

The Implications of Climate Change in the Management of Vulnerable Species

- The Case Study of Polar Bears -



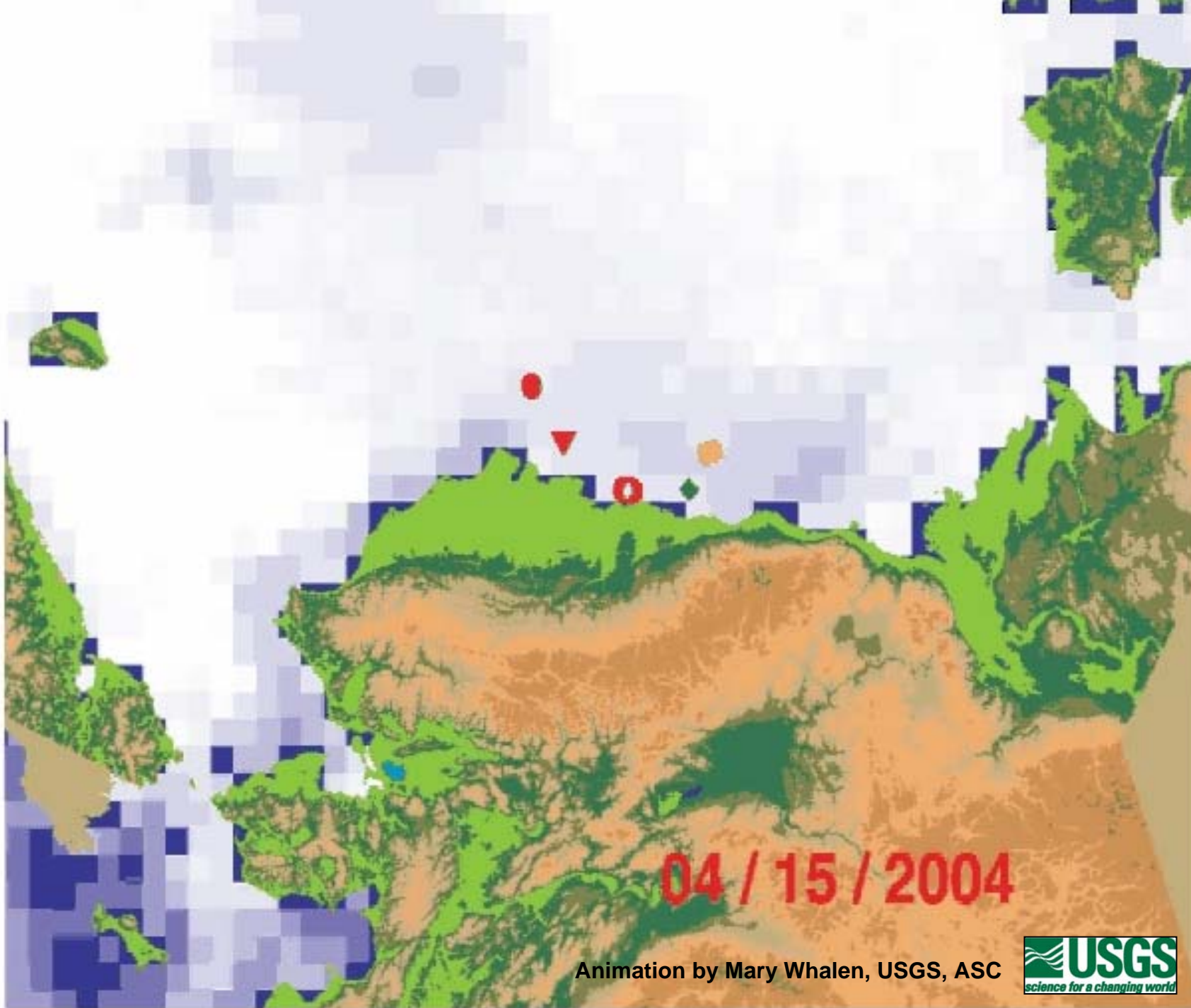
George Durner, Steven C. Amstrup, David Douglas, Gennady Belchansky, Geoff York, Eric Regehr, Ryan Neilson, and Trent McDonald



