

Effects of a Retreating Ice Edge in the Bering Sea on Fisheries Activities

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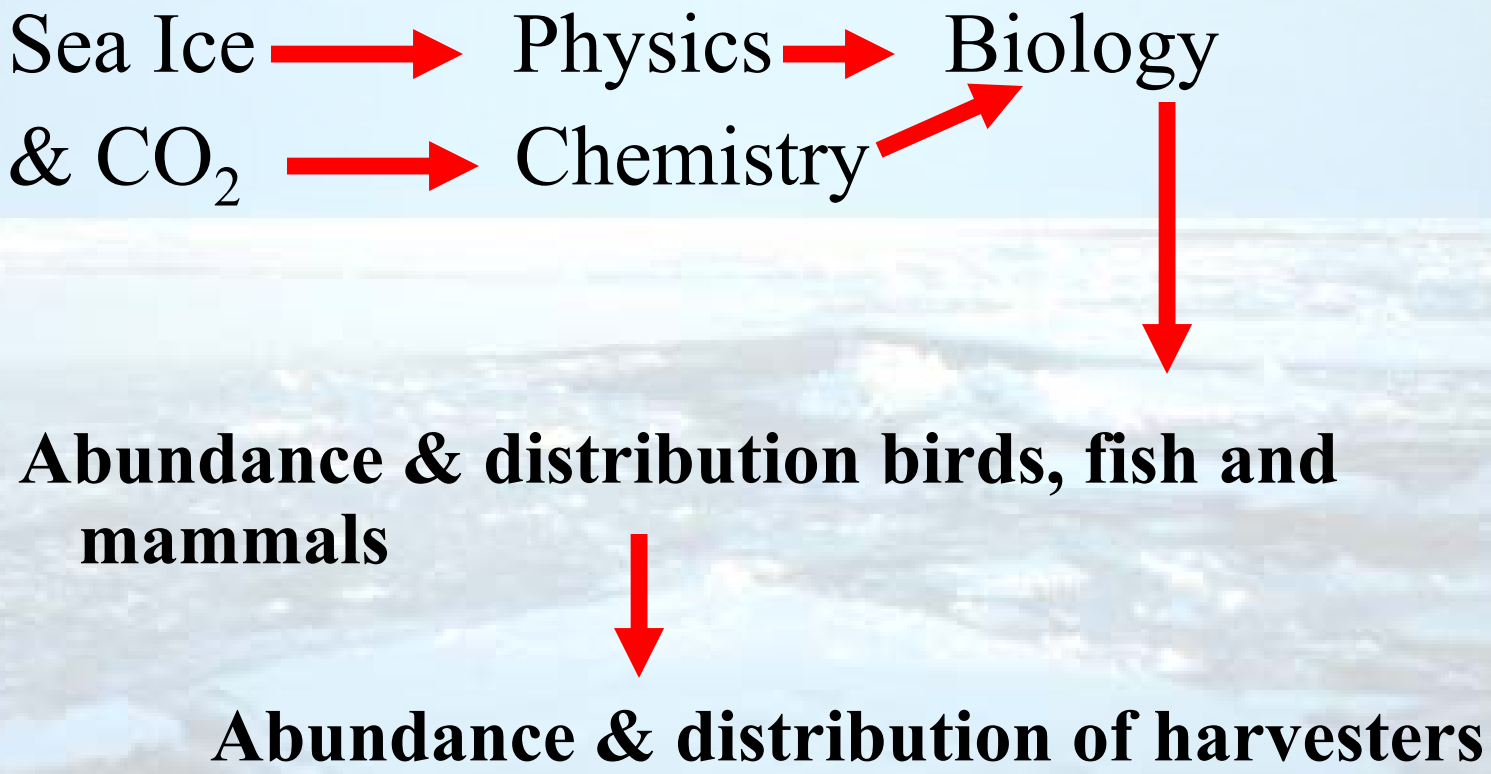
Symposium on the Impact of an Ice-Diminishing Arctic on Naval and Maritime Operations
U.S. Navy Memorial and Naval Heritage Center in Washington, D.C.
July 10 – 12, 2007

Fishing Activities

- Large scale industrial (Bering)
- Resource dependent communities (Bering Sea north)
  - Coastal communities commercial (CDQ)
  - Subsistence – fish, birds and mammals

Outline of Effects on Fisheries Activities



Alaskan Fisheries Scientists Cope with Climate Change, Beaufort Sea Summer 2006

Time and space scales for birds, fish and mammals are small

Photo credit: Scott Johnson and John Thedinga, NMFS/AFSC/ABL/TSMRI

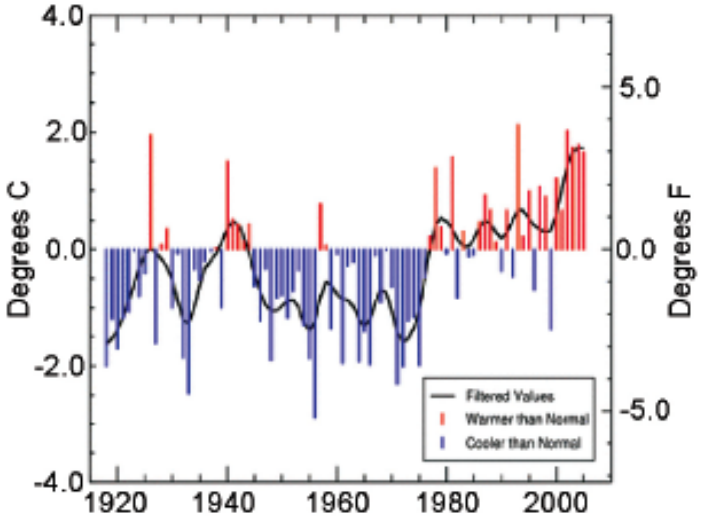
