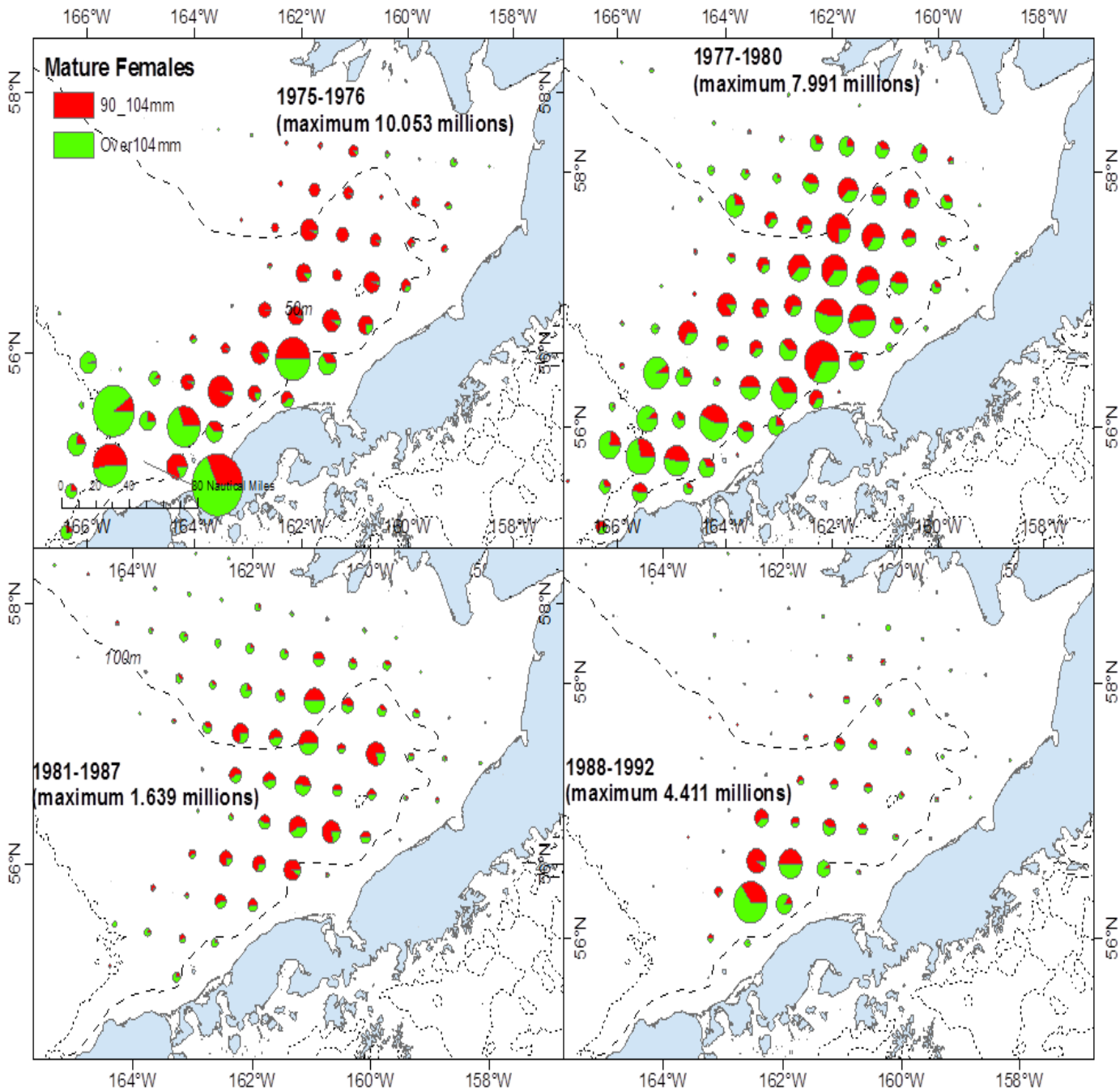
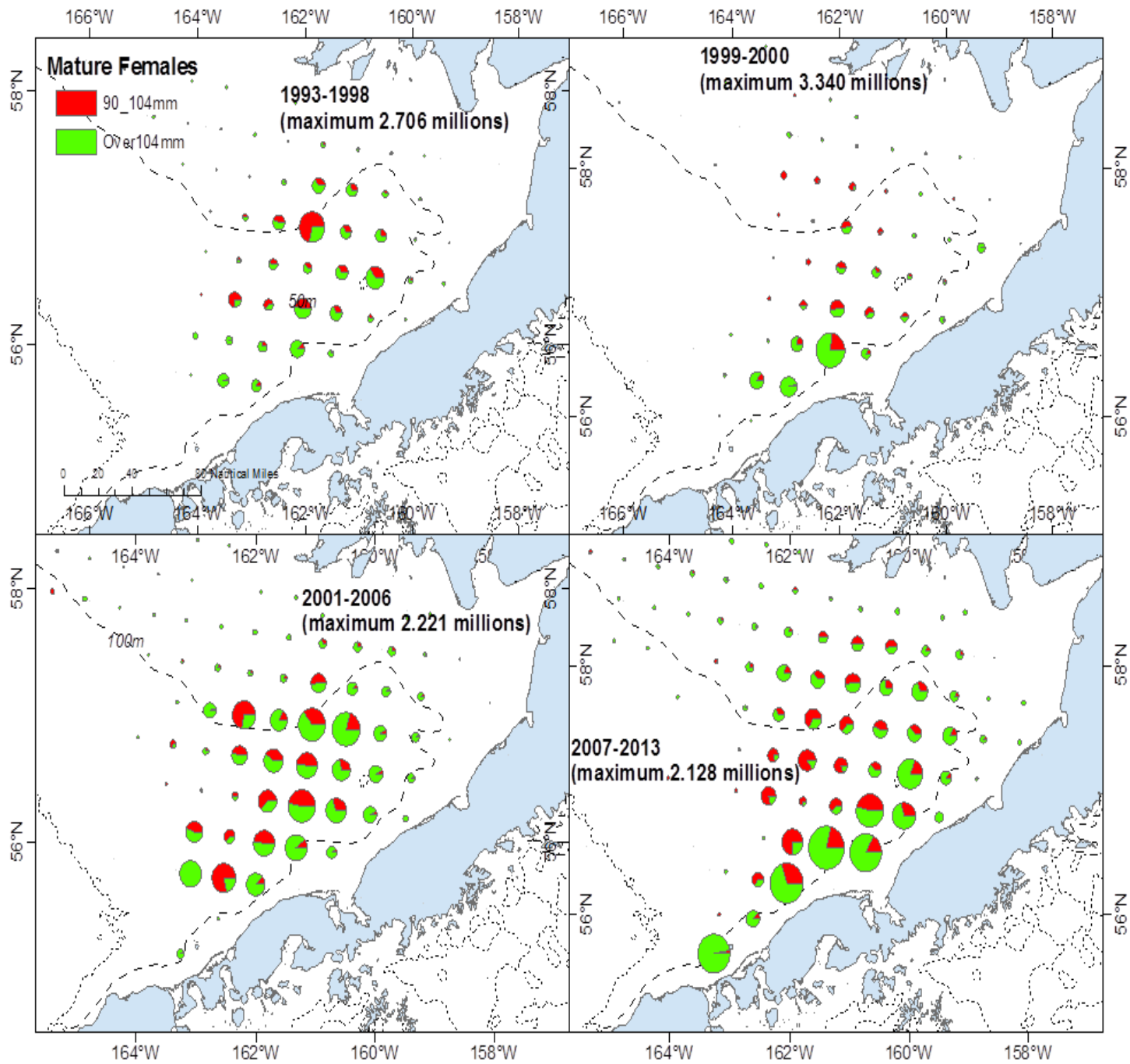


Temporal changes in spatial distribution of Bristol Bay red king crab in the eastern Bering Sea and their implications for fisheries management