Life history dependence on sea ice



- Foraging
- Reproduction

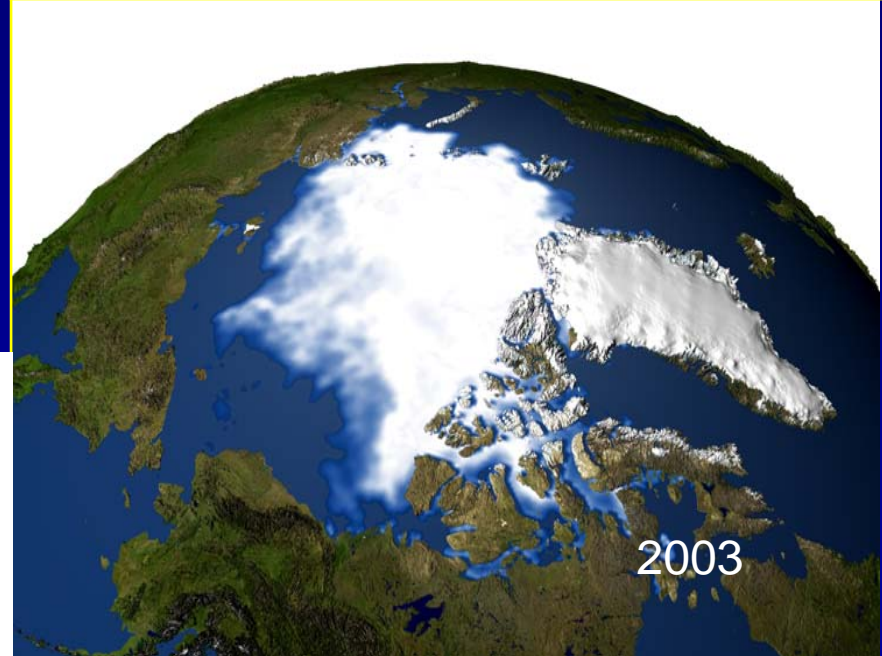
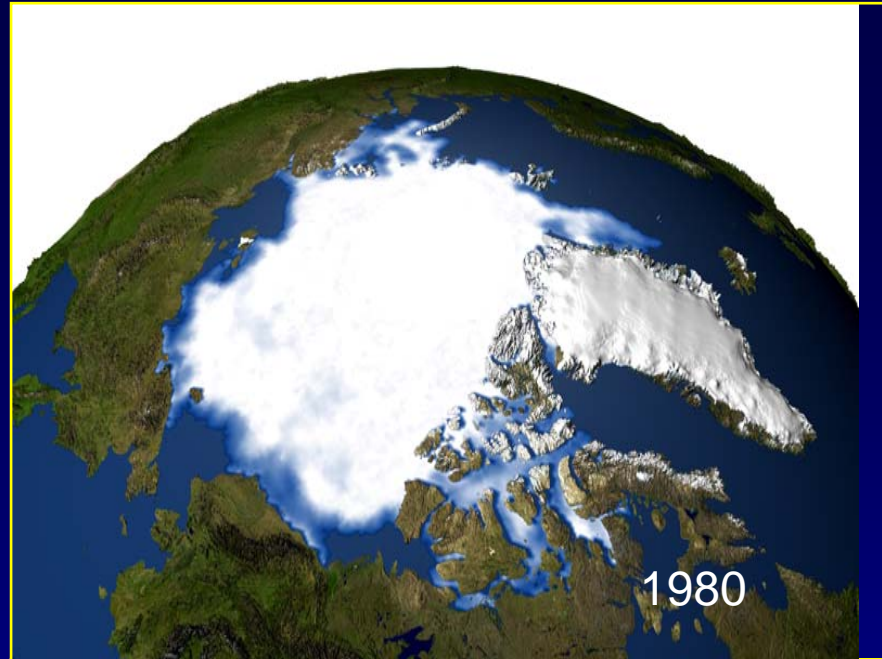


Animation by Mary Whalen, USGS, ASC



1980-1995 vs. 1996-2005

- More summer open water
- Longer melt duration
- Younger and thinner ice



Comiso, J. C. 2002. A rapidly declining sea ice cover, **Geophysical Research Letters**.

Belchansky, G.I., D.C. Douglas, and N.G. Platonov. 2004. Duration of the Arctic Sea Ice Melt Season: Regional and Interannual Variability, 1979–2001. **Journal of Climate** 17: 67-80.

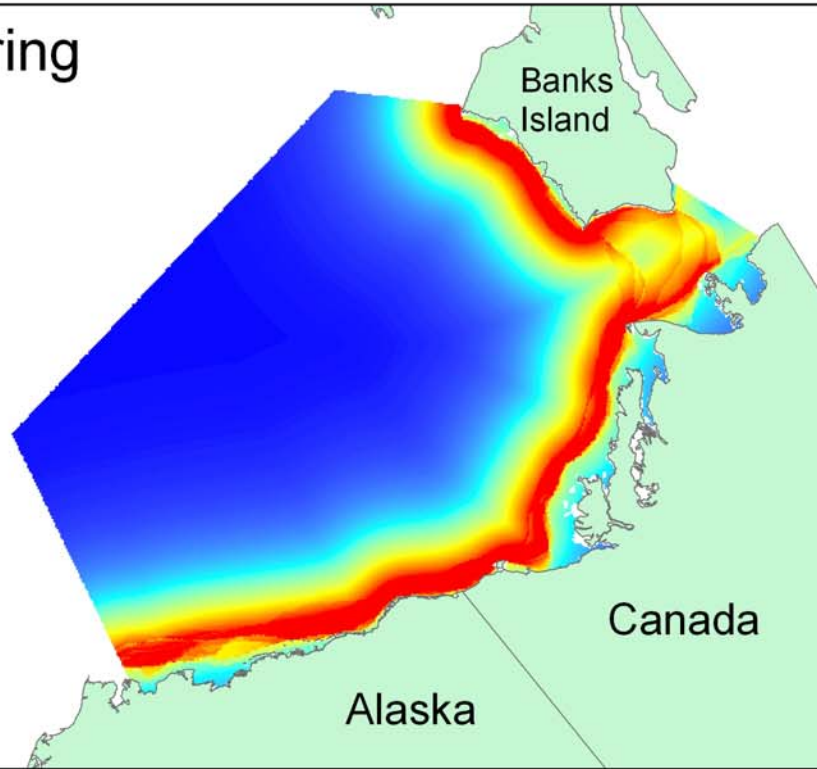
Belchansky, G.I., D.C. Douglas, and N.G. Platonov. 2005. Spatial and temporal variations in the age structure of Arctic sea ice. **Geophysical Research Letters**, vol. 32, L18504, doi:10.1029/2005GL023976, 2005.



