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Distribution and Abundance of Canadian Polar Bear Populations: A Management Perspective

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ABSTRACT. Seasonal fidelity to relatively local areas and natural obstacles to movements allow the range of polar bears (*Ursus maritimus*) in Canada to be divided into 12 relatively distinct populations. These divisions are not the only ones possible, and may not be the best ones; however, they were consistent with observed movements of marked bears. The average area of sea ice (mainly annual ice) that constitutes polar bear habitat for populations within and shared with Canada was estimated to total approximately 3.1 million km^2 in April each year. The density estimates of polar bears ranged between 1.1 and 10.4 bears per 1000 km^2 with a weighted mean of 4.1 bears per 1000 km^2. The sum of polar bear population estimates within or partially within Canada is approximately 12 700. However, the available data were insufficient to quantify the precision and accuracy of some population estimates.

Key words: abundance, Arctic, bear, distribution, polar bear, population, *Ursus maritimus*

RÉSUMÉ. La fidélité saisonnière des ours polaires (*Ursus maritimus*) à des régions suffisamment délimitées et des obstacles naturels à leurs déplacements permettent de diviser leur territoire au Canada en 12 populations relativement distinctes. Cette division n'est pas la seule possible et elle n'est peut-être pas la meilleure; elle cadre cependant avec les déplacements d'ours marqués que l'on a observés. On estime à environ 3,1 millions de km^2, en avril de chaque année, la superficie moyenne de la glace de mer (surtout de glace annuelle) qui constitue l'habitat de l'ours polaire pour les populations vivant à l'intérieur du Canada, ou communes à d'autres pays. L'estimation de la densité des ours polaires va de 1,1 à10,4 ours par 1000 km^2, avec une moyenne pondérée de 4,1 ours par 1000 km^2. Le total des populations d'ours polaires dont le territoire est situé en tout ou en partie au Canada est estimé à environ 12 700 individus. Les données disponibles sont cependant insuffisantes pour quantifier la précision et l'exactitude de certaines estimations de population.

Mots clés: abondance, Arctique, ours, distribution, ours polaire, population, *Ursus maritimus*

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INTRODUCTION

Polar bears are not circumpolar nomads as was once believed (Pederson, 1945); neither do they exist as genetically isolated stocks (Larsen et al., 1983). Land barriers, sea ice type, and sea ice movements have been proposed as explanations for the limited exchange observed between geographical areas (Lentfer, 1974, 1983; Stirling et al., 1975, 1977, 1980, 1984; Jonkel et al., 1976; Schweinsburg et al., 1982; Furnell and Schweinsburg, 1984; Larsen, 1985). More recently, seasonal fidelity to local areas (home ranges) has been suggested as another factor that may explain the tendency of marked animals to be recaptured close to the initial capture site (Amstrup, 1986; Stirling et al., 1988). Sea ice and land barriers to movements and a continuum of overlapping home ranges are not mutually exclusive hypotheses, because the barriers to movements are relative rather than absolute.

The International Agreement for the Conservation of Polar Bears of 1972 (Stirling, 1986) triggered an increased effort by the five arctic nations (Canada, United States, Greenland/Denmark, Norway, Russia) to place polar bear management on a scientific basis throughout the circumpolar basin. This effort has been particularly intensive in Canada, where about 692 polar bears per year (1986/87–1990/91 annual average) are harvested or killed to defend life or property.

Our purpose is to examine the geographic boundaries of the 12 polar bear populations that are within or are shared with Canada, to list the population estimates available for these subgroups, to provide an estimate of the area of sea ice habitat used by polar bears in these populations, and thereby to estimate the density of each subgroup. We also consider some aspects of the existing data that may distort current perceptions of polar bear population numbers and spatial units.

Ricklefs (1986:507) notes: "Ecologists apply the term population very loosely to pragmatically defined assemblages of individuals of one species." Similarly, Lincoln et al. (1982:199) define a population as: "A group of organisms of one species, occupying a defined area and usually isolated to some degree from other similar groups." We use the term population to mean simply the individual polar bears that inhabit a given geographic area. We do not claim that the populations thus defined are genetically isolated, nor do we

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claim that the geographic boundaries are absolute. We acknowledge that immigration and emigration do occur.