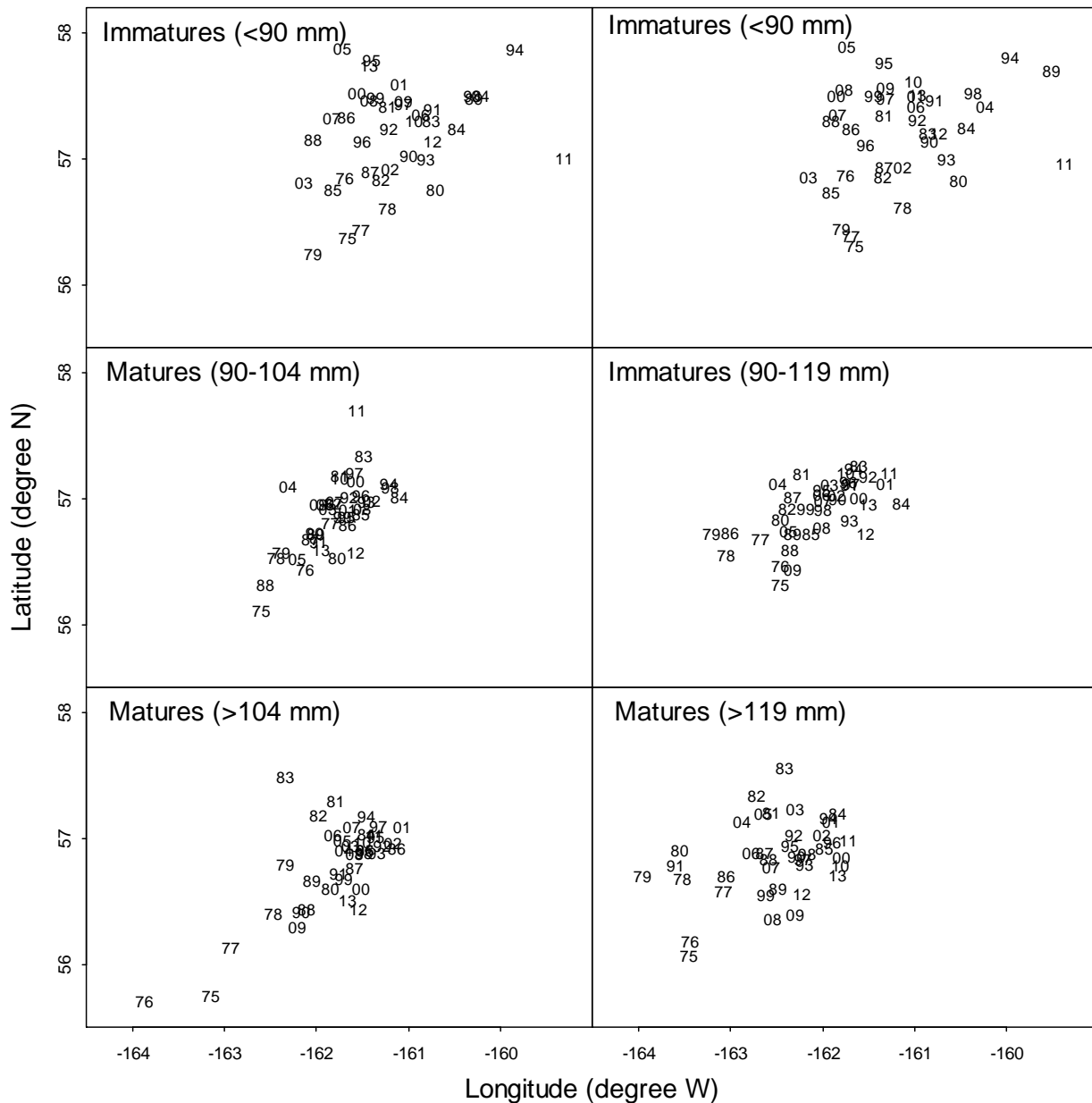
Jie Zheng, M.S.M. Siddeek, Gordon Kruse
Alaska, USA





