Characteristics of polar bears killed in defense of life and property in Nunavut, Canada, 1970–2000

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Abstract: Canada's newest territory, Nunavut, has experienced increasing human population and growing resource extraction and exploration activities. Interactions between polar bears (*Ursus maritimus*) and humans are very likely to increase in the future, and knowing where, when, and why they occur could aid in preventing these events. I examined age, sex, time of year, general location, distribution by polar bear population, community, and region of polar bears killed in defense of life and property (DLP) between 1 July 1970 and 30 June 2000. A total of 618 polar bear DLP kills were recorded. Most DLP kills (73%) were bears ≤6 years of age, of which the majority (71%) were males. Males represented 55% of all bears >6 years of age. Native camp types accounted for most (74%) DLP mortalities (settlements, 18%; industry type camps, 4%; and research related DLP kills, 4%). The difficulty in deterring bears from native camp types might be because of the type of attractants (seal [*Phoca* spp.] and whale [*Delphinapterus leucas* and *Monodon monoceros*] meat and blubber), which are food items for polar bears and humans alike. Good record keeping of bear–human interaction occurrences and their analyses can aid in understanding specific circumstances leading to these incidents, and possibly minimize future DLP kills.

Key words: bear–human interactions, defense of life and property, Nunavut, polar bears, problem bears, *Ursus maritimus*

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About 60% of the world's polar bears (*Ursus maritimus*) occur in or are shared with Canada's eastern Arctic (Stirling and Taylor 1999). Whenever humans venture into the polar bears' habitat, confrontations arise that can lead to the death of 'problem' bears and death or injuries to humans. Such confrontations include bears entering communities, camps, or industrial sites, destruction or damage of human property, raiding food caches, attacking dogs and humans, and endangering public safety (Stenhouse et al. 1988).

The potential for polar bear–human interactions (defined as one or more persons and one or more bears being aware of one another; Smith et al. 2005) is increasing in northern Canada. Increases in the human population (Inuit and non-Inuit), economic development through natural resource exploration and extraction, and interest in the Arctic as a tourist destination can contribute to the likelihood of bear–human interactions (Stirling and Calvert 1983, Ross 2000). Since the mid-1970s, management agencies of the Northwest Territories (and what is now Nunavut) have been working toward effective bear deterrent programs using public education (Bromley 1987) and proactive planning to reduce bear–human interactions. Wildlife officers trained in bear deterrent activities explain and demonstrate to community members how polar bears can be effectively deterred (for example, by using cracker shells, rubber bullets, vehicles) from communities or camps without being destroyed. During proactive planning, wildlife management personnel assist individuals or industry to assess (a) potential hazards that may attract bears (dumpsters, garbage, carcasses), and (b) how the effects of encounters can be minimized (for example, by electric fences, dogs) to avoid destroying a problem bear.

Polar bears can be legally harvested by Inuit and Inuit-guided sport hunters following a quota system based on maximum sustainable yield (Taylor et al. 1987, Lee and Taylor 1994). Before 1995, local hunters' and trappers' organizations (HTO) had the option to include

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bears killed in defense of life and property (DLP) in their annual quota allocation. After 1995, when co-management agreements between the Government of the Northwest Territories (GNWT) and the HTO/Regional Wildlife Organizations were signed, it became mandatory to include all human-caused bear mortalities in the quota to minimize the risk of overexploiting polar bear populations.

Polar bear–human interactions were examined for Churchill, Manitoba (Kearney 1989), and for northern Canadian national parks (Fleck and Herrero 1988, Ferguson and Messier 1999, Clark 2003), where case histories or potential for bear–human encounters were characterized. However, little information is available that addresses characteristics of problem polar bear kills for the Nunavut Territory. Stenhouse et al. (1988) examined age, sex, season, and general circumstances of problem polar bear kills in the Northwest Territories (NWT), 1976–86. Such information can aid in understanding the circumstances leading to problem kills and can help develop effective deterrent programs. In this paper, I summarize information on polar bear DLP mortalities for Nunavut for 1 July 1970 through 30 June 2000. Age and sex of polar bears, season, incident location, and distribution of occurrences by polar bear population, community, and region are presented. I also examine long-term trends of DLP kills to provide insight into the effectiveness of public education and proactive planning activities.

