

Changes in the Composition of the Harvest in Three Polar Bear Subpopulations in the Western Canadian Arctic after the U.S. Listing of the Polar Bear as a Threatened Species

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ABSTRACT. The 2008 United States (U.S.) listing of the polar bear as a threatened species prohibits the importation of polar bear trophies into the U.S., significantly decreasing the number of Americans paying for guided polar bear hunts in Canada. We examined the numbers and composition of the harvest in three polar bear subpopulations, Northern Beaufort Sea, Southern Beaufort Sea, and Viscount Melville Sound, located in the Inuvialuit Settlement Region in the western Canadian Arctic to identify what happens when the support for guided hunting is withdrawn. We find that there was no significant change in the number of polar bears harvested or in the sex composition of the harvest in the three subpopulations after the U.S. listing. Over the twelve-year study period, harvests in each subpopulation were always within the quota. The number of guided hunts decreased after the U.S. listing and the number of subsistence hunts increased in each subpopulation during this time. The number of bears harvested as a percentage of tags used was significantly higher in the Northern Beaufort Sea after the listing. This is because a tag issued for a guided hunt is considered “used” even if the hunt is unsuccessful, which is often the case as hunters seek large male bears, whereas a tag issued for subsistence is re-issued until a successful harvest. We conclude that while the U.S. listing and rapid decline in guided hunts did not affect the number of polar bears harvested, it did disrupt the Inuit cultural economy.

Key words: conservation hunting; guided hunting; Inuit; Inuvialuit; sport hunting; wildlife co-management

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INTRODUCTION

Polar bears (*Ursus maritimus*) are important to Inuit in Canada for culture, spirituality, subsistence, and economics (Boas, 1888; Van de Velde, 1957; Wenzel, 1983; Schmidt and Dowsley, 2010). To Inuit, wildlife conservation and cultural conservation are one and the same, and Inuit have effectively managed polar bears and other populations of wildlife for generations (Brody, 1976). Indeed, polar bears are one of the most culturally regulated species for Inuit (Riewe and Gamble, 1988; Schmidt and Dowsley, 2010). Inuit have always harvested polar bears for food, clothing and tools, and after contact with non-Inuit, also for income from the sale of pelts (Wenzel, 2005). Today, Inuit are full partners in the management of polar bears in Canada through their involvement on wildlife co-management boards, drawing upon the best available scientific data and Inuit traditional knowledge.

Beginning in the early 1970s, “sport hunting”, also referred to as “conservation hunting” and referred to herein as “guided hunting” was developed in the Canadian Arctic and took on an important economic role in the lives of Inuit (Freeman and Wenzel, 2006). Inuit in the Canadian Arctic have the right, under their land claims settlements, to harvest polar bears at sustainable levels and to use these harvesting rights to offer guided hunts to non-Inuit. Sports hunters travel to the Canadian Arctic from around the world, but most have come from the U.S. (Wenzel, 2008). Guided hunts provide important social and economic benefits to Inuit communities, many which have limited economies, while strengthening the conservation hunting regulatory framework (Wall, 2005; Wenzel, 2008). The conservation benefits of guided hunting include the selective harvesting of large male bears, which is consistent with most polar bear management harvest quotas that are set at a minimum 2:1 male/female sex ratio, and additional justification and incentives to protect polar bear habitat from potentially damaging activities (Freeman and Foote, 2009). The economic benefits of guided hunting include cash payments to the community, guides, and helpers in addition to the meat, which is widely distributed throughout the community (Freeman and Wenzel, 2006; Wenzel, 2008; Dowsley, 2010). Guided hunting also provides important social benefits. Participating in a guided hunt as a guide or helper connects Inuit to an activity that is highly valued within Inuit society and generates significant social capital (Wenzel, 2008). Guiding non-resident hunters likewise promotes the transfer of traditional knowledge and land skills across generations (Pearce et al., 2011).

In the last two decades, polar bear conservation has been at the forefront of many international climate change campaigns because of the threat that declining summer sea ice poses to polar bear survival (Tyrrell and Clark, 2014). Polar bears are highly sensitive to changes in sea ice due to their reliance on it for hunting and travel (Laidre et al., 2008; Hamilton et al., 2014; Lunn et al., 2016). In the Southern Beaufort Sea of the U.S. and Canada, studies

have linked declines in summer sea ice to reduced physical condition, growth, and survival of polar bears (Regehr et al., 2010; Bromaghin et al., 2015; Ware et al., 2017; Bromaghin et al., 2021). Projected future climate change and reduced spatial and temporal availability of sea ice is expected to increasingly force population dynamics of polar bears in the future (Hunter et al., 2010; Schliebe et al., 2008; Castro de la Guardia et al., 2013; Bromaghin et al., 2021). Scientists and Inuit generally agree that observed declines in summer sea ice extent have already negatively affected some polar bear subpopulations, but the impact of anticipated future loss of sea-ice habitats on other polar bear subpopulations is questioned by some Inuit groups in Nunavut (Tyrrell, 2006; Dowsley and Wenzel, 2008).

Polar bear conservation is governed by a strict set of cultural and formalized rules, many of which are self-imposed by Inuit hunters and reflect the pride that Inuit take in making decisions to ensure that populations will be sustained (Joint Secretariat, 2015). Co-management bodies, including Inuit and scientists, carefully monitor the status of polar bears and have developed formal management plans for their conservation, which consider expected future climate change impacts (Joint Secretariat, 2017). These plans include annual harvest quotas that are divided between communities and outline aspirations for the collection of traditional knowledge, scientific knowledge, and monitoring to inform management decisions.