Female red king crab

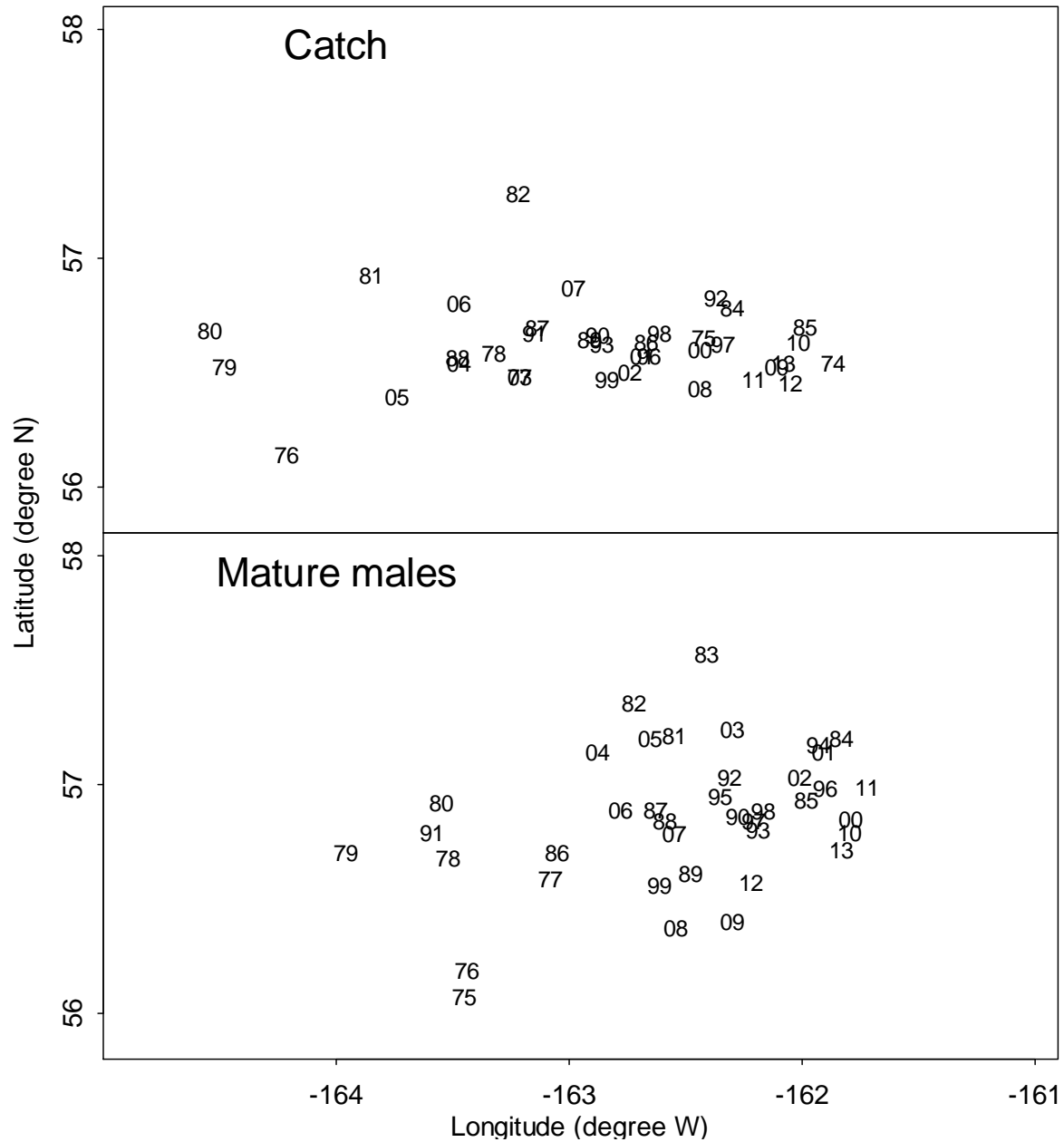
Male red king crab

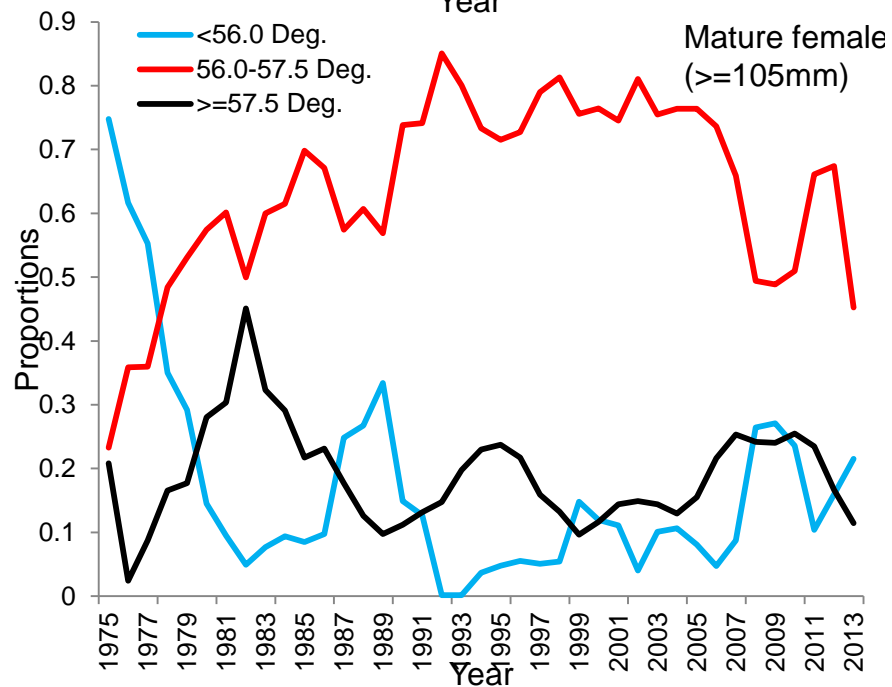
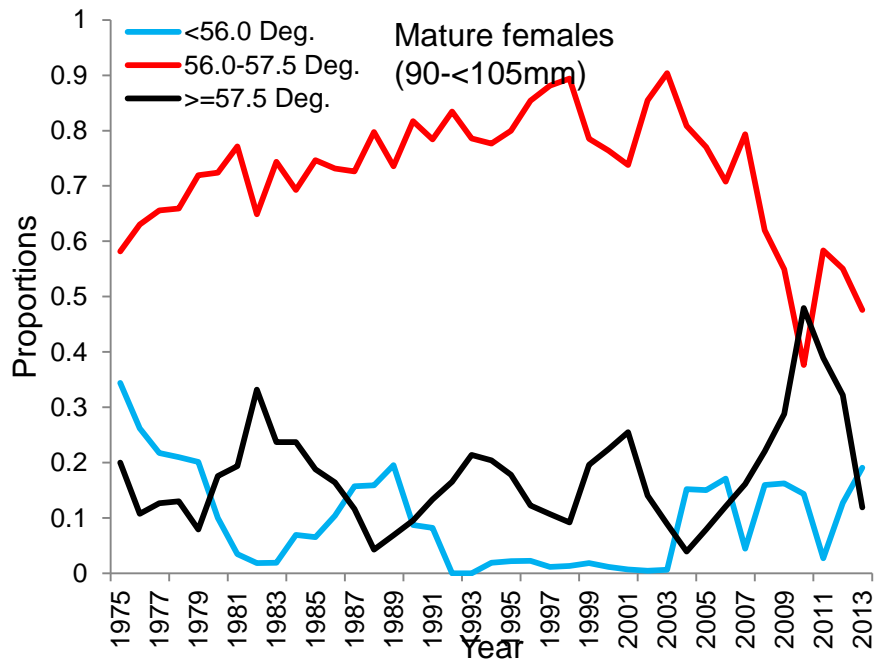
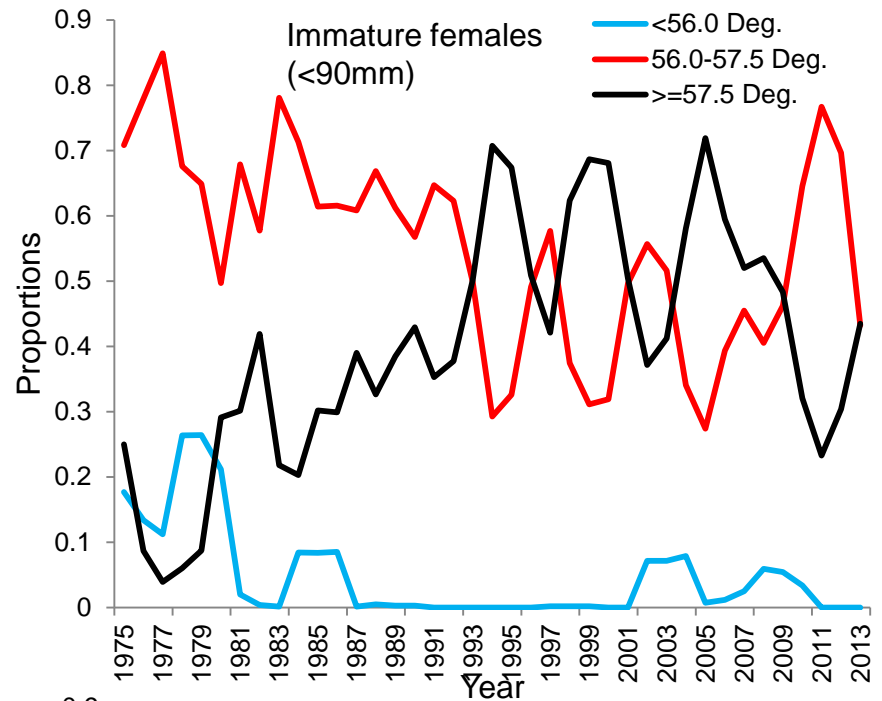
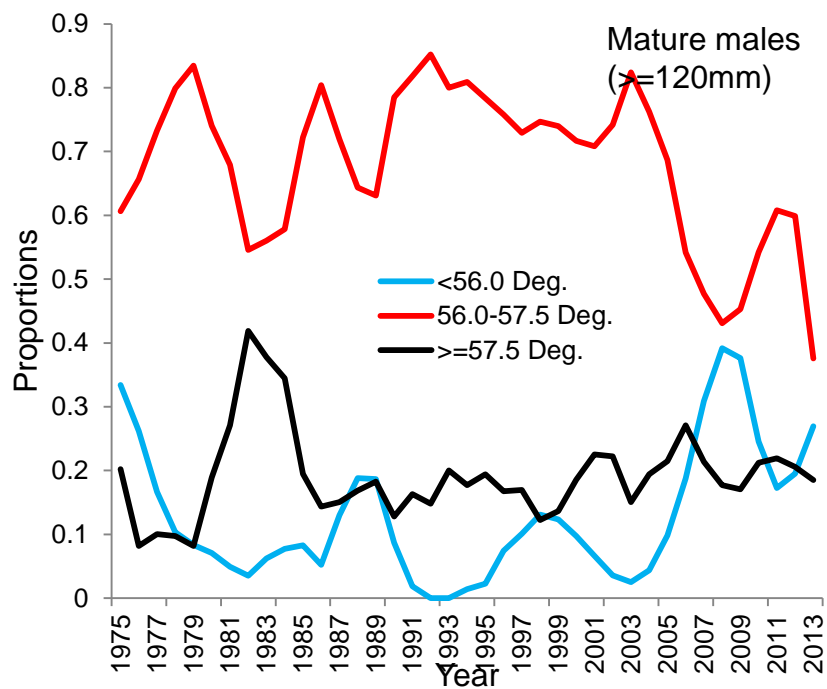