Definition

Although it occurs frequently in the literature, the term 'problem bear' lacks a clear, descriptive definition (Stenhouse et al. 1988, Calvert et al. 2002). In this paper, a problem bear or polar bear DLP mortality is defined as a polar bear that has come into contact with humans, their property, or both, and is destroyed to preserve the life of one or more persons or when public safety and property are at stake. These are also the same criteria that designate a DLP kill for it to be entered into the national database, from which these kills were extracted.

The Nunavut polar bear defense kill regulations do not require deterrent attempts of bears before destruction of the animal. However, deterring bears has been part of the management staff training and the bear deterrence program (S. Pinksen, Government of Nunavut, Iqaluit, Nunavut, Canada, personal communication, 2005).

Study area and methods

The study area was the Nunavut Territory (~2,300,000 km^2), which was the eastern part of the NWT before division on 1 April 1999. Nunavut is divided into 3 administrative regions (Baffin, Keewatin, and Kitikmeot; Fig. 1). Population boundaries of individual polar bear populations occurring in the Canadian Arctic are described in Taylor et al. (2001). Polar bear population boundaries, of course, do not follow administrative boundaries. The majority of Nunavut's communities are located in the Baffin Region (Fig. 1). Some communities have access to >1 polar bear population (Dyck et al. 2003).

The harvest year runs from 1 July to 30 June (bears killed between 1 Jul 1970 and 30 Jun 1971 were designated as killed in 1971). Data from 1 July 1970 to 30 June 2000 were taken from the shared federal, provincial, and territorial polar bear database, maintained by the Canadian Wildlife Service. Within this database, only reported DLP kills are included, and so the data represent minimum numbers; some kills may not have been reported for fear of prosecution. All recorded DLP kills are included in this database, regardless of whether they were part of the community quota. Records were based on enforcement investigation reports of DLP kills and include gender, field age, location, lower jaw (or pre-molar) for ageing, hide, and bear identification number. Ages of bears were established either by counting annular rings of the cementum of a pre-molar tooth (Calvert and Ramsay 1998) or from previous capture records.

Description of location of DLP kills followed those of Stenhouse et al. (1988): (a) Native: DLP kills in association with outpost camps (permanent camps away from settlements consisting of one or more families) and Inuit camping or traveling on the land; (b) Industry: DLP kills occurring at permanent camps such as mines, well sites, and exploration camps; (c) Settlement: DLP kills occurring in communities of at least 50 people living long-term in permanent buildings; (d) Research: DLP kills associated with scientific expeditions and research; and (e) Other: DLP kills not fitting any categories. Data on the locations for all years were either not readily available or incomplete for the study period. I therefore used the most complete data available (for 1989–2000).

Polar bears that are members of a family group are protected by law in Nunavut (Calvert et al. 1994). However, if human safety or property is at stake, complete family groups or individual members identified as problem bears can be destroyed by wildlife officers or designated third parties (usually a member of the local HTO).

The Mann-Whitney *U*-test was used to examine differences in ages for gender because the age distri-