The findings that a decline in summer sea ice have had a negative impact on polar bear body condition and survival rates in the Southern Beaufort Sea subpopulation combined with projections of population declines due to continued warming and the ensuing loss of sea ice habitat, contributed to the 2008 decision to list polar bears as threatened under the U.S. Endangered Species Act. The listing means that Americans are no longer allowed to import polar bears as hunting trophies into the U.S. In this paper, we examine the numbers and composition of the polar bear harvest between 2004 and 2016 for three polar bear subpopulations: Northern Beaufort Sea (NB), Southern Beaufort Sea (SB), and Viscount Melville Sound (VM), located in the Inuvialuit Settlement Region (ISR) in the western Canadian Arctic to identify what happens when U.S. support for guided hunting is withdrawn. To do this, we aggregated harvest data for each subpopulation and checked for normality and homogeneity of variances for each location between “least concerned” (2004–2008) and “threatened groups” (2008–2016). Assumptions were not met and the nonparametric Wilcoxon Rank-Sum test was used to compare values between groups. Significance was tested at $p < 0.05$, $\alpha = 0.05$. We hypothesise that for each subpopulation there will be no significant change in the number of bears harvested but a change in the composition of the harvest. In particular, we hypothesise that the percentage of guided hunts that make up the overall harvest will decline and the percentage of subsistence hunts that make up the overall harvest will increase after the U.S. listing, and that the number of bears harvested as

a percentage of tags claimed will increase after the U.S. listing.

POLAR BEAR CONSERVATION IN CANADA

Through the 1950s, and particularly during the 1960s, there was a rapid increase in the recorded number of polar bears harvested, likely driven by an increase in the price paid for polar bear hides, and the use of snow machines, aircrafts, and boats for hunting (Stirling, 1988). In just a few decades, illegal unregulated trophy hunting of polar bears across the Arctic led the species to be considered an animal in danger of extinction (Prestrud and Stirling, 1994; Freeman, 2001). In response, and after sizeable negotiation, the five nations with jurisdiction over areas where polar bears are distributed (Canada, Denmark [Greenland], Norway, U.S., and former Union of Soviet Socialist Republics [Russia]), signed the International Agreement on the Conservation of Polar Bears and their Habitat (referred to herein as ‘the Agreement’) in Oslo, Norway in 1973 (Larsen and Stirling, 2009). The Agreement came into effect on 26 May 1976 and was unanimously reaffirmed in 1981 (Fikkan et al., 1993). This Agreement was significant because it was one of the first treaties in international wildlife law to specify that decisions should be based on sound conservation practices based on the best available scientific data, and was the first time the five arctic rim nations collaborated in a signed commitment to solve a common regional problem (Prestrud and Stirling, 1994). The Agreement prohibited all taking (killing, hunting, etc.) of polar bears except for some specific exemptions (Articles I and III); the ecosystems of which polar bear are a part are to be protected (Article II); and national research programs on polar bears are to be conducted (Article VII) (Prestrud and Stirling, 1994). At the time of the signing of the Agreement, all range states except for Canada had placed restrictions or stopped all sport hunting of polar bears. Canada, however, successfully argued for the inclusion of a provision (Article III) allowing for the harvesting of polar bears by local people using traditional methods in the exercise of their traditional rights and in accordance with the laws of that Party, including guided hunts (Larsen and Stirling, 2009). Article III was particularly important for the U.S. and Canada with their large Inuit population, and for Greenland’s Indigenous people, whose access to traditional hunting and fishing was important for their livelihoods and who’s rights were already recognized in national legislation (Prestrud and Stirling, 1994). See Freeman and Wenzel (2006) for a discussion of trophy hunting as a basis for developing polar bear conservation hunting programs (pp 22–23).

The principles of the International Agreement on the Conservation of Polar Bears and their Habitat are implemented in Canada through Wildlife Management Boards established through land claim agreements, and provincial, territorial, and federal governments. Quotas

are established based upon the best available scientific data and local traditional knowledge. The harvest is strictly regulated and monitored using hunting permits and quotas to determine the number of polar bears harvested per year in each jurisdiction (Prestrud and Stirling, 1994). This study focuses on three polar bear subpopulations located within the jurisdiction of the ISR that was created under the Inuvialuit Final Agreement (IFA, 1984). All polar bear subpopulations in the ISR are shared with other jurisdictions and have user-to-user agreements: Alaska (SB) and Nunavut (NB and VM) (Brower et al., 2002). In the ISR, wildlife is managed by the Wildlife Management Advisory Councils (WMACs) for the North Slope (NS) and Northwest Territories (NWT) in accordance with sections 12(46-57) and 14(45-60) of the IFA. The WMAC (NS) and the WMAC (NWT) provide advice to the appropriate ministers on all matters relating to wildlife policy and the management, regulation, and administration of wildlife, habitat, and harvesting for the ISR (s.14(60)). The Inuvialuit Game Council (IGC) plays a vital role in the co-management system. Under the IFA, the IGC represents the collective Inuvialuit interest in all matters pertaining to the management of wildlife and wildlife habitat in the ISR (s.14(74)). The duties of the IGC are set out in section 14(74) of the IFA and include appointing Inuvialuit members for all joint government/Inuvialuit bodies having an interest in wildlife, including the WMACs (NWT and North Slope). The IGC allocates wildlife harvest quotas among the six ISR communities (s.(14(74f))). In regard to polar bears, Inuvialuit are permitted to transfer their exclusive hunting rights to other guided hunts. When this occurs, the tag allocated to the guided hunter cannot be reallocated if the hunt is unsuccessful. When a tag is issued for subsistence, the hunter has a specified length of time during which they can harvest a polar bear. At the end of this time, if a bear is not harvested, the tag is returned to the HTC and reissued. The hunter is eligible to be considered for another tag after others have had a chance.