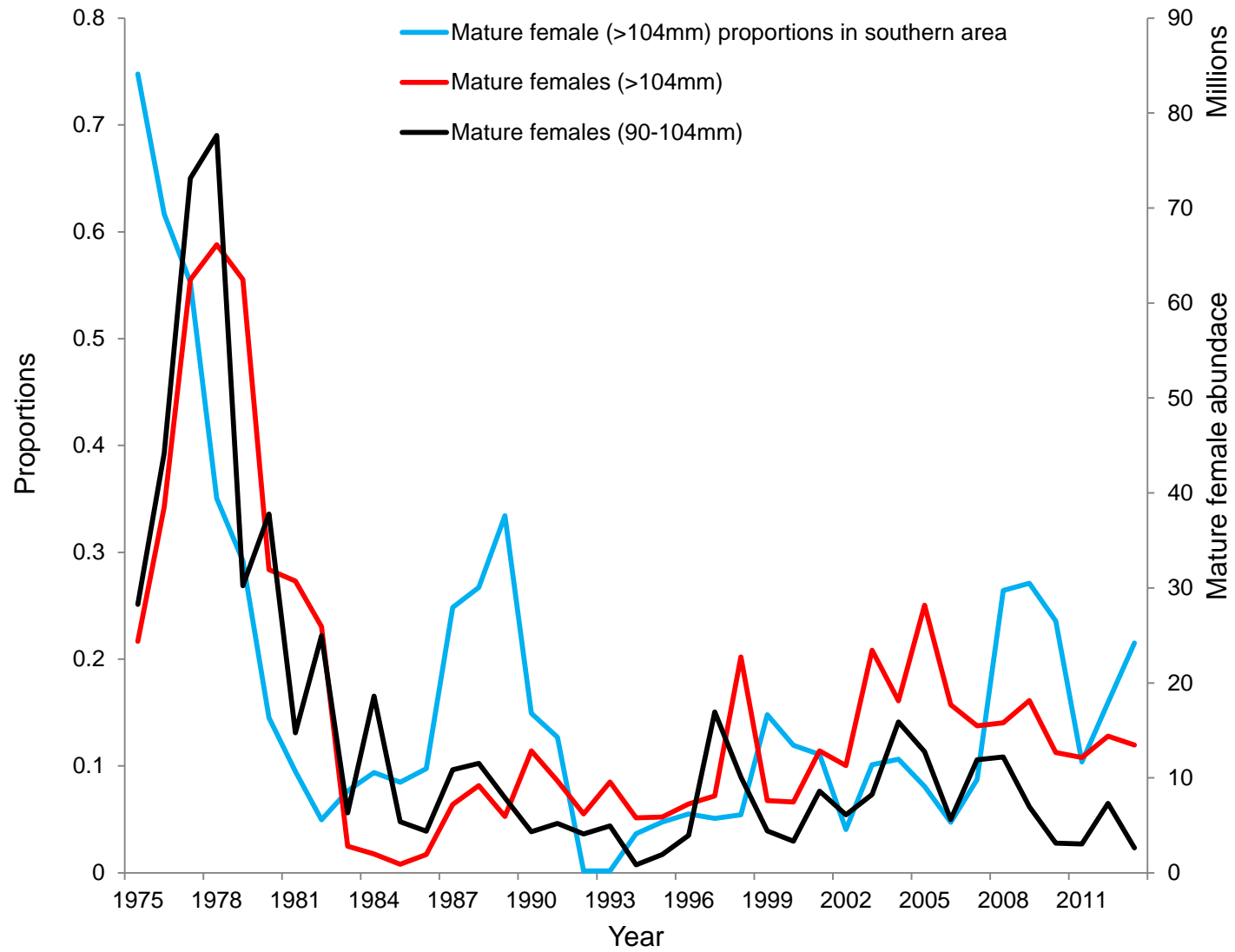
The shift to northeast from southwest for mature female red king crab started in 1977 and the annual distribution centers from the NMFS summer surveys occurred in the most northern area during the early 1980s.

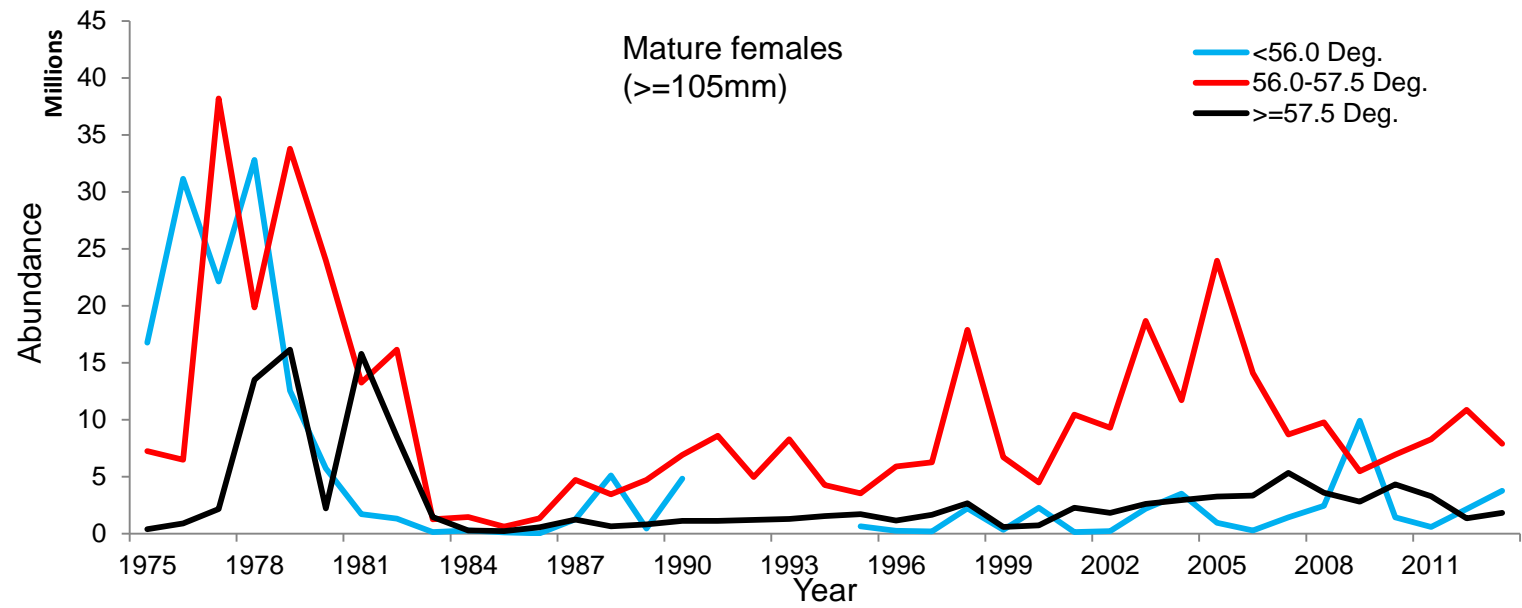
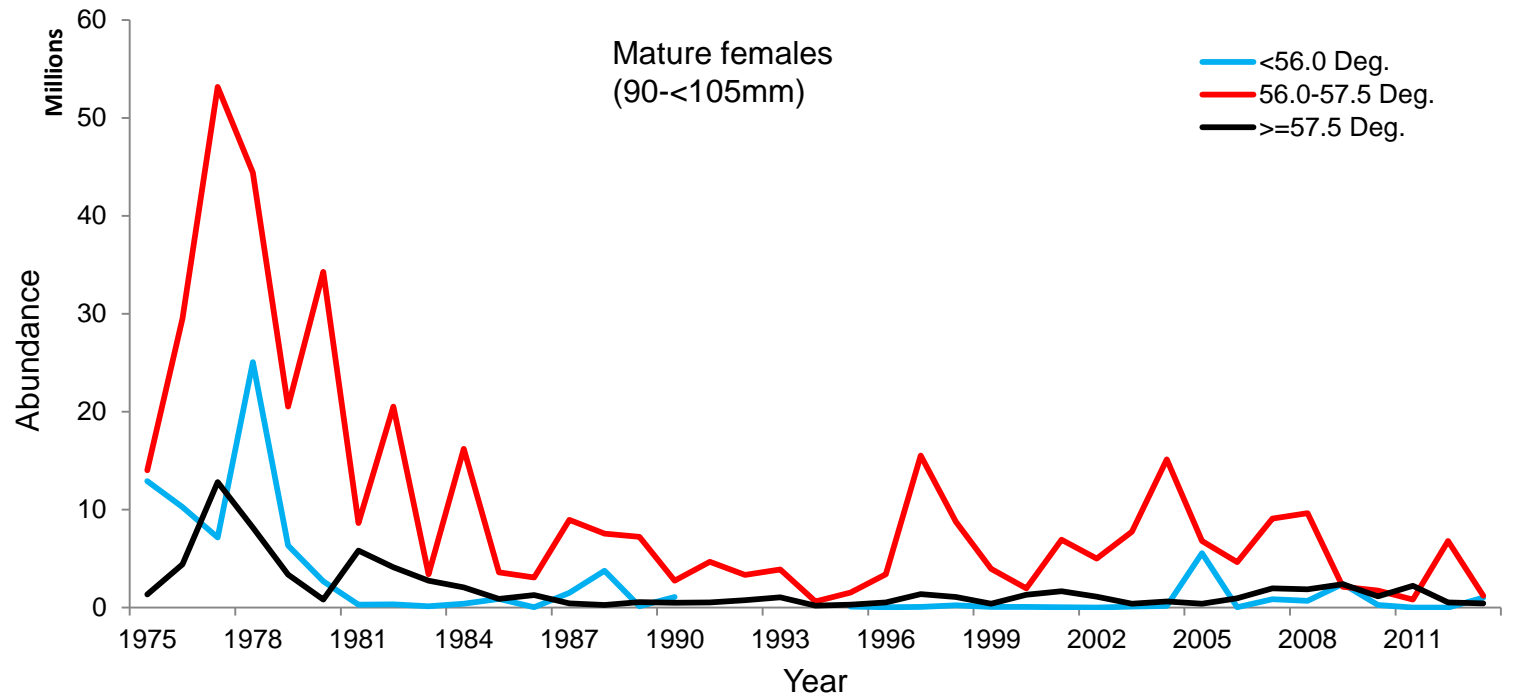
What are the causes for the shifts?