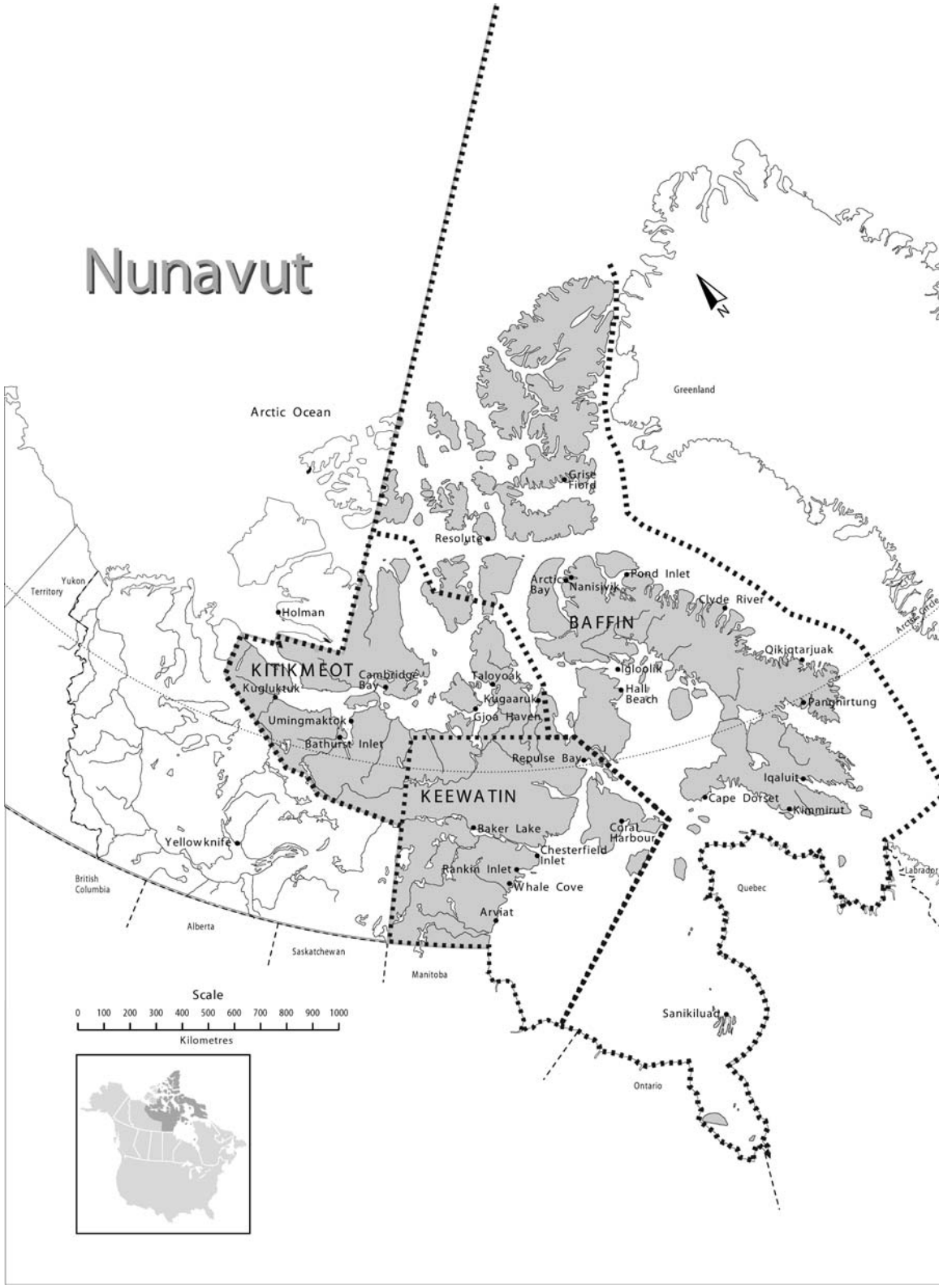

Fig. 1. Map of Nunavut communities and regions, Canada.

bution was not normal (Fig. 2; Zar 1999). Data are presented as mean (SE), and statistical comparisons were considered significant at $\alpha = 0.05$.

Stenhouse et al. (1988) reported that a monitoring program for DLP mortalities in the NWT (what is currently the NWT and Nunavut) was established during the 1979–1980 season. One long-term goal of that program was a decrease of the number of DLP kills. A second goal was to include more DLP kills in the community quota to reduce the overall number of bears killed. I predicted that, if these initiatives were successful, overall DLP kills would decrease and the percent of DLP kills included in the community quota would increase. To test these hypotheses, I used simple linear regressions to examine the relationship between the number of recorded DLP kills and time during 1980–2000. To assess long-term trends during1980–2000 for DLP kills by location, I used data from this study (1989–2000) and Stenhouse et al. (1988:Table 1; data for 1980–86) to complement the data. Data for locations were not available for 1987–88.

I classified bears $\leq$2 years of age as dependent young because these bears usually still depend on their mother (Stirling and Taylor 1999) and are members of family groups. Third year offspring usually become independent because large males force 2-year-old offspring to leave their mother during the mating season (Taylor et al. 2002). Bears >6 years old were classified as adults due to recent analyses of polar bear morphology and physiology. Polar bears usually attain 97% of their asymptotic body mass at age >6 years (Derocher and Wiig 1998). Similarly, reproduction seems more likely to occur at those ages (Rosing-Asvid et al. 2002, Dyck et al. 2004). Bears >2 and $\leq$6 years of age were classified as subadults by default (they are not members of family groups, are not reproductively active, and have not attained maximum body mass). The chosen age-class criteria for these analyses are less arbitrary than previously chosen age classes (subadult age classification; bears aged 1–4 years in Fleck and Herrero [1988], or 2–5 years in Stenhouse et al. [1988]) and reflect polar bear biology more realistically.