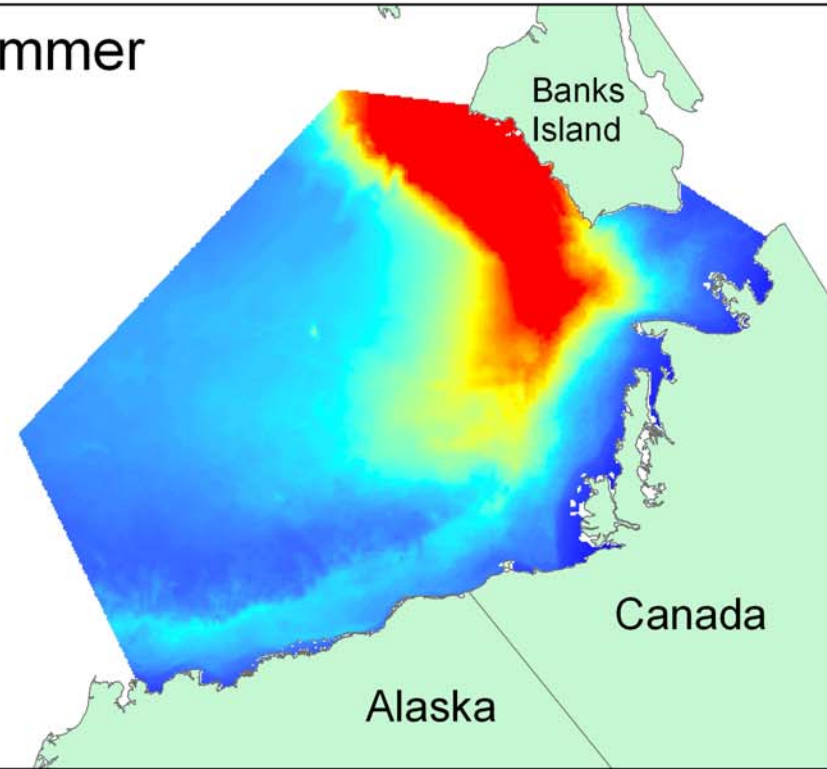
Reduced access to foraging habitats



Spring



Summer



**Expected polar bear distributions during spring (15 Mar - 31 May) and summer (1 Jul - 14 Oct).
Average conditions 1999 - 2004.**

$$\text{espRSF} = \exp((-0.01344 * \text{dist2fi}) + (1.96726 * \text{fastice})) + ((-2.82280 * (\text{dist2fi} * \text{dist2fi})))$$

$$\text{sumRSF} = \exp((4.35942 * \text{totcon}) + (-0.0004194 * \text{bath})) + (-2.07871 * (\text{totcon} * \text{totcon})) + (-0.02697 * \text{dist2edge}) + (-0.71469 * \text{firstyr}) + (0.01171 * (\text{dist2edge} * \text{firstyr})) + (0.02353 * (\text{dist2edge} * \text{totcon}))$$

RSF
value



High relative probability

Low relative probability



**Comparing September polar bear population distributions:
1987-1993 to 1999-2005**

population intensity

Value



higher 1987-1993 distribution

higher 1999-2005 distribution

Chukchi
Sea

Beaufort Sea

Banks
Island

Alaska

Canada



Sea ice loss and maternal denning

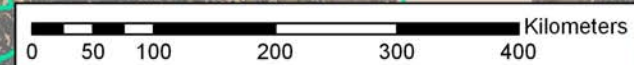
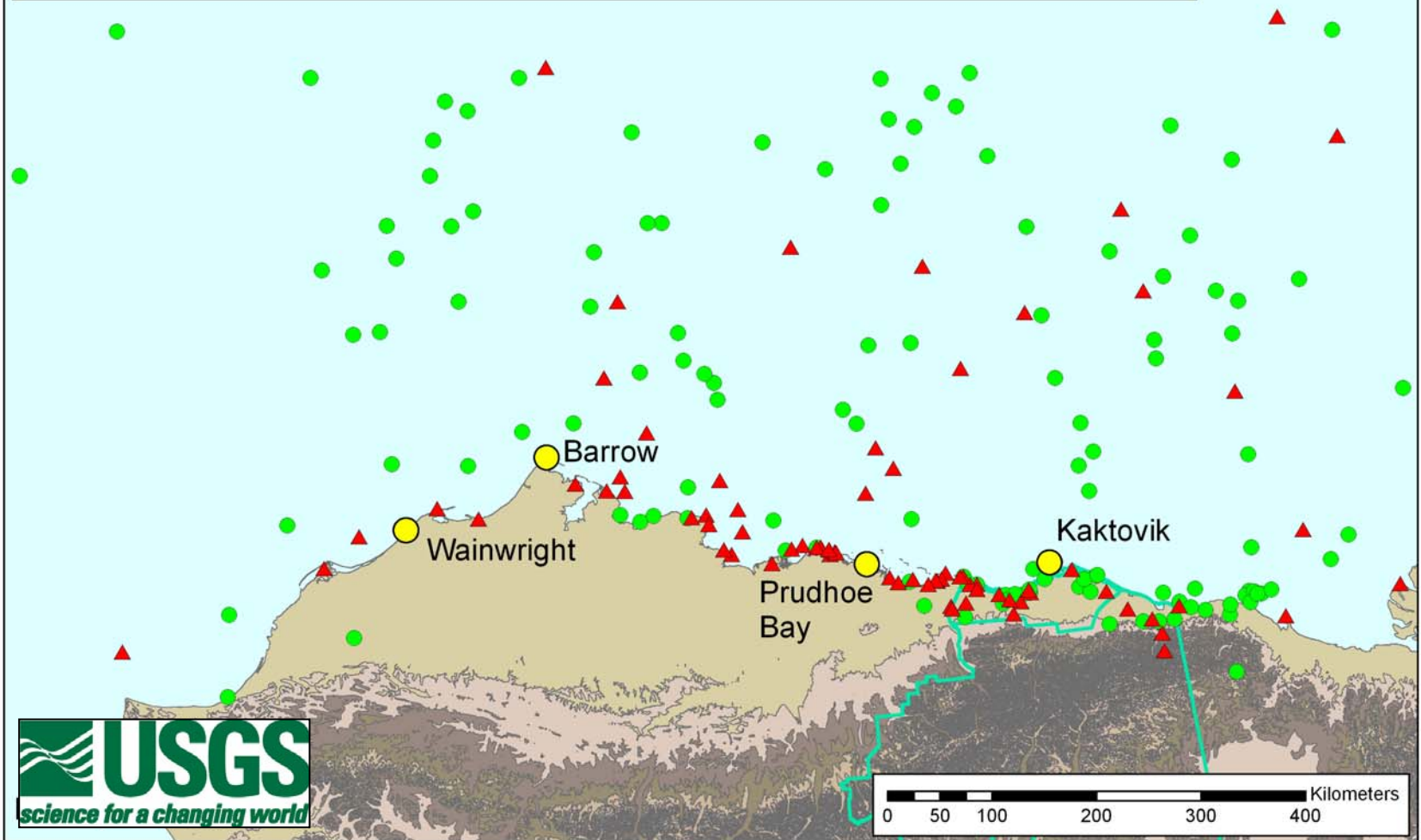