METHODS

We focused on the three polar bear subpopulations located within the ISR because scientific findings about sea ice change and polar bear survival in the SB subpopulation were central to the U.S. listing and the author’s experience working with communities in the region. The analysis required using harvest data collected in the ISR; therefore, the authors first presented the paper concept to the IGC and requested use of the harvest data (September 2019). The IGC did not have any issue with the paper concept, instructed the authors to work with the Department of Environment and Natural Resources (ENR), GNWT to obtain harvest data, and report back to the IGC with the results of the analysis. The authors reported the results and their interpretations of them to the IGC in March 2021. The IGC did not have any issue with the report and advised

the authors to contact Environment and Climate Change Canada (ECCC) to ensure that there was no conflict or duplication of work. The authors confirmed with ECCC that there was indeed no conflict or duplication of work.

Data were obtained from ENR and included harvest data reported by communities in the ISR (Aklavik, Inuvik, Paulatuk, Sachs Harbour, Tuktoyaktuk, Ulukhaktok) and Nunavut (Kugluktuk and Cambridge Bay) for the SB, NB, and MV subpopulations between July 2004 and June 2016 (GNWT, 2009, 2011, 2016). Reporting for each harvest period (beginning July 1 of one year and ending on June 30 of the next) included: the total number of tags issued (quota); the number of polar bears harvested and the sex composition of the harvest; and how many tags were used for successful sport hunts, unsuccessful sport hunts, subsistence hunts, and problem/defence/illegal/humane kills. It would have been desirable to include data for more harvest periods before and after the U.S. listing but these are the data that ENR made available to us.

Under the harvest management system in the ISR and Nunavut, the use of a tag, harvest reporting, and sample collection (including proof of sex and tooth) are mandatory under the Hunter and Trapper Committee (Hunters and Trappers Organization in Nunavut) (HTC/HTO) by-laws. These data and samples are collected from harvesters by ENR officers in each community and shared with the regional ENR offices. Sometimes the sex of the bear harvested is classified in the harvest report as “unverified male/unknown.” This means that the harvested bear was reported as male but no baculum was submitted for verification, a tag was unreturned and assumed used, or the sex is unknown because no samples were submitted. These data are listed as “un-sexed” in the analysis table, were included in calculations of number of bears harvested and tags used, but not in the calculation of sex-ratio.

We grouped the data as “least concern” (2004–2008) and “threatened” (2008–2016). Data were aggregated for each subpopulation and percentages were calculated for responses as a portion of the total harvest or tags used. It is noteworthy, that the subpopulation boundaries were delineated using information on polar bear movement patterns and genetics as well as consideration of management. There is frequent movement of bears between these areas, and both scientists and Inuvialuit, consider the SB and NB to be a single group of bears that move according to good hunting conditions, but subpopulations are used as units to facilitate harvest management (Joint Secretariat, 2017). The boundary between the NB and SB subpopulations was revised in 2013/14 in an attempt to better reflect separation between these subpopulations based on movement analyses (Amstrup et al., 2006) (Fig. 1). The changes were implemented commencing in the 2013/2014 harvest period. After the boundary change, harvest quotas changed in the SB (from 40 to 21) and in the NB (from 65 to 77 and then to 70 in 2015/2016).

Our analysis focused on identifying what correlation, if any, the listing had on the numbers and composition of

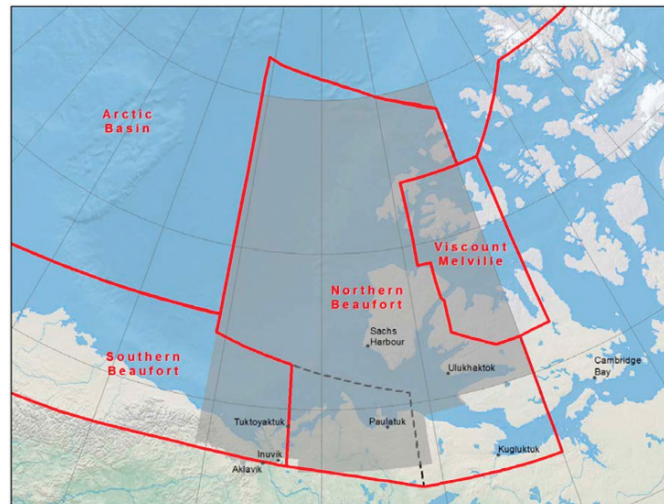


FIG. 1. Subpopulations boundaries for polar bears in the ISR. New subpopulations boundaries as of 2013/2014 are shown as red lines and previous boundaries as dashed lines. The ISR is shown in light grey (Joint Secretariat, 2017).

the harvest. The following response variables were tested for each subpopulation: total bears harvested, female bears as a percentage of total harvest, subsistence hunts as a percentage of total harvest, successful sport hunts as a percentage of total harvest, unsuccessful sports hunts as a percentage of tags used, and harvest as a percentage of total tags used. Data were checked for normality and homogeneity of variances for each subpopulation between least concerned and threatened groups. Assumptions were not met and the nonparametric Wilcoxon Rank-Sum test was used to compare harvest numbers between least concern and threatened groups. Significance was tested at $p < 0.05$, $\alpha = 0.05$. The findings of the analysis are complemented by ethnographic observations and conversations documented over the past eighteen years with Inuit who harvest polar bears in the three management areas. These data and experiences are used to help interpret and explain the numbers and composition of the harvest before and after the U.S. listing and implications for Inuit.