Stenhouse et al. (1988) and Fleck and Herrero (1988) reported that younger males were more likely to be involved in DLP circumstances than older males. I made the same prediction for Nunavut polar bear DLP kills. To test this hypothesis, I developed 2 x 2 contingency tables comparing the frequency of males aged 2–5 and 6–24 in DLP-killed bears with capture samples from 2 Nunavut polar bear populations (Baffin Bay and Lancaster Sound capture data, 1993–97; M. Taylor, Department of Environment, Government of Nunavut, Iglulik, Nunavut, Canada, unpublished data).

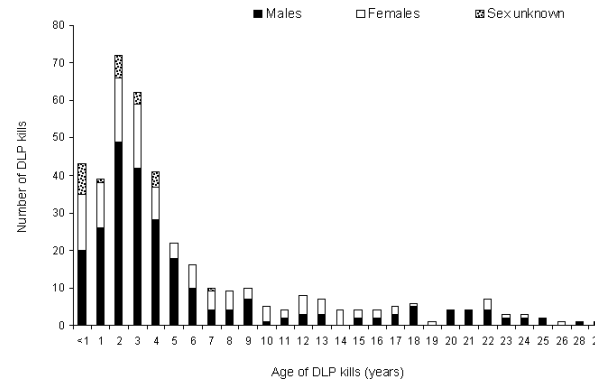

Fig. 2. Age and sex distribution of known-age polar bear defense of life and property (DLP) kills for Nunavut, Canada, 1970–2000 ($n = 398$).

Results

Overview of DLP kills

Between 1971 and 2000, 618 polar bear mortalities occurred in Nunavut as DLP kills (20.6 bears/year, SE = 1.6, range: 0–37). These mortalities comprised 317 males (51.3%; 249 of known age), 185 females (29.9%; 126 of known age), and 116 bears of unknown gender (18.8%; 23 of known age). A significant decline in the number of recorded DLP kills occurred from 1980 through 2000 (Fig. 3; $F = 13.60$; 1, 19 df; $P = 0.002$; $r^2 = 0.42$). During the same period, an increasing percent of DLP mortalities were included in community polar bear quotas (Fig. 3; mean (1980–2000) = 9.5 DLP kills in quota; mean (1977–86) = 3.5 DLP kills; $F = 57.89$, $P < 0.0001$, $r^2 = 0.75$; Stenhouse et al. 1988).

Age distribution of DLP kills

The DLP kills of known-age bears ($n = 398$) ranged from 0 to 26 years for females and 0 to 29 years for males. Of the known age and sex DLP kills ($n = 375$), 72.8% were $\leq$6 years old ($n = 273$; Fig. 2). Of those, 51.0% were 0–2 years old and 49.0% were 3–6 years old. The mean age of DLP kills was 5.8 years (median = 3; SE = 0.3). Mean age of females (6.3 years, SE = 0.5) did not differ from that of males (5.6 years, SE = 0.4; Mann-Whitney U-test: $Z = -1.078$, $U = 14618$, $P = 0.281$, $n = 375$).

At least 42 family groups (10 females with one cub, 10 females with twin cubs, 9 females with one yearling,

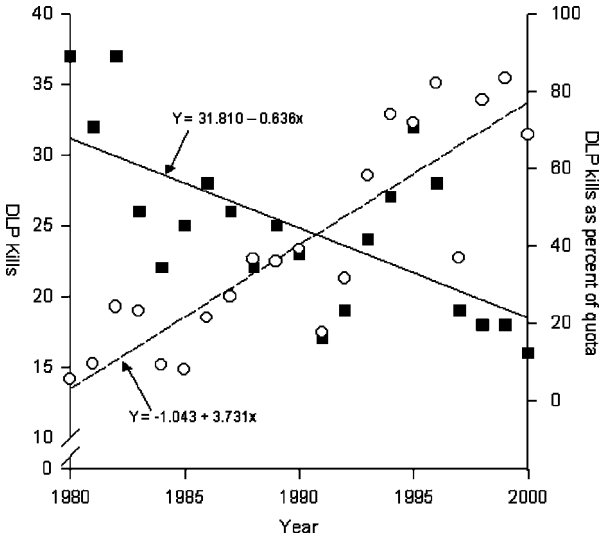

Fig. 3. Polar bear defense of life and property (DLP) kills (■; solid line regression) and DLP kills as percent of quota (○; dashed line regression) for Nunavut between 1980 and 2000, after introduction of a monitoring program for polar bear DLP kills.

and 13 females with twin yearlings) were killed in DLP circumstances. Individuals of family groups (107 of 618) represented 17.0% of the total DLP kills.

