

Preliminary reliability assessment of Inuit diagnoses of sex, age, size, and age of track from in situ polar bear (*Ursus maritimus*) tracks

Pamela Wong¹, Peter van Coeverden de Groot¹, Markus Dyck³, Cynthia Fekken⁴, Gabriel Nirlungayak², and Peter Boag¹. 1=Department of Biology and 4 = Department of Psychology, Queens University, Kingston, Ontario, K7L 3N6, 2=Environmental Technology Program, Nunavut Arctic College, Iqaluit, Nunavut X0A 0H0, 3=Wildlife Department, Nunavut Tunngavik Inc., Rankin Inlet, Nunavut, X0C 0G0

Abstract

A prompt and inexpensive noninvasive polar bear-activity survey that includes Inuit traditional ecological knowledge (TEK) estimates of polar bear characteristics from tracks could complement ongoing capture-mark-recapture methods to better monitor polar bear populations in response to climate-induced habitat changes. Prior to the inclusion of these Inuit track estimates, they need to be evaluated for reliability and accuracy. Building on our previous work, which showed increased reliability among active hunters, we report reliability in estimates of sex, age, size, and age of track of an increased number of tracks (78) by a larger number of Inuit hunters (N=8) in M'Clintock Channel, Nunavut. Using Cronbach's alpha (α) we show these 8 hunters as a group are reliable in estimates of sex ($\alpha=0.77$), age ($\alpha=0.79$), size ($\alpha=0.92$), and age of track ($\alpha=0.85$). We show estimates of sex are significantly different ($\chi^2=15.42$, $df=7$, $P<0.05$) as are estimates of age (one-way ANOVA, $df=7$, $F=64.49$, $P<0.05$), size (one-way ANOVA, $df=7$, $F=15.85$, $P<0.05$) and age of track (one-way ANOVA, $df=7$, $F=6.11$, $P<0.05$) suggesting differences among the hunters. Semi-structured, open-ended interviews with each participant reveal they vary in their methods of tracking and polar bear hunting experience, which may explain some of these differences. We describe genetic and other means of testing the accuracy of these sex, age and size of bears from tracks. These findings suggest Inuit hunters are reliable in their estimates, which has encouraging implications for a non-invasive polar bear-activity survey.

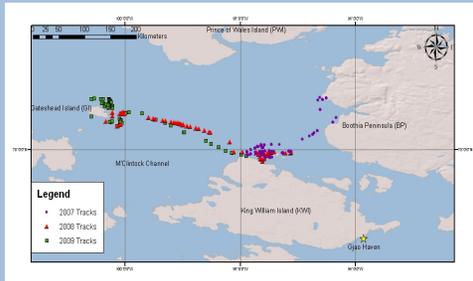


Figure 1. Tracks observed in M'Clintock Channel, Nunavut, Canada from 2007 to 2009. 19 Tracks were diagnosed by all participants; in 2007 27 tracks were diagnosed by all participants in 2008; and 78 tracks were diagnosed by all participants in 2009. Some tracks were collected at the same location on different days and some locations contained more than one track.

Introduction

- A prompt, non-invasive, Inuit-based polar bear activity survey that includes Inuit hunter diagnoses of bear characteristics from tracks can complement ongoing capture-mark-recapture surveys, which may be too infrequent to monitor range-wide responses of polar bears to climate change^{1,2}
- Prior to their inclusion in any future survey, hunter estimates from tracks need to be evaluated for reliability and accuracy
- Previous reliability assessments of 3 Inuit hunters and 3 elders in 2007 and 3 Inuit hunters and 4 non-Inuit in 2008 suggested Inuit hunters were more reliable, but results were limited by small sample size (19 and 27 tracks respectively; Figure 1)³

Objectives

- To provide an estimate of reliability in diagnoses of sex, age, size and age of track made by a larger group of hunters across a larger sample size of wild polar bear tracks
- To characterize mean estimates of sex, age, size and age of track within and among hunters
- To quantify patterns of variation in group estimates of age, size and age of track over time
- To determine qualitative differences in tracking methods and hunting experience among the hunters