RESULTS

A total of 652 polar bears were harvested from the three subpopulations during the twelve harvest periods included in this analysis between 1 July 2004 and 30 June 2016. Of this total, 423 bears were harvested from the NB, 170 from the SB, and 57 from the VM subpopulations. In the twelve harvest periods included, the number of bears harvested never exceeded the quota.

The results of the analysis comparing the numbers and composition of the harvest before and after the U.S. listing are presented separately for each subpopulation (Table 1).

Table 1 Significance of difference between least concern (n = 4) and threatened (n = 8) groups in three polar bear subpopulations using the Wilcoxon Rank-Sum test.

Variable	Wilcoxon rank-sum test P-value and W-value					
	Northern Beaufort Sea		Southern Beaufort Sea		Viscount Melville Sound	
	P-value	W	P-value	W	P-value	W
Bears Harvested	0.11	6	0.55	20	0.73	13.5
Females (% Harvest)	0.20	24	0.55	12	0.10	6
SUB (% Harvest)	0.008**	0	0.047*	4	0.01*	4
SSH (% Harvest)	0.008**	32	0.03*	29	0.01*	28
USH (% Harvest)	0.008**	32	0.10	26	0.67	16
Harvest (% Tags used)	0.008**	0	0.19	8	0.22	12

Notes: **P-values <0.01; *P-values <0.05

Abbreviations: SUB = Subsistence; SSH = Successful Sport Hunt; USU = Unsuccessful Sport Hunt

Northern Beaufort Sea (NB)

There was no significant change in the number of bears harvested in the NB per season after the change in conservation status in the U.S. (Wilcoxon rank sum test, $p = 0.11$; Fig. 2a). There was also no significant change in the number of female bears harvested as a percentage of the total harvest after the listing (Wilcoxon rank sum test, $p = 0.20$; Fig. 2b). However, the percentage of bears harvested for subsistence relative to the total harvest significantly increased after the change in conservation status (Wilcoxon rank sum test, $p = 0.008$; Fig. 2d), and the percentage of successful sport hunts that made up the overall harvest significantly declined (Wilcoxon rank sum test, $p = 0.008$; Fig. 2e) as did the number of unsuccessful sport hunts as a percentage of tags claimed (Wilcoxon rank sum test, $p = 0.008$; Fig. 2f). Consistent with these findings, the number of bears harvested as a percentage of tags claimed was significantly higher after the listing (Wilcoxon rank sum test, $p = 0.008$; Fig. 2c).

Southern Beaufort Sea (SB)

There was no significant change in the number of bears harvested in the SB per season after the change in conservation status in the U.S. (Wilcoxon rank sum test, $p = 0.55$; Fig. 3a). There was also no significant change in the number of female bears harvested as a percentage of the total harvest after the listing (Wilcoxon rank sum test, $p = 0.55$; Fig. 3b). However, the percentage of bears harvested for subsistence relative to the total harvest significantly increased after the change in conservation status (Wilcoxon rank sum test, $p = 0.047$; Fig. 3d), and the percentage of successful sport hunts that made up the overall harvest significantly declined (Wilcoxon rank sum test, $p = 0.03$; Fig. 3e). There was no significant change in the number of unsuccessful sport hunts as a percentage of tags claimed (Wilcoxon rank sum test, $p = 0.10$; Fig. 3f) or in the number of bears harvested as a percentage of tags claimed (Wilcoxon rank sum test, $p = 0.19$; Fig. 3c) after the listing.

Viscount Melville Sound (VM)

There was no significant change in the number of bears harvested in the VM per season after the change in conservation status in the U.S. (Wilcoxon rank sum test, $p = 0.73$; Fig. 4a). There was also no significant change in the number of female bears harvested as a percentage of the total harvest after the listing (Wilcoxon rank sum test, $p = 0.10$; Fig. 4b). However, the percentage of bears harvested for subsistence relative to the total harvest significantly increased after the change in conservation status (Wilcoxon rank sum test, $p = 0.01$; Fig. 4d), and the percentage of successful sport hunts that made up the overall harvest significantly declined (Wilcoxon rank sum test, $p = 0.01$; Fig. 4e). There was no significant change in the number of unsuccessful sport hunts as a percentage of tags claimed (Wilcoxon rank sum test, $p = 0.67$; Fig. 3f) or in the number of bears harvested as a percentage of tags claimed (Wilcoxon rank sum test, $p = 0.22$; Fig. 4c) after the listing.

DISCUSSION

The finding that there was no significant change in the number of polar bears harvested or in the sex composition of the harvest in the three subpopulations after the U.S. listing shows that the co-management system in the ISR has been successful at regulating a sustainable harvest even after support for guided hunting was withdrawn. The result that in each of the three subpopulations the percentage of guided hunts that made up the overall harvest declined and the percentage of subsistence hunts that made up the overall harvest increased after the U.S. listing was to be expected. A possible explanation for this is because polar bear harvesting is culturally important to Inuit, and because the economics of guided hunting versus subsistence harvesting are comparable.