For management purposes, populations should be sufficiently large that the effects of immigration and emigration on population dynamics can be ignored relative to rates of birth and death within the enclosed area. Canadian polar bear populations were chosen to conform to the above criteria, and to be as small as possible to confer a sense of stewardship on the communities that harvest polar bears from the population. Ideally, a boundary line would fall where there were land, sea-ice, or open-water barriers to movement; however, a continuum of overlapping home ranges could be meaningfully divided into populations if the units were sufficiently large. We examine only populations that have already been proposed as polar bear management units.

We did not attempt to determine which population boundaries were optimal, because the data were insufficient to approach that question in an objective way. Our data were mainly observations of movements of bears that were marked and recaptured, or marked and killed by hunters. These data were biased, in that the only movements that could have been observed were between locations where bears had been marked and locations where bears had been recaptured or killed. Both initial marking and subsequent recapture or hunting activities were geographically non-random. These data could not provide unbiased estimates of migration rates. However, these data were sufficient to examine the null hypothesis of equal use of adjacent areas (e.g., populations so small that individuals used adjacent population areas equally).

The populations proposed as management units were based partly on reconnaissance data that indicated sea ice and land barriers to movements (C. Jonkel as related by I. Stirling, pers. comm. 1992), discontinuities to movements as determined by mark-recapture and mark-kill (Lentfer, 1974, 1983; Stirling et al., 1975, 1977, 1980, 1984; Jonkel et al., 1976; Schweinsburg et al., 1982; Furnell and Schweinsburg, 1984; Larsen, 1985), and partly on management considerations given the geographic location of polar bear harvest activity. The current boundaries (Fig. 1) were established by the Canadian Federal-Provincial Polar Bear Technical Committee, which modified the initial boundaries after reviewing published and unpublished data, reconnaissance surveys, ice maps, land forms, and ocean currents (Calvert et al., in press).

