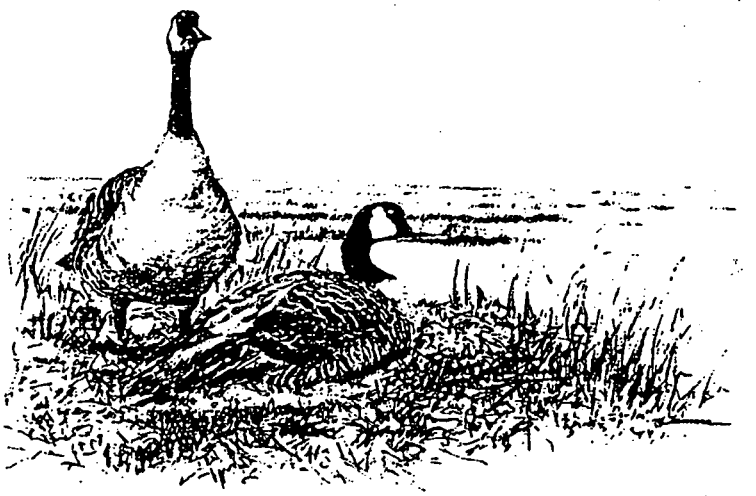
A BREEDING PAIR SURVEY OF CANADA GEESE IN NORTHERN QUEBEC - 1998



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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 geese on wintering areas has seriously compromised the value of mid-winter surveys for monitoring 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 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 1998 breeding grounds survey.

Acknowledgments: The 1998 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. Jean Rodrigue (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. 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), Alan Davenport (USFWS) and Larry Hindman (MD DNR).

STUDY AREA

The 1998 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 few geese use this mountainous area.

The boreal forest (region 4), approximately bounded by 51° and 57° latitude, was sampled in 1988, 1993, and 1996. 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 (i.e., next survey in 1999).

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. Observers also recorded similar information for other waterfowl species. Coordinates for each location were generated using a global positioning system (GPS) and stored on a lap-top computer. Transect width was calibrated before the survey began. Transects were flown using a GPS to assist with navigation.

Transects flown in 1998 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.

The observer team was changed in 1998 with the retirement of Andre Bourget and his replacement by Jean Rodrigue. We compared the average difference in the number of indicated pairs observed by transect among years by Andre Bourget (Observer 1, 1996 and 1997) and Jean Rodrigue (Observer 1, 1998) relative to William Harvey (Observer 2, present in all years) with a 1-way ANOVA.

RESULTS

Habitat Conditions and Spring Phenology

Transects were sampled from June 20-27, similar to survey dates in 1993-97, but later than the 1988 survey (Table 1). Warm spring temperatures and limited snowfall during winter contributed to a very early spring in 1998. In coastal habitat, all ponds were ice-free and snow occurred only in occasional 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 generally free of snow and ice cover. Ice remained on medium and large lakes in the area northwest of Kangirsuk. Habitat conditions and plant chronology were similar along the Hudson and Ungava Bay coasts.

The 1998 survey was later than previous surveys relative to the spring phenology and Canada goose reproduction (Table 1). In all previous surveys combined (1993-97), only 1 or 2 Canada goose broods were observed. In 1998, we observed 61 pairs with broods (20% of all indicated pairs). Other indicators of spring phenology, including plant growth and insect abundance, were also far more advanced in 1998 than in previous years.

Breeding Pair and Total Population Estimates

The distribution of breeding and nonbreeding geese was similar in 1998 to previous years, with the highest densities occurring in the coastal zone, and particularly along the Hudson Bay coast (Figure 3). The estimated number of breeding pairs on the Ungava Peninsula (regions 1,2, and 3) decreased in 1998 (42,166 pairs) from the 1997 estimate of 63,216 pairs ($P = 0.008$) (Table 2, Figure 4) . The number of indicated pairs observed in 1998 increased on 9 transects, remained the same on 3 transects, and decreased on 24 transects compared to 1997. The number of breeding pairs in 1998 was greater than the estimate for 1995 (29,302 pairs, $P < 0.028$), but less than 1993 (91,307 pairs) ($P < 0.001$) and 1988 (118,031 pairs) ($P < 0.001$) (Table 2).

In region 1 (inland tundra), the number of breeding pairs in 1998 (16,709 pairs) was greater than the 1995 estimate (8,101 pairs, $P = 0.023$), and similar to all other years ($P > 0.05$) (Table 2). The 1998 breeding pair estimate (19,006 pairs) for region 2 (coastal tundra) was less than estimates for 1997 (32,301 pairs, $P = 0.011$), 1993 (57,122 pairs, $P < 0.001$), and 1988 (70,833 pairs) ($P < 0.001$) and similar to all other years ($P > 0.05$) (Table 2). No difference in the number of breeding pairs was detected in region 3 (transition zone) between 1998 and any other year of the survey ($P > 0.20$) (Table 2).

Nonbreeding geese increased on 27 transects and decreased on 9 transects in 1998 compared to 1997. The total population estimate (breeding pairs + non-breeders) was greater in 1998 (462,414 individuals, SE = 60,580) 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) ($P < 0.009$), except 1988 (348,950

individuals; SE = 69,879; P = 0.219) and 1997 (392,956 individuals; SE = 52,112; P = 0.384) (Figure 4).

