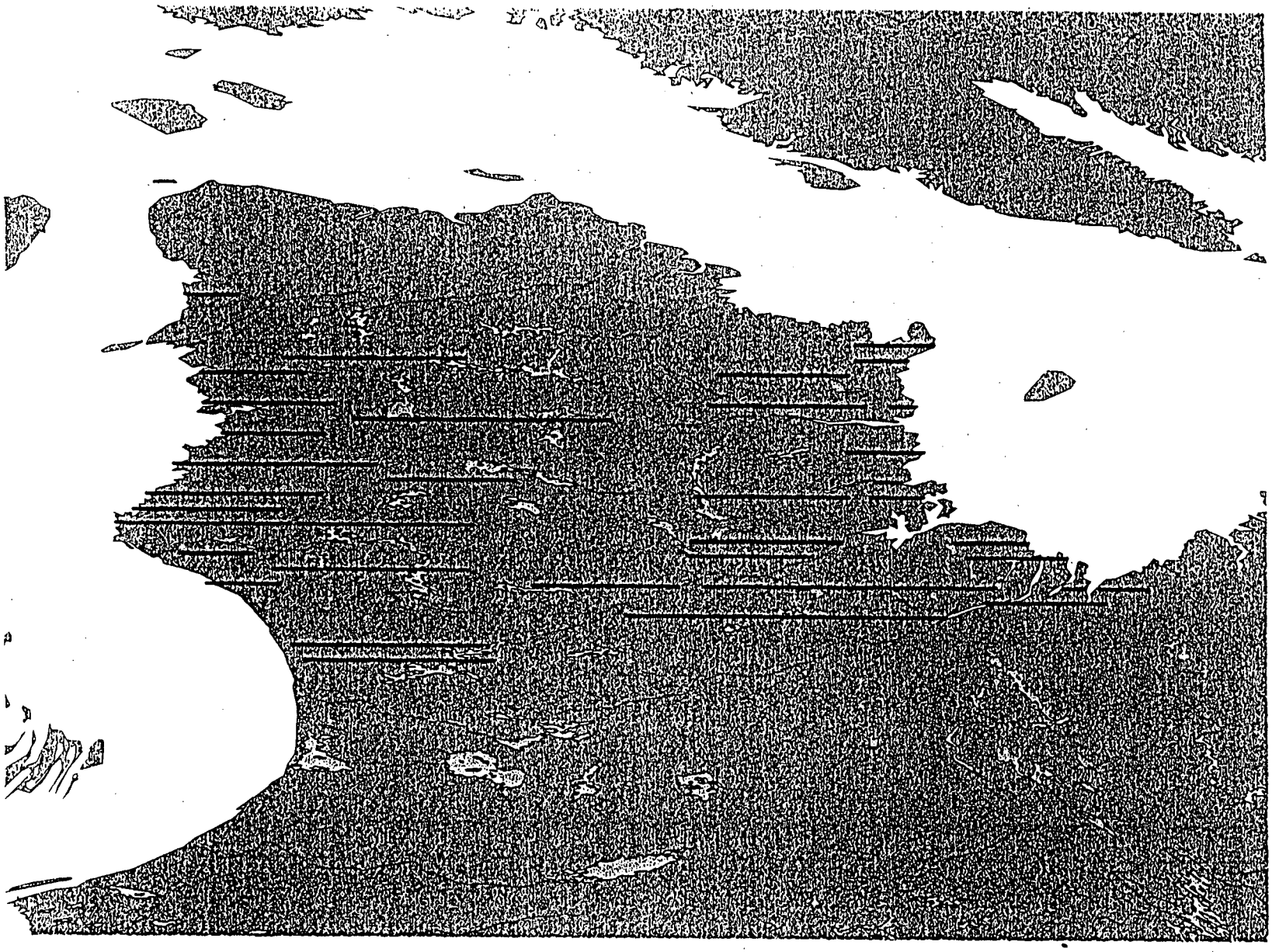

Figure 2. Location of aerial transects used for breeding pair survey of Canada geese in northern Quebec.