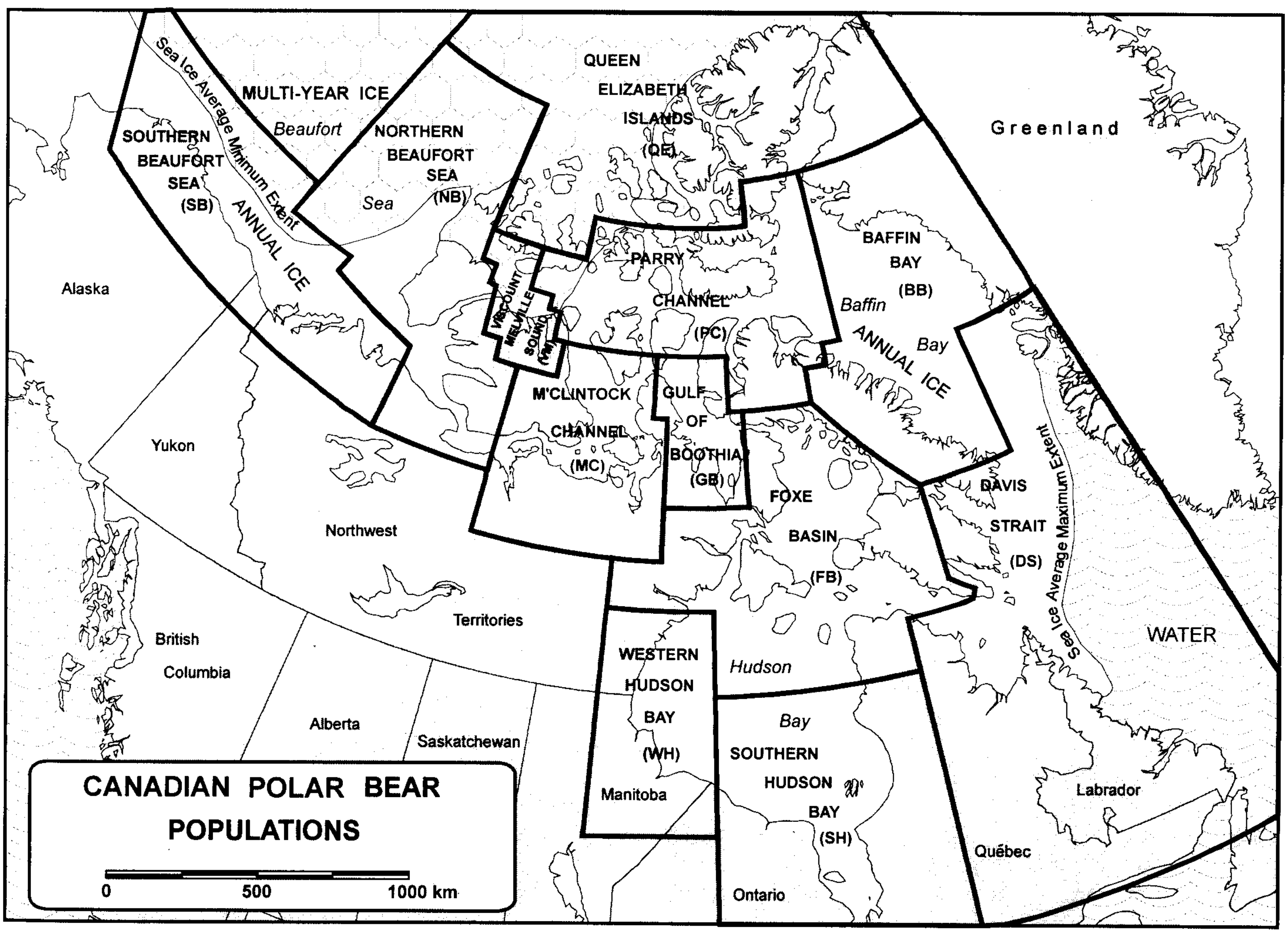

FIG. 1. Analysis based on the movements of marked and recaptured/killed polar bears indicates that Canada has twelve polar bear populations. Four are shared with other countries. The average southern limit of sea ice and the average northern retreat of sea ice are shown.

METHODS

Capture and Marking

Polar bears were captured mainly from a helicopter using remote injection equipment (Cap-Chur, Palmer Chemicals Ltd., Douglasville, Georgia). Capture and marking techniques have been described by Lentfer (1968), Larsen (1971), Schweinsburg et al. (1982), and Ramsay and Stirling (1986). Each animal handled was permanently marked with an individual identification tattoo and ear tags.

Population Boundaries

We evaluated population boundaries by comparing movements of individual animals between two adjacent areas (Lentfer, 1983). The null hypothesis was that a population in question occupies the two areas as all or a subset of its range (i.e., we hypothesize equal use of adjacent areas). If the proposed populations were too small to be meaningful, polar bears would as likely be found in an adjacent population as in the one where they were initially captured. We evaluated the null hypothesis of equal use of adjacent populations (e.g., I and II) with a Fisher's exact test (Fisher, 1958) analysis of a 2×2 contingency table which tabulates bears recaptured in population I that were marked in populations I and II, and bears recaptured in population II that were marked in populations I and II. The Fisher's exact test examines the equality of the ratios (I→I)/(II→I) to (I→II)/(II→II) which would be equal under the null hypothesis. We considered differences to be significant at the $p \leq 0.05$ level.

Some areas compared were adjacent to more than one area. Animals could have moved to adjacent areas that were not included in the relevant pair-wise comparison. The Bonferroni rule of joint confidence (Miller, 1966; Neu et al., 1974) was employed to determine the probability required for rejection of a family of 12 adjacent populations. Only pair-wise comparisons were made to ensure that all animals in a given analysis had access to both categories (Byers et al., 1984). Although no area bordered all other areas, the family of 12 (all areas possible) correction to the rejection criteria was chosen to ensure the test was conservative (i.e., that although the power of the test was reduced, the probability of rejecting a true null hypothesis by chance was definitely less than 0.05).

All marked individuals were permanently and uniquely marked in all populations, and the marks were assumed to be always recognized. The only exception was for the Foxe Basin and surrounding populations, where the mark-recapture data was augmented with between year (spring to spring) radio telemetry locations. Not all bears with radio collars were located each spring, and only one movement (April to April) was recorded per bear.

