Demographic conservation/recovery criteria for polar bears: ~~great~~ realistic expectations

Polar Bear Conservation/Recovery Plan Meeting

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Overview

- Background on demographic conservation/recovery criteria; ideal information.
- Examples of realistic demographic information for actual polar bear populations:
  - Accommodating system and the best-studied population (western Hudson Bay).
  - More challenging system and a well-studied population (southern Beaufort Sea).
  - More challenging system and a less-studied population (Chukchi Sea).
- General considerations for how to define meaningful demographic criteria.

Background

- Conservation/recovery goal: to achieve conditions where the species no longer requires ESA listing; "to ensure that polar bears remain a healthy, functioning, and resilient component of the Bering-Chukchi and Beaufort Sea ecosystems".
  - Conservation/recovery objectives: specific components of the goal; sets of conditions under which threats are mitigated and the goal is achieved.
    - Demographic objective: establish that polar bears are not likely to face severe declines or extinction in the foreseeable future.
      - Demographic criteria: the types of population parameters—and their values—used to determine that the demographic objective has been reached.

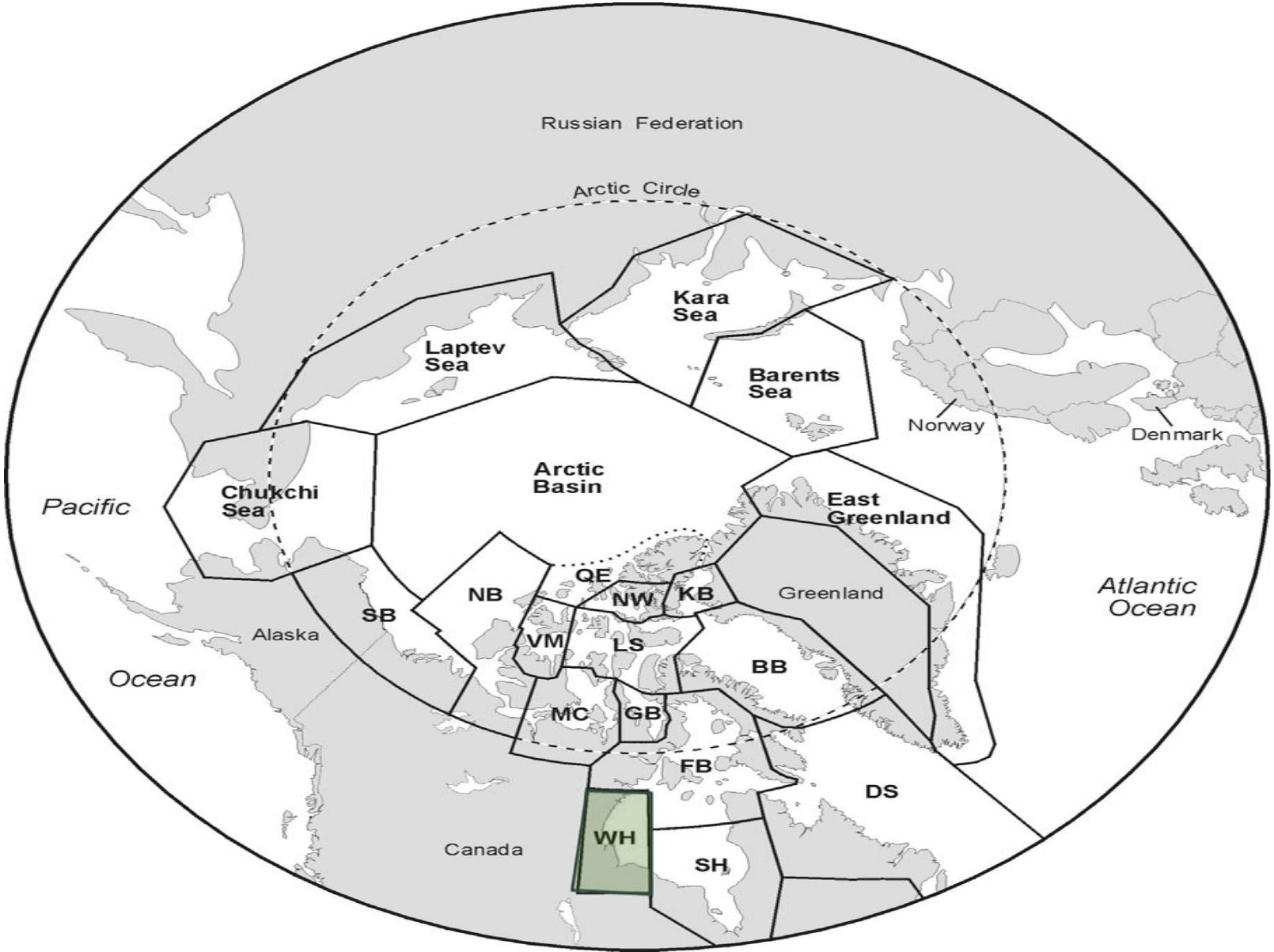
Box 5.1.8.3 - 1 - When drafting recovery criteria, remember that they should be "SMART"

- **S**pecific - Who, what, & where
- **M**easurable - So that species status and recovery progress can be assessed
- **A**chievable - Authority, funding, staffing are technically feasible (even if not always likely)
- **R**ealistic - Grounded in good science and defensible
- **T**ime-referenced - Not open-ended, having a set time frame for determining if the objective is be met, e.g., stable or increasing "for 3 generations" or "for a minimum of 10 years."