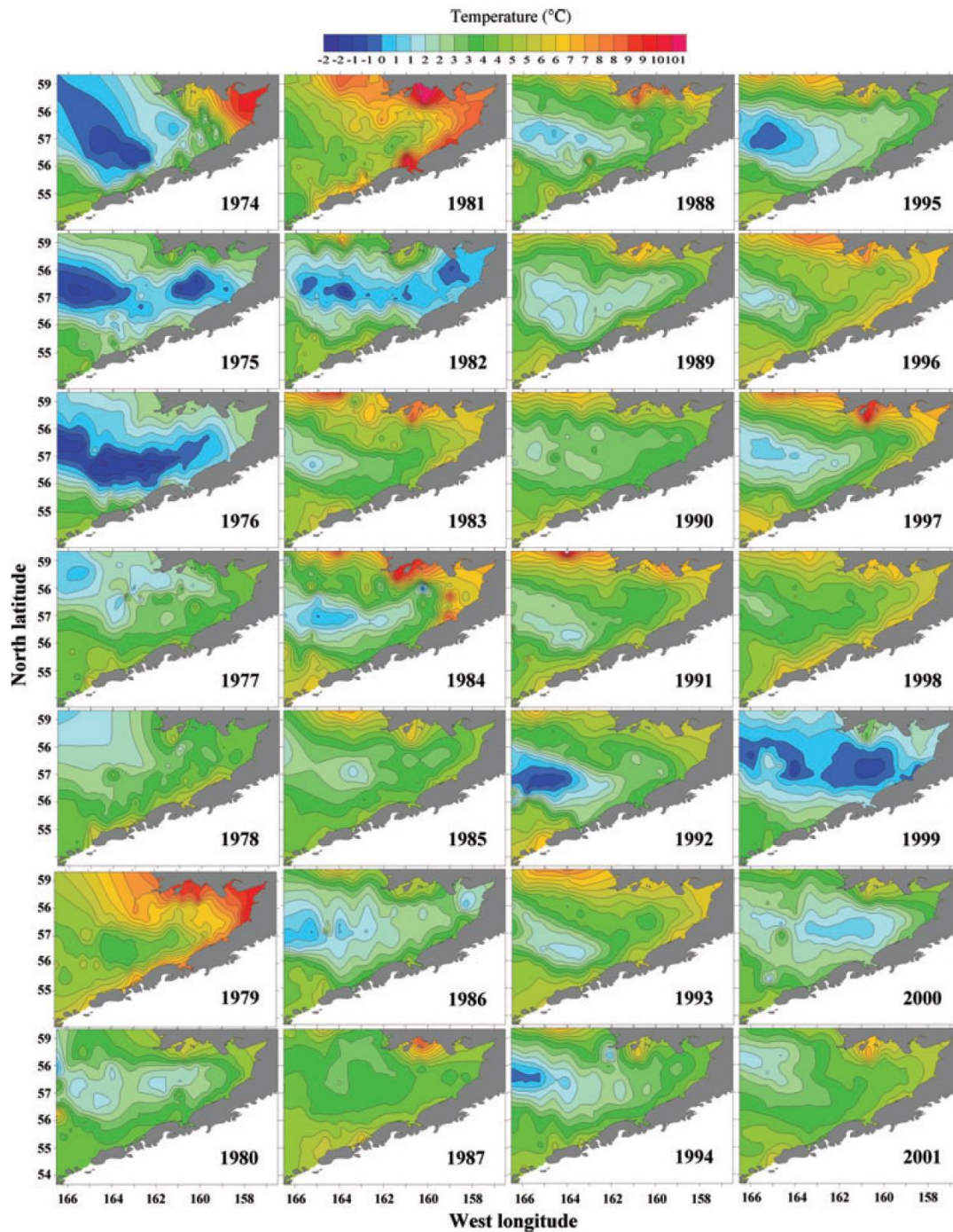
- ✓ Fishing?
- ✓ Environmental factors?
 - ✓ Summer bottom temperatures
 - ✓ Winter PDO index