Population Estimates

Population estimates were obtained using various mark-recapture models (Calvert et al., in press; Table 1). The estimates for populations Southern Hudson Bay, Foxe Basin, Davis Strait, M'Clintock Channel, Gulf of Boothia, Southern Beaufort Sea, and Northern Beaufort Sea were calculated using an age-constant survival rate model (DeMaster et al., 1980) to estimate the number of marked animals in the population. The survival rate was estimated from the standing age structure (Chapman and Robson, 1960).

Density Estimates

We estimated the density of polar bears by dividing the population estimate by the average area of available habitat in April. Definition of available habitat was guided by Stirling et al. (1975) and Stirling (1988), who indicated that multi-year ice was not frequently used by polar bears. The area of polar bear habitat was delineated by the average southern extent of the ice pack in winter, and the average northern retreat of the ice pack in summer. Areas containing some multi-year ice, but south of the average summer ice edge, were included with areas that were ice free in summer as "polar bear habitat." The areas of habitat, excluding islands, were measured using a digital polar planimeter and on the basis of ice coverage information (Weeks, 1978; Dey et al., 1979). All areas were measured twice to determine the mean deviation, and to check for mechanical or operator error. The mean deviation was 0.89% and the maximum deviation was 2.7% in the replicate measurements. We used the average of the two measurements.

RESULTS

The data are summarized with Fisher's exact test tables (Fig. 2). The null hypothesis of equal use was rejected for pair-wise comparisons of all 12 proposed populations of polar bears (Fig. 1) within or shared with Canada (Table 1). The existing data were insufficient to estimate exchange rates between areas.

The sum of the population estimates indicated that the total population of polar bears within or shared with Canada was approximately 12 670 (Table 2). The existing data were inadequate to quantify the precision and accuracy of some individual or the summed estimates (Calvert et al., in press). The spring densities of Canadian polar bear populations ranged between 10.4 and 1.1 bears/1000 km^2 of habitat (Table 2). The average density was 4.1 bears/1000 km^2.

DISCUSSION

Our analysis was not sufficient to discriminate between the "barrier to movements" and the "overlapping home range" possibilities, because either mechanism would result in animals not moving freely between the two areas. Polar bears are extremely mobile, and absolute barriers to movements have not been identified for any populations. Mating between individuals from widely separated populations is probably

TABLE 1. Equal use tests for adjacent polar bear population areas are given for each North American pair. The rejection criteria for two-tailed 95% confidence intervals for families of 12 was determined to be 2 ¥ 10^{-3} using the Bonferroni rule of joint confidence.

Population Comparisons	Fisher's Exact Test (two-tailed probability)
Western Hudson Bay - Southern Hudson Bay	3.2×10^{-164}
Western Hudson Bay - Foxe Basin	6.4×10^{-178}
Southern Hudson Bay - Foxe Basin	1.8×10^{-67}
Foxe Basin - Baffin Bay	2.9×10^{-65}
Foxe Basin - Davis Strait	8.9×10^{-45}
Foxe Basin- Gulf of Boothia	7.1×10^{-39}
Foxe Basin - Parry Channel	2.6×10^{-106}
Baffin Bay - Davis Strait	6.4×10^{-42}
Baffin Bay - Parry Channel	1.7×10^{-65}
Viscount Melville Sound - M'Clintock Channel	2.2×10^{-39}
Viscount Melville Sound - Parry Channel	2.2×10^{-54}
Viscount Melville Sound - Queen Elizabeth Islands	4.8×10^{-5}
Viscount Melville Sound - Northern Beaufort Sea	4.9×10^{-46}
M'Clintock Channel - Gulf of Boothia	2.9×10^{-26}
M'Clintock Channel - Parry Channel	2.6×10^{-92}
M'Clintock Channel - Northern Beaufort Sea	5.7×10^{-80}
Gulf of Boothia - Parry Channel	1.2×10^{-40}
Parry Channel - Queen Elizabeth Islands	8.2×10^{-5}
Queen Elizabeth Islands -Northern Beaufort Sea	5.2×10^{-6}
Southern Beaufort Sea - Northern Beaufort Sea	1.3×10^{-32}