Background

- Types of population parameters and other information used to define demographic conservation/recovery criteria (for a single polar bear population):
  - Population size.
  - Population growth rate, based on survival and reproduction.
  - Relationships between population parameters and the environment.
  - The risk of future population declines, based on population parameters , their relationships to the environment, and anticipated changes to the environment (e.g., using population projection modeling or PVA).
- In an ideal world, we would have accurate (i.e., unbiased and precise) knowledge of these types of information.
- In the real world, these things are imperfectly estimated or unavailable.
- To define SMART demographic recovery/conservation criteria, we need to discuss how well the various types of demographic information can be evaluated for this species, and what alternatives exist.
- The focus here is on the types of information used to define recovery/conservation criteria, not the actual values of specific parameters.

Western Hudson Bay: an accommodating system and the best-studied population



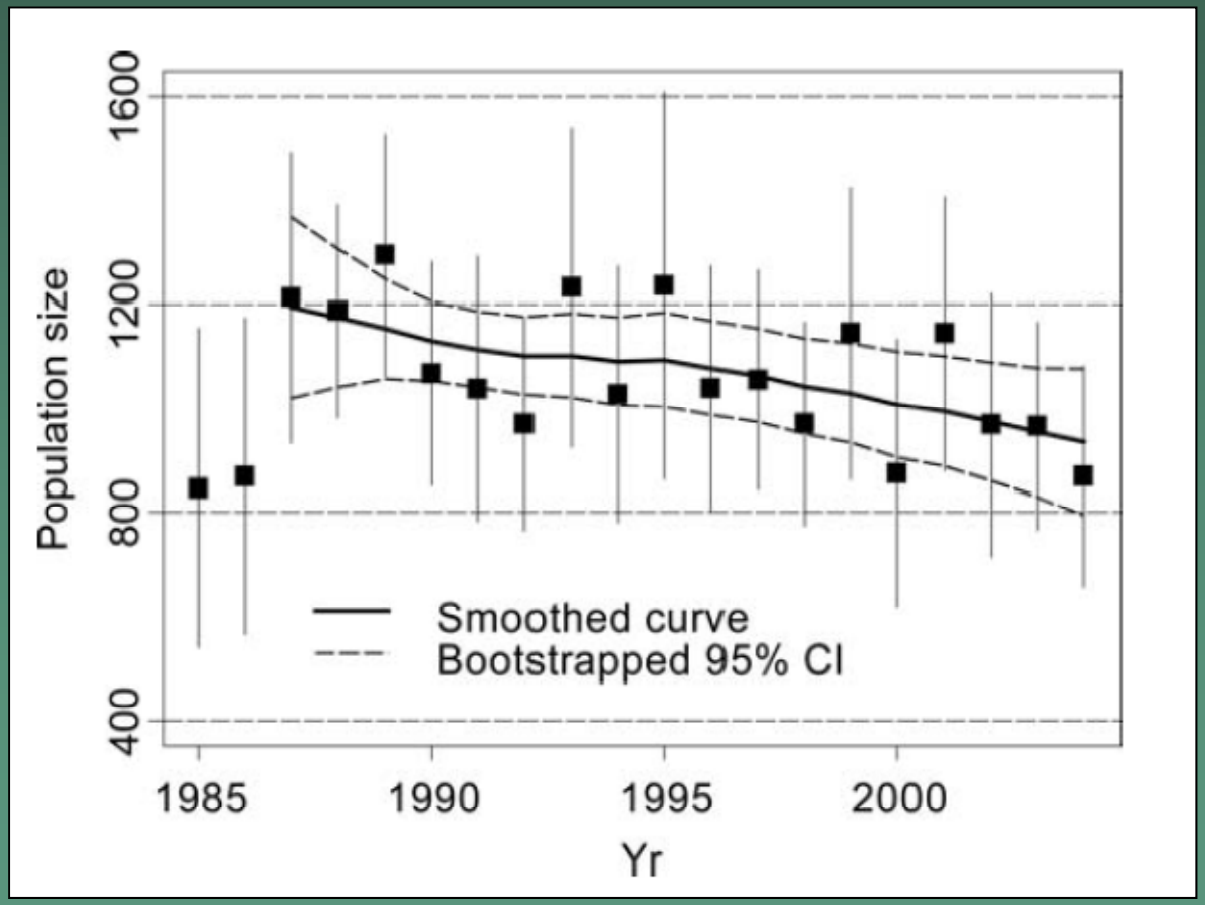
Western Hudson Bay

- Complete annual sea ice cycle.
- Polar bears are studied in the fall when concentrated in a discrete area on land.
- From 1984-2004, there were 4,723 captures, using two sampling methods.

Western Hudson Bay

- Population size declined from 1984-2004:
  - CV(N) ≈ 0.09
  - Probability of a stable population was negligible (P < 0.002).