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 43% in 1998, the lowest level recorded during 1993-98 (mean = 52%, range = 43-60%) (Figure 5). 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 5). In 4 of 6 years (1994, 1996, 1997, and 1998), the percentage of indicated pairs observed as singles was lower on the Ungava Bay coast than along Hudson Bay (Figure 5). However, given differences in survey timing, results for 1998 should be compared cautiously with other years.

Comparison of Hudson and Ungava Bay Coasts

During 1993-98, the Hudson Bay coast supported an average of 81% (range = 74-84%) of the breeding pairs estimated for the coastal zone (region 2) (Figures 6 and 7). In 1998, the estimated number of breeding pairs decreased 40% along Hudson Bay and 44% on the Ungava Bay coast compared to 1997 (Figures 6 and 7). An average of 91% (range = 82-95%) of the nonbreeding geese estimated for the coastal zone were located along the Hudson Bay coast during 1993-98 (Figure 6 and 7). The estimated number of nonbreeding geese in 1998

increased 36% on the Hudson Bay coast (1997: 155,069 birds; 1998: 211,547 birds) and 82% along Ungava Bay (1997: 13,063 birds; 1998: 23,790 birds) (Figure 6 and 7) compared to 1997. In 1998, total Canada geese increased by 16% along the Hudson Bay coast and 24% along the Ungava Bay coast compared to 1997.

The proportion of total geese comprised of breeding pairs varied widely during 1993-98 in the Hudson and Ungava Bay portions of the coastal zone (Figure 8). However, in 5 of 6 years, a greater proportion of total geese were comprised of breeding pairs in the Ungava Bay portion of the coastal zone (Figure 8).

Comparison of Observers

The observer team was changed in 1998 with the retirement of Andre Bourget and his replacement by Jean Rodrigue. However, there was no difference among years ($F = 1.89$, 2, 105 df; $P = 0.157$) in the number of indicated pairs recorded by Observer 1 (1996: 0.47 pairs/transect, SE = 0.60; 1997: 1.0 pairs/transect, SE = 0.70; 1998: -0.67 pairs/transect, SE = 0.55) relative to Observer 2. Therefore, the change in observers in 1998 was unlikely to have had a major effect on the survey results.

DISCUSSION

The estimated number of Canada goose pairs on the Ungava Peninsula decreased 33% between 1998 and 1997. However, comparisons of the 1998 survey with previous years should be made cautiously. The timing of the 1998 survey was later than previous surveys relative to Canada goose breeding phenology. The presence of pairs with broods likely decreased the probability of detecting breeding pairs compared to surveys conducted during mid-late incubation (1993-97). The behavior of pairs with broods likely lowered their probability of

detection relative to incubating pairs in a couple of ways. First, pairs with broods were unlikely to run or fly when the survey plane approached. They were more likely to crouch down and remain still, making them difficult to detect. With incubating pairs, the male and sometimes both birds will usually run or fly when the survey plane passes over. Secondly, pairs with broods were occasionally observed in groups with nonbreeding geese (some of the associated geese were likely young from previous years). In instances where we could observe the brood, pairs associated with nonbreeding geese could be distinguished. However, pairs with hidden broods would appear to be part of the group and would be categorized as nonbreeding geese.

Data from field studies along Hudson and Ungava Bay indicate similar or slightly higher densities in 1998 compared to 1997 (Hughes and Reed 1998). Given the poor production that occurred in 1995 (the year-class that would enter the breeding population in 1998), little growth in the breeding population was expected. Habitat conditions at the time of the survey were the most favorable observed since 1993. Early nest initiation dates and large clutch sizes are consistent with the extremely early spring thaw (Hughes and Reed 1998). Overall, we expect excellent production in 1998 from a breeding population of roughly similar size to 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 estimates 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. This pattern was evident

again in 1998. Furthermore, in 4 of 6 years, the percentage of indicated pairs observed as singles has been higher along Hudson Bay compared to Ungava Bay, indicating that productivity may also vary between these areas.

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, USFWS, 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 markedly in 1997 and 1998 (Figure 4). 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 large numbers of birds from populations other than the Atlantic Population.

Despite the difficulty in interpreting the total population estimate, we believe that the total population in northern Quebec was larger in 1998. The increase in nonbreeding geese occurred throughout the study area (27 of 36 transects), including the Ungava Bay coast where most birds belong to the AP. As we have noted, the estimated breeding population is likely biased low because of lower visibility of pairs with broods. Growth in the total population estimate is consistent with the excellent production that occurred in 1997.

RECOMMENDATIONS

The results of this survey have become the primary means of monitoring the status of the AP. Unfortunately, because we conducted the 1998 survey later in the breeding cycle than in previous years, comparisons and interpretation are difficult. Plans for future years should include, if possible, a wider window of availability for the USFWS plane and pilot.

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Table 1. Dates of Canada goose pair surveys conducted in northern Quebec[1] in 1988 and 1993-98.

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
1998	20-27 June	20 June	22 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), Hughes and Reed (1998).

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

REGION[a]	YEAR[b]	TOTAL AREA (km^2)	SURVEYED AREA (km^2)	n[c]	PAIR /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)
	1998	116000	458	11	0.14 (0.033)	16709 (3769)
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)
	1998	43500	491	21	0.44 (0.067)	19006 (2986)
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)
	1998	63200	265	4	0.10 (0.022)	6452 (1402)
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)
	1998	222700	1214	36	0.19 (0.023)	42166 (5009)

[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 Borget 1996); 1997 (Harvey and Bourget 1997); 1998 (this report).