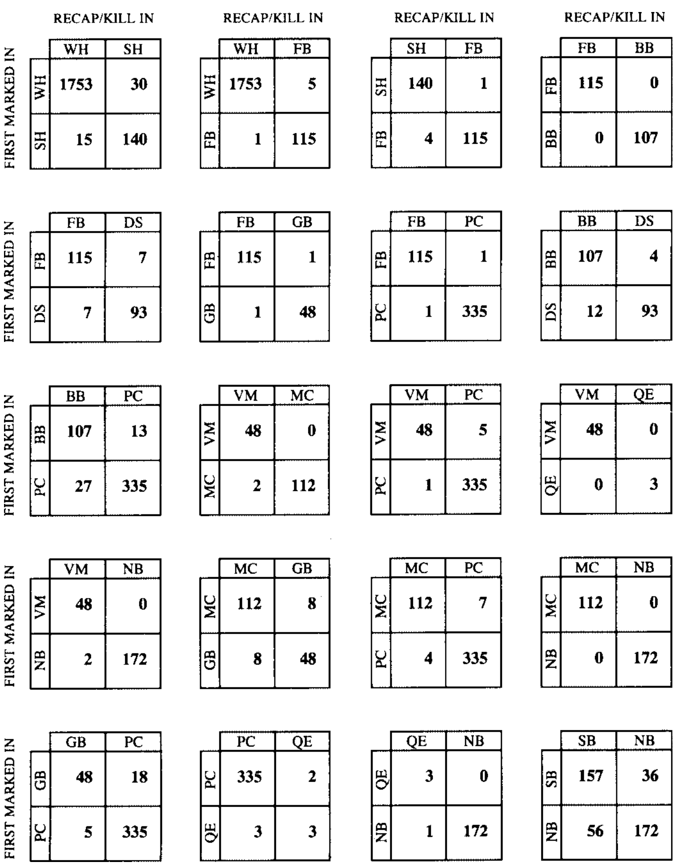

FIG. 2. Equal use tests for adjacent polar bear population areas were based on pair-wise comparisons (Fisher's Exact Test) of movements for the following populations: Southern Hudson Bay (SH), Western Hudson Bay (WH), Foxe Basin (FB), Davis Strait (DS), Baffin Bay (BB), Parry Channel (PC), Queen Elizabeth Islands (QE), Gulf of Boothia (GB), M'Clintock Channel (MC), Viscount Melville Sound (VM), Northern Beaufort Sea (NB), and Southern Beaufort Sea (SB).

TABLE 2. Current Canadian polar bear population numbers (Calvert et al., in press) and densities on the spring (April) sea ice are given for the Western Hudson Bay (WH), Southern Hudson Bay (SH), Foxe Basin (FB), Baffin Bay (BB), Davis Strait (DS), Viscount Melville Sound (VM), M'Clintock Channel (MC), Gulf of Boothia (GB), Parry Channel (PC), Queen Elizabeth Islands (QE), Southern Beaufort Sea (SB), and Northern Beaufort Sea (NB).

Population	Number	Habitat Area ($1000\ km^2$)	Density per $1000\ km^2$
WH[1]	1200	pooled[1]	3.5
SH[1]	1000	pooled[1]	3.5
90% of FB[1]	1820	pooled[1]	3.5
WH + SH + 90% FB[1]	4020	1148.4[1]	3.5
BB	470	413.5	1.1
DS	950	420.1	2.3
VM	230	46.8	4.9
MC	700	146.5	4.7
GB	900	86.8	10.4
PC	2000	338.0	5.9
QE	200	54.0	3.7
SB	1800	255.9	7.0
NB	1200	183.8	6.5
	Σ = 12 672[1]	Σ = 3 093.8	
	Weighted mean density:		4.1
	Standard deviation:		2.64
	Coefficient of variation:		0.528

[1] Approximately 90% of FB population is located in Hudson Bay in spring. The other 10% is distributed at very low density in Foxe Basin. The WH, SH, and FB populations are separate during the ice-free season. However, during the winter and spring, these populations are intermixed in Hudson Bay and western Hudson Strait. We pooled the three population estimates and used the total Hudson Bay-Hudson Strait area to determine a common spring density estimate for these populations. Foxe Basin sea ice was not included because of the strong currents and shallow water there. The sum of the population estimates includes the 10% of the FB population that is located in Foxe Basin in April.

not frequent, but there has been no suggestion that genetic differences between polar bears from different geographic areas are sufficient to provide barriers to interbreeding (Larsen et al., 1983; Cronin et al., 1991). The populations specified are intended as management units which may also be ecological units.