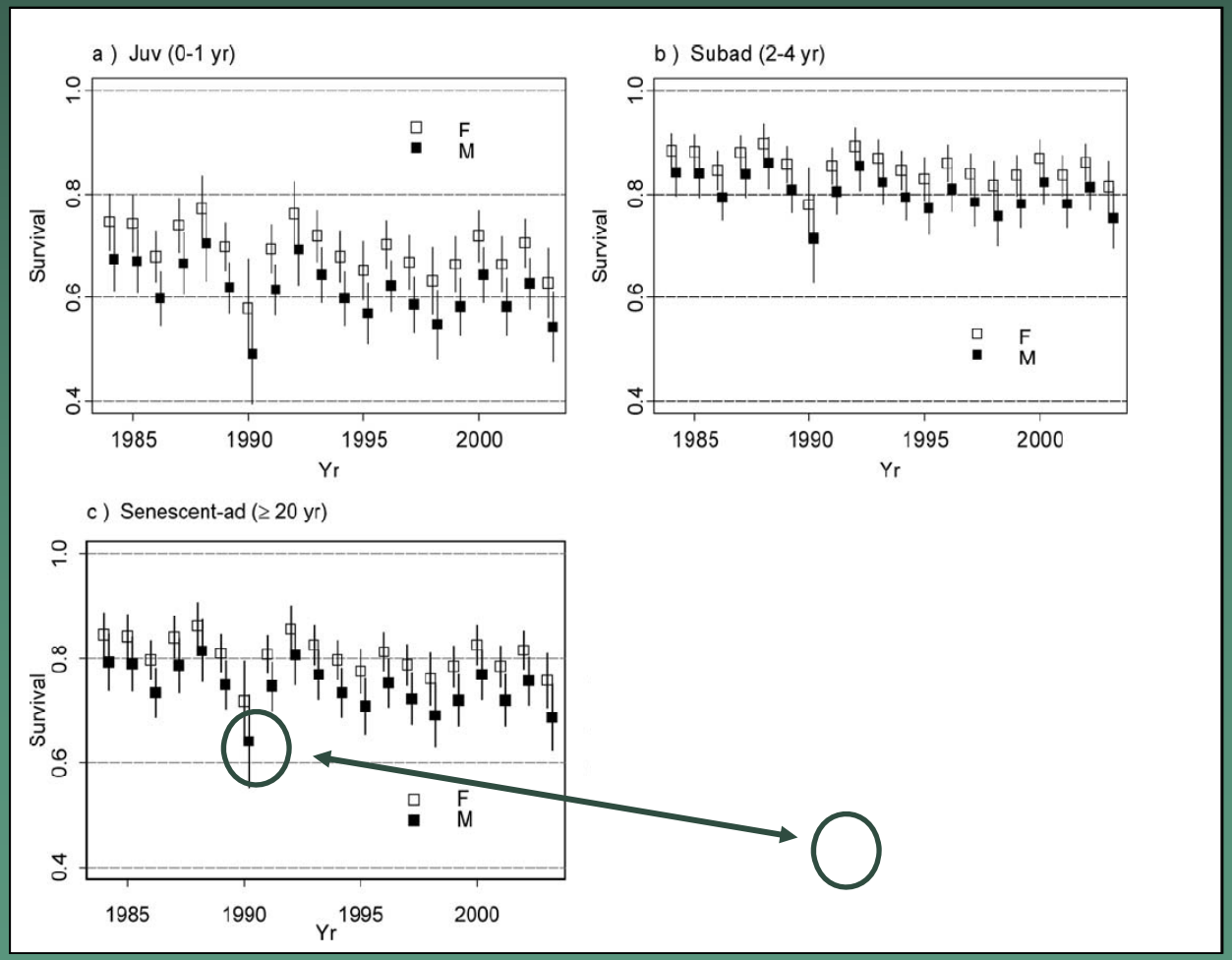
Regehr et al. 2007



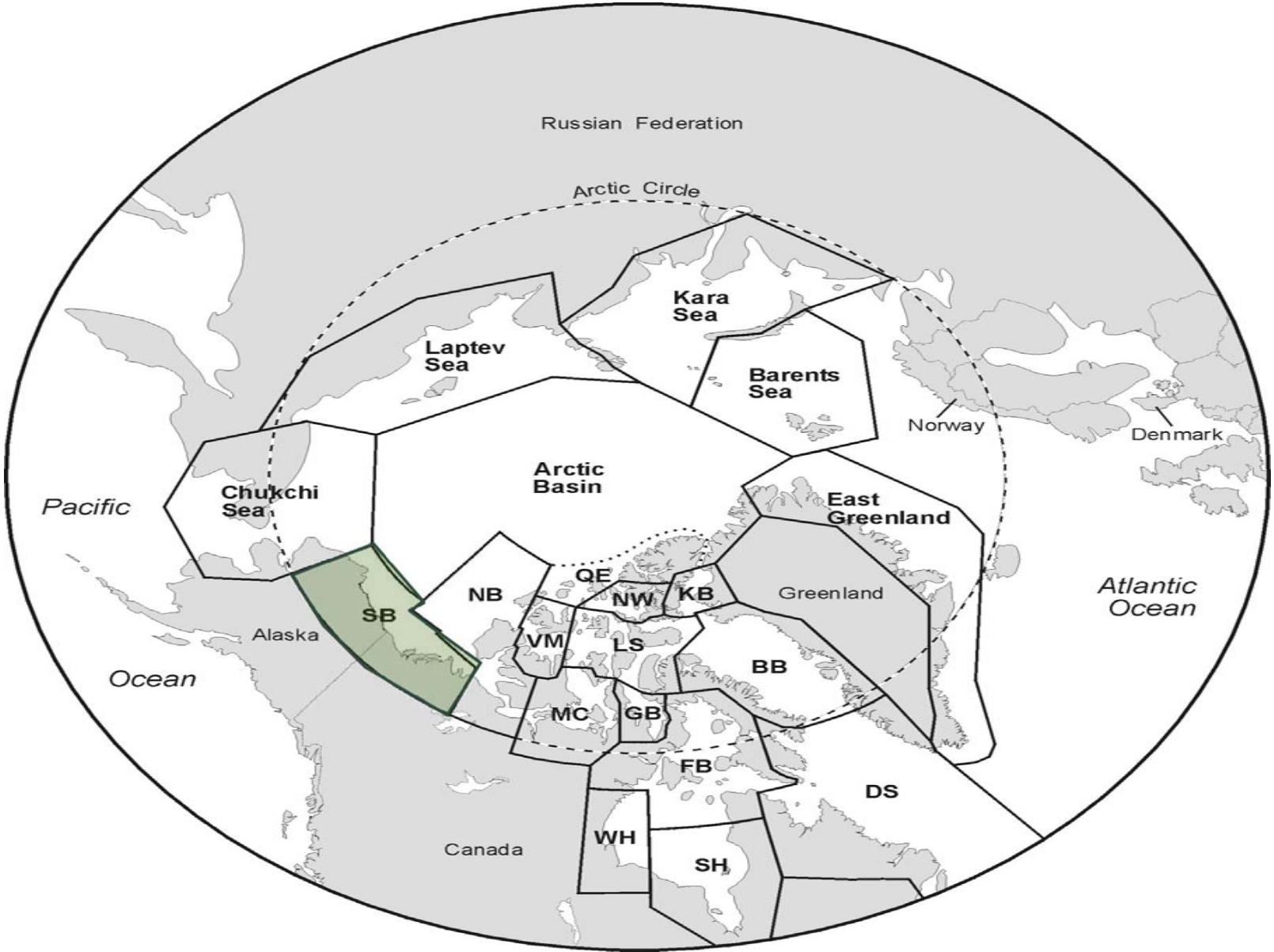
Western Hudson Bay

- From 1987-2004, survival of prime-adults (5-19 yr) was stable:
  - 0.93 (95% CI = 0.91-0.94) for females.
  - 0.90 (95%CI = 0.88-0.91) for males.
- Survival of other age classes varied over time.
- Breakup date was the best predictor of survival.

Regehr et al. 2007

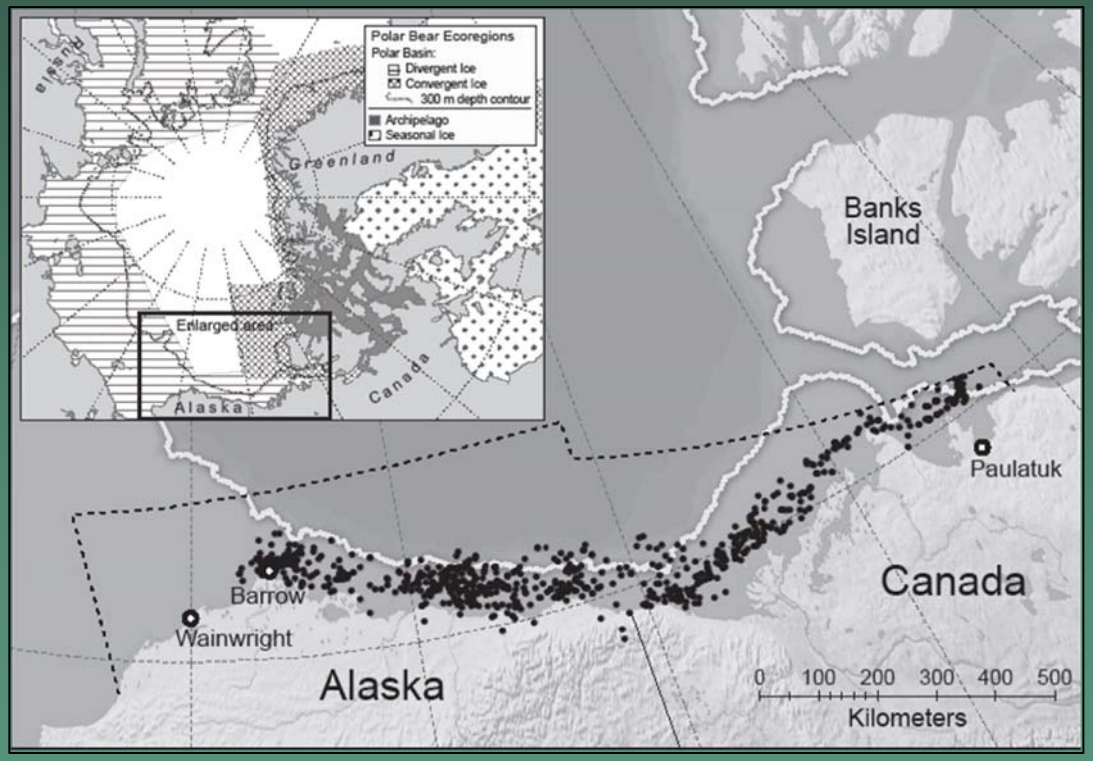


