

The Polar Bear Management Agreement for the Southern Beaufort Sea: An Evaluation of the First Ten Years of a Unique Conservation Agreement

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ABSTRACT. Polar bears (*Ursus maritimus*) of the southern Beaufort Sea population, distributed from approximately Icy Cape, west of Point Barrow, Alaska, to Pearce Point, east of Paulatuk in Canada, are harvested by hunters from both countries. In Canada, quotas to control polar bear hunting have been in place, with periodic modifications, since 1968. In Alaska, passage of the United States Marine Mammal Protection Act (MMPA) of 1972 banned polar bear hunting unless done by Alaska Natives for subsistence. However, the MMPA placed no restrictions on numbers or composition of the subsistence hunt, leaving open the potential for an overharvest with no possible legal management response until the population was declared depleted. Recognizing that as a threat to the conservation of the shared polar bear population, the Inuvialuit Game Council from Canada and the North Slope Borough from Alaska negotiated and signed a user-to-user agreement, the Polar Bear Management Agreement for the Southern Beaufort Sea, in 1988. We reviewed the functioning of the agreement through its first 10 years and concluded that, overall, it has been successful because both the total harvest and the proportion of females in the harvest have been contained within sustainable limits. However, harvest monitoring needs to be improved in Alaska, and awareness of the need to prevent overharvest of females needs to be increased in both countries. This agreement is a useful model for other user-to-user conservation agreements.

Key words: polar bears, Beaufort Sea, management, agreement, North Slope Borough, Inuvialuit Game Council

RÉSUMÉ. Les ours polaires (*Ursus maritimus*) constituant la population de la mer de Beaufort méridionale sont répartis d'environ Icy Cape, à l'ouest de Point Barrow (Alaska), à Pearce Point, à l'est de Paulatuk (Canada). Ils sont prélevés par des chasseurs des deux pays. Au Canada, les quotas visant le contrôle de la chasse à l'ours polaire sont en vigueur – avec des modifications périodiques – depuis 1968. En Alaska, l'adoption en 1972 de la loi américaine (MMPA) visant la protection des mammifères marins a interdit la chasse à l'ours polaire sauf la chasse de subsistance pratiquée par les Autochtones alaskiens. La MMPA n'a toutefois placé aucune restriction sur le nombre ou la composition de la chasse de subsistance, laissant la porte ouverte à une éventuelle surexploitation sans possibilité d'une réaction de gestion sur le plan légal jusqu'à ce que la population soit déclarée décimée. Reconnaisant en cela une menace à la conservation de la population commune d'ours polaires, le Conseil canadien de gestion du gibier et le North Slope Borough de l'Alaska ont négocié et signé en 1988 une entente entre usagers, le Polar Bear Management Agreement pour la mer de Beaufort méridionale. On a examiné le fonctionnement de l'entente durant sa première décennie pour conclure que, dans l'ensemble, elle a porté fruit car le total des prises et la proportion de femelles prélevées ont été maintenus dans des limites viables. Il faut toutefois améliorer le contrôle du prélèvement en Alaska et accroître dans les deux pays la sensibilisation à la nécessité de prévenir une surexploitation des femelles. Cette entente constitue un modèle pour d'autres accords entre usagers en matière de conservation.

Mots clés: ours polaires, mer de Beaufort, gestion, entente, North Slope Borough, Conseil de gestion du gibier

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INTRODUCTION

Concern about worldwide polar bear (*Ursus maritimus*) harvests, which increased rapidly during the 1960s, led to the first international meeting on the conservation of polar bears in 1965 (Anon., 1966). In 1968, the Government of the Northwest Territories (GNWT) in Canada responded to the conclusions of the 1965 meeting by establishing arbitrary interim quotas, roughly based on past harvest records, for each village hunting polar bears (Kwaterowsky, 1967; Schweinsburg, 1981). The first significant controls on the Alaskan polar bear harvest came in 1972, when the Marine Mammal Protection Act (MMPA) nullified state regulations that allowed sport hunting, although hunting of polar bears by Alaska Natives for subsistence purposes continued (Lentfer, 1976). Continuing international concern for the security of polar bear populations led to the Agreement on the Conservation of Polar Bears, signed in 1973 (Stirling, 1988: Appendix I).

Initially, because polar bears living in the Alaskan and Canadian portions of the southern Beaufort Sea were thought to be distinct (Stirling et al., 1975; Lentfer, 1976, 1983), management activities in each country were independent. By the mid-1980s, however, expanded mark-recapture studies and conventional radio-tracking of adult female polar bears suggested that Alaskan and Canadian polar bear hunters were harvesting from the same southern Beaufort Sea population that ranged between about Icy Cape in Alaska and Pearce Point, to the east of Paulatuk, in Canada (Fig. 1) (Amstrup, 1986; Stirling et al., 1988). Early mark-recapture studies indicated approximately 1800 bears occurring in this region (Amstrup et al., 1986). Because harvests in Canada and Alaska were being managed differently and independently, recognition that the population was shared raised new concerns for polar bear conservation.

Laws and Regulations

Regulation of polar bear harvesting is strikingly different in Canada and Alaska. The quota system established in the Northwest Territories in 1968 limited the number of bears that could be harvested by hunters from each settlement (Aklavik, Inuvik, Paulatuk, and Tuktoyaktuk; Fig. 1) in the southern Beaufort Sea region (Kwaterowsky, 1967; Schweinsburg, 1981). In 1974, the NWT prohibited the harvest of bears in dens and family groups of females accompanied by cubs of the year (COYs), and by 1976, yearlings with their mothers were also protected (Stirling and Smith, 1976, 1980). Starting in 1976, the fall hunting season was eliminated to protect females looking for dens along the coast. Hides from polar bears harvested within the quota system could be commercially sold, and Inuvialuit hunters were allowed to use some of their quota tags to guide non-Native sport hunters.

Concurrently with quota management, the Inuvialuit formed wildlife management bodies to protect their cultural, conservation, and economic interests in harvested

wildlife. In 1984, the *Federal Western Arctic (Inuvialuit) Claims Settlement Act* legally confirmed the Inuvialuit Final Agreement (IFA). The IFA formalized the concept of co-management and created the Inuvialuit Game Council (IGC), the community-based Hunters and Trappers Committees (HTCs), and the Wildlife Management Advisory Council (WMACs) in the Yukon and Northwest Territories. WMAC (NWT), the primary wildlife management authority in the NWT portion of the Inuvialuit Settlement Region, is a wildlife co-management board on which the Inuvialuit and government (federal and territorial) have equal representation while the appropriate government retains the ultimate authority.