The data were not collected in a manner that would allow meaningful calculation of exchange rates across the proposed boundaries. Observations of mark-recapture polar bear movements depend on polar bear movements and on geographic allocation of capture and recapture effort. Logistic constraints and an emphasis in most areas on capturing as many bears as possible made the geographic allocation of capture effort highly non-random.

Population boundaries imply barriers to movements between populations. For many management purposes (e.g., allocation of polar bear quotas), it would be useful if these boundaries were absolute, so that harvest activities only affected the populations where the harvest occurred. However, limited exchange is also sufficient to establish useful boundaries. In the case of overlapping home ranges, the size of the home range relative to the population area determines the usefulness of a proposed boundary. The average home range should be small compared to the population area. When there is an actual barrier to movements causing a discontinuity in distribution, the location of the boundary is fixed. Our population boundaries range between these two extremes. Although we rejected the hypothesis of equal use for all 12 populations, this is not a demonstration that these are the only or the best population units for management, or any other purpose. Our evidence and the existing data support the boundaries that are being used, but these boundaries may be modified as more information becomes available. Recent studies (Amstrup, 1995) suggest the boundaries proposed (Fig. 1) can be examined more critically using satellite telemetry.

Satellite telemetry results in Alaska (Amstrup, 1995) corroborate Stirling's (1988) suggestion that spring polar bear densities are low in areas dominated by multi-year ice. About 68% of the polar ice region (measured during maximum seasonal ice coverage) is suitable habitat for polar bears. The remainder is heavy multi-year pack ice. This multi-year ice is suitable for denning because of the snow drifts which form on the rough ice and the low densities of other (particularly adult male) polar bears (Amstrup and Gardner, 1994).

The two lowest densities estimated were for the Baffin Bay (1.1/1000 km^2) and Davis Strait (2.3/1000 km^2) populations. The estimate for the Baffin Bay population was calculated after a period of over-harvest that may have reduced the population (Lloyd, 1986). It is also possible that these populations were underestimated by studies that captured polar bears in coastal areas only. The high density observed for the Gulf of Boothia population (10.4/1000 km^2) is consistent with reconnaissance surveys (Taylor, unpubl. data) and local information. Alternatively, the high density recorded may suggest that the population estimate for this area should be used with caution until it can be confirmed.

Using similar methods, Amstrup and DeMaster (1988) estimated the density of polar bears in the Southern Beaufort Sea as 5.1/1000 km^2, and in the Canadian portion of the Southern Beaufort Sea and Northern Beaufort Sea as 8.3/1000 km^2.

The density of barrenland grizzly bears (*Ursus arctos*) along the arctic coast of Canada has been reported as 3.8–4.7/1000 km^2 (Nagy et al., 1983) and 10.0–10.5/1000km^2 (Clarkson and Liepins, 1992). Reynolds and Garner (1987) reported grizzly densities of 22.9/1000 km^2 in the western Brooks Range and 6.8/1000 km^2 in the eastern Brooks Range. The density of wolves (*Canis lupus*) in the National Petroleum Reserve in Alaska was reported to be 1.9–2.6/1000 km^2 (Stephenson, 1979), and in the Arctic National Refuge of Alaska 1.4–1.5/1000 km^2 (Weiler and Garner, 1987). Polar bear densities (average = 4.1/1000 km^2, Table 2) appear to be similar to other populations of carnivores at arctic latitudes.