Frequency of Ice denning has decreased

Polar Bear Maternal Dens Located with Radio-telemetry 1982 - 2005

- ▲ 1995 - 2005 (n = 94)
- 1982 - 1994 (n = 160)

□ ANWR boundary



Beaufort Sea

Barter
Island

Arctic National Wildlife Refuge

— polar bear den habitat



0 1.25 2.5 5 7.5 10
Kilometers



July 2003

Coastline by J.W. Dalton well site

2000
Shoreline

Estimated Aug 2003 shoreline

Erosion of coastal denning habitats



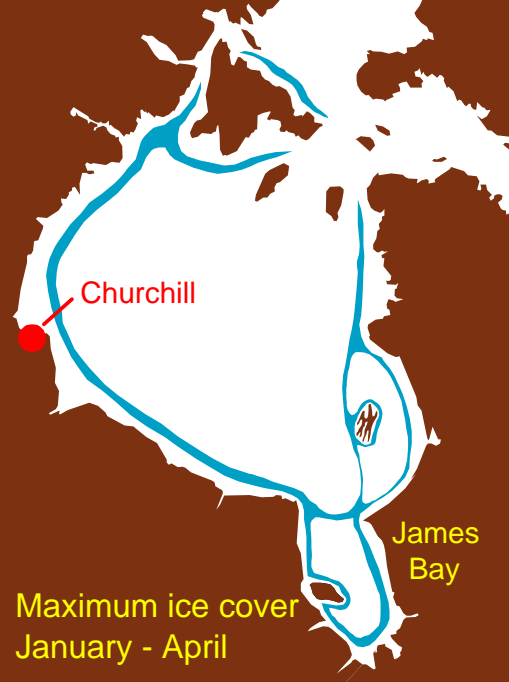
SOURCE:

USGS. 2005. Avian population response to ecological change along the Arctic coastal plain. U. S. Geological Survey, Alaska Science Center, internal report.
http://www.absc.usgs.gov/research/birds/DOI_Landscape_Initiative.pdf.