[c] Number of transects.

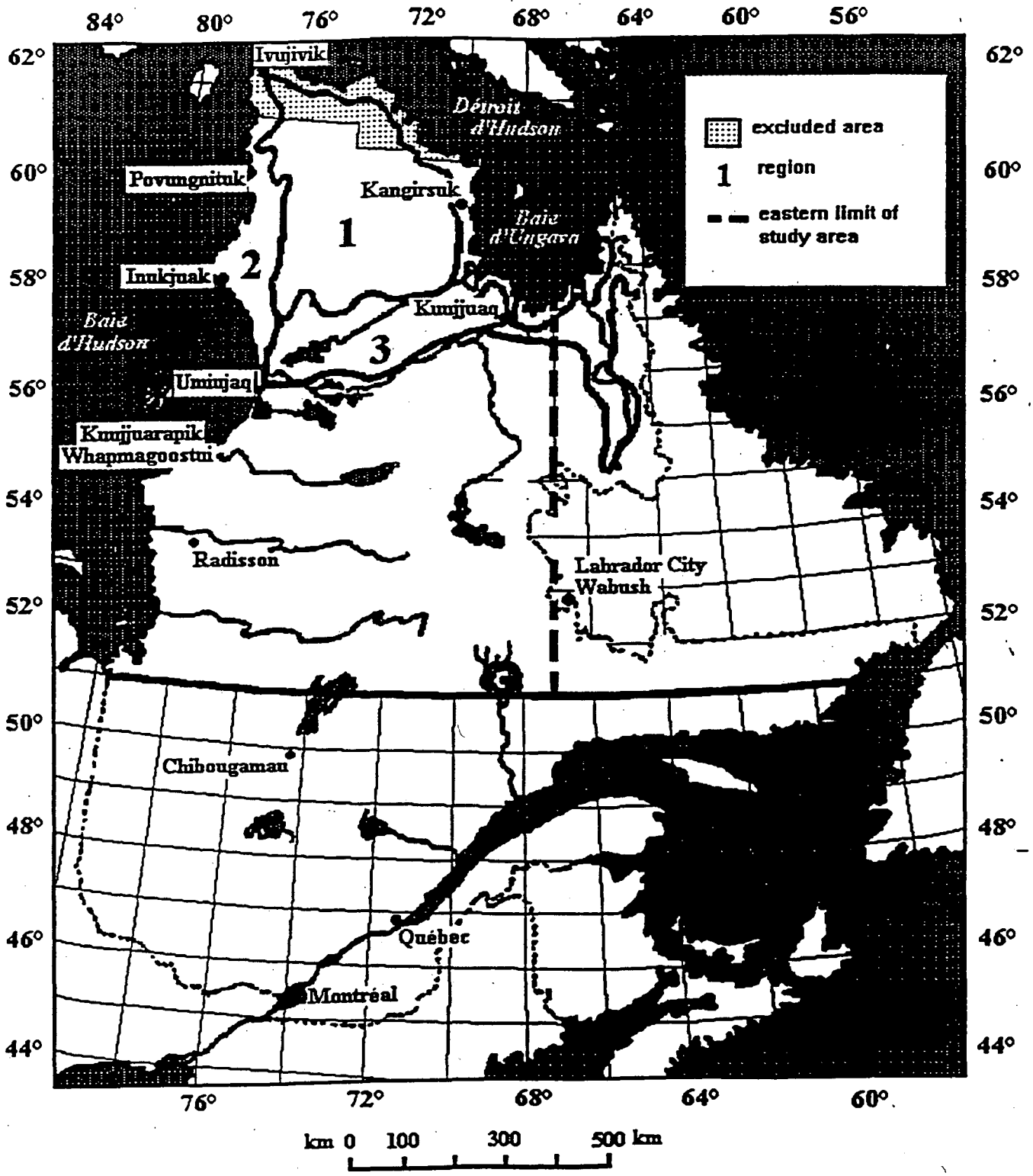

Figure 1. Study area for 1998 breeding pair survey in northern Quebec.