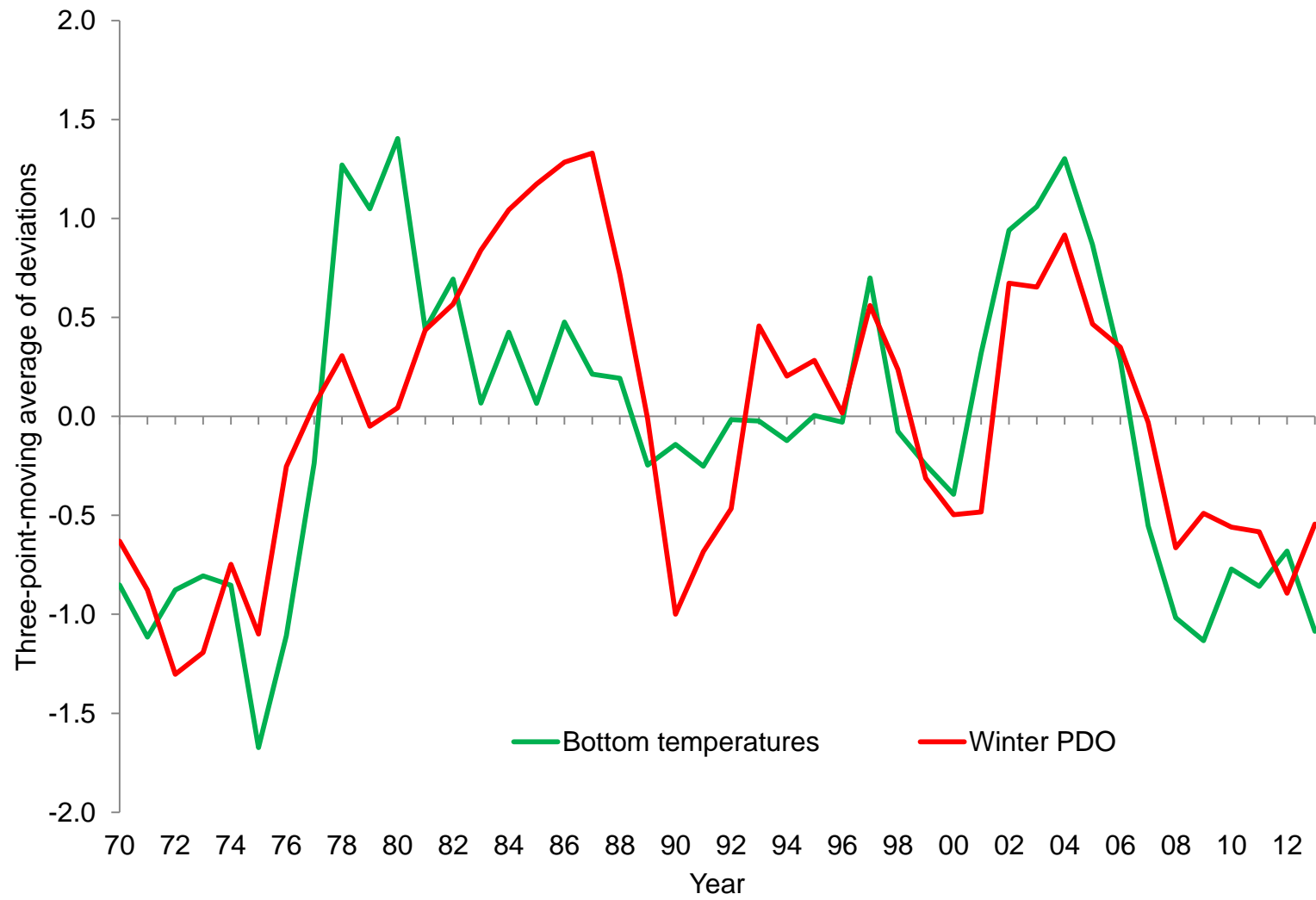


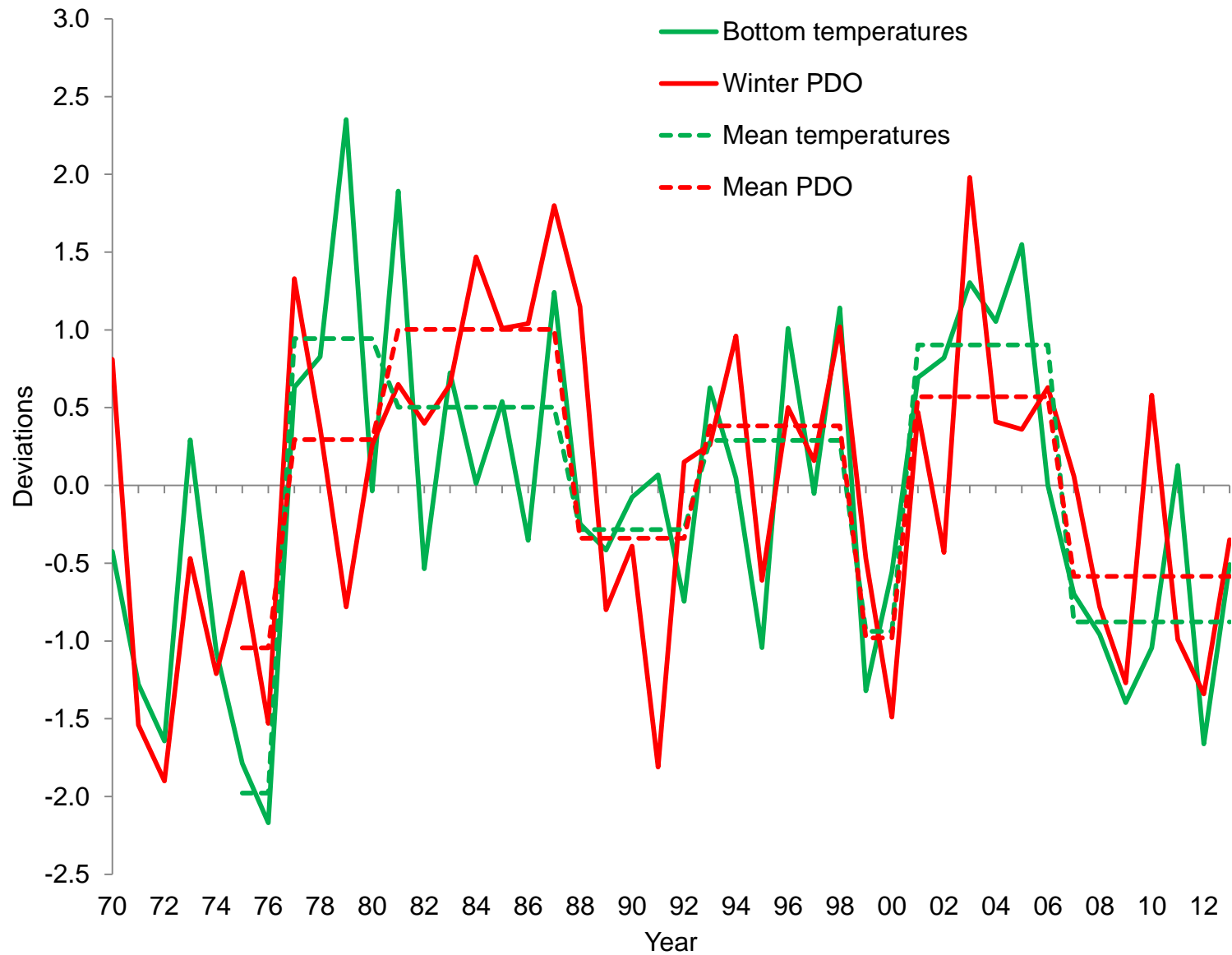


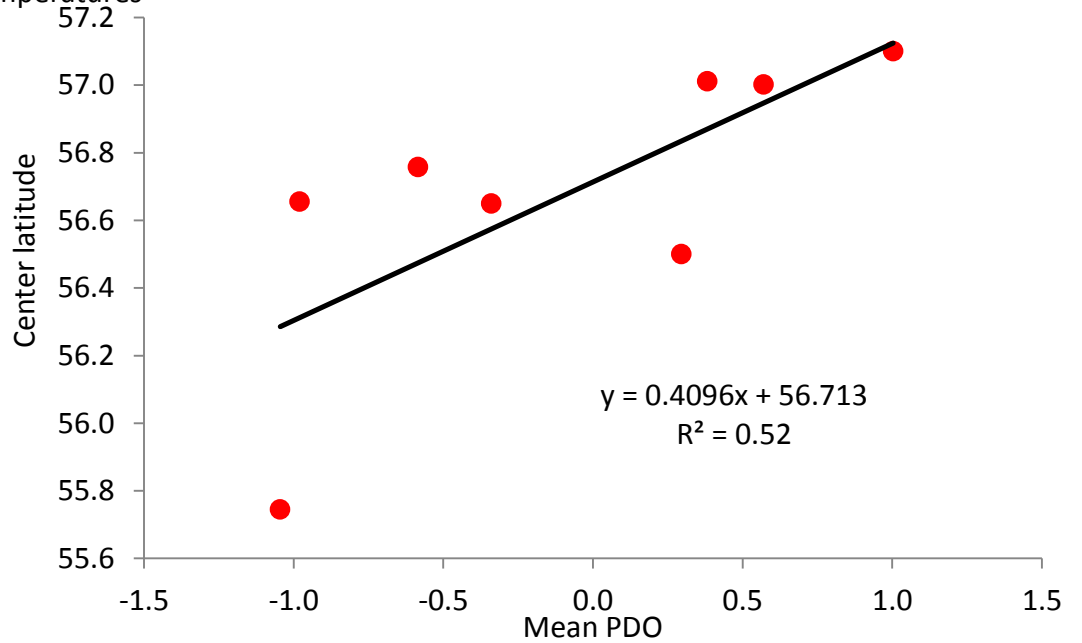
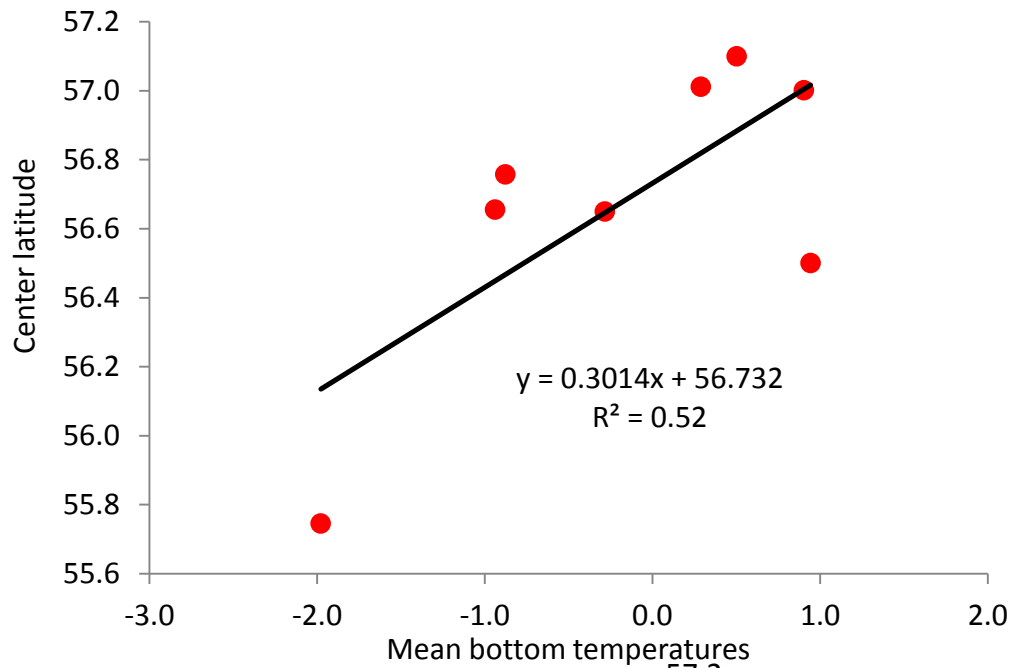