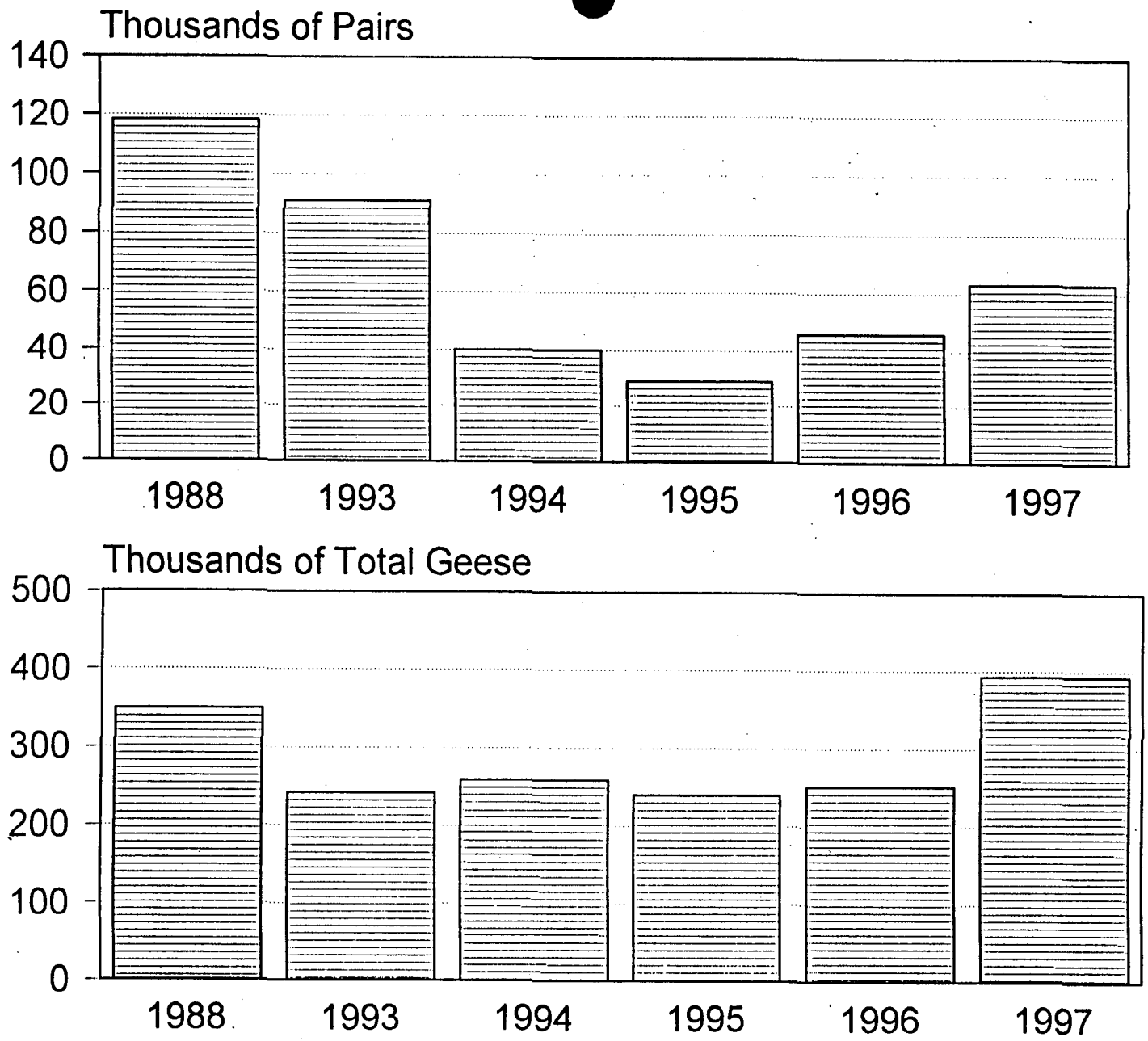

Figure 3. Estimated number of Canada goose breeding pairs and total geese on the Ungava Peninsula of northern Quebec during 1988 and 1993-97.