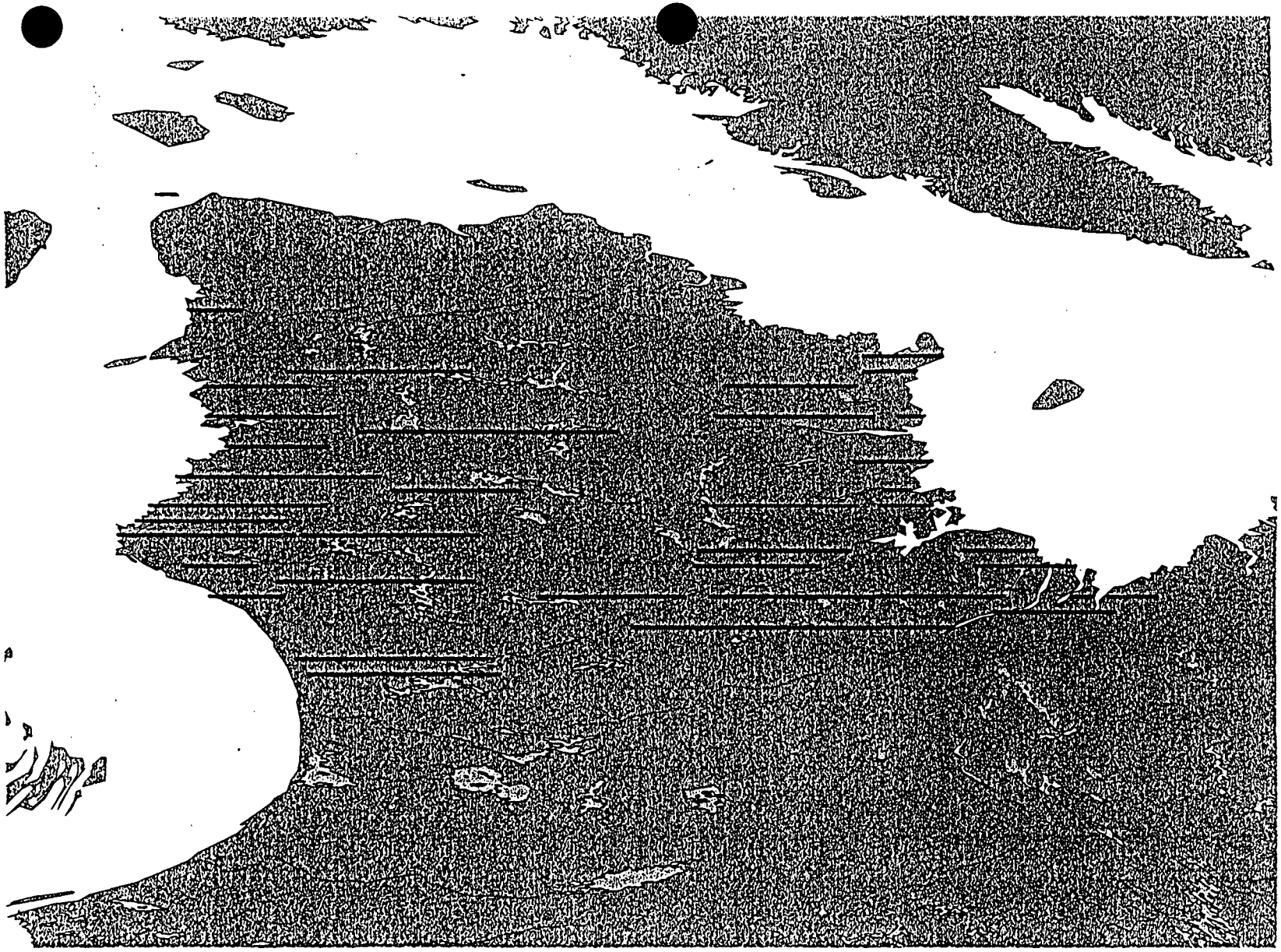

Figure 2. Location of aerial transects used for breeding pair survey of Canada geese in northern Quebec.