Under the MMPA, coast-dwelling Alaska Natives may hunt polar bears for subsistence use and making handicrafts. The Act prohibits the sale of raw polar bear products (e.g. hides, skulls) to non-Natives. However, the MMPA does not limit the numbers harvested, sex or age class, or time of year, and the federal government can regulate the harvest only if the population is legally declared depleted. The size of the subsistence harvest in Alaska fluctuated widely in the years following the implementation of the MMPA (Lentfer, 1985; Schliebe, 1986). The MMPA left open the possibility that an overharvest could occur with no legal recourse until the population was depleted. Under the MMPA, a “depleted” declaration is a complicated and time-consuming process.

The municipality of the North Slope Borough (NSB), established in 1972 to provide regional government services to the people of Alaska’s North Slope, included a Department of Conservation and Environmental Protection, later renamed the Department of Wildlife Management (DWM). The DWM was designed to assist the residents of the North Slope to provide for the wise management of wildlife resources, help minimize industrial impacts (oil and gas) on the environment and wildlife, and protect the subsistence lifestyle of the Inupiat. DWM also oversees the operations of the Fish and Game Management Committee, comprising representatives from all eight North Slope villages (only five of which are affected by the polar bear agreement), which provides advice and comments on state or federal research, management, and regulatory actions. The representatives from the Committee share responsibility for implementing the polar bear agreement but formal regulations like those found in Canada do not exist in Alaska.

The IGC-NSB Agreement

Article VII of the 1973 [International] Agreement on the Conservation of Polar Bears commits countries that share polar bear populations to conduct and coordinate research, exchange information, and consult on management (Stirling, 1988: Appendix I). The IGC and the NSB wished to conform to the requirements of the Agreement by avoiding an overharvest and thereby demonstrating their ability to practise sound stewardship of the polar bear resource. They

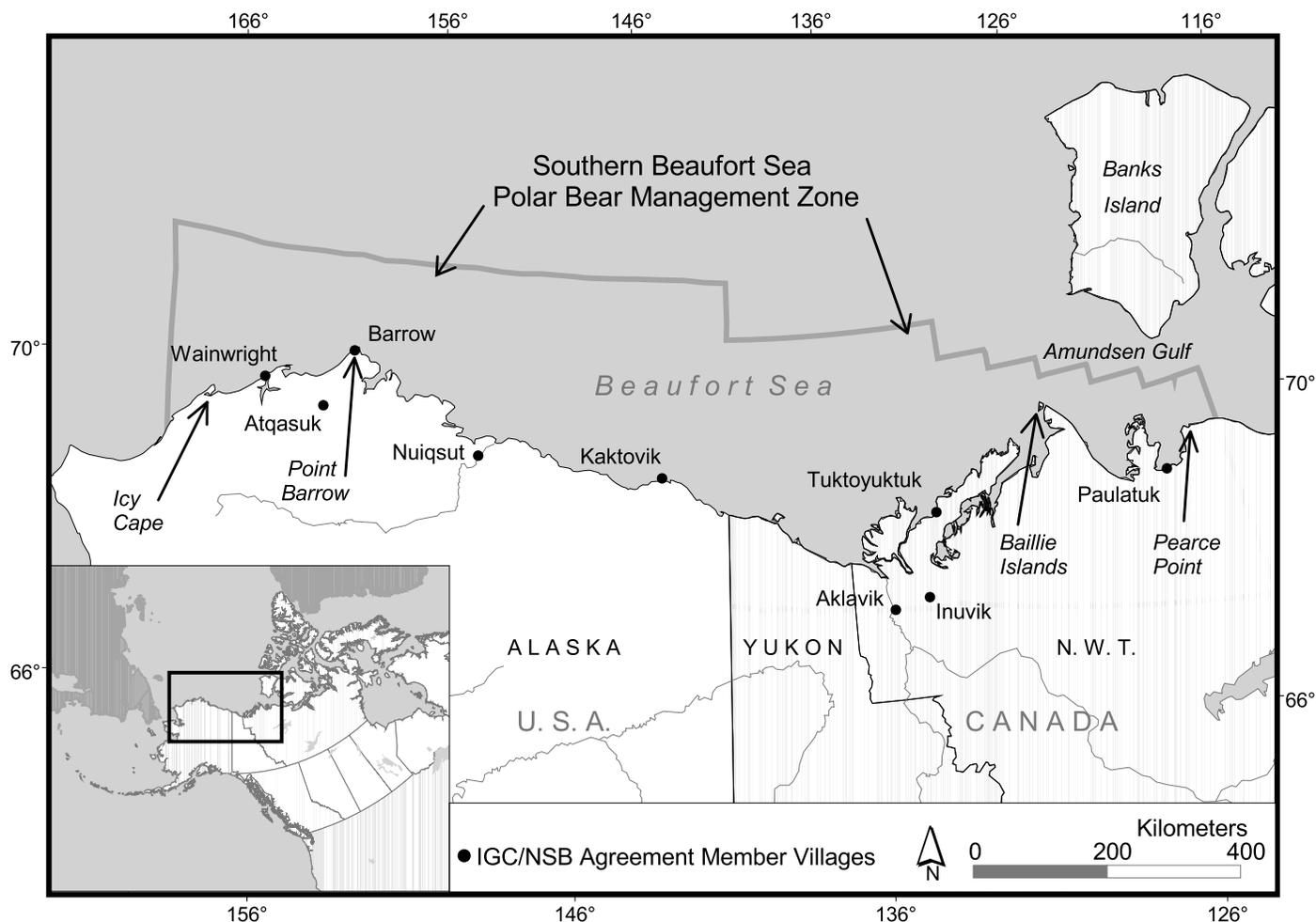


FIG. 1. Map of the area covered by the Polar Bear Management Agreement for the Southern Beaufort Sea.

also recognized that negotiation of a formal international agreement between governments would take years. Therefore, they developed the Polar Bear Management Agreement for the Southern Beaufort Sea (henceforth referred to as the Agreement) (Stirling, 1988: Appendix II; Treseder and Carpenter, 1989; Nageak et al., 1991). The Agreement, signed by both parties (IGC and NSB) in Inuvik, Northwest Territories, in January 1988, followed two years of technical discussions and community consultations.