Sex composition of DLP kills

Males constituted 63.1% of DLP kills of known sex ($n = 502$). Of the 273 aged and sexed DLP kills $\leq$6 years of age, 70.7% ($n = 193$) were males, whereas males accounted for only 55.0% of DLP kills >6 years of age ($\chi^2 = 8.303$, 1 df, $P = 0.004$). Compared to a

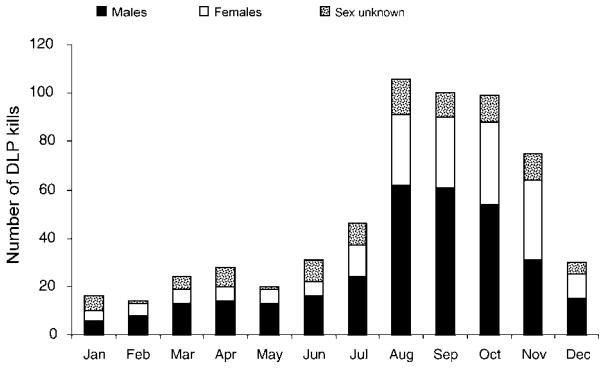

Fig. 4. Monthly distribution of polar bear defense of life and property (DLP) kills for Nunavut, Canada, 1970–2000 ($n = 616$).

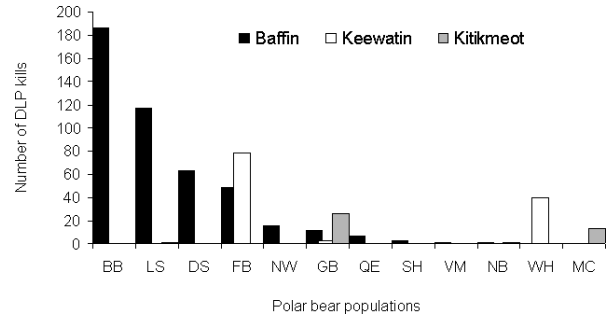

Fig. 5. Distribution of polar bear defense of life and property (DLP) kills in Nunavut by polar bear population and administrative region, 1970–2000 ($n = 618$). BB = Baffin Bay, LS = Lancaster Sound, DS = Davis Strait, FB = Foxe Basin, NW = Norwegian Bay, GB = Gulf of Boothia, QE = Queen Elizabeth Islands, SH = Southern Hudson Bay, VM = Viscount Melville Sound, NB = Northern Beaufort, WH = Western Hudson Bay, MC = M'Clintock Channel.

Nunavut harvest sample from 1980–90, proportionally more males $\leq$6 years old were DLP kills than were harvested ($\chi^2 = 23.070$, 1 df, $P < 0.0001$). Moreover, the comparison between the DLP kills and capture samples of males indicated that younger males (age 2–5) were disproportionately represented in the DLP samples (Baffin Bay: $\chi^2 = 70.770$, 1 df, $P < 0.0001$; Lancaster Sound: $\chi^2 = 84.750$, 1 df, $P < 0.0001$).

Timing and location of DLP kills

For 99.7% of all DLP kills, month of death could be determined. DLP mortalities occurred throughout the year with most bears killed from August through November (395 of 616 bears or 64.1%; Fig. 4).

The Baffin Region accounted for 73.7% (455 of 618) of all DLP kills (Fig. 5). Of 24 Nunavut communities that recorded DLP kills, Resolute registered the most for 1970–2000 (99 DLP kills), accounting for 16.0% of all DLP kills. From the 12 Nunavut polar bear populations recording DLP kills, the Baffin Bay population had the highest DLP mortalities (188 of 618, 30.4%; Fig. 5). In 266 cases where the location of the DLP mortality was known, 74% occurred at native camps, 18% at settlements, 4% at industry camps, and 4% during research activities (Table 1). Long-term trends for industry camps indicated a significant decrease in DLP kills ($F = 15.74$; 1, 18 df; $P = 0.001$, $r^2 = 0.48$). Temporal trends of DLP kills for settlements ($F = 1.77$, $P = 0.201$, $r^2 = 0.09$) and native camps ($F = 0.16$; 1, 18 df; $P = 0.070$, $r^2 = 0.009$) were not significant between 1980–2000 (excluding 1987–88).