Populations occurring in areas of mixed annual and multi-annual ice appear to support higher densities than areas that do not contain multi-year ice. The habitats of the Western Hudson Bay, Foxe Basin, Baffin Bay, and Davis Strait populations are mainly unconsolidated annual pack ice in spring. The estimated densities for these areas ranged between 1.0 and 3.2 per 1000 km^2. In comparison, the densities in areas where there is a mixture of relatively consolidated multi-year and annual ice (i.e., M'Clintock Channel, Gulf of Boothia, Parry Channel, Southern Beaufort Sea, Northern Beaufort Sea) ranged between 4.7 and 10.4 per 1000 km^2.

Comparison of densities in different areas is complicated by local differences in the spring sea ice habitat. Exclusion of the multi-year sea ice and land areas restricts the habitat to shorefast ice and active pack ice. Stirling et al. (1981) documented differences in polar bear densities between shorefast ice, floe edge, and active ice containing mixed annual and multi-year ice in the Beaufort sea. Some areas such as M'Clintock Channel and Amundsen Gulf are covered entirely by landfast ice. Other areas such as Hudson Bay and Baffin Bay are mainly unconsolidated annual pack ice. A measure which lumps both types of habitat must be regarded as a first approximation. However, the distribution of ice types and relative use by polar bears has been documented only for the eastern Beaufort Sea (Stirling et al., 1981).

Stirling (1988) suggested that the world total number of polar bears could be represented as 14 populations totalling 21 000 polar bears. The population estimates given were for overlapping areas in several cases, and some areas were not included. Stirling (1988) further suggested that the total population might be as large as 40 000 animals because of incomplete or inaccurate survey data. Extrapolation of the mean density observed in Canada to the total "polar bear habitat" (same criteria as in Methods) in the circumpolar basin suggests a world population of approximately 28 000 animals. A recent status report (IUCN/SSC Polar Bear Specialists Group, in press) estimated the total number of polar bears at between 21 470 and 28 370. On the basis of this range of estimates, Canada appears to contain roughly half of the world's polar bears.

The accuracy of polar bear mark-recapture population estimates has been limited by non-random capture of animals and poor estimates of adult survival. Logistic limitations have restricted most polar bear capture work to areas accessible from arctic communities. Analyses of recapture and harvest movement data document that polar bears show seasonal fidelity to local areas, and that the fidelity to a given location is greatest in areas where the sea ice melts completely (e.g., Hudson Bay) and in areas where movements are constrained by island archipelagos (Table 1, Stirling et al., 1975, 1977, 1980, 1984; Jonkel et al., 1976; Stirling and Kiliaan, 1980; DeMaster and Stirling, 1981; Schweinsburg et al., 1982; Taylor, 1982; Larsen et al., 1983; Lentfer, 1983; Furnell and Schweinsburg, 1984; Amstrup et al., 1986). The observed ratios of marked to unmarked animals (and the subsequent population estimates) have been influenced by the geographic areas where polar bears were marked, and the geographic areas where recapture effort was allocated. The degree of "capture bias" has not been quantified for any polar bear mark-recapture estimates.

The various multi-year mark-recapture models vary mainly in the manner by which the mortality of marked animals is estimated. For reasons not clearly understood, models that estimate the survival of marked animals from multi-year mark-recapture sampling have not provided reasonable estimates of annual survival in some studies (DeMaster et al., 1980). Polar bear population estimates for the Southern Beaufort Sea (Amstrup et al., 1986), Northern Beaufort Sea (Stirling et al., 1988), Viscount Melville, M'Clintock Channel, Gulf of Boothia (Schweinsburg et al., 1981; Furnell and Schweinsburg, 1984), Parry Channel (Schweinsburg et al., 1982), Baffin Bay (Lloyd, 1986), Davis Strait (Stirling et al., 1980), Southern Hudson Bay (G. Kolenosky, unpubl. data 1992), and Svalbard (Larsen, 1985) use a modified Lincoln-Peterson method proposed by DeMaster et al. (1980) which estimates the survival of marked animals by log-linear regression of the standing age distribution. Chapman and Robson (1960) showed that the logarithmic transformation introduces bias into the geometric survival model. Caughley (1977) noted that either approach yields an estimate of survival rate only when the population is stable and stationary.