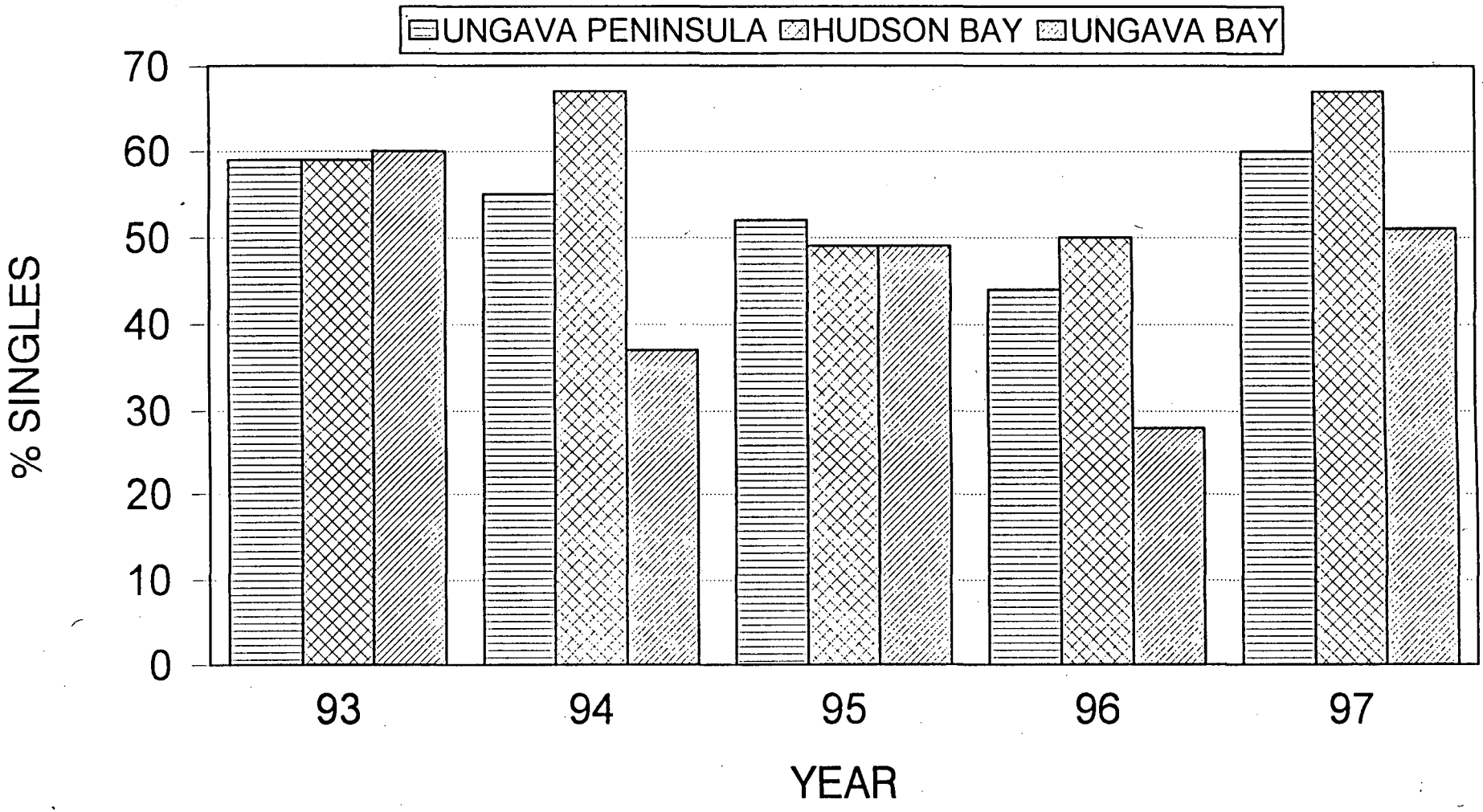

Figure 4. Percent of indicated Canada goose pairs (i.e., singles and pairs) that were observed as singles on the Ungava Peninsula and the coastal zones along Ungava Bay and Hudson Bay in 1993-97.