Table 1. Polar bear defense of life and property (DLP) mortalities for Nunavut by camp type, 1 Jul 1988–30 Jun 2000.

		Camp type					
Season	Problem kills	Native[a]	Industry[b]	Settlement[c]	Research[d]	Unknown	Other[e]
1988–89	25	18	4	1	1	0	1
1989–90	23	16	0	2	4	0	1
1990–91	17	12	1	4	0	0	0
1991–92	19	11	0	6	0	0	2
1992–93	24	10	1	11	2	0	0
1993–94	27	20	0	5	2	0	0
1994–95	32	27	1	4	0	0	0
1995–96	28	19	2	7	0	0	0
1996–97	19	13	1	4	1	0	0
1997–98	18	17	0	0	1	0	0
1998–99	18	18	0	0	0	0	0
1999–2000	16	12	0	3	0	1	0
Total	266	193	10	47	11	1	4
Mean	22.2	16.1	0.8	3.9	0.9	0.08	0.3
Percent of known camp types		74	4	18	4		

[a]Outpost camps (away from settlements) and Inuit camping and traveling on the land.
[b]Permanent camps such as mines, well sites, exploration camps.
[c]Community of at least 50 people living long-term in permanent buildings.
[d]Scientific expeditions and research activities.
[e]DLP kills not fitting previous categories.

Discussion

Age and sex composition of DLP kills

This study (5.6 years) and Lee and Taylor (1994; 5.3 years) reported a similar average age for problem bears. Fleck and Herrero (1988) and Stenhouse et al. (1988) also found that younger male polar bears are more likely to be killed in DLP situations than older bears.

In general, male polar bears $\leq$6 years of age were more likely to be killed in DLP circumstances than females of the same age or older bears of either gender. Young and subadult male bears represent about 50–60% of other capture samples (Western Hudson Bay: Derocher and Stirling 1995; Baffin Bay: Taylor et al. 2005), supporting the notion that males are more prone to become involved in DLP circumstances than females.

Several factors might explain why younger males contribute disproportionately to DLP mortalities. Male-biased dispersal of subadults in species with polygynous mating systems is quite common (Greenwood 1980, Dobson 1982, Derocher and Stirling 1990, McLellan and Hovey 2001). Males tend to be more aggressive (Tate and Pelton 1983; Ramsay and Stirling 1986, 1988), and subadults may be more curious, less cautious, more easily habituated to humans, and possibly more nutritionally stressed than older bears (Stirling and Latour 1978, McArthur Jope 1983).

Young bears ($\leq$2 years of age) usually still depend on their mother (Stirling and Taylor 1999). While the mother is raising her offspring, energy demands on her are high (Arnould 1990). If a female with dependent young becomes attracted to food sources associated with humans and cannot be deterred, she will likely end up being killed. Dependent young have a reduced probability of survival in the wild (Stirling and Latour 1978) and are often destroyed as well. This may explain the 42 family groups destroyed in DLP circumstances. Due to a lack of complete or existing records, however, it is unclear whether all other DLP mortalities $\leq$2 years of age were part of family groups or if they were orphaned bears.

Timing of DLP kills

All Inuit communities in Nunavut except Baker Lake are situated along ocean coastlines (Riewe 1991), mostly along the shores of fiords. Ice formation begins in these fiords in early October, but substantial ice build-up does not occur before early November (Stirling et al. 1980). Bears await the freeze-up in these areas and may get involved in bear–human confrontations as they wander into settlements or camps searching for food (Stenhouse et al. 1988).

DLP kills occurred throughout the year, although more commonly between August and November. The period of maximum open water begins late August to early September with considerable variations among regions. With cooler temperatures, freeze-up progresses, and the number of DLP kills tend to decrease because

bears return to the early ice to hunt seals. By January and February, only isolated incidents occur (Stenhouse et al. 1988). Although there is some seasonal variability, bears move offshore to hunt during early freeze-up. A late freeze-up results in more incidents because bears stay on shore longer (Kearney 1989).