Harvesting a polar bear is an important marker of culture and identity for Inuit. Traditionally, harvesting a polar bear was an important marker of one's manhood and this continues to be relevant today (Joint Secretariat, 2015). Even if a bear is harvested for a guided hunt, the

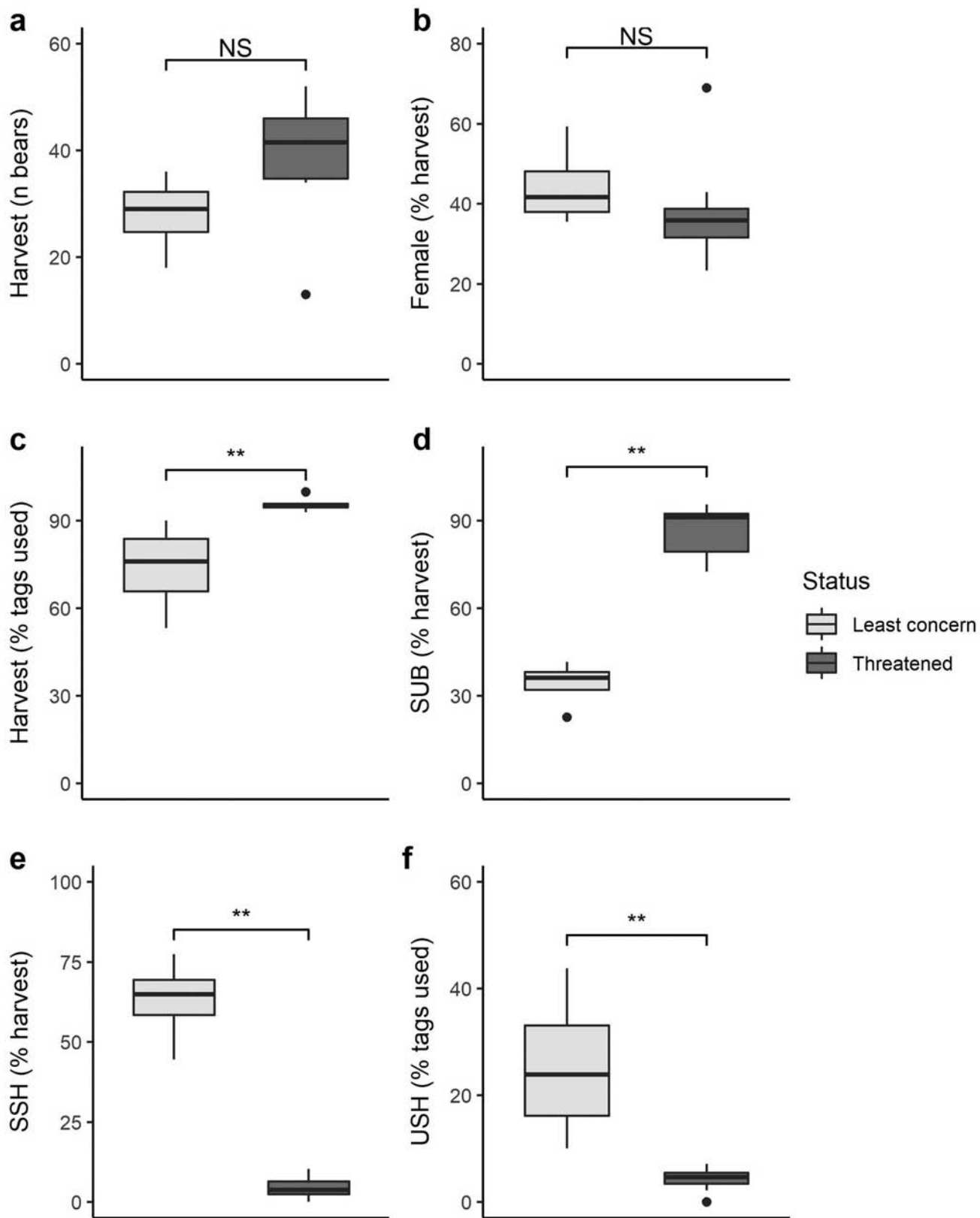


FIG. 2. Number (or percentage) of polar bears harvested per season in the Northern Beaufort Sea subpopulation before (1 July 2004 – 30 June 2008) and after (1 July 2009 – 30 June 2016) the change in conservation status. From top-left to bottom-right: a) number of bears harvested; b) female bears as percent of harvest; c) bears harvested as percent of tags claimed; d) percent of harvest for subsistence; e) percent of harvest for sport (successful harvest); and f) percent of tags claimed for sport (unsuccessful harvest). Probability values indicate significant differences between groups at $\alpha = 0.05$ using the Wilcoxon Rank-Sum test (** = < 0.01 , * = < 0.05 , NS = not significant) for Least concern (n = 4) and Threatened (n = 8) groups.