The Agreement provided for annual quotas (which may include kills of problem bears); hunting seasons (1 September to 31 May in Alaska and 1 December to 31 May in Canada); protection of bears found in or constructing dens and of females accompanied by cubs of the year and yearlings; collection of specimens from killed bears to monitor the sex and age composition of the harvest; annual meetings to exchange information on research and management, set priorities, and agree on quotas for the coming year. It also prohibited hunting with aircraft or large motorized vessels and trade in products taken in violation of the Agreement. To facilitate implementation, two bodies were formed: a Joint Commission, comprising two Commissioners appointed by each party, and a Technical

Advisory Committee, appointed by the Joint Commission, made up of biologists from government agencies in both countries who were actively involved in collecting research and management data. These two groups meet annually, alternating between Alaska and the Northwest Territories, and make decisions by consensus. Travel and other costs associated with holding and hosting meetings are paid by the NSB and the IGC, and those of technical advisors are paid by their agencies. In Canada, recommendations and decisions from the Commissioners are then implemented through Community Polar Bear Management Agreements, Inuvialuit Settlement Region Community Bylaws, and the NWT Wildlife Act. WMAC and the Department of Resources, Wildlife, and Economic Development (DRWED) facilitate the development of community management agreements and bylaws.

Harvest Levels and Quotas

In 1988, the Commissioners for the Agreement, in consultation with their technical advisors, established a total annual harvest quota of 76 polar bears from the southern Beaufort Sea population. They based the quota

on previously documented harvest levels and on population biology. In the Northwest Territories, the annual quota for the Inuvialuit settlements was already set at 38, while the long-term average of the recorded harvest in the Inupiat settlements in Alaska also averaged about 38. Taylor et al. (1987) estimated that the maximum sustainable yield from a polar bear population could be 4.5%, if no more than one-third of the animals killed annually were females (i.e., two males harvested for each female at maximum sustained yield). Although that guideline was understood and accepted, the Commissioners initially chose to harvest the population below its theoretical maximum and selected a 4% rate. Amstrup et al. (1986) estimated the size of the population at 1800 to 2000 polar bears. Annual harvest rates of 4% for populations of 1800 and 2000 would be 72 and 80 respectively. The midpoint of 76 bears, or 38 per jurisdiction (with a maximum annual female harvest of 13 each), was selected as the initial quota because it was both sustainable and consistent with past harvest patterns.

In 1991, the HTC's from the Canadian communities that hunted polar bears from the southern Beaufort Sea population signed a management agreement that included all the conditions in the IGC-NSB Agreement. All human-caused mortalities were required to be included in the quota. As laid out in the IFA, these agreements were implemented through the creation of HTC polar bear bylaws that are enforceable under the Wildlife Ordinance of the Northwest Territories.

Effective for the 1994–95 season, the Commissioners asked for, and were granted, an increase of one bear to the Canadian quota, thus increasing it from 38 to 39, for a total of 77. For the 1997–98 season, the Commissioners requested a total quota of 80, divided equally between the two jurisdictions. The sustainable harvest of 4.5% was estimated to be 81 if the population numbered 1800 or more, and if females accounted for no more than one-third of the total harvest. A quota of 80 bears was agreed to, with the understanding that no more than 27 would be females, that no further increases would be sought unless new research indicated a larger population, and that the quota would be reduced if future research indicated a smaller population.

In March 2000, the Agreement was revised and signed again. Changes included requiring all kills of problem bears or research handling deaths to be included in the calculation of the annual harvest, formally stating that the female portion of the harvest should not exceed one-third of the total, and that prior notification and consultation are required before research can be initiated. Amstrup et al. (2001) re-analyzed population data collected between 1971 and 1998 and concluded the population was still in the range of 1800 to 2000 animals, and possibly more, but recognized that the data were compromised to some degree by a variety of biases in their collection. Thus, no changes were made to the estimate of the sustainable harvest.

This Agreement, the first of its kind between aboriginal groups in the Canadian and U.S. Arctic, was simply a “gentlemen’s agreement”: it has had no formal status in law, though most aspects were already enforceable in Canada. In Alaska, peer pressure is the only means of enforcing the conditions of the Agreement unless the population is declared depleted under the MMPA. Remarkably, and solely because of concern for the conservation and wise use of the polar bear population, the North Slope Borough adheres to the Agreement by voluntarily committing its members to regulations that do not legally exist. The Agreement sets a unique precedent and has since served as a model for similar involvement of aboriginal groups in wildlife management. In this paper, we evaluate how the Agreement has functioned through the first 10 years of its existence.

METHODS

To assess whether the Agreement affected polar bear hunting practices in the southern Beaufort Sea, we compared harvest data collected in both Alaska and Canada before and after the Agreement was signed. We focused on the size of the harvest, the number of females killed, the proportion of dependent (COY or yearling) cubs in the harvest, the accuracy of the harvest-monitoring data, and efforts made to publicize and support the Agreement.

Duration of Study Period

In this study, we included only Alaska data collected by the U.S. Fish and Wildlife Service (USFWS), a data series that began eight years prior to the Agreement. Thus, we compared harvests from both countries from the eight-year period prior to the Agreement (1980–81 through 1987–88) to those from the 10 years afterwards (1988–89 through 1997–98). Although hunting polar bears during the fall in Canada was eliminated after 1975–76, hunting in Alaska usually begins after freeze-up in the fall, when the bears come south with the ice, and continues until breakup the following spring, when the bears move north again to remain with the pack ice and are generally inaccessible to hunters. Therefore, the harvest from the autumn of one year through the end of the following spring was considered a single season. We compiled data from all bears harvested (including a small number of problem bears that were included in the quota) through a 12-month period, beginning 1 July of one year and ending on 30 June of the next.

Data Collected from Harvested Bears

In Canada, local HTC's and the NWT Department of Renewable Resources (later the DRWED) monitored the harvest. In Alaska, a combination of biologists from the USFWS and locally contracted individuals monitored the harvest. Harvest monitors were requested to record the

TABLE 1. Annual kill of polar bears by season (July 1 through June 30) in the Canadian portion of the southern Beaufort Sea.