Southern Beaufort Sea: a more challenging system and a well-studied population



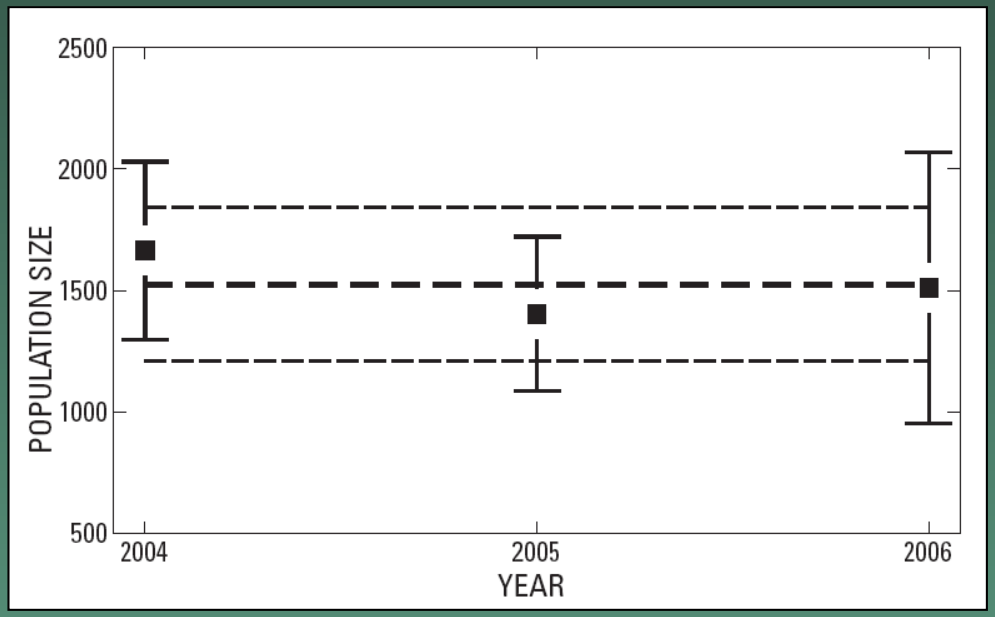
Southern Beaufort Sea

- Annual formation and retreat of sea ice.
- Polar bears are studied in the spring when dispersed on the ice.
- The population does not exhibit discrete seasonal boundaries, and occurs in two countries.
- From 2001-2006, there were 1,099 captures.