Methods

- Estimates of sex, age in years, size in feet and age of track in days were made at tracks encountered in M'Clintock Channel, Nunavut by 4 hunters from Gjoa Haven, 2 hunters from Taloyoak, and 2 hunters from Cambridge Bay
- Cronbach's alpha (α) was calculated for each of the 4 variables for the group
- Differences in individual estimates of sex, age, size and age of track was determined using a chi-square test (χ^2) for sex and a one-way analysis of variance (ANOVA) for age, size, and age of track
- Relationships between coefficients of variation in group estimates of age, size and age of track and tracks, diagnosed in order, were tested using linear regression analysis
- Semi-structured interviews were conducted with each hunter regarding criteria used to diagnose tracks and their hunting experience

Results

- 78 tracks were diagnosed with sex, age, size, and age of track by all 8 hunters (Figure 1)
- The group of 8 hunters was reliable ($\alpha > 0.7$) in making estimates of sex, age, size, and age of track from tracks (Table 1)
- Mean hunter estimates were significantly different across the group for sex ($\chi^2=15.42$, $df=7$, $P<0.05$), age (one-way ANOVA, $df=7$, $F=64.49$, $P<0.05$), size (one-way ANOVA, $df=7$, $F=15.85$, $P<0.05$), and age of track (one-way ANOVA, $df=7$, $F=6.11$, $P<0.05$)
- The co-efficient of variation across hunter estimates for age, size and age of track did not change significantly over time (Figure 2)
- Individual hunters varied in criteria used to diagnose tracks for sex, age, size and age of track (Table 2)
- Individual hunters varied in their age, education level, birthplace, frequency of polar bear hunting and guiding, and reasons for hunting



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Table 1. Cronbach's alpha (α) of the group of 9 hunters for sex, age, size, and age of track estimates from polar bear tracks observed in M'Clintock Channel.

Variable	α
Sex	0.77
Age	0.79
Size	0.92
Age of track	0.85

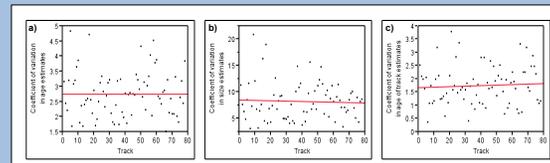


Figure 2. Linear regression analysis of coefficients of variation in group estimates of age, size, and age of track across 78 tracks diagnosed by all 8 hunters. Relationships between track and coefficients of variation in a) age ($r^2=1.19 \times 10^{-3}$, $df=76$, $P=0.98$), b) size ($r^2=0.0025$, $df=76$, $P=0.66$) and c) age of track ($r^2=0.0037$, $df=76$, $P=0.59$) estimates were not significant.

Table 2. Summary of criteria used by different hunters to diagnose sex, age, size and age of track from polar bear tracks. OF = orientation of footprints, FS = footprint size, FSh = footprint shape, AT = accompanying tracks, ES = estimated sex, W = weather conditions and Sn = snow conditions. Method refers to whether hunters diagnosed 1-2 footprints (S) or looked at number of footprints (a track, M). ND refers to no data.

Variable	Hunter							
	1	2	3	4	5	6	7	8
Sex	OF, AT	OF, FS	ND	OF, FS, FSh	OF, FSh	OF, FSh	OF, FS, FSh	FS, FSh
Age	FS, ES, AT	FS, FSh, ES	FSh	FS, ES	FS	FS	FS	FS
Size	FS	FS	FS	FS	FS	FS	FS	FS
Age of track	W, Sn	W, Sn	W, Sn	W	Sn	W, Sn	W, Sn	W, Sn
Method	S	S	S, M	M	M	M	S	S, M

Conclusions

- Inuit hunters are reliable in making estimates of sex, age, size and age of track from polar bear tracks
- Differences in mean estimates of sex, age, size, and age of track may be explained by varying tracking methods as well as background and hunting experience in Inuit hunters
 - The integration of these qualitative data with (quantitative) reliability results are ongoing
- Accuracy of these data is being estimated :
 - Genetic sexing of noninvasively collected hair, blood and faecal samples along tracks allows for estimates of "true" sex associated with hunter-diagnosed tracks
 - Accuracy of age estimates may be determined by noninvasively sampling bears previously captured in the 1998-2000 survey of this region, as these bears were aged using tooth wear
 - Accuracy of size estimates may be determined by measuring gait length which may be correlated with size of known bears across zoos in North America
- If Inuit hunters are both reliable and accurate, they can inform any polar bear-activity survey



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