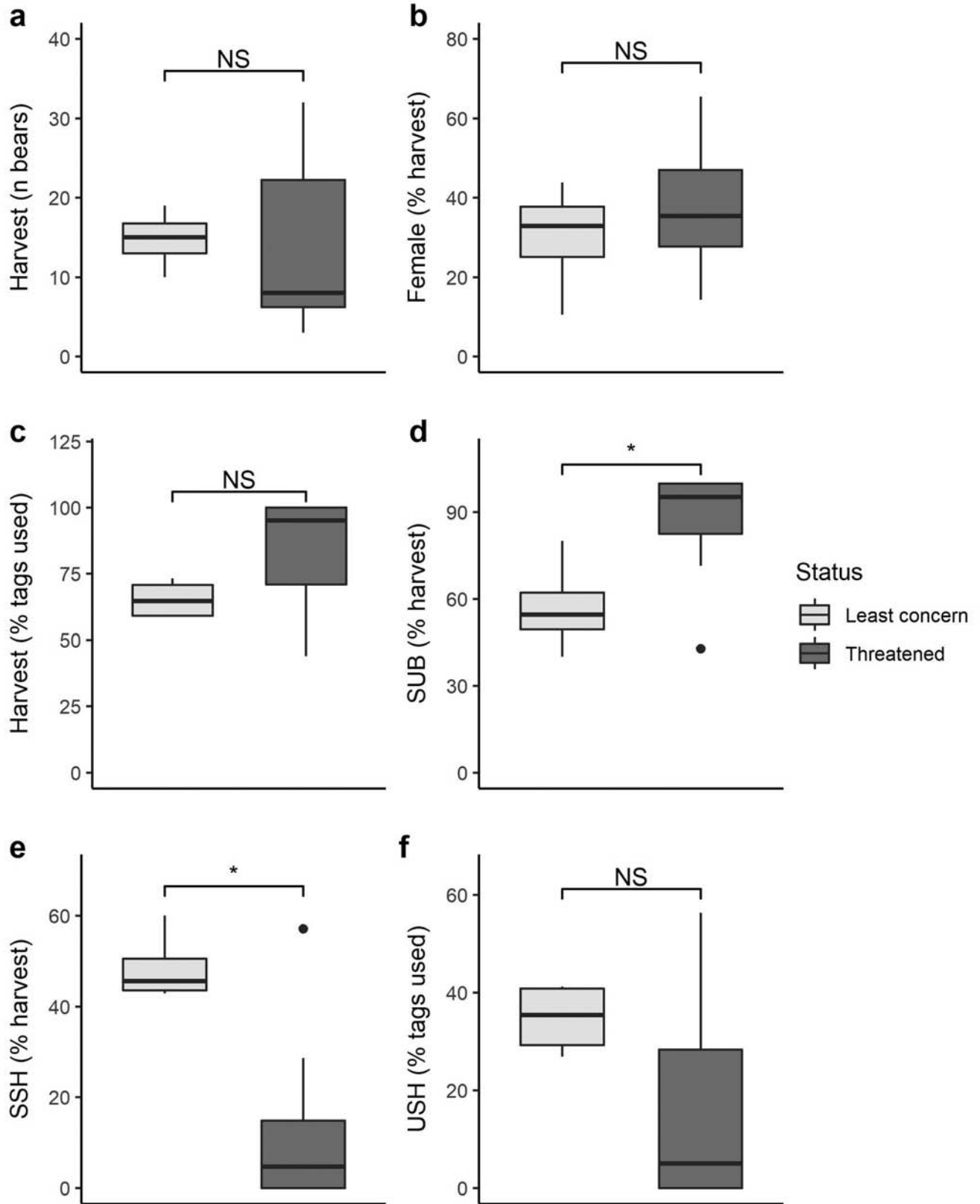


FIG. 3. Number (or percentage) of polar bears harvested per season in the Southern Beaufort Sea subpopulation before (1 July 2004 – 30 June 2008) and after (1 July 2009 – 30 June 2016) the change in conservation status. From top-left to bottom-right: a) number of bears harvested; b) female bears as percent of tags claimed; c) bears harvested as percent of tags claimed; d) percent of harvest for subsistence; e) percent of harvest for sport (successful harvest); and f) percent of tags claimed for sport (unsuccessful harvest). Probability values indicate significant differences between groups at $\alpha = 0.05$ using the Wilcoxon Rank-Sum test (** = < 0.01 , * = < 0.05 , NS = not significant) for Least concern (n = 4) and Threatened (n = 8) groups.