Southern Beaufort Sea

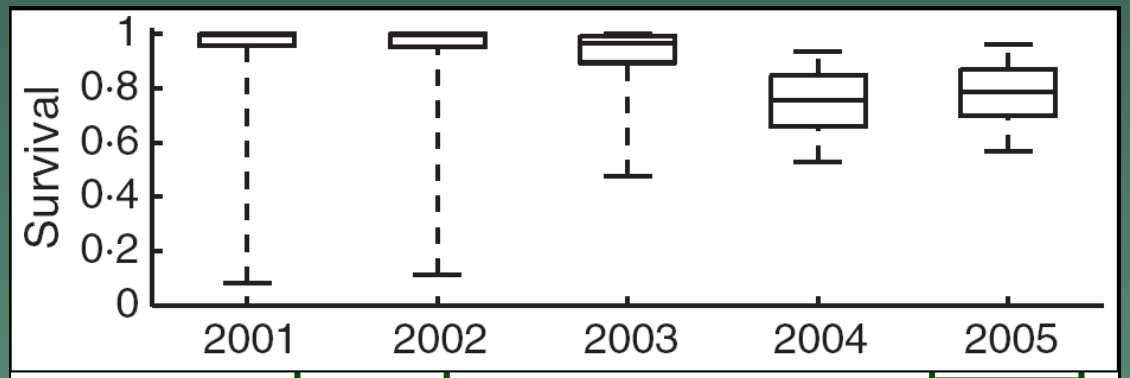
- Historic estimates of population size were 1,800 in the 1980s (CI not available) and possibly > 2,000 (CI not available) in the 1990s.
- Mean population size from 2004-2006 was 1,526 (95% CI = 1,211-1,841).
  - CV(N) ≈ 0.11
- The large amount of uncertainty, especially with historic estimates, and changes in sampling methods prevent a statistical determination that population size declined from the 1980s to present.



Southern Beaufort Sea

- Survival and breeding were high 2001-2003, low in 2004 and 2005.
- Declining sea ice → declining vital rates.
- Confidence intervals were wide on estimates of survival and reproduction (not shown).

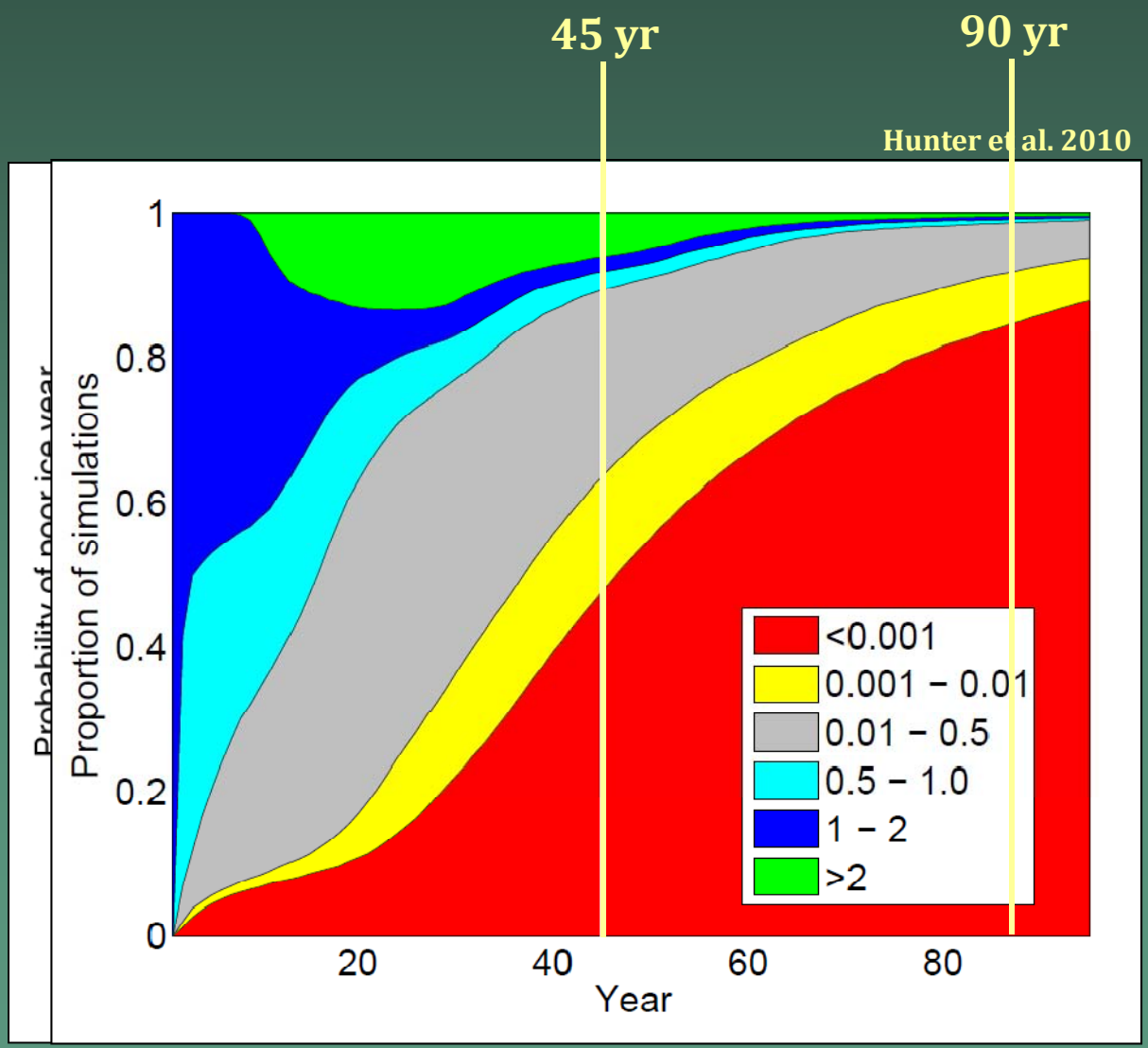
Regehr et al. 2010



2004	0.76	0.29	135
2005	0.79	0.09	134

Southern Beaufort Sea

- IPCC climate models predict more "poor" ice years.
- Future of the population:
  - In 45 years, ≥ 60% probability of a severe decline.
  - In 90 years, ≥ 90% probability of a severe decline.