Bottom temperatures
during summer

After Loher
and Armstrong 2005



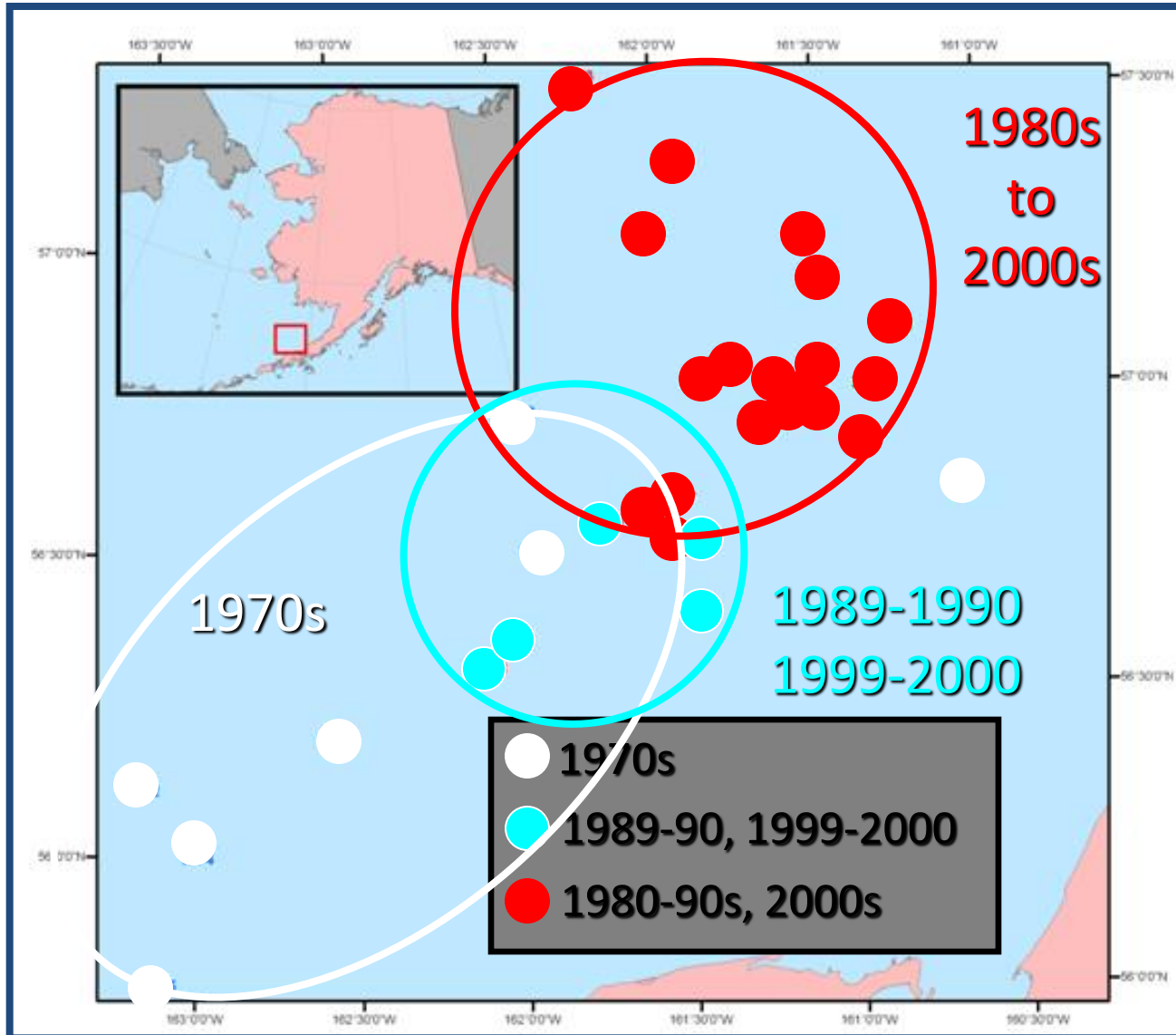




Summary

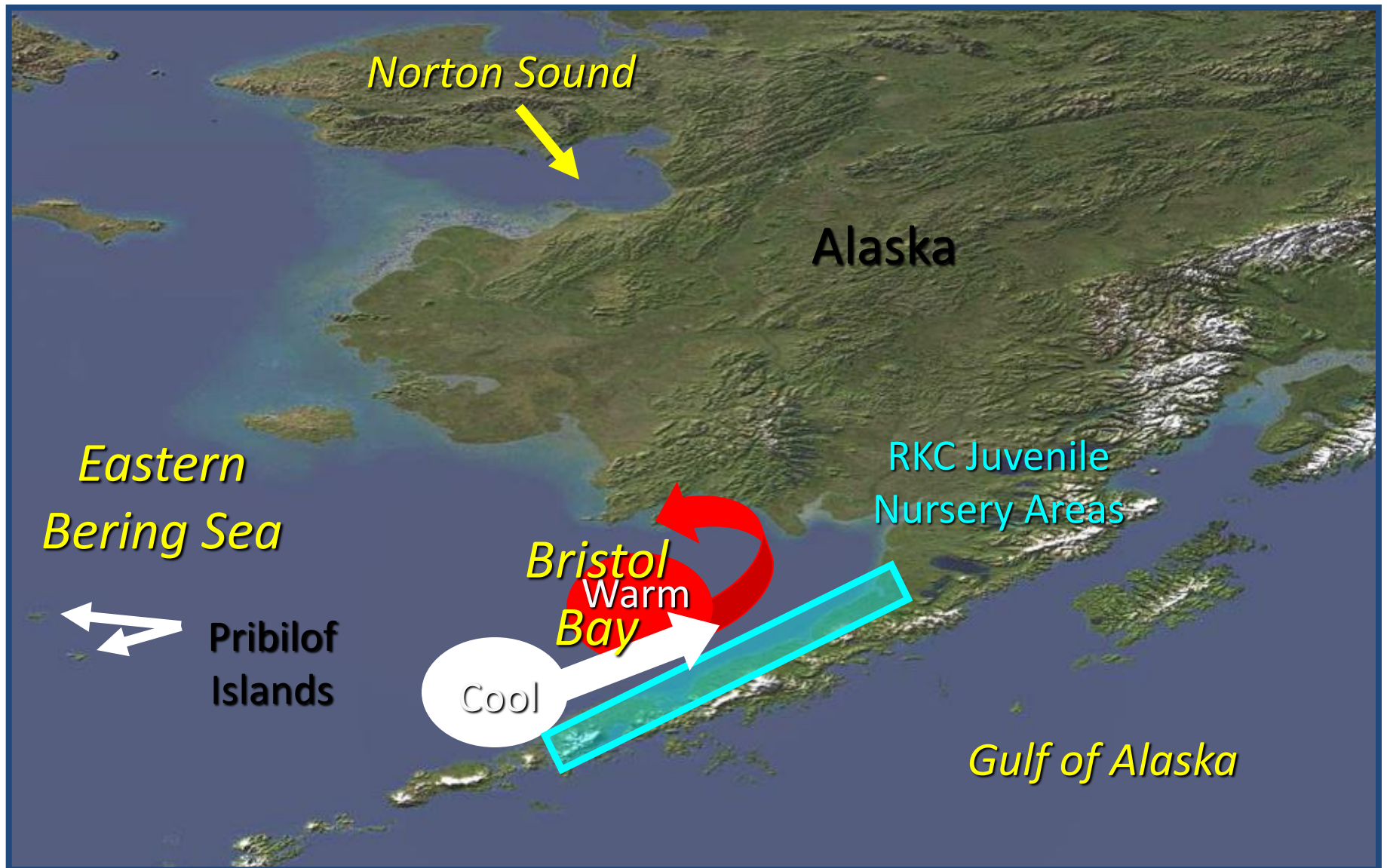
- The evidences do not support the fishing as a main factor:
 - The directed fishing concentrated in the middle Bristol Bay
 - Proportions for all size groups of red king crab declined in the southern area at about the same time during the late 1970s, including immature crab that should have a very low catchability from the commercial fishing gears
 - The decline of mature females occurred when the mature female abundances were very high, and some of mature females in the southern area might have moved into the middle area
- The shifts were associated with changes in environmental conditions:
 - The shifts started with the regime shift in 1976/77
 - Northward shifts associating with high temperatures and high PDO index and southward movements relating to the low temperatures and low PDO index.