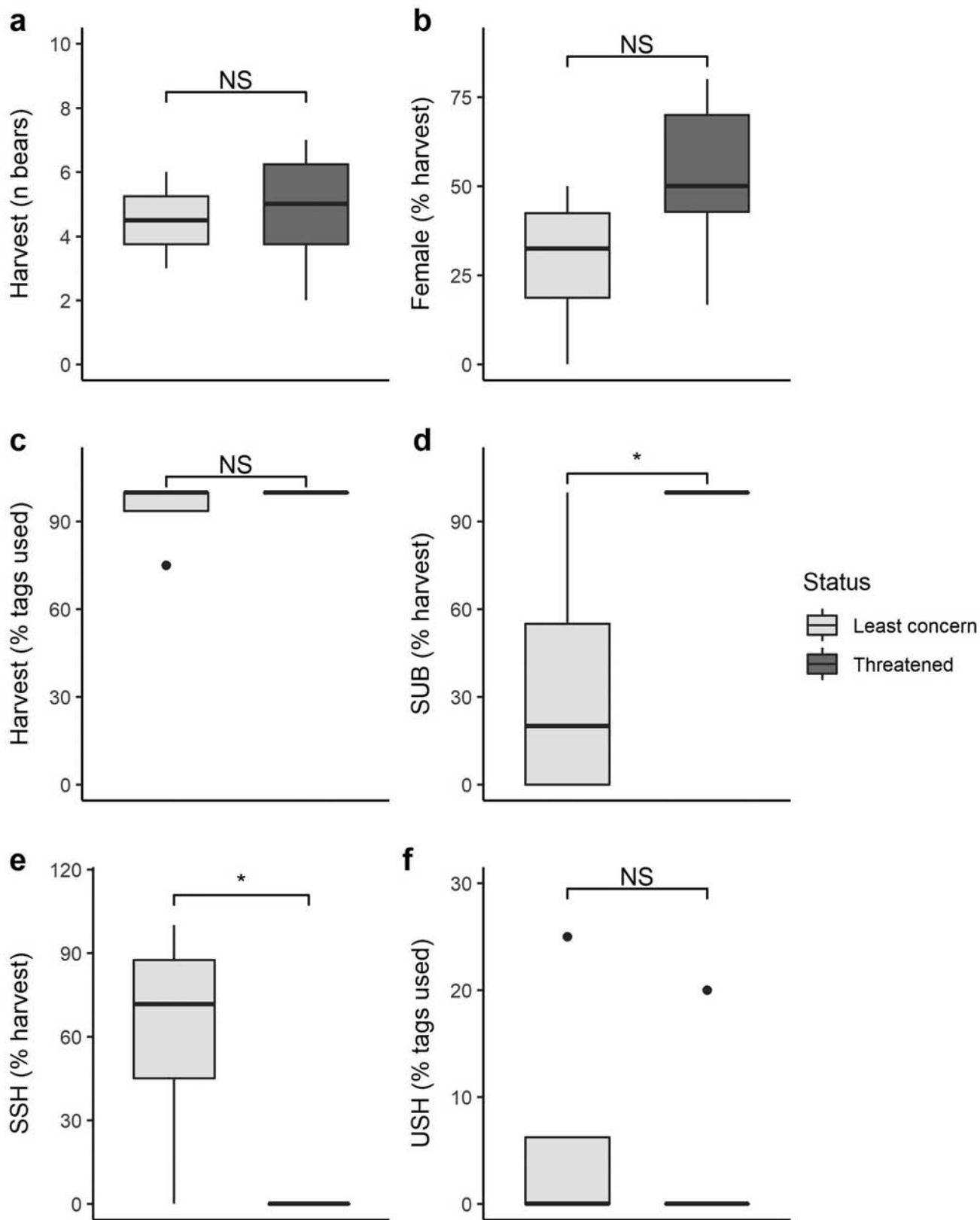


FIG. 4. Number (or percentage) of polar bears harvested per season in the Viscount Melville Sound subpopulation before (1 July 2004 – 30 June 2008) and after (1 July 2009 – 30 June 2016) the change in conservation status. From top-left to bottom-right: a) number of bears harvested; b) female bears as percent of tags claimed; c) bears harvested as percent of tags claimed; d) percent of harvest for subsistence; e) percent of harvest for sport (successful harvest); and f) percent of tags claimed for sport (unsuccessful harvest). Probability values indicate significant differences between groups at $\alpha = 0.05$ using the Wilcoxon Rank-Sum test (** = < 0.01 , * = < 0.05 , NS = not significant) for Least concern (n = 4) and Threatened (n = 8) groups.

Inuit guide is understood to be the real hunter, the one who actually took the bear. It was commonplace for people in Ulukhaktok to say that “John got a bear” and not “John’s hunter got a bear.” Elders often said that it was great to see young people carrying on their traditions, even if the guides were not that young, but the sentiment was that people were continuing to harvest polar bears, using dog teams, taking younger helpers with them, and sharing meat within the community. The cultural importance of harvesting polar bears might partially explain the increase in the number of subsistence harvests in place of guided hunts after the U.S. listing. The motivation for the harvest, guided and subsistence, might appear to be economic, but the data suggests that this may be a minor aspect of the practice (Wenzel, 1983). Inuit have continued to harvest polar bears after the U.S. listing despite the loss of income from the guided hunt and uncertainty in the price of pelts.

Guided hunts seem like they generate a lot of cash income, but the hidden costs make it so that the Inuit guide does not necessarily benefit beyond the initial injection of cash. In 2008, an Inuit guide in Ulukhaktok earned on average approximately \$8,500 CAD for guiding a polar bear hunt. From this, he had to pay for the fuel and supplies to support three people using two snowmobiles for a two-week trip and all the costs of maintaining his dog team before and after the trip. In the end, he might have broken even, but the real economic value was that the \$8,500 CAD was a large up-front payment, which enabled him to purchase a new snowmobile, which he used for the trip and afterwards for subsistence. A helper earned on average approximately \$3,500 CAD and was required to provide their own snowmobile, sled, and camping supplies. Unlike guided hunts, a subsistence harvest does not require using a dog team to pursue the bear or the substantial equipment that is needed to guide multi-day expedition hunts. Instead, many subsistence harvests are now undertaken as day trips, by a hunter on a snowmobile pulling a sled with the necessary resources for themselves—i.e., gas, oil, naphtha (fuel for stove), and food—rather than to support a sport hunter, helper, and a dog team. If successful, the hunter also has the option to sell the pelt for some income. This may be more economical in terms of time and expenses than a guided hunt but many of the noted benefits of guided hunts described by Freeman and Wenzel (2006) are not always captured within subsistence harvests. A downside to the collapse of guided hunts is the lost opportunity for training. A guided hunt provides a venue for generating and sharing knowledge of caring for a dog team and harvesting polar bears. Specifically, helpers travel with the guide and learn about navigating on the sea ice, running dogs, camping in the winter, and tracking bears. These training opportunities are recognized as important in building capacity among younger generation Inuit to gain competency in subsistence, and by doing so, gain respect in the community by providing vital, tangible benefits — harvesting and sharing country foods (Pearce et al., 2015). Research on the transmission of land skills among Inuit men in Ulukhaktok found that only

a few younger generation respondents had acquired the skills important for harvesting polar bears compared with older respondents, and that they had learned these skills from their grandparents, all of whom at some point guided polar bear sport hunts (Pearce et al., 2011). That said, the younger respondents who had participated in a polar bear harvest and had learned some polar bear harvesting skills had yet to learn the detailed knowledge about polar bear harvesting held by elders (e.g., how to track a bear and how to identify a bear’s gender and size from observation). Lacking the economic incentive and capacity that a guided hunt provides it is likely that fewer younger generation Inuit will participate in polar bear harvesting under the tutelage of an experienced teacher.