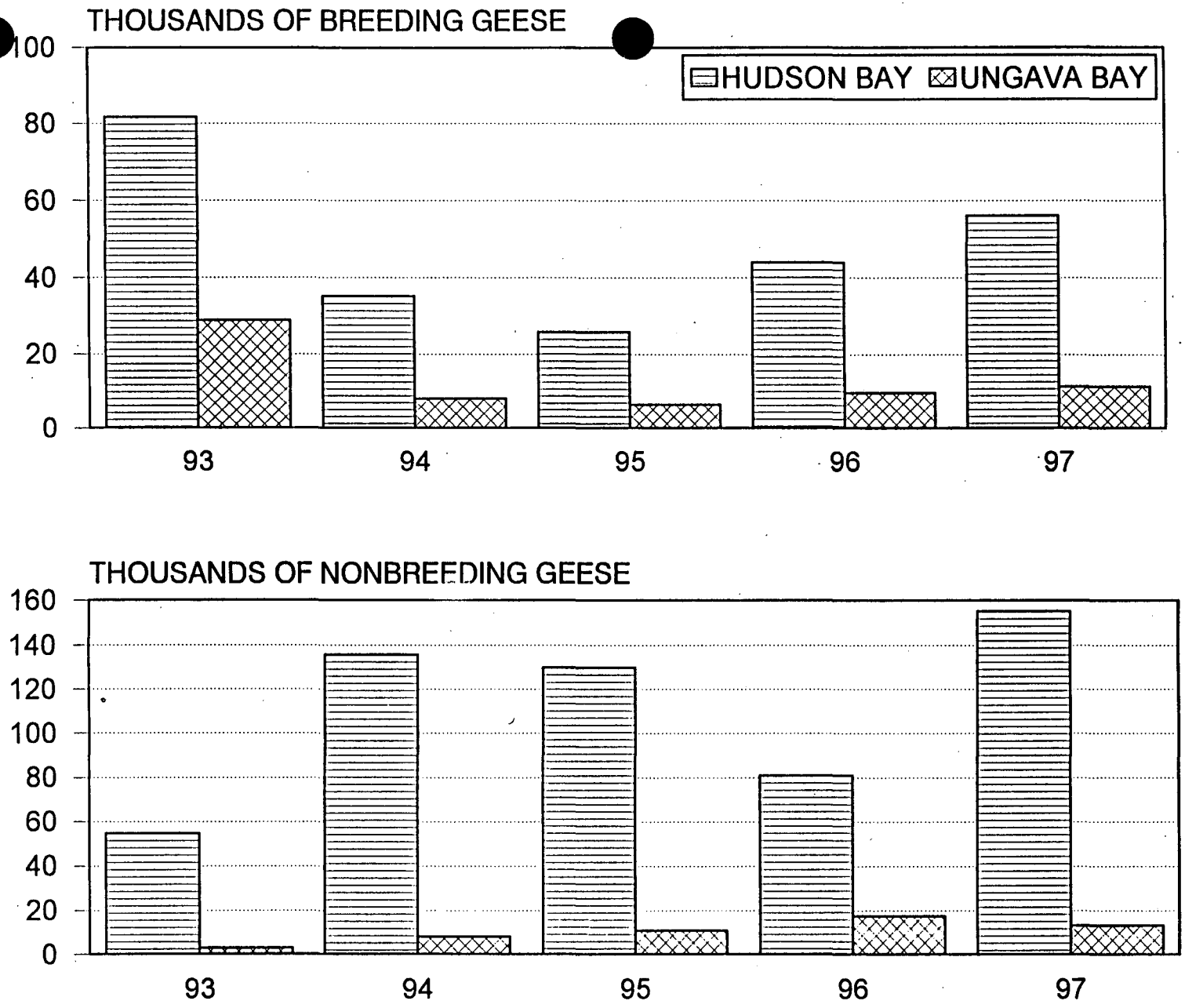

Figure 5. Estimated number of Canada goose breeding pairs and nonbreeding geese in the coastal zones along Hudson Bay and Ungava Bay in 1993-97.