Season	Quota	Total kill	Sex				% females	Age and sex classes included in total					
			Males	Females	Un-sexed	COYs		Yearlings	Sport-hunted bear kills				
									Tags	Males	Females	Un-sexed	
80 – 81	38	27	16	11	0	40.7	0	0	? ¹	0	0	0	
81 – 82	38	34	23	11	0	32.4	0	0	?	0	0	0	
82 – 83	38	38	25	11	2	30.6	0	1	?	0	0	0	
83 – 84	38	31	23	8	0	25.8	0	2	?	0	0	0	
84 – 85	38	30	19	10	1	34.5	0	1	?	0	1	0	
85 – 86	38	32	19	13	0	40.6	0	0	?	0	0	0	
86 – 87	38	32	18	12	2	40	0	0	?	2	0	1	
87 – 88	38	24	15	8	1	34.8	0	1	?	0	0	1	
Subtotal	304	248	158	84	6	mean = 34.7	0	5	~13	2	1	2	
88 – 89	38	32	22	8	2	26.7	0	0	?	0	1	0	
89 – 90	38	33	17	15	1	46.9	1	0	?	0	1	0	
90 – 91	38	15	7	7	1	50	0	1	?	0	0	1	
91 – 92	38	29	12	17	0	58.6	0	1	?	0	1	0	
92 – 93	38	32	17	14	1	45.2	0	1	?	1	0	0	
93 – 94	38	17	10	6	1	37.5	1	0	6	2	1	0	
94 – 95	39	22	14	8	0	36.4	0	1	15	8	1	0	
95 – 96	39	20	14	6	0	30	0	0	18	5	1	0	
96 – 97	39	19	12	7	0	36.8	0	0	17	8	3	0	
97 – 98	40	12	8	4	0	33.3	0	1	14	3	2	0	
Subtotal	385	231	133	92	6	mean = 40.9	2	5	~86	27	11	1	
Total	689	479	291	176	12	mean = 37.7	2	10	~99	29	12	3	

¹ Numbers of sport tags issued were not recorded in some years, so totals can only be estimated.

date and location of the kill and the sex of the bear. Problem bears taken after the Agreement in both countries were assigned tags and were included in the harvest total. Data were included from bears killed by guided non-resident hunters in Canada. After 1991, all human-caused bear mortalities were included in the quota.

Whenever possible, the lower jaw with teeth or the first premolar tooth from each bear killed was collected for age determination (Calvert and Ramsay, 1998). We defined adults as bears five or more years of age. In most cases, the reported sex was not verified independently; but, since 1991, submission of the baculum as proof of sex is required in Canada. According to the Canadian community bylaws, if evidence of sex is not provided, the bear is considered to be female for quota setting purposes. Whenever hunters killed bears previously tagged by researchers, the sex reported was checked against the research records. In Alaska, specimens from a sample of animals were analyzed genetically to determine the sex of the animal for comparison to the sex reported by hunters (Schliebe et al., 1999).

Analysis of Data

Data on the total number of bears killed, the sex of the bears taken, and the number of COYs and yearlings in the harvest were summarized annually by jurisdiction. Pooled data were used to monitor population totals and the degree to which activity in one jurisdiction may have influenced or counterbalanced the other.

RESULTS

Total Number and Sex Ratio of Polar Bears Harvested by Hunters

The recorded numbers of polar bears harvested from the southern Beaufort Sea polar bear population were totalled for Canada (Table 1), Alaska (Table 2), and both jurisdictions combined (Table 3), for the eight years prior to the Agreement and 10 years afterwards. The tables also report the number and proportion of females in the known-sex harvest and the number of COYs and yearlings killed. The recorded number of sport hunts is reported for Canada (Table 1). The total number of females harvested in the southern Beaufort Sea is estimated by using the proportion of females in the known-sex harvest to estimate the number of females in the unsexed harvest.

In the eighteen years included in this analysis, the Inuvialuit have not exceeded their annual quota (Table 1). Of the total 385 bears available on the Canadian quota after the Agreement, 231 (60%) were harvested, including a small number of problem bears and illegal kills that were later assigned unused tags from the quota. The recommended maximum harvest of females for the ten-year period was 129, which is one-third of the 385 bears allocated to Canada. The total number of females recorded killed was 92, or 23.8% of the total tags available. However, the proportion of females in the harvest for which sex was reported was at or below the recommended level of one-

TABLE 2. Annual kill of polar bears by season (July 1 through June 30) in the Alaskan portion of the Beaufort Sea.

Season	Quota	Total kill	Sex			% females	Age and sex classes included in total	
			Males	Females	Unsexed		COYs ¹	Yearlings ¹
80 – 81		38	9	7	22	43.8	0	3
81 – 82		23	14	3	6	17.6	0	0
82 – 83		32	11	12	9	52.2	2	4
83 – 84		62	35	12	15	25.5	0	3
84 – 85		53	22	21	10	48.8	3	1
85 – 86		30	12	5	13	29.4	0	3
86 – 87		36	14	12	10	46.2	0	1
87 – 88		34	22	8	4	26.7	0	2
Subtotal		308	139	80	89	mean = 36.5	5	17
88 – 89	38	58	38	4	16	9.5	1	1
89 – 90	38	25	16	6	3	27.3	0	0
90 – 91	38	21	14	5	2	26.3	0	3
91 – 92	38	28	16	12	0	42.9	0	1
92 – 93	38	38	24	8	6	25	0	1
93 – 94	38	47	32	11	4	25.6	0	6
94 – 95	38	23	11	7	5	38.9	0	1
95 – 96	38	33	19	3	11	13.6	1	4
96 – 97	38	51	24	21	6	46.7	0	3
97 – 98	40	24	13	6	5	31.6	0	0
Subtotal	382	348	207	83	58	mean = 28.6	2	20
Total		656	346	163	147	mean = 32.0	7	37

¹ Numbers are from the sample with ages: 314/664 of the total.

third only three times in the ten years after the Agreement was signed (1988–89, 1995–96, and 1997–98) compared with three times in the eight years prior to the Agreement (Table 1). During the ten years after the Agreement was signed, 39.8% (92/231) of the kills for which sex was reported were female, which was not significantly higher than the 34.7% (84/242) in the eight years before the Agreement was signed ($z = 1.281$, $p = 0.20$). Even so, the annual total number of females killed exceeded 13 (the annual sustainable female yield) in only three years since the Agreement, compared with none before, and, as noted above, the overall harvest has been sustainable through the period of study. Even if all of the six unsexed bears killed were also females, there would have been 98 females harvested, which is still only 25.5% of the total harvest allocation and, again, is well within the long-term sustainable harvest limit for females in Canada.