Our hypothesis that the number of polar bears harvested as a percentage of tags claimed would increase after the U.S. listing was correct for the NB but not for the SB or MV subpopulations. Before the U.S. listing, a portion of the tags claimed were from unsuccessful sport hunts, meaning Inuit guides were paid and some of the benefits of the guided hunt were realized, but a bear was not harvested. In the NB, after the U.S. listing there was a significant decrease in the percentage of unsuccessful sport hunts as a percentage of tags used and a significant increase in the number of bears harvested as a percentage of tags claimed. It appears that the tags that would have previously been filled by guided hunts (successful and unsuccessful) are now being filled by subsistence harvests, for which a tag can be re-issued until a successful harvest is achieved. That said, Inuit could have harvested more bears for subsistence during the seasons before the U.S. listing and still have been well under the quota. This finding suggests that Inuit have adapted the polar bear cultural economy from guided hunts to subsistence harvests, from which they are able to generate some income from the sale of the pelt if they choose to. It is likely that this trend was not observed for the SB because of reported unsuccessful sport hunts in the 2008–2009 ($n = 9$) and 2009–2010 ($n = 5$) harvest periods and change in boundaries as of 2013/2014. It is possible that these guided hunts had been planned and paid for before the U.S. listing and America hunters opted to participate in the pursuit of a polar bear without harvesting a bear due to the import ban. Also, the change in boundaries nearly halved the quota for the SB resulting in fewer bears being harvested. The trend was likely not observed in the VM because most guided hunts before the listing were successful. It takes a considerable amount of time, resources, and effort to reach the Viscount Melville area from Ulukhaktok and Cambridge Bay, which is possibly why guided hunts persisted until they harvested a bear.

The number of polar bears harvested for subsistence after the U.S. listing and an increase in the price paid a polar bear pelt suggests that hide price may motivate the subsistence harvest. The highest numbers of polar bears harvested during the study period were in the harvest periods 2010–2011 (81), 2011–2012 (88 bears) and 2012–2013 (70 bears), during which time prices paid for polar bear

hides reached record highs. In 2013 the top price paid for a polar bear pelt from Canada was \$21,115 CAD, nearly three times the top price paid for a hide in 2008 (\$7,400 CAD) (Cooper, 2015). However, the income generated from subsistence harvests through the sale of the pelt depends on the size and quality of the pelt and is sensitive to changes in global markets whereas the income generated from a guided hunt is guaranteed, regardless if a polar bear is harvested or the size and quality of the pelt. Other income generated from a guided hunt that is not captured in a subsistence harvest includes tips to the guide and helper, payments for food and accommodation in the community, purchases of local arts and crafts, and other transportation and incidental costs associated with the visiting hunter's travel and stay in the community.

CONCLUSION

In this paper, we examined how polar bear harvesting strategies changed in response to the rapid decline in guided hunting within the SB, NB, and VM polar bear subpopulations. Although there may be factors other than the U.S. listing that could influence the numbers and composition of the polar bear harvest, the combination of the listing of polar bears as a threatened species, and subsequent ban on the importation of polar bear products into the U.S., largely account for the decline in guided hunts. The results show that subsistence harvests have made up for the decline in guided hunts in the three subpopulations after the listing, resulting in no significant change in the number of polar bears harvested or in the sex composition of the harvest. Notably, in the twelve years of harvest data included in this analysis, Inuit have always been within their harvest quotas.

Based on future climate and sea ice models, current science shows that the SB subpopulation is likely to decline and the NB and VM are likely stable (Joint Secretariat, 2017). The results show that co-management boards are successfully managing harvest levels in the three subpopulations and have been responsive to emerging scientific and traditional knowledge on changes in sea ice and polar bear health, as demonstrated by changing the SB boundaries and reducing the overall harvest quota

in the SB and NB from 112 tags in 2004–2005 to 98 tags in 2015–2016. Given that the premise of the U.S. listing is that continued warming and loss of sea ice will lead to population declines in polar bears, it is logical that the listing and ensuing ban on the importation of polar bear products into the U.S. would apply to subpopulations deemed sensitive to these changes rather than to all subpopulations.

The results suggest that Inuit motivations for harvesting polar bears are driven by the cultural importance of the harvest as well as the opportunity to earn income. A subsistence harvest is an important cultural activity for Inuit, but it does not have a guaranteed income, nor does it necessarily bring the same training opportunities, or secondary cash inputs that a guided hunt can. Before the U.S. listing, the polar bear harvest was a combination of guided and subsistence hunts, which afforded Inuit the benefits of both. The U.S. listing and rapid decline in guided hunts did not affect the number of polar bears harvested but it did disrupt the Inuit cultural economy.

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