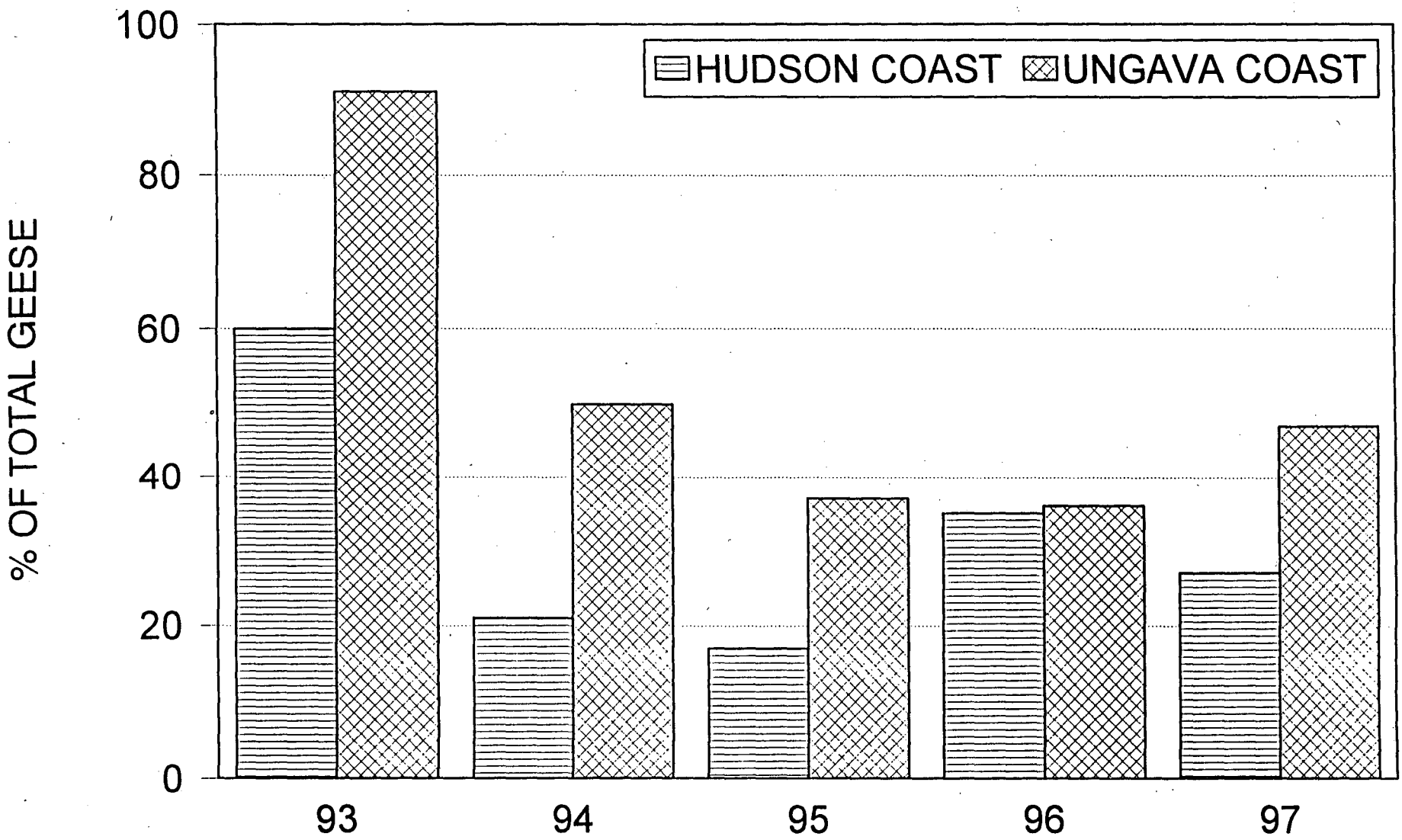

Figure 6. Percent of total Canada geese estimated for the coastal zones along Ungava Bay and Hudson Bay that were breeding pairs in 1993-97.