Of the 382 quota bears allocated to Alaska in the 10 years after the Agreement, 348 (90%) were reported killed, and the annual quota was exceeded three times (Table 2). The reported number of females killed exceeded 13 (the annual sustainable female yield) once after the Agreement and once before. The proportion of females in the known-sex harvest of polar bears was at or below the recommended level of one-third seven times after the Agreement was signed, compared to only three times before. Although sex was not reported for a substantial number of bears killed after the Agreement was signed, 28.6% (83/290) of the known-sex bears killed

were females. This was not significantly lower than 36.5% (80/219) before the Agreement was signed ($z = 1.798$; $p = 0.07$). If the sex ratio of unsexed bears was the same as the sex ratio of the rest of the harvest, then approximately 17 (58 unsexed bears \times 28.6% female from the sexed harvest) would have been female, which gives an estimate of 100 females taken. This estimated harvest of females would be only 26% of the Alaskan harvest allocation after the Agreement was signed (100/382) and within the sustainable harvest limit.

In the 10-year period after the Agreement, 579 bears were reported killed from the southern Beaufort Sea polar bear population, from a cumulative recommended maximum of 767. When considered on an annual basis, the harvest exceeded the combined recommended maximum once before the Agreement (when there was no recommended limit in Alaska) and once afterwards (in 1988–89). The total number of females reported killed in the first ten years of the Agreement was 175, which is substantially less than 256 (one-third of the 767 overall total). Sex was not reported for 11% (64/579) of the total harvest. The annual number of females reported killed has exceeded 27 (the sustainable harvest of females if the quota of 80 is filled) twice since the Agreement, compared with once before. The proportion of females in the total kill for which sex was recorded was 35.6% (164/461) before the Agreement and 33.9% (175/515) afterwards, which was a change in the desired direction but not significantly different ($z = 0.455$; $p = 0.65$).

TABLE 3. Annual kill of polar bears by season (July 1 through June 30) in the southern Beaufort Sea.

Season	Quota	Total kill	Sex			% females	Adjusted estimate of females killed ¹
			Males	Females	Unsexed		
80 – 81		65	25	18	22	41.9	27
81 – 82		57	37	14	6	27.5	16
82 – 83		70	36	23	11	39	27
83 – 84		93	58	20	15	25.6	24
84 – 85		83	41	31	11	43.1	36
85 – 86		62	31	18	13	36.7	23
86 – 87		68	32	24	12	42.9	29
87 – 88		58	37	16	5	30.2	18
Subtotal		556	297	164	95	mean = 35.6	200
88 – 89	76	90	60	12	18	16.7	15
89 – 90	76	58	33	21	4	38.9	23
90 – 91	76	36	21	12	3	36.4	13
91 – 92	76	57	28	29	0	50.9	29
92 – 93	76	70	41	22	7	34.9	24
93 – 94	76	64	42	17	5	28.8	18
94 – 95	77	45	25	15	5	37.5	17
95 – 96	77	53	33	9	11	21.4	11
96 – 97	77	70	36	28	6	43.8	31
97 – 98	80	36	21	10	5	32.3	12
Subtotal	767	579	340	175	64	mean = 34.0	193
Total		1135	637	339	159	mean = 34.7	393

¹ Calculated as (females)+((unsexed)*(%females)).

Proportion of COYs and Yearlings

In Canada, two COYs and 10 yearlings (five before the Agreement and five afterwards) were reported killed during the study period (Table 1). In addition, one orphaned COY was sent to a zoo. Seven of the 10 yearlings were reported as being alone when they were shot. Two of these were problem bears in a village.

In Alaska, seven COYs and 37 yearlings were reported killed during the study period (Table 2). Most bears of these age classes were classified on the basis of skull measurements and information collected from the hunters, and 11% were confirmed from tooth ages. However, specimens for age-determination were collected from only 46.3% of the total harvest before the Agreement and 45.5% after. Thus, because samples for age determination were not received from more than half the kills, the total number of cubs and yearlings killed in Alaska is unknown. It appears from the aged sample that the recorded kill of dependent young, mainly yearlings, may be as high as 15% in the Alaskan portion of the study area, and possibly as high as 10% of the total kill. Although the sample size is too small for statistical analysis, the reported number of COYs harvested dropped from five before the Agreement to two afterward.

Sport Hunt

In 1994, the U.S. Congress amended the MMPA to allow importation to the United States of hides taken from qualified populations during legally guided sport hunts in Canada.

The southern Beaufort Sea polar bear population was one of those that qualified. Following this change, the number of tags allocated to sport hunters in the southern Beaufort Sea increased markedly. Although records of the number of tags allocated each year to sport hunts in the 13 hunting seasons between 1980 and 1992–93 are incomplete, only 10 sport-hunted bears were taken. In comparison, in the five years from 1993–94 to 1997–98, 70 tags were allocated for sport hunting and 34 bears were harvested. Eight (23.5%) of those 34 sport-hunted bears were females.

DISCUSSION

Evaluation of the efficacy of the Agreement is not a simple matter because several components are difficult to measure. Aspects such as the size, sex, and age composition of the harvest before and after the signing of the Agreement are relatively easy to document. It is more difficult to quantify topics such as the extent to which knowledge of the Agreement may have affected decisions made by hunters in the field. Other independent variables, such as ice conditions or changes in economic factors, may have influenced hunter success and motivation in unrecorded ways.

One factor that likely played a significant role in successfully concluding the Agreement was that the estimated sustainable harvest, which was based on the population estimate, was about the same as the average annual recorded harvest (Alaska + NWT) during the study period.

The similarity of those values probably aided acceptance of the recommended harvest allocations because it precluded the necessity of difficult bargaining over equitably sharing a reduced quota. We are not suggesting that without this advantage the Agreement would not have been developed and signed, just that it would have been more difficult. In fairness, it should also be noted that while the Agreement was signed in January 1988, the first quotas were not actually set until the following October, which indicates both parties were determined to make it work without preconditions.