Cameron Point West – 1979

Cameron Point West – 2002

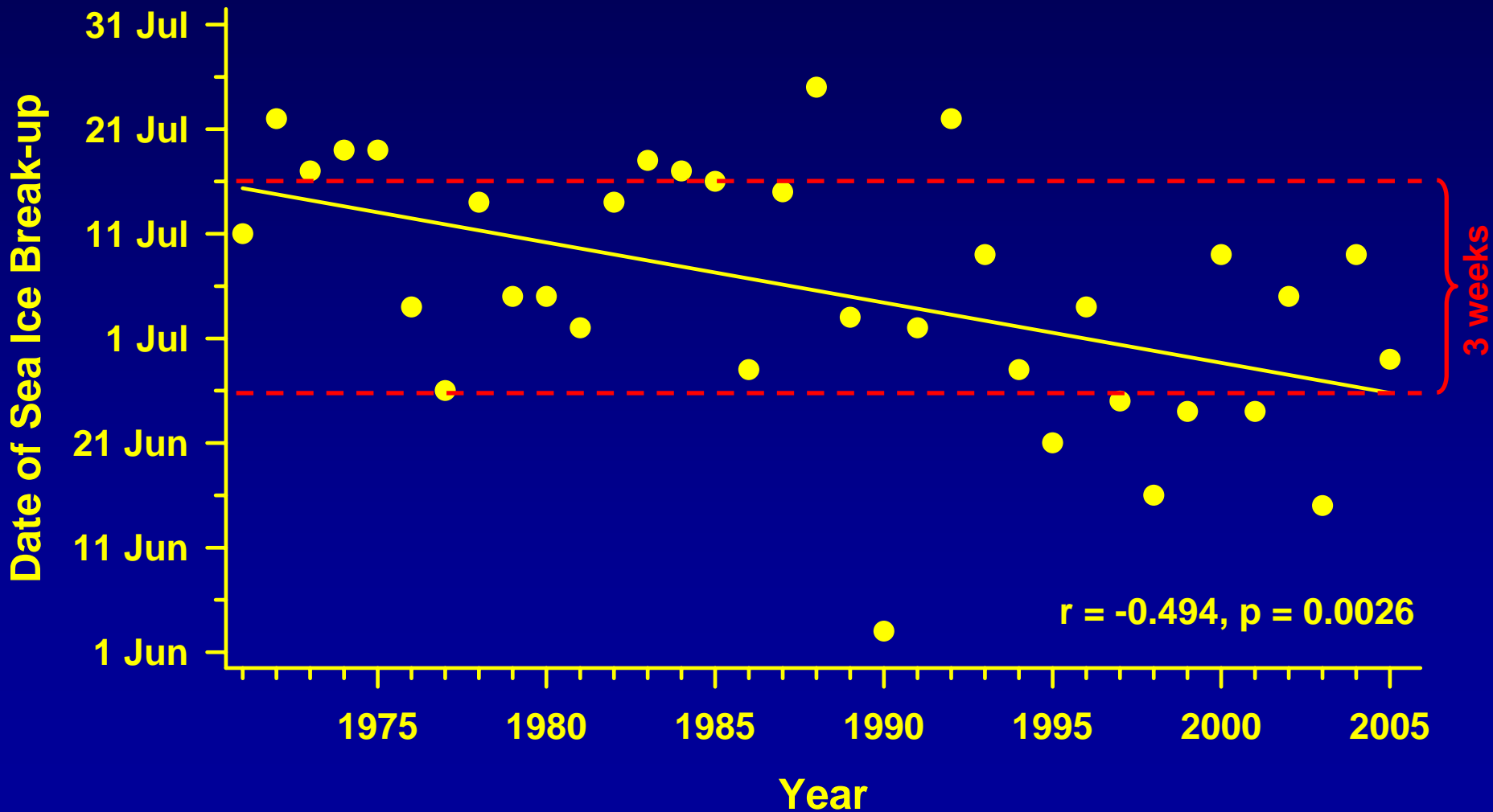
Hudson Bay seasonal ice patterns



Timing of Break-up in Relation to Year, Western Hudson Bay, 1971-2005

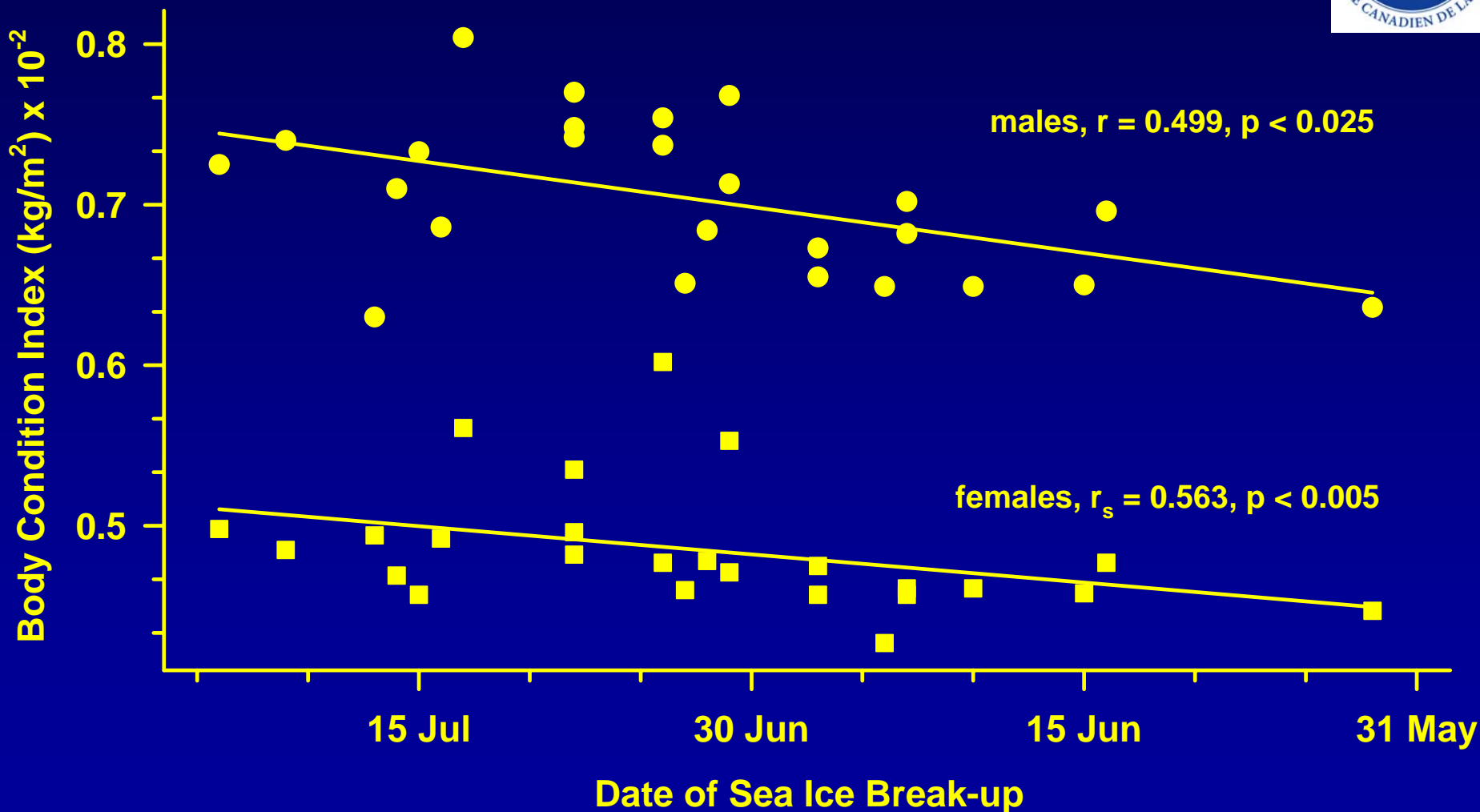


(after Stirling et al. 1999, *Arctic* 52:294-306; Lunn & Stirling unpublished data)



Relationship between Date of Break-up and Body Condition Index, Western Hudson Bay, 1980-2004