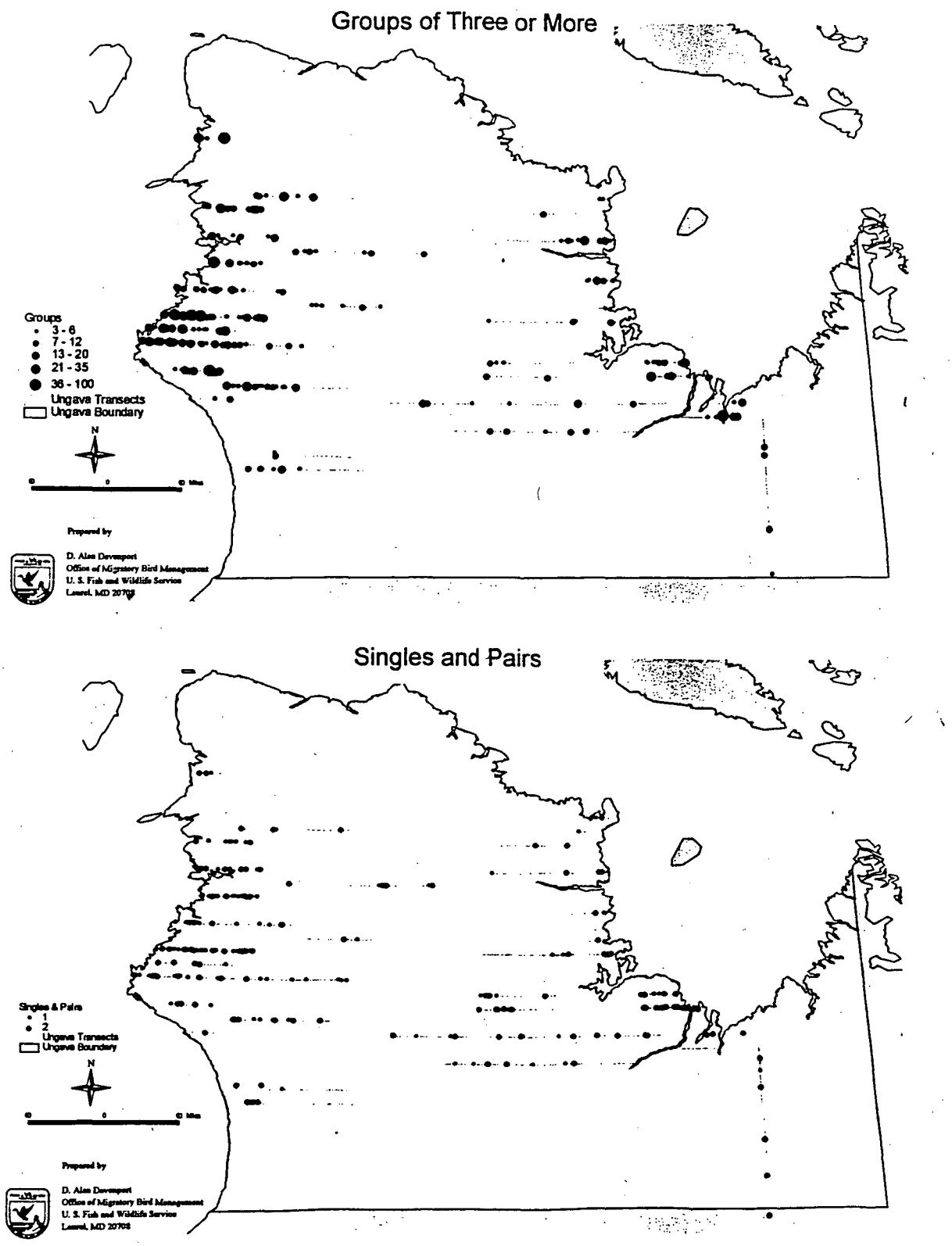

Figure 3. Distribution of observed Canada goose breeding pairs and nonbreeding geese in northern Quebec on transects surveyed in 1998.

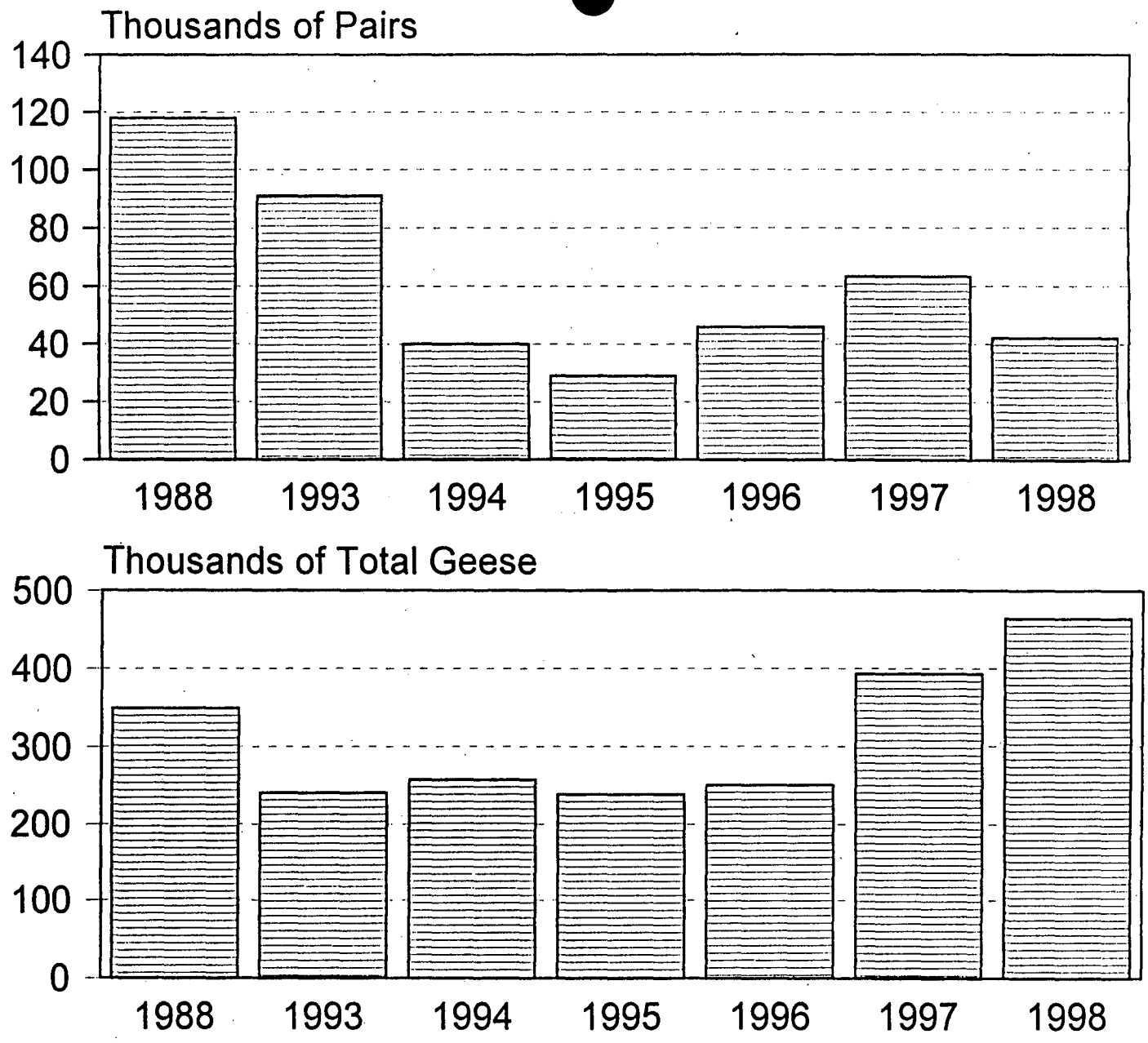

Figure 4. Estimated number of Canada goose breeding pairs and total geese on the Ungava Peninsula of northern Quebec during 1988 and 1993-98.