An additional motivation for the IGC to develop a management agreement for the entire southern Beaufort Sea polar bear population was that they wished to guide American polar bear hunters at some time in the future, should the MMPA be amended to allow them to import their trophies (hides and skulls) to the United States. Guided sport hunting for polar bears has been legal in the Northwest Territories, Canada, since the early 1970s. However, when the MMPA was passed in 1972, American hunters were prohibited from importing their hides into the United States, which eliminated the majority of the Inuvialuit guides' sport-hunting clients. In 1994, the MMPA was amended to allow the import of hides legally taken by American hunters, provided the bears were taken from a population that met several conditions (Federal Register, 1997). The existence of a signed management agreement between parties that share a polar bear population was identified as important to demonstrate that the conditions specified by the Act were being met. Such agreements describe the allocation of the sustainable quota to each party and other conservation measures, such as harvest seasons, sex ratio of the harvest, and protection of females and cubs. Thus, in part, the existence of this Agreement helped to qualify the southern Beaufort Sea polar bear population for importation of hides taken by guided American hunters. The foresight of the IGC and the NSB to develop a formal agreement, as part of their joint initiative to ensure the southern Beaufort Sea polar bear population did not become overharvested, was rewarded when this population was approved for importation.

Extensive publicity about the Agreement and its requirements was critical. Posters developed in both countries were displayed in all the communities, educational material was developed to help younger hunters identify female bears in the field, and information was regularly provided to hunters' meetings and local radio stations. Additional efforts to build support were required in Alaska because compliance could not be enforced. For example, USFWS provided financial support to the Partners for Wildlife program for NSB to monitor problem bears near villages during the fall and to renovate a prominent Polar Bear Alert sign along the main road leading to Point Barrow through an area of high seasonal polar bear use. The sign provided advice on avoiding confrontations with polar bears. Finally, proactive hazing of bears away from settled areas by members of the Department of Wildlife

Management of the NSB in Barrow, Kaktovik, and outlying camps significantly reduced the number of bears killed. A large proportion of the animals deterred from inhabited areas along the shoreline in the fall were females accompanied by dependent young. This program, at a cost of approximately US\$100,000 each year from 1993 through 2000, underscores the high priority that the NSB placed on meeting the terms of the Agreement; it was especially important in years when whale carcasses close to town attracted large numbers of bears.

Total Number and Sex Ratio of Polar Bears Harvested by Hunters

Considering all the factors involved, it was a significant achievement to keep the harvest within sustainable limits through the first 10 years of the Agreement, and to exceed the total annual quota only once (in 1988–89, the first year). The number of females reported killed through the first 10 years was below the allowable maximum, which compensated for exceeding the target sex ratio of 1:3 in six of the 10 years since signing (Table 3). For example, let us assume that the allowable quota for a population of 1800 bears (Amstrup et al., 1986) is 80 (although it was actually set at 76 until 1994–95, and did not rise to 80 until 1997–98). Then the total allowable kill from the population for the first 10 years of the Agreement would have been 800, of which up to 266 could have been females. Only 175 females were reported taken. Although sex was not recorded for 64 (11%) of the bears taken, even if they had all been females (which is very unlikely), the sustainable yield would not have been exceeded.

The total number of females harvested to date has been sustainable. However, we still need to focus attention on the importance of keeping the female harvest from exceeding one-third of the total each year. Hunters will fill their quota when practical, and if the total quota is taken, there is no room for flexibility (Schliebe et al., 1999). In Canada, the female portion of the known-sex harvest increased, though not significantly, from 34.7% in the 8 years before the Agreement to 40.9% in the combined 10 years after (Table 1). The way in which tags are allocated in Canada contributes to the difficulty of keeping the harvest of females at or below one-third of the total. Because there are many more hunters than tags, hunters must have tags with them before they can go hunting. If the hunt is unsuccessful after some predetermined period, a hunter must return the tag so that someone else can take it hunting. Thus, if hunters see only one bear and think it might be a female, or are simply uncertain of the sex, they may feel pressure to harvest it. If they don't see another bear before their time with the tag is up, they may not get a second opportunity that year—all the tags may be filled before it is their turn again. Each HTC maintains a poster recording the number of males and females killed to date to inform hunters on the current status of that year's harvest.

Other factors also influence the number of bears harvested each year. In some years, especially more recently, considerable open water or rough ice near the coast has restricted travel, reducing hunting success. Because non-Native sport hunters prefer large male bears, the proportion of females taken by them is lower than that in the Inuvialuit harvest. Lastly, the success of sport hunts is often lower than for Inuvialuit hunters, and tags allocated to unsuccessful sport hunters, unlike those allocated to Inuvialuit, cannot be re-issued. Thus, the Canadian quota is rarely filled.

Even though Alaska has no mechanism in place to monitor the harvest during the season and provide that information to hunters in the villages on an ongoing basis, the female portion of the known-sex harvest decreased, though not significantly, after the Agreement (Table 2). The female proportion declined from an average of 0.75 of the adult harvest each fall before the Agreement to an average of 0.32 during the fall hunt in the 10 years afterwards. In spring, the proportion of females in the sexed adult harvest fell from an average of 0.26 before the Agreement to an average of 0.18 afterwards. These low figures helped to compensate for the relatively high proportion of females harvested in Canada in some years (Table 2). The dramatic reduction in the harvest of females in the fall, when they are abundant along the Alaskan coast, likely resulted from the DWM's proactive efforts to haze bears and educate hunters throughout the NSB about the Agreement and the importance of meeting their collective commitment to it.

In summary, two factors made it possible to maintain the total harvest within sustainable limits. First, in Canada, the full annual quota of 38–40 has not been taken since the adoption of the Agreement, so that the number of females killed was sustainable. Second, in Alaska, hunters managed to harvest within the limitations of the voluntary quota in seven of the first 10 years of the Agreement, with a relatively low number and proportion of females, which nullified the detrimental effect of exceeding the quota in the other three years.