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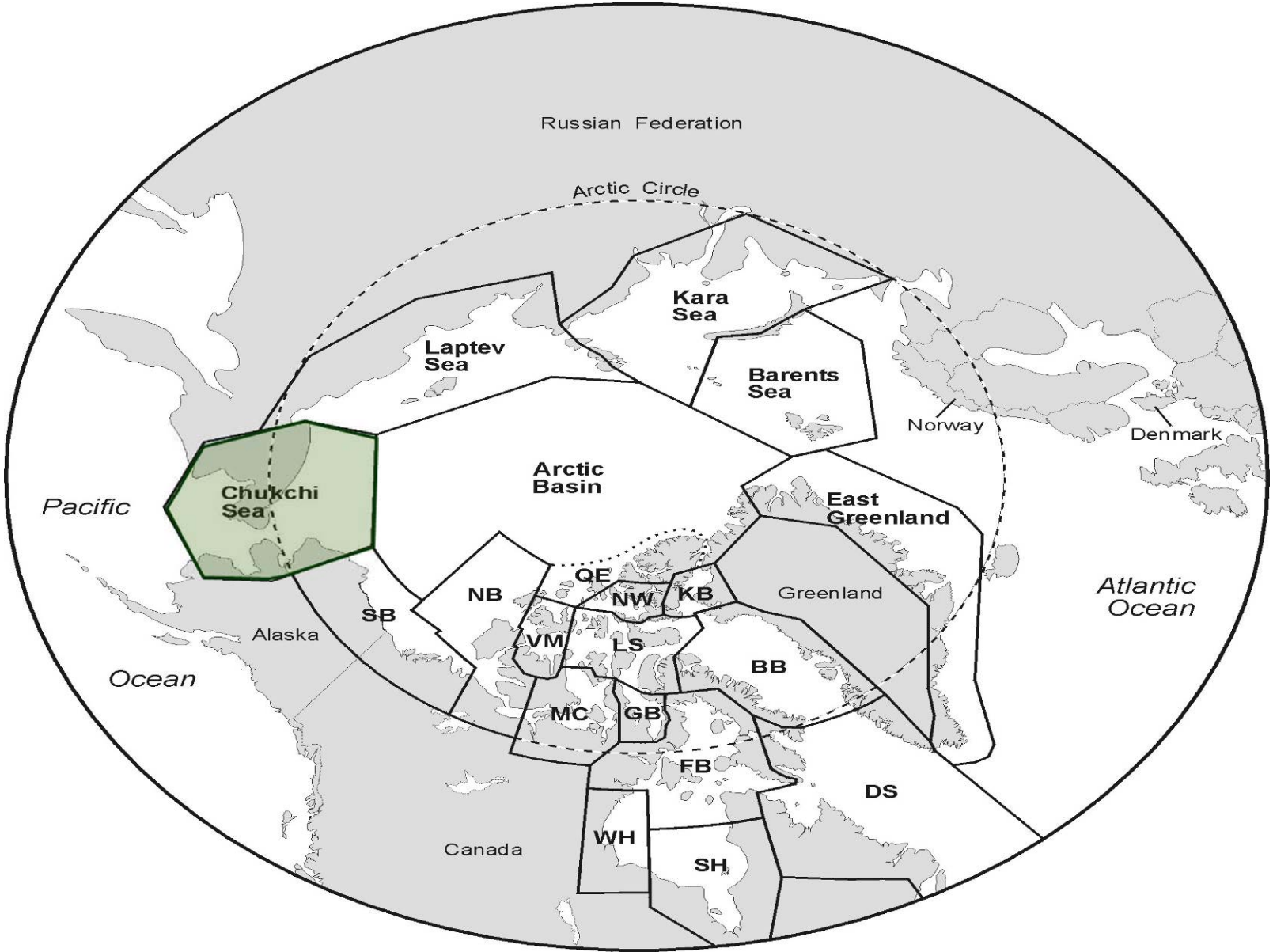
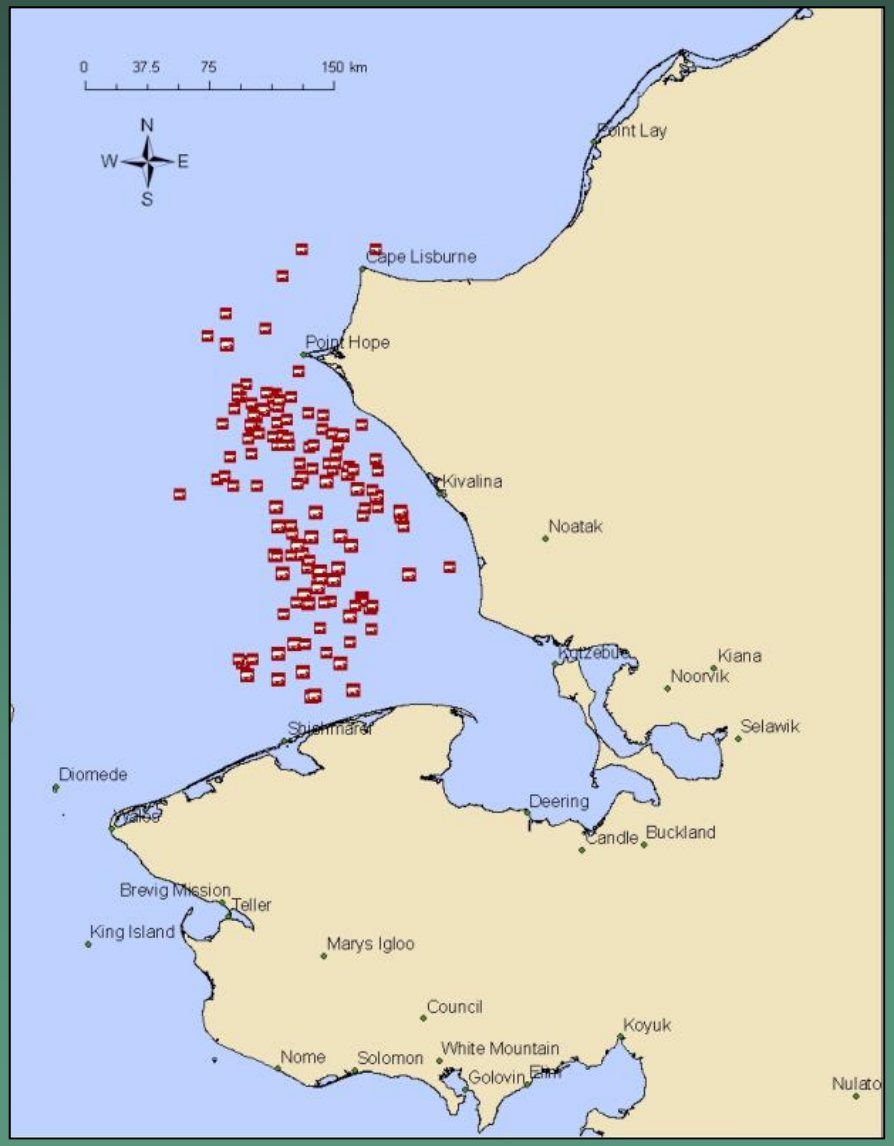
Chukchi Sea: a more challenging system and a less-studied population



