Polar Bears in a Sea of Change

36 years of observations from a barrier island in the Beaufort Sea

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ABSTRACT

The barrier islands of the Alaskan Beaufort Sea have been included in a proposed designation of polar bear critical habitat following the listing of that species as "threatened" under the Endangered Species Act. The continuing decline of summer sea ice has been considered the primary factor leading to the increased bear occurrence on these islands but most supporting evidence has been incidental and lacked a decadal perspective and behavioral observations. A unique time-series has been obtained at Cooper Island, a barrier island 30 km east of Point Barrow, where observations of polar bear summer occurrence and activities have been obtained annually since 1975 during the course of seabird research. Polar bear occurrence has increased greatly in recent years, with ***bears being seen on only five of the 27 years from 1975 to 2001 but on eight of the nine years since then***. Preliminary analyses indicate this increase in occurrence is related to the reduction of adjacent sea ice, with the ice concentration at the shelfbreak on August 15 as the best predictor for the occurrence of bears on the island. ***Bears occurred in only 13 percent of the years when ice cover immediately north of the shelfbreak was >40 percent but in 83 percent of the years when ice north shelfbreak was <40 percent***, indicating bears remain with the ice until it leaves the shelf. Bear behavior has changed as well, with bear visits typically <2 days before 2002, but now regularly >3 days while they sleep and forage on the island.

STUDY LOCATION

Figure 1. Location of Cooper Island in the western Beaufort Sea

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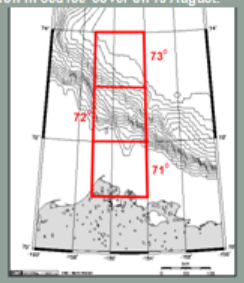
BACKGROUND AND METHODS

- Cooper Island field camp occupied annually in summer from 1975 to 2010 (Figure 1) with exception of 1998
- Observations of late summer (after 15 July) polar bear numbers, presence and activities obtained during research on colony of Black Guillemots (*Cepphus grylle mandti*)
- Annual ice concentrations for three latitudinal blocks north of Cooper Island (1983-2010) obtained from NOAA Optimum Interpolation SST V2 database (Reynolds et al. 2002).
- Binary logistic regression used to determine the relationship of annual variation in local sea ice concentrations and occurrence of polar bears on the island

Figure 2. Latitudinal blocks considered in annual variation in sea ice cover on 15 August.



RESULTS

- Polar bears present in only five of the 27 years before 2002 but since 2001 polar bears seen annually with the exception of 2006 (Figure 3)
- All latitudinal blocks north of Cooper Island had decadal decrease in ice concentration (Figure 4) but polar bear presence on island best predicted by decreases in ice decreases between 73° and 74° N (Table 1)
- Bears occurred in 13 percent of years when ice cover immediately north of the shelfbreak and slope was >40 percent but in 83 percent of the years when ice concentration was <40 percent (Figure 4).
- Before 2002 most sightings were of single bears but recently multiple bears frequently present on island
- Before 2002 bears were primarily transitory but recently most bears sleep and search for food on the island sometimes for many days
- Polar bear predation on Black Guillemots has caused nearly complete nesting failure in 2008-2010

Figure 3. Number of polar bears observed annually on Cooper Island in late summer (1983-97, 1999-2010), not including cubs.

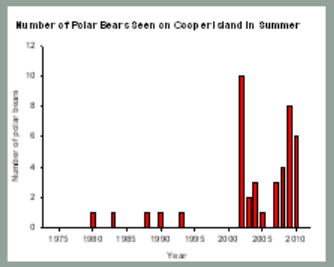


Figure 4. Decadal average ice concentration on 15 August for three longitudinal blocks north of Cooper Island (1983-2010).

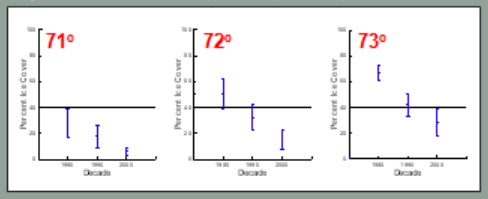


Figure 5. Annual sea ice cover 73-74° N on 15 August and occurrence of polar bears on Cooper Island (1983-2010).

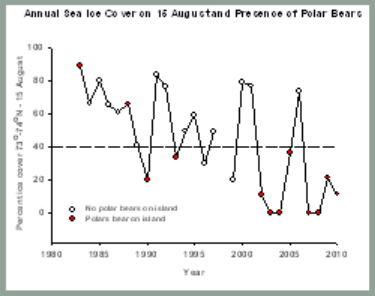


Table 1. Logistic regression analysis of annual presence of polar bears and sea ice concentration on 15 August in three latitudinal blocks (1983-97, 1999-2010)

Latitudinal block	Coef.	Std. Error	Z	P	95% Conf. Interval		AIC	R^2
71°	0.035	0.026	1.37	0.171	-0.015	0.085	35.34	0.112
72°	0.064	0.027	2.355	0.019	0.011	0.117	27.21	0.452
73°	0.084	0.031	2.703	0.007	0.023	0.145	21.12	0.646

DISCUSSION

- Decreases in the summer sea ice habitat of polar bears have been occurring since at least the 1980s but bears apparently did not abandon the sea ice until concentrations north of the shelfbreak were reduced to <40 percent
- In the past proximity to sea ice allowed bears on land in late summer to return to the sea ice but the much larger distance to the ice now forces bears to remain on land until new ice reforms in the fall
- Anticipated decreases in arctic sea ice will likely cause barrier islands to have increased numbers of bears in the future and with longer annual residency time
- Ongoing studies of coastal nesting birds, such as the one on Cooper Island, provide ideal locations for monitoring temporal changes in polar bear distribution and activities (Rockwell and Gormezano 2009)
- Polar bear predation on Black Guillemot eggs and young can be expected to continue with increasing foraging by bears at terrestrial locations
- In an attempt to maintain the Black Guillemot population on Cooper Island, wooden nest sites utilized as nest cavities are being replaced with rugged plastic cases. These cases were shown to allow normal fledging success in 2010

Literature Cited

Reynolds, R.W., N.A. Rayner, T.M. Smith, D.C. Stokes, and W. Wang. 2002. An Improved In Situ and Satellite SST Analysis for Climate. J. Climate 15:1609-1625

Rockwell, R. F. and L.J. Gormezano. 2009. The early bear gets the goose: climate change, polar bears and lesser snow geese in western Hudson Bay. Polar Biology 32:539-547.

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