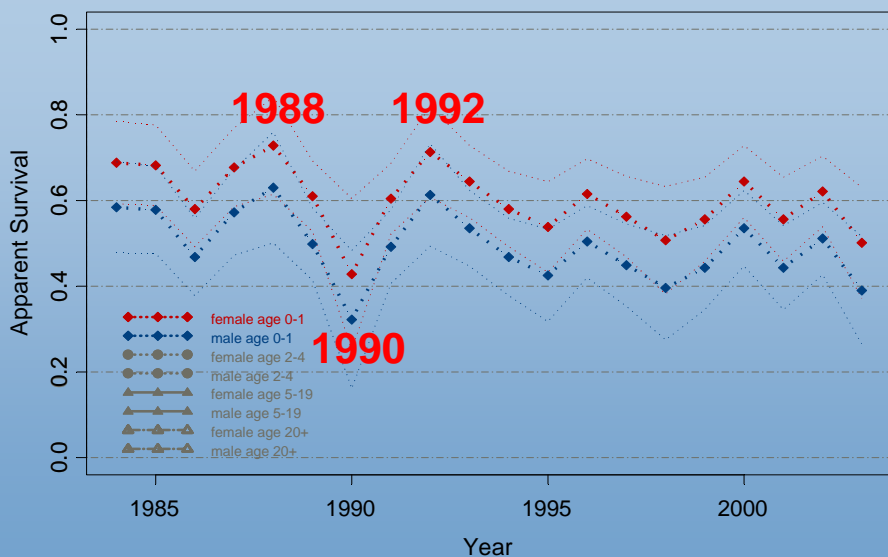
(Stirling et al. 1999; Lunn & Stirling unpublished data)



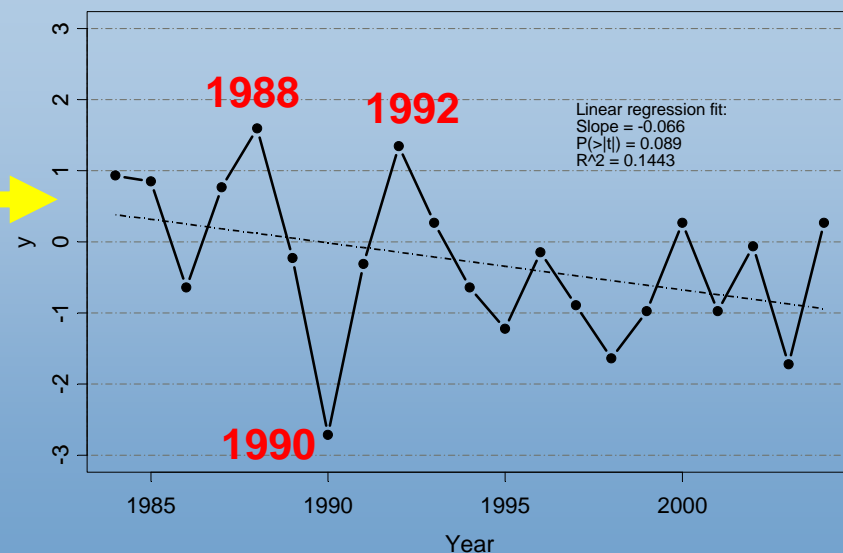
WHB population dynamics

We found quantitative evidence for a correlation between early spring ice breakup and decreased polar bear survival.

Estimates of sex- and age-specific apparent survival and 95% CIs for polar bears in Western Hudson Bay.



Standardized ice breakup date* for Western Hudson Bay.