Proportion of COYs and Yearlings

Most COYs and yearlings taken were killed in Alaska. The number of COYs taken dropped from five before the Agreement to two afterwards, and the proportion of yearlings in the harvest was about 15% through both periods (Table 2). Because specimens from about half the kills in Alaska were not turned in for age determination, it is likely that additional dependent young were killed but not identified. However, because in Alaska hunters who harvest COYs are stigmatized, we suggest that few additional cubs were taken. COYs and yearlings in family groups have been protected in Canada throughout the period of this study, and few have been harvested. Seven of ten yearlings taken during the study period were reported as alone at the time of capture; thus, it was difficult for the hunters to identify them as yearlings. Since the ages of most polar

bears killed in Canada are known, the numbers reported are probably accurate.

Note that the killing of dependent cubs and yearlings, though not viewed favourably by the public, is not a conservation issue within a sustainable quota system (IUCN Polar Bear Specialists Group, 1998). The greater concern is that the adult females accompanying dependent cubs are probably killed at the same time. Thus, protection of family groups helps to protect adult females and reduces their occurrence in the total kill.

Accuracy and Completeness of Data Reporting

Managing polar bear populations requires knowledge of population size, recruitment rates, and sex-specific survivorship. Maintaining harvests within sustainable limits depends on knowing the number and sex of the animals harvested and on collecting teeth for age determination. In Canada, an active program of harvest reporting and specimen collection in place since the early 1970s ensures that ages are known for about 90% of the harvest. In Alaska, unfortunately, ages are known for less than half the harvest. While harvest is reported and hides are tagged, some hunters still appear not to appreciate the value of providing teeth for age determination, indicating that continued educational efforts are necessary. The proportion of the harvest with completed age and sex information was only 0.48 from 1981 to 1988 and 0.47 in 1989–98 in the Alaskan Beaufort Sea, compared with 0.80 and 0.74 for the same periods in Western Alaska (S. Schliebe, unpubl. data). The largest proportion of well-documented harvests is reported from the Barrow area, where the greatest effort has been made to disseminate information about the Agreement.

In Alaska, 17% of the kills had no sex reported (an improvement from 29% in the previous 8 yrs) compared to less than 3% unreported in Canada over both periods. We assessed the accuracy of reporting the sex of bears taken by comparing the sex reported from bears tagged by researchers and later shot by hunters. Sex was reported incorrectly for three of the 149 bears tagged by researchers in Canada between 1970–71 and 1978–79 and later harvested by hunters, although the numbers on those bears' ear tags were reported correctly. Similarly, the sex was reported incorrectly for one of 56 research-tagged polar bears killed since 1980 by hunters in Alaska, and sex was not recorded for another. Twenty-six of those bears were killed from the southern Beaufort Sea population. While the accuracy of reporting sex in these samples was very high, hunters may be more careful when reporting the sex of a research-tagged animal because the sex of the bear is already known.

Chromosomal DNA was used to verify the sex reported for a sample of 139 polar bears harvested in Alaska that had not been previously tagged by researchers. In this sample, the sex of 19 (13.7%) was inaccurately reported (Schliebe et al., 1999). Because more incorrectly sexed animals were recorded as males when they were females than vice versa, it is possible that the number of females in the Alaskan portion of

the harvest could be underestimated by as much as 12%. Four of the 19 incorrectly sexed bears were from the Beaufort Sea area. Of these, two males were reported as females and two females were reported as males. Although the sample is small (4), it may indicate that the male bias in the Beaufort Sea is less than in other areas of Alaska. Schliebe et al. (1999) modelled the point where failure to report accurately the sex of all harvested polar bears could be a management issue in relation to population size. They concluded that at current harvest levels in the southern Beaufort Sea, the male bias was not an issue. However, as harvest levels increase, the level of bias becomes more critical until the maximum sustainable level is reached, and then no male bias is acceptable. A similar genetic test has not yet been done in Canada, although the return of the baculum as proof of sex is now required to confirm the sex of the animal killed. If the hunter wishes to retain the baculum, a small hole is drilled into it so it cannot be used twice.

The importance of collecting specimens and reporting the sex of harvested animals has been a major objective of the Agreement since it was signed, but this is still an area in which significant improvement is needed. The goal is 100% compliance.

Protection of Denning Females and Females with Cubs

How well the Agreement protected denning bears is difficult to quantify. In Alaska, an experienced hunter killed a pregnant adult female in a den during the fall of the year before the Agreement. After the Agreement was signed, one female was killed in the spring, and her two orphaned cubs were placed in a zoo (and not recorded in harvest of cubs in Table 2). This was the first polar bear the young hunter had ever killed. However, C.D. Brower notes that, as details of the Agreement have become more widely known and accepted in Alaska, the stigmatization of those who take bears in dens or preparing to den has become more widespread. No bears are known to have been hunted at den sites in the 10 years after the Agreement. On the Yukon coast in Canada, a hunter from Inuvik killed a female bear and her single cub near her maternity den site in spring 1994. Because bears in dens and females with COY were protected, the hunter was charged with an illegal kill. In addition, the Inuvik Hunters and Trappers Committee decided the penalty should include loss of his polar bear hunting privileges for five years. The severity of this punishment clearly indicates the importance the hunters put on support of the Agreement. Overall, the protection of denning females is thought to have contributed significantly to a steady increase in the incidence of denning along the coast through the 1980s and 1990s (Stirling and Andriashek, 1992; Amstrup and Gardner, 1994).

OVERVIEW COMMENTS AND CONCLUSIONS

We conclude that the Agreement has been significant and successful. In particular, the total harvest and the harvest of

females have both been maintained within sustainable limits, and publicity about the Agreement has aided promotion of polar bear conservation by hunters of this population. It is also notable that the Inuvialuit and Inupiat remain fully committed to continuing this Agreement into the future.

Knowledge of the Agreement is quite variable throughout the southern Beaufort Sea area, and it would be difficult to compare this Native-to-Native agreement with a conventional government-to-user agreement in terms of compliance. However, evidence such as first-hand observations of hunters not taking bears, though difficult to quantify, indicates peer pressure has helped to decrease the hunts on family groups and denning females. Similarly, at Barrow, individual lectures have been given to offending hunters, the access road to bowhead whale carcasses has been blocked when bears were scavenging, and there have been local media advisories on bear viewing. Collectively, these efforts have probably contributed to keeping the total number of females killed within sustainable limits, but educational efforts need to be maintained to ensure this continues.