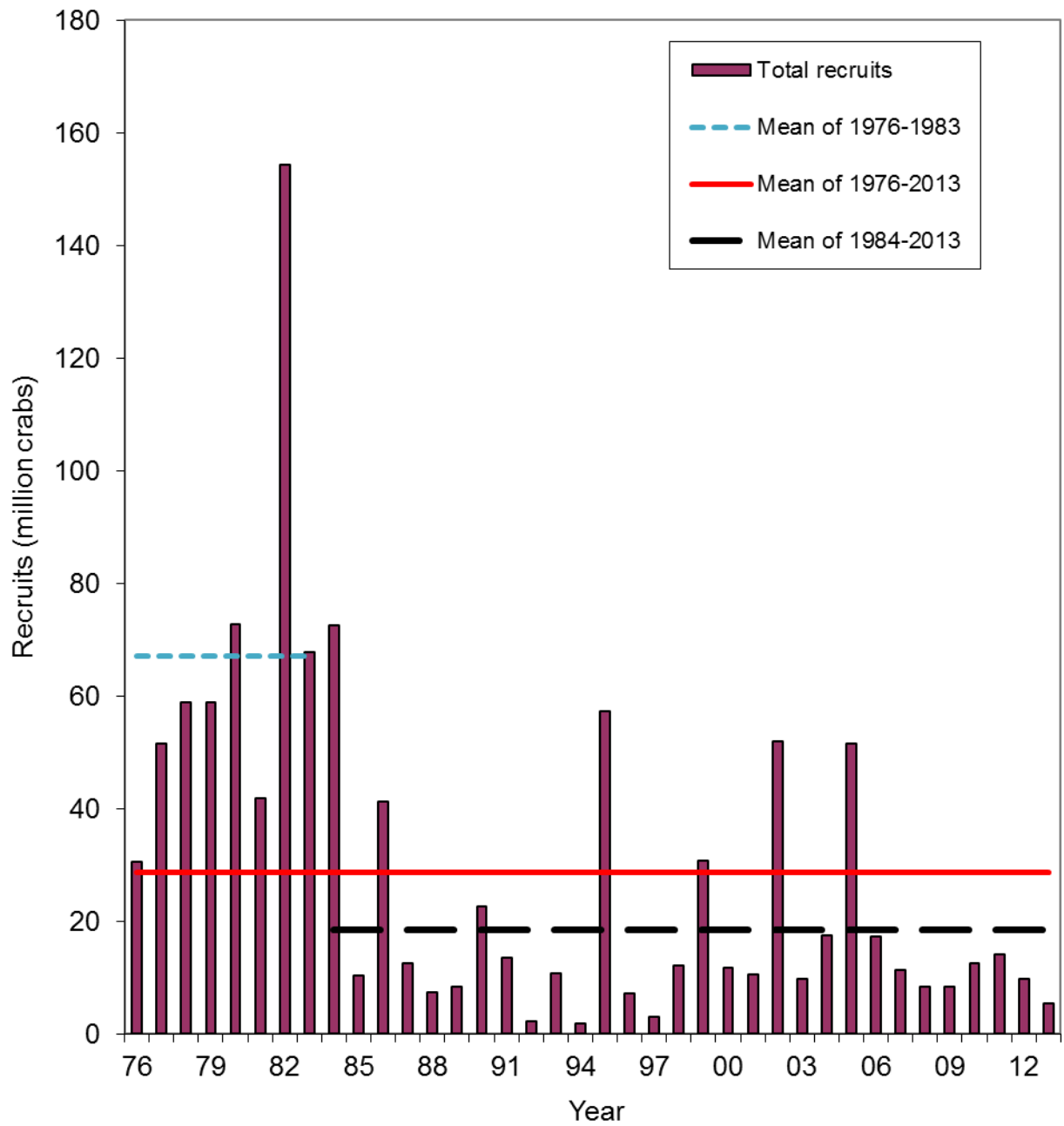
Temperature Affects Crab Distribution

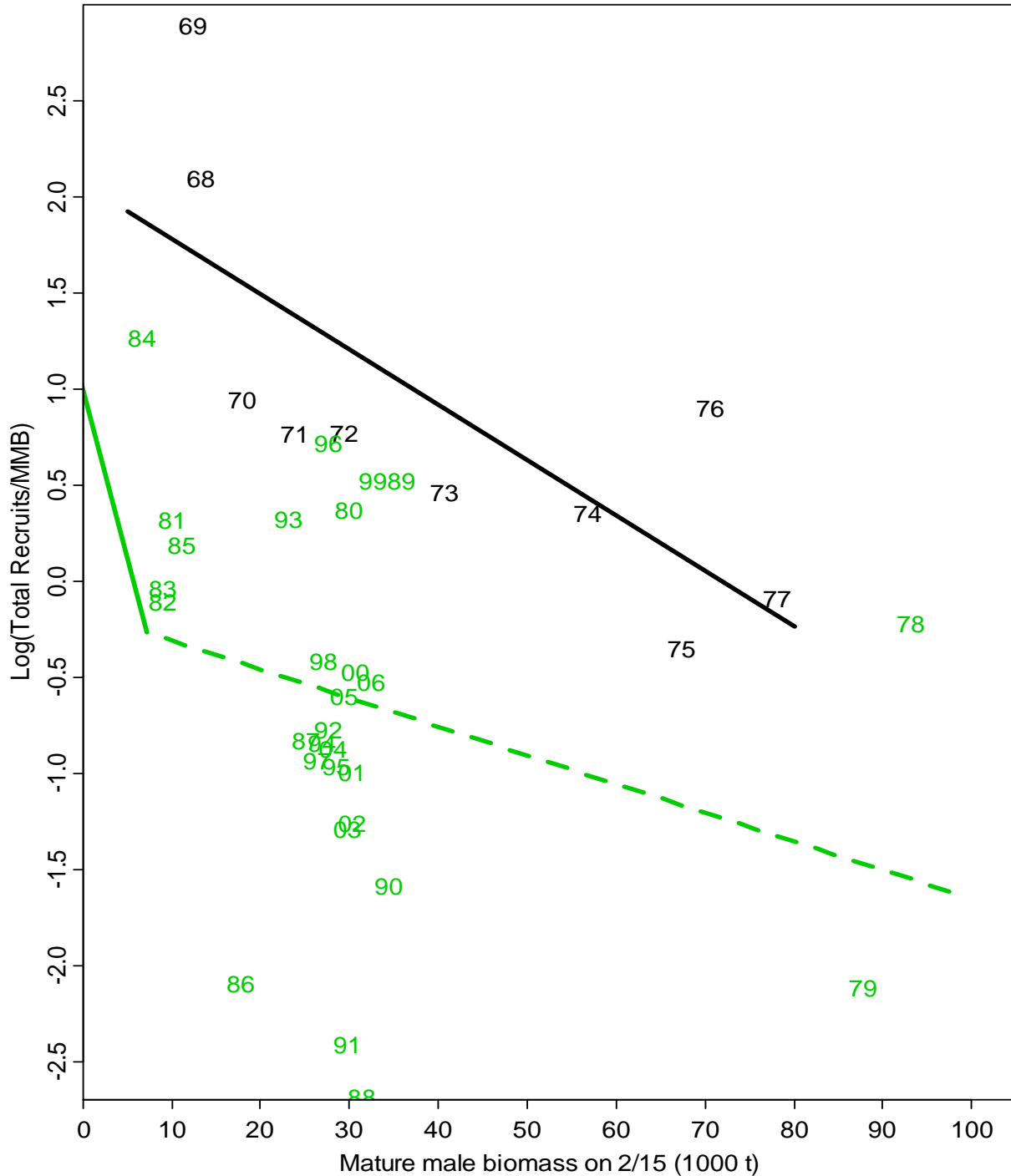


Centers of Distribution of mature female red king crabs in Bristol Bay (after Zheng & Kruse 2006)

Expected Effects on Larval Advection







The relationships between productivities and MMB are also very different between 1968-1983 and 1984-2012

Implications for Fisheries Management

- low productivities after 1976/77 regime shift
- Shifts in geographic distribution of mature females relative to nursery grounds may be an important factor for low productivities
- Biological reference such as B35% is low based on low mean recruitment after the 1976/77 shift

Thanks