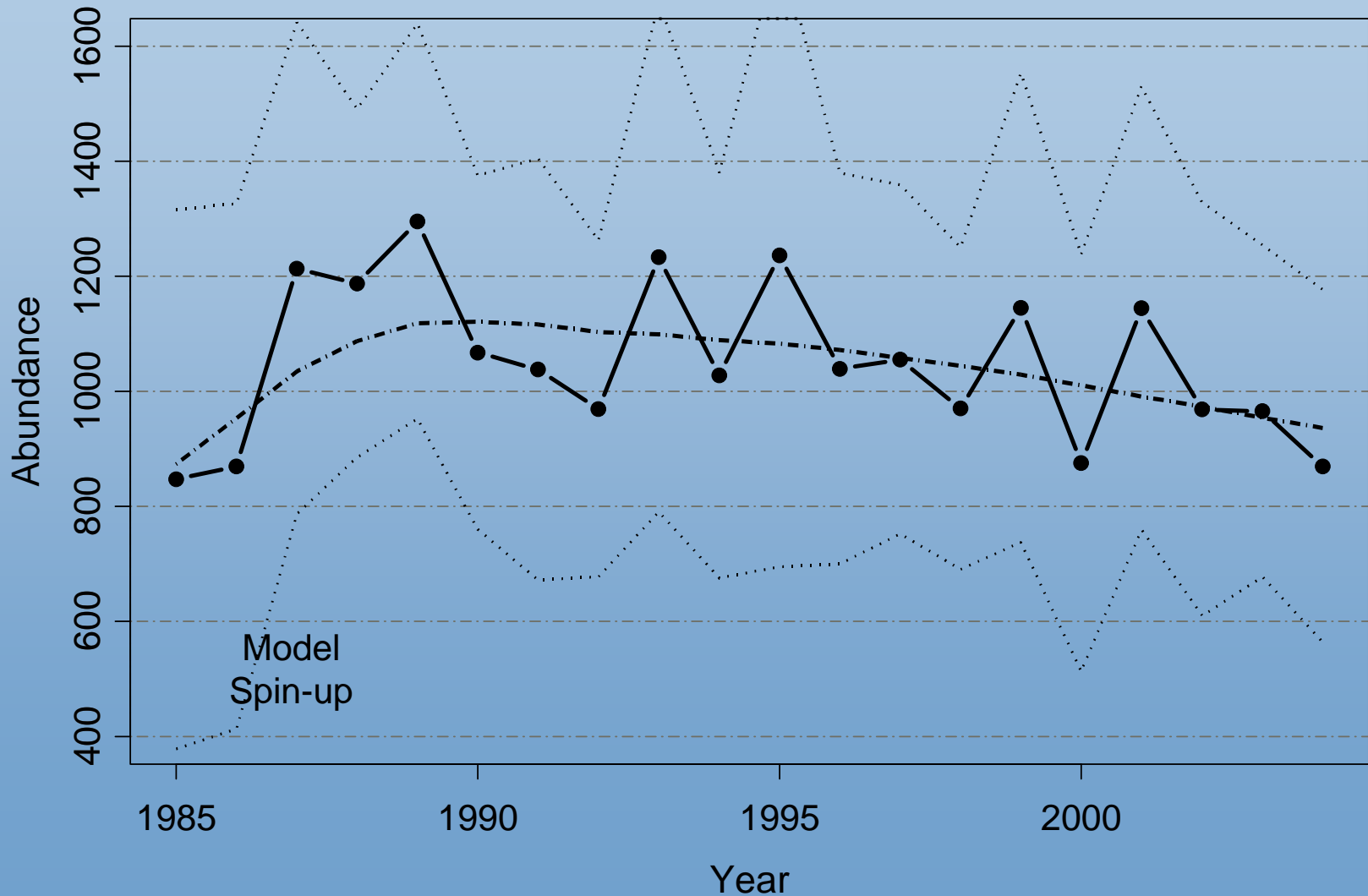
*Stirling, I., Lunn N.J., Iacozza J. Long-term trends in the population ecology of polar bears in Western Hudson Bay in relation to climatic change. Arctic, 1999; 52(3):294-306.

$$\hat{\beta}_{ice} = 0.2977; 95\% \text{ CI} = 0.1258, 0.4696$$

Breakup 1 week early \approx 3 - 8% decrease in survival.

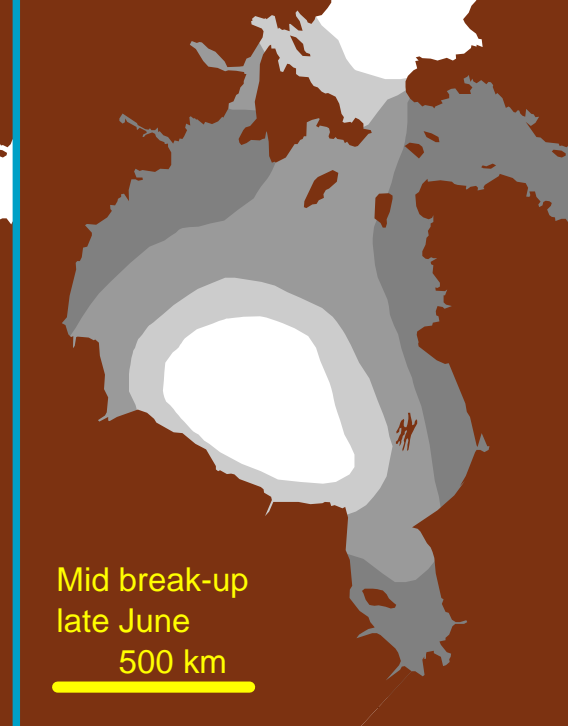
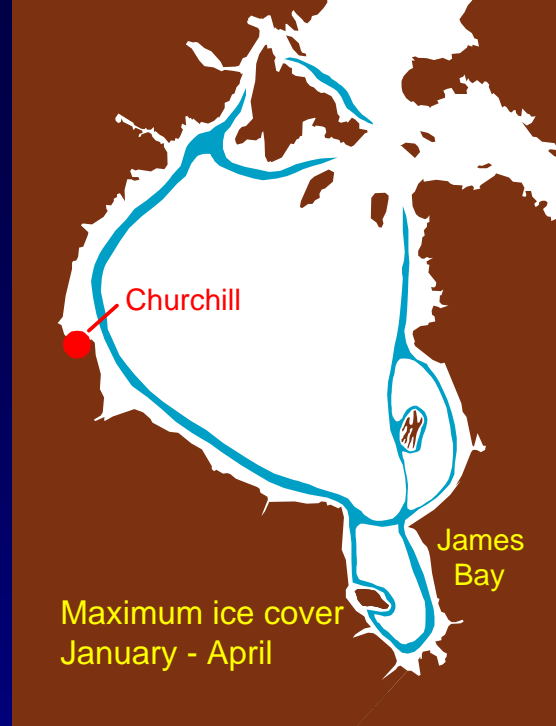