It is clear that the most substantial advantage of negotiating this Agreement directly between the NSB and the IGC was that it could be done quickly by those benefiting most directly from the process, thereby ensuring pride of ownership, which has been significant. Should the parties wish in future to negotiate a more formal, legally binding agreement including governments (for example, to facilitate a greater enforcement capacity should selling hides or guiding hunters in Alaska become legal), that possibility remains open. In the meantime, the current Agreement remains in place and continues to function.

An additional benefit of this successful polar bear Agreement (and the user groups' pride in it) is that it has served as a precedent and model for several additional user-to-user conservation agreements in Alaska and the Northwest Territories. These include the Canadian internal management agreements for polar bears in the Southern and Northern Beaufort Sea (1991), formation of the Alaska Nanuq Commission (1994), the Agreement between the United States of America and the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population (2000), and the Inuvialuit-Inupiat Beaufort Sea Beluga Whale Agreement (2000). This is a legacy of which the Inuvialuit and Inupiat may be truly proud.

DEDICATION

We dedicate this paper to the memory of the late Nelson Green and the late Nolan Soloman, two of the original four Commissioners to this Agreement when it was first signed in 1988. Both contributed significantly to its success.

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REFERENCES

- AMSTRUP, S.C. 1986. Research on polar bears in Alaska, 1983–1985. Proceedings of the Ninth Working Meeting of the IUCN/SSC Polar Bear Specialist Group. Cambridge: International Union for the Conservation of Nature. 85–108.
- AMSTRUP, S.C., and GARDNER, C.L. 1994. Polar bear maternity denning in the Beaufort Sea. *Journal of Wildlife Management* 58:1–10.
- AMSTRUP, S.C., STIRLING, I., and LENTFER, J. 1986. Size and trends of Alaskan polar bear populations. *Wildlife Society Bulletin* 14:251–254.
- AMSTRUP, S.C., MacDONALD, T., and STIRLING, I. 2001. Polar bears in the Beaufort Sea: A 30 year mark-recapture case study. *Journal of Agricultural, Biological and Environmental Statistics* 6:221–234.
- ANON. 1966. Proceedings of the 1st. International Meeting on the Polar Bear. 6–10 September 1965, Fairbanks, Alaska. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, and the University of Alaska, Fairbanks. 71 p.
- CALVERT, W., and RAMSAY, M.A. 1998. Evaluation of age determination of polar bears by counts of cementum layer counts. *Ursus* 10:449–453.
- FEDERAL REGISTER. 1997. Importation of Polar Bear Trophies From Canada Under the 1994 Amendments to the Marine Mammal Protection Act: Final Rule. *Federal Register* 62(32):7302–7331.
- IUCN POLAR BEAR SPECIALIST GROUP. 1998. Resolutions. In: Proceedings of the 12th Working Meeting of the IUCN Polar Bear Specialist Group, January 1997. Oslo, Norway. 47–48.
- KWATEROWSKY, P.A. 1967. Instructions for the implementation of polar bear quotas. Unpubl. memo from the Superintendent of Game, Department of Indian Affairs and Northern Development. Fort Smith, NWT. Available from the Department of Resources, Wildlife, and Economic Development, Government of NWT, 600 5102 50th Ave., Yellowknife, NWT X1A 3S8. 8 p.
- LENTFER, J.W. 1976. Polar bear management and research in Alaska, 1972–74. In: Proceedings of the Fifth Working Meeting of the IUCN Polar Bear Specialist Group. IUCN New Series (Morge, Switzerland) 42:53–60.
- . 1983. Alaskan polar bear movements from mark and recapture. *Arctic* 36:282–288.
- . 1985. Report to IUCN Polar Bear Specialist Group. In: Proceedings of the Eighth Working Meeting of the IUCN/SSC Polar Bear Specialist Group. Gland, Switzerland: IUCN. 125–127.
- NAGEAK, B.P., BROWER, C.D., and SCHLIEBE, S.L. 1991. Polar bear management in the southern Beaufort Sea: An agreement between the Inuvialuit Game Council and the North Slope Borough Fish and Game Committee. *Transactions of the North American Wildlife and Natural Resources Conference* 56:337–343.
- SCHLIEBE, S.L. 1986. Alaska polar bear native subsistence harvest. In: Proceedings of the Ninth Working Meeting of the IUCN/SSC Polar Bear Specialist Group. Gland, Switzerland: IUCN. 117–131.
- SCHLIEBE, S.L., EVANS, T.J., FISCHBACH, A.S., and CRONIN, M.A. 1999. Using genetics to verify sex of harvested polar bears: Management implications. *Wildlife Society Bulletin* 27(3): 592–597.
- SCHWEINSBURG, R.E. 1981. A brief history of polar bear management in the NWT. *Northwest Territories Wildlife Notes* 2:1–5.
- STIRLING, I. 1988. Polar bears. Ann Arbor, Michigan: University of Michigan Press. 232 p.
- STIRLING, I., and SMITH, P. 1976. Polar bear management changes in Canada. In: Proceedings of the Fifth Working Meeting of the IUCN Polar Bear Specialist Group. IUCN New Series (Morge, Switzerland) 42:61–67.
- . 1980. Polar bear management changes in Canada, 1974–76. In: Proceedings of the Sixth Working Meeting of the Polar Bear Specialist Group. Gland, Switzerland: IUCN. 130–142.
- STIRLING, I., and ANDRIASHEK, D. 1992. Terrestrial denning of polar bears in the eastern Beaufort Sea area. *Arctic* 45: 363–366.
- STIRLING, I., ANDRIASHEK, D., LATOUR, P., and CALVERT, W. 1975. The distribution and abundance of polar bears in the eastern Beaufort Sea. Final Report to the Beaufort Sea Project. Victoria, B.C.: Fisheries and Marine Service, Department of Environment. 59 p.
- STIRLING, I., ANDRIASHEK, D., SPENCER, C., and DEROCHE, A.E. 1988. Assessment of the polar bear population in the eastern Beaufort Sea. Final Report to the Northern Oil and Gas Assessment Program. Edmonton, Alberta: Canadian Wildlife Service. 81 p.
- TAYLOR, M.K., DeMASTER, D.P., BUNNELL, F.L., and SCHWEINSBURG, R.E. 1987. Modelling the sustainable harvest of female polar bears. *Journal of Wildlife Management* 51: 811–820.
- TRESEDER, L., and CARPENTER, A. 1989. Polar bear management in the southern Beaufort Sea. *Information North* 15(4):1–4.