Location of DLP kills

Polar bear mortalities in native camp types remained higher than any other category, consistent with Stenhouse et al. (1988). Both analyses, however, differ from those in Svalbard, Norway (87 DLP kills from 1973–97), where mostly inexperienced non-residents were involved in such polar bear–human interactions (Gjertz and Persen 1987, Gjertz et al. 1993, Gjertz and Scheie 1998). Native camp types in Nunavut are mainly occupied by Inuit, are some distance away from settlements, and are usually within 50 km of coastlines. These camps are generally used as base camps for hunting (walrus [*Odobenus rosmarus*], beluga whale [*Delphinapterus leucas*], narwhal [*Monodon monoceros*], ringed seal [*Phoca hispida*], and harp seal [*P. groenlandica*]). In many instances, meat and blubber from harvested animals is brought back to these camps, cached, or stored for immediate consumption. Polar bears that meander along shorelines in search for food may be attracted by food, garbage, or odors from these camps. They become a danger for camp occupants, and the bears are destroyed in DLP circumstances if they are not successfully deterred.

Two other possibilities could explain the higher numbers of native camp DLP kills. First, an increase in the number of polar bears could explain increased DLP kills at native-type camps. This has been suggested through *Inuit Qaujimajatuqangiit* (Inuit Traditional Knowledge) for the Davis Strait polar bear population (IUCN/SSC Polar Bear Specialist Group 2002). Polar bear population increases could be correlated to available biomass in the form of narwhal and beluga whale blubber and meat that are left after hunters have taken their share. Most whale hunts occur during August–September when polar bears are on shore. Nunavut hunters harvested approximately 8,000 narwhals and 7,508 Beluga whales (excluding wounded and lost whales) between 1977 through 2000 (Department of Fisheries and Oceans Canada, Iqaluit, Nunavut, Canada, unpublished data). Meat and blubber of whales not consumed by Inuit represent a supplementary biomass for polar bears at a time of the year when living off stored fat reserves is the norm, especially for pregnant females or those with dependent young (Watts and Hansen 1987, Ramsay and Stirling 1988). Increased body mass and reproduction could result when polar bears consume these food items. Such increases were documented for black bears (*Ursus americanus*) and brown bears (*Ursus arctos*) using supplementary food sources from garbage dumps (Stringham 1989).

Second, an increase in land-use activity and the numbers of native camps could explain the persistence of relatively high number of DLP kills in native camps. For example, between 1980 and 2000, the number of cabins in the Kugluktuk area (Kitikmeot Region; Fig. 1) increased from 16 to about 150. During that period, confrontations with brown bears also increased, indicating a positive correlation between the 2 factors (Department of Environment, Government of Nunavut, Iglulik, Nunavut, Canada, unpublished data). A similar trend could also be true for polar bear DLP kills at native camp types. However, documentation of all these cabins within Nunavut has not been completed to substantiate this hypothesis.

There are several possible explanations for the high number of DLP kills in Baffin Region. Twelve of the 24 communities with DLP kills are part of the Baffin Region, and about 53% of Nunavut's human population lives there (Government of Nunavut 2002). Moreover, the majority of Nunavut's polar bear populations occur in this region (Davis Strait, Baffin Bay, Southern Hudson Bay, Lancaster Sound, Queen Elizabeth Islands, Foxe Basin, Kane Basin, and Norwegian Bay), perhaps totalling more than 62% (9,100 of 14,670 polar bears, according to Lunn et al. [2002*a*]) of Nunavut's polar bears. Both greater human land-use activity (cabins, hunting and camping) and farther travel distances (motorized skidoo and boat versus traditional dog team and kayak transport individuals greater distances per unit time) increase the potential for bear–human interactions, consequently resulting in greater DLP kills for the Baffin Region.

Alternatively, two other hypotheses could explain why more DLP kills occurred in the Baffin Region. The polar bear populations in that region may have increased over the study period. Population numbers from the early 1970s are sparse and are more readily available for 1988–2000. There was an increase in the 4 main polar bear populations (Baffin Bay, Davis Strait, Lancaster Sound, Foxe Basin) of the Baffin Region from an estimated 5,440 in 1988 to 7,600 in 1993, which remained steady through 2000 (Wiig et al. 1995, Derocher et al. 1998, Lunn et al. 2002*b*). However, whether the increase is real or reflects the application of more powerful statistical population models for mark–recapture data is difficult to determine.