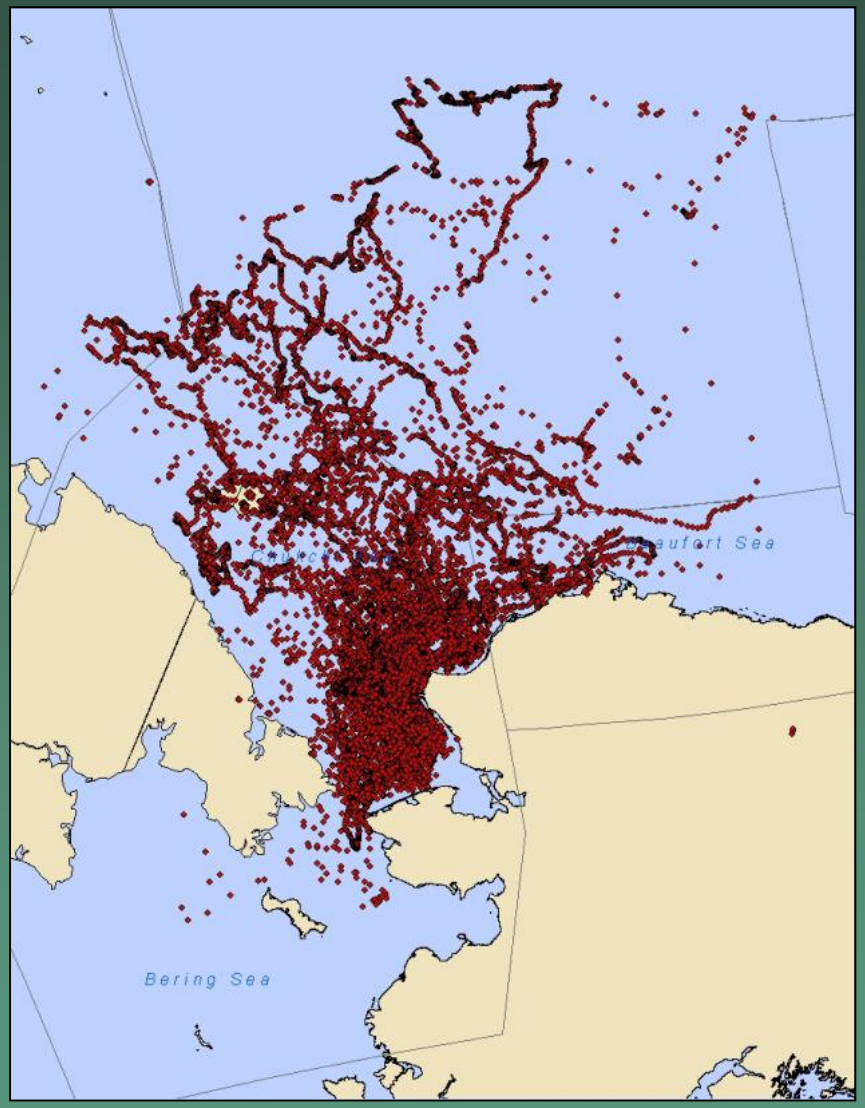
Chukchi Sea

- Annual formation and retreat of sea ice.
- Polar bears are studied in the spring when dispersed on the ice, with only a small area accessible.
- The population does not exhibit discrete seasonal boundaries, occurs in two countries, and is poorly defined.
- From 2008-2011, there were 220 captures.