The assumption of stable age distribution cannot be tested directly without better estimates of survival rates. However, the assumption that the population is simultaneously stable and stationary (i.e., population growth rate = 1.0) can be examined by using observed recruitment and survival rate estimates to project the stable age population growth rate (λ_s). Caughley (1977:118) notes that if the population is at stable age distribution, and if the survival rate is age constant, the geometric rate of decline in numbers at age (∅) will be the ratio of annual survival rate to λ_s. If $\lambda_s = 1.0$ (i.e., stationary), then ∅ = annual survival rate. A correct projection model using ∅ as the survival rate estimate should recover a λ of 1.0 for any stable age population regardless of its true rate of increase (Caughley, 1977:119). Chapman-Robson estimates of ∅ for the above-mentioned populations are included with the associated λ_s projections (Table 3). The population projections used cub survival and recruitment estimates at or exceeding the maximum average rates observed for arctic polar bears (Taylor et al., 1987). The assumption that the populations were stable and stationary was not supported for most areas examined (Table 3). The annual survival rate of weaned female polar bears must equal or exceed 0.93 or the population will decline (Table 3).

The age distributions must be unstable or Caughley's (1977:118) tautology would be satisfied. An unstable population is by definition not a stationary population because λ will vary year by year until the age distribution becomes stable. The estimate of λ may be incorrect because maximum rates for recruitment and reproduction were chosen. However, in all cases the projected λ was less than 1.0. Using vital rates less than the maximum would have increased the disparity observed in Table 3. If survival rates were overestimated, the population estimate would be biased upwards and if the survival rates were underestimated, the population estimates would be biased downwards. However, the implications for the population estimates which employed age structure survival estimates are unclear, because the direction and magnitude of bias in survival rate estimates have not been quantified.

TABLE 3. The truncated Chapman-Robson (1960) estimate of the age constant, annual rate of decrease in numbers per age class (∅) is given for 7 populations of North American polar bears. The "Pooled" population was obtained by pooling all Canadian data except that collected from the Churchill, Manitoba (Western Hudson Bay) population. Assuming favourable recruitment and cub survival rates (Taylor et al., 1987) and assuming ∅ to be the annual survival of females older than age 2, the female population growth rate (λ) at stable age distribution is given. The annual survival of weaned female polar bears (∅) must equal or exceed 0.93 or the population will decline. The populations are identified as follows: Baffin Bay (BB), Davis Strait (DS), Viscount Melville Sound (VM), M'Clintock Channel (MC), Gulf of Boothia (GB), Parry Channel (PC), Southern Beaufort Sea (SB), and Northern Beaufort Sea (NB).

Population	Reference	C-R ∅	λ
Pooled	Taylor, unpubl. data	0.861	0.938
BB	Taylor, unpubl. data	0.894	0.964
DS	Stirling et al. (1980)	0.932	1.004
VM+MC+GB	Furnell and Schweinsburg (1984)	0.871	0.946
PC	Schweinsburg et al. (1981)	0.879	0.952
SB	Amstrup et al. (1986)	0.888	0.959
NB	Stirling et al. (1988)	0.849	0.928

SUMMARY

It is currently suggested that there are about 12 700 polar bears in twelve populations that are within or shared with Canada. Our analysis supported the population divisions that have been proposed; however, the data to unambiguously define population boundaries were not available. These boundaries and estimates of the population numbers and population densities should be regarded as tentative. Difficulties with the data and analysis models allow unambiguous confidence intervals on population numbers for only a few areas. Similarly, investigations of ice type distribution and polar bear habitat preference have remained at reconnaissance levels except for the eastern Beaufort Sea. However, the consistency of density estimates developed from the corrected population estimates and a first approximation of spring polar bear habitat is reason to be optimistic about the accuracy of the various approximations.

The impact of toxic chemicals, global warming, point source contamination (oil spills), and harvest cannot be evaluated without accurate estimates of population numbers and a better understanding of polar bear movements and fidelity to local areas. The initial inventory of polar bears within or shared with Canada in only 20 years stands as a remarkable achievement. However, that inventory is dated and uncertain in many areas. Management of Canada's polar bear harvest within the guidelines of the International Agreement for the Conservation of Polar Bears will require a continued commitment to improving the information on polar bear distribution and abundance.

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