Secondly, increases in polar bear–human interactions may have been indirectly caused by climatic warming, as predicted by Stirling and Derocher (1993). However, clear evidence of this is limited. More problem bears were handled in Churchill, Manitoba, by wildlife management staff when bears came off the ice earlier (and thinner) than when break-up of the ice was later (Stirling et al. 1999). Whether the Baffin Region is more affected by possible climatic warming than other Nunavut regions is not clear. Ultimately, to understand the relationship between climatic warming and a potential increase in polar bear–human interactions, solid record keeping of all bear encounters should be encouraged and maintained.

While deterrents have worked well to break brown and black bears' cycle of food conditioning and habituation (Thorpe 1956, Scott 1958, Herrero and Herrero 1997, Whittaker and Knight 1998) with respect to human food items (Dalle-Molle et al. 1986, Dalle-Molle and Van Horn 1989), they could be less successful when polar bears associate humans with a natural food item (such as seal or whale meat and blubber that is consumed by both humans and polar bears). It is not likely that a polar bear could differentiate between a seal in the wild and a seal harvested by humans for human consumption, regardless of deterrents. To feed on seal or whale blubber and meat is an innate behavior, which could mean that a greater effort in deterring polar bears is required when feeding on such items occurs. This, in part, is supported by the review of Resolute Bay occurrence records (below) where multiple deterrence devices are used simultaneously to deter bears. However, evaluation of more such records from across Nunavut can only shed more light on this topic.

Success of the monitoring and educational program

My predictions about the success of the initiatives were met. The monitoring and educational programs were initiated to (a) prevent communities from potentially overharvesting polar bear populations by using a quota tag for a DLP kill, thus including it in their community quota, and (b) educate industry (mining and other exploration companies) and citizens about minimizing polar bear–human encounters through proactive thinking and actions. These objectives were achieved through proper wildlife officer training and wildlife officer–community and industry interactions. The long-term trends indicate the success of the program: the total number of DLP kills decreased between 1980 and 2000, the proportion of DLP kills as part of the quota increased (Fig. 2), and trends of DLP kills for industry type camps declined significantly. Communities were educated about the consequences of overharvesting polar bear populations (a reduction in the following year's quota). To minimize the DLP kill potential, some communities work closely with wildlife management staff and keep polar bear quota tags as a reserve for problem bears to include the human-caused mortality within the allocated community quota. Other communities concentrate part of their polar bear harvest around potential problem bears—for example, bears that frequent community dumps or remain a possible threat to public safety before freeze-up of the sea ice are harvested instead of being allowed to wander into communities.

Wildlife management staff have been constantly trained in bear deterrence, and necessary equipment (such as rubber bullets and cracker shells) has been provided for deterrence activities. Residents have been educated in the use and effect of these devices, which enhanced campers' and hunters' ability to deter bears.

Wildlife management staff, HTOs, and community members work closely during bear–human interactions and deterrence activities to minimize the number of bears killed in DLP circumstances. Usually many more bears are actually deterred than DLP-killed. For example, during 2003 in Resolute Bay (a Nunavut community; data not included in this analysis), 146 bear–human interactions occurred between September and November. Only 4 bears (2.7%) were killed to ensure public safety, whereas in 142 instances bears (some of them repeated offenders) were deterred by people shouting, throwing debris, or using scaring devices (e.g., cracker shells), rubber bullets, air horn, or vehicles. In about 71% of the interactions, >2 deterrents (such as shouting, air horn, and vehicle combined) were used. The reason for most interactions (28 of 31) was presence of food (garbage at the dump, animal carcasses [seals or whales] along the beach, around houses), which attracted bears and jeopardized public safety.

Management implications

There will always be polar bear DLP kills in the Arctic. However, learning more about circumstances leading to them and knowing where these incidents are more likely to occur can help minimize this outcome. Critical analyses of the circumstances surrounding each polar bear DLP kill may allow for the identification of hotspots (such as circumstances, localities, how often these circumstances occur and why), which could enable management agencies to focus on essential tasks. For example, public education programs about polar bear

behavior and the relationship between food rewards and altered behavior should be encouraged for Nunavut communities and native-type camps with a priority for the Baffin Region, since the majority of the DLP kills occurred there. Communities could get more involved proactively in preventative measures, such as community planning and bear risk assessment. Nunavut is a new territory offering many economic opportunities, especially in the fields of exploration and tourism. Educating the public about the proper use of proven bear deterrents (Miller 1983, Wooldridge 1983, Davies and Rockwell 1986) and the continuation of a bear safety program (Bromley 1987, Clarkson and Gray 1989) could minimize the numbers of bears that become part of statistics such as the ones reported here.

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