Estimates of abundance and 95% CIs for the Western Hudson Bay polar bear population.



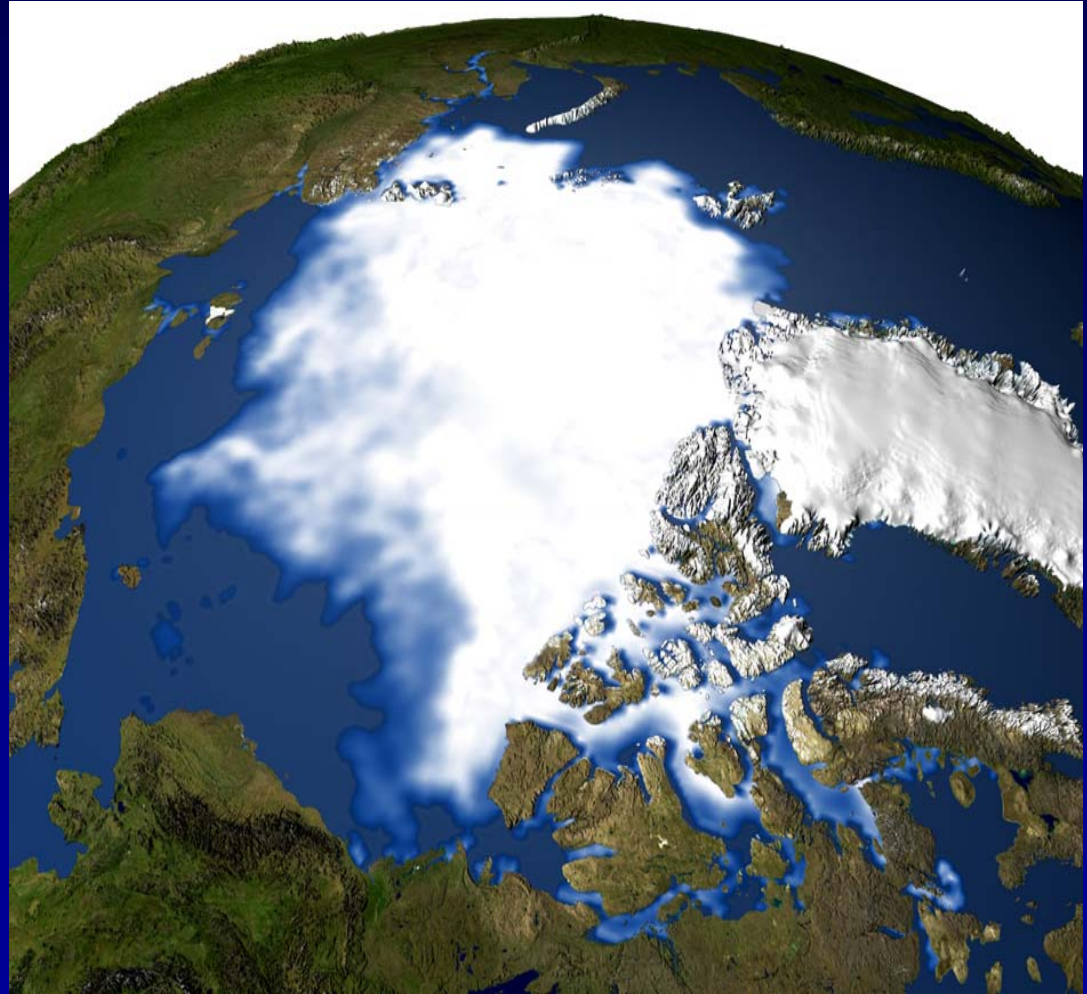
Earlier ice melt in Hudson Bay =

- bears come ashore earlier
- reduced weights
- poorer survival of young and old
- declining population size



Greater summer ice retreat equals:

- bears summer over deep water
- reduced size
- poorer survival?
- Impact on population size?



A polar bear is walking across a large, broken piece of sea ice. The bear is white and is looking down. The ice is light blue and white, with some cracks and shadows. The background is a vast, flat expanse of ice under a clear sky.

“If sea ice loss continues...

... 30% decline in the world population of polar bears in 50 years.” (IUCN/SSC Polar Bear Specialist Group, 2005).

Information needs addressed by polar bear research at the USGS Alaska Science Center

Population parameters

- size
- trend
- survival
- recruitment
- body condition

Population distribution

- habitat requirements
- changes in distribution

Habitat conditions

- sea ice dynamics and trends



Tourism



Refugia

Adaptive management



Industry



Hunting

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