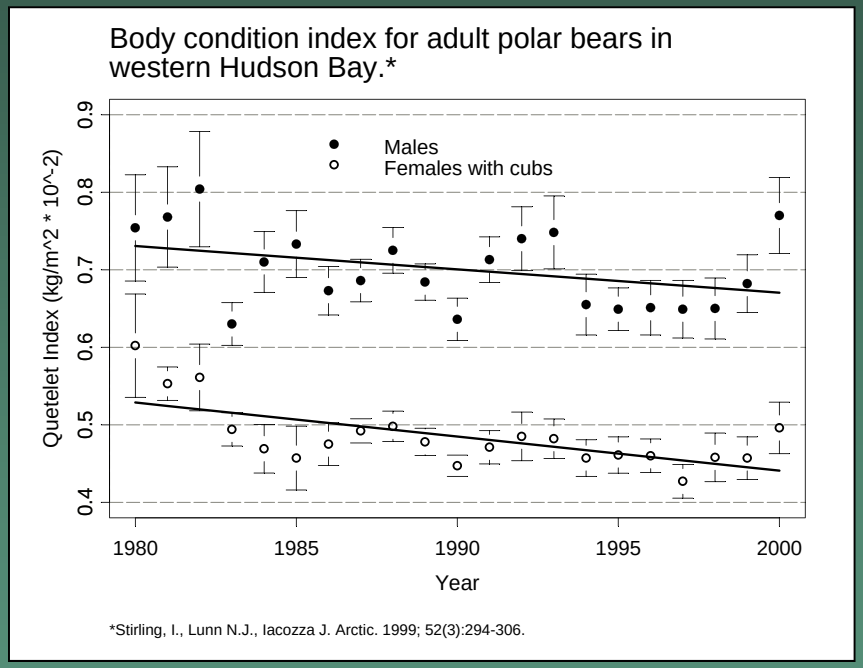
Chukchi Sea

- It's unlikely that data collected from 2008-2011 will provide reliable estimates of population size or survival.
- However, we still expect to obtain information relevant to demographic criteria. For example:
  - Evaluate study design to inform future research.
  - Population distribution and habitat use.
  - Body condition, reproduction, and health.
  - Sex and age composition.

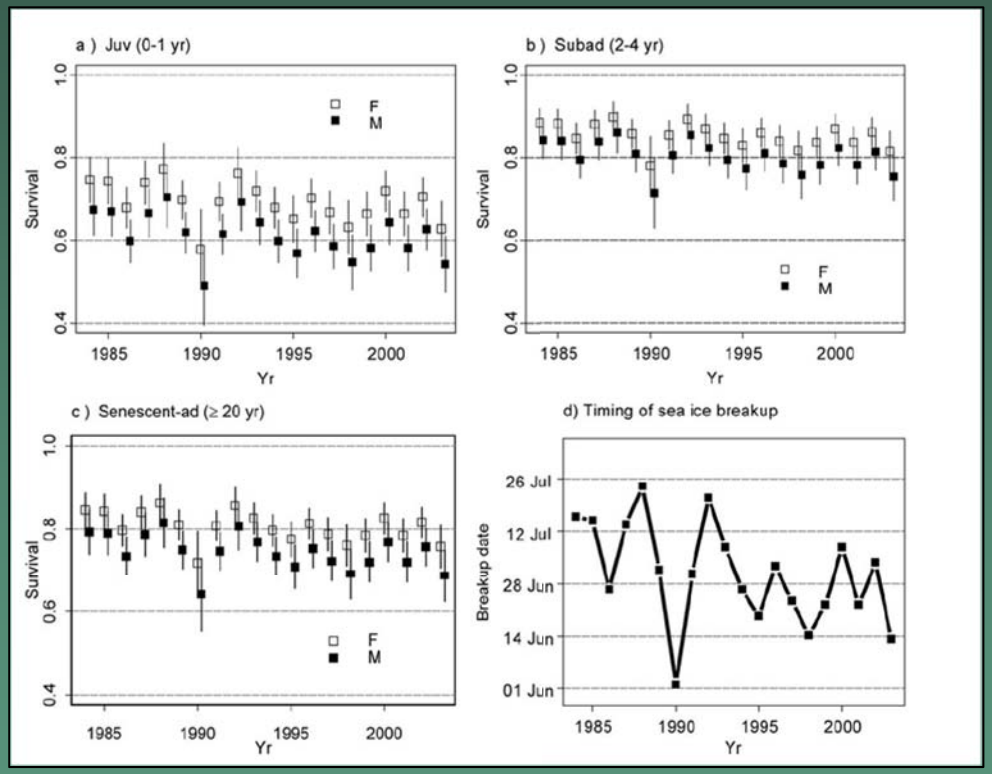


Western Hudson Bay

Body condition



Survival



Meaningful demographic criteria for well-studied populations

- Use population-specific, a priori evaluations of study design to evaluate statistical ability to detect changes in population parameters.
- Do not focus on population size.
- Evaluate vital rates (i.e., survival and reproduction) and their relationships to environmental conditions.
  - Population of interest must be defined.
  - Potential bias in parameter estimates must be quantified and, if possible, mitigated.
  - Studies should be sufficiently long to incorporate natural variability in the Arctic environment.
- Use population projection models to predict risks of future population decline.
  - All types of uncertainty must be considered.
  - Relationships between vital rates and environmental conditions in the current study must also be valid in the future.

Meaningful demographic criteria for all populations (including less-studied)

- Place emphasis on recovery/conservation criteria for specific threats, which are easier to evaluate and are related to demographic status (i.e., the availability of sea ice habitat).
- Evaluate a broad range of ecological indices that are related to demographic status, and their relationships with the environment. For example:
  - Body condition, reproduction, and health for a representative sample of animals.
  - Community-based monitoring and traditional ecological knowledge.
- Develop transparent and structured methods to synthesize multiple lines of evidence, which may be weak individually, but in combination allow for stronger inference regarding population status.
- For all populations: think creatively.

Thank you and discussion