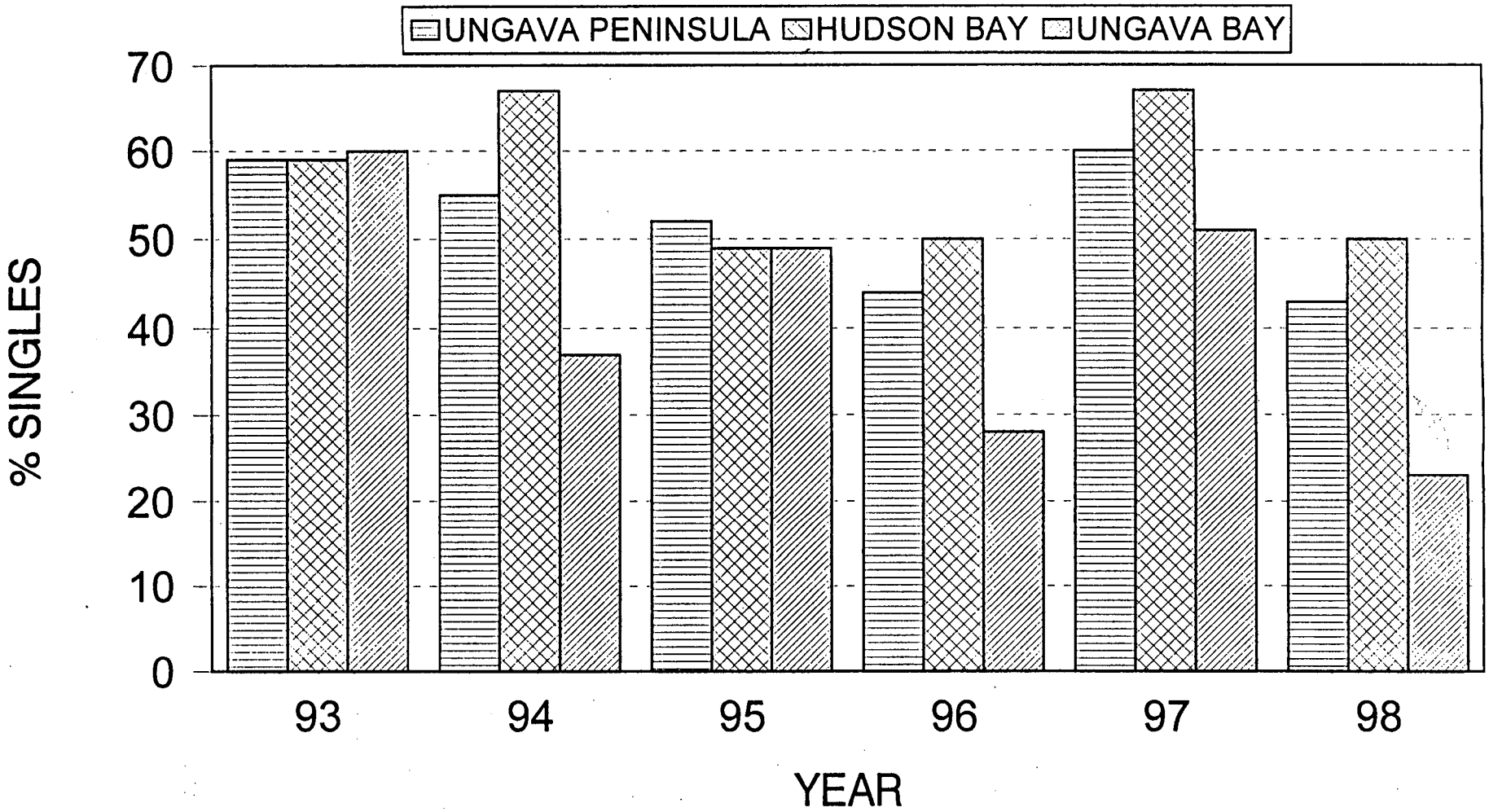

Figure 5. Percent of indicated Canada goose pairs (i.e., singles and pairs) that were observed as singles on the Ungava Peninsula and the coastal zones along Ungava Bay and Hudson Bay in 1993-98.

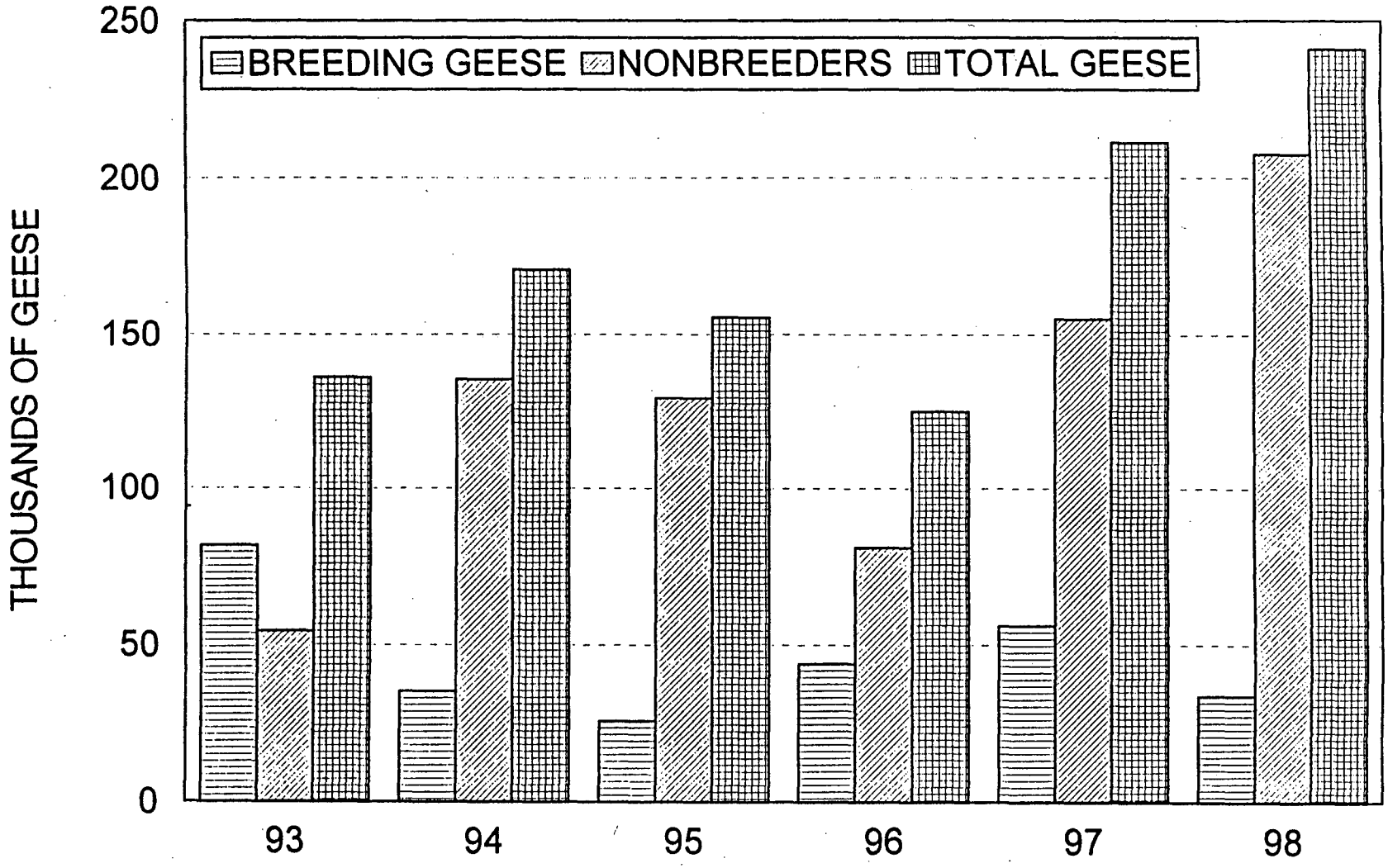

Figure 6. Estimated number of Canada goose breeding pairs, nonbreeding geese, and total geese in the coastal zone along Hudson Bay in 1993-98.

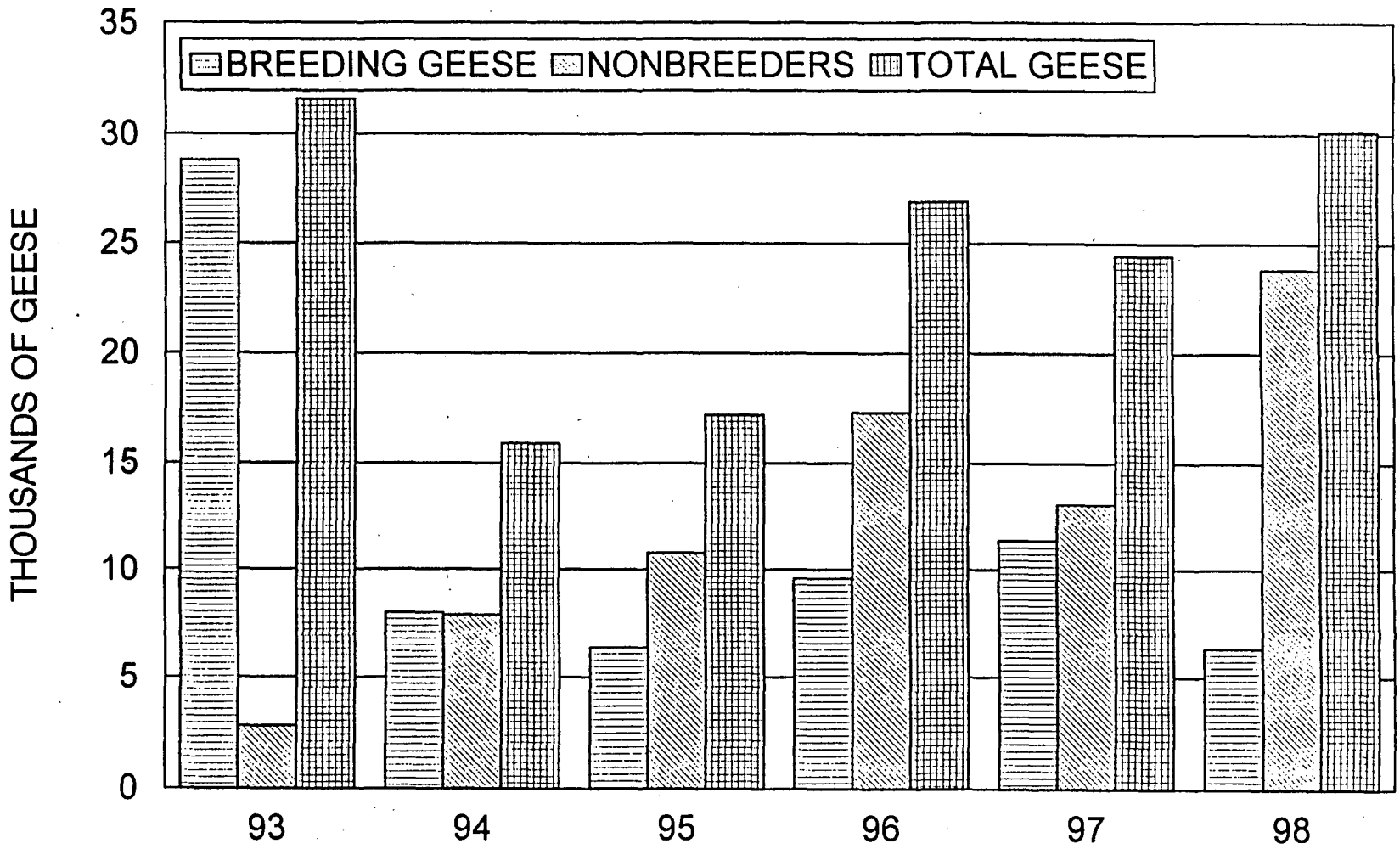

Figure 7. Estimated number of Canada goose breeding pairs, nonbreeding geese, and total geese in the coastal zone along Ungava Bay in 1993-98.

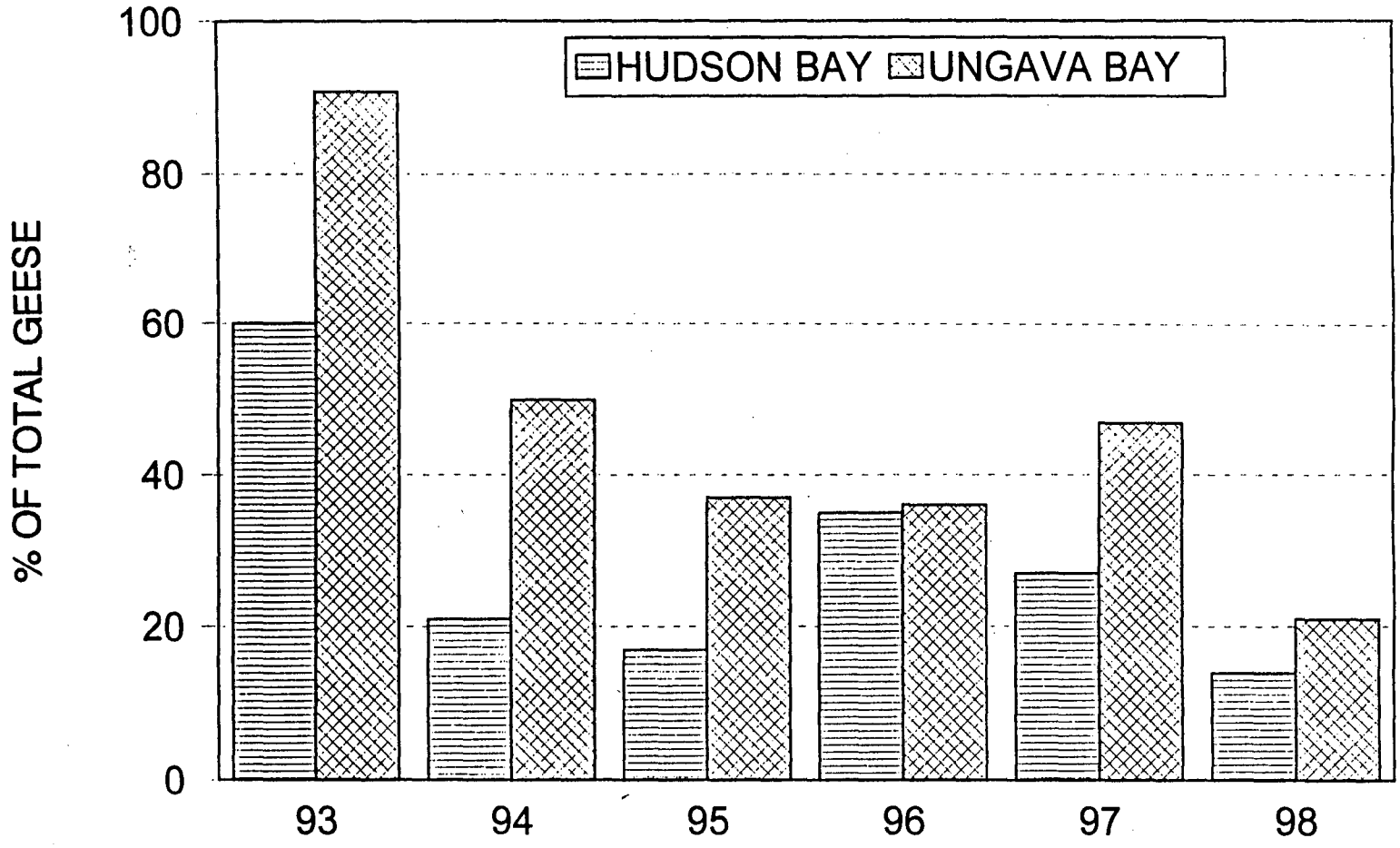

Figure 8. Percent of total Canada geese estimated for the coastal zones along Ungava Bay and Hudson Bay that were breeding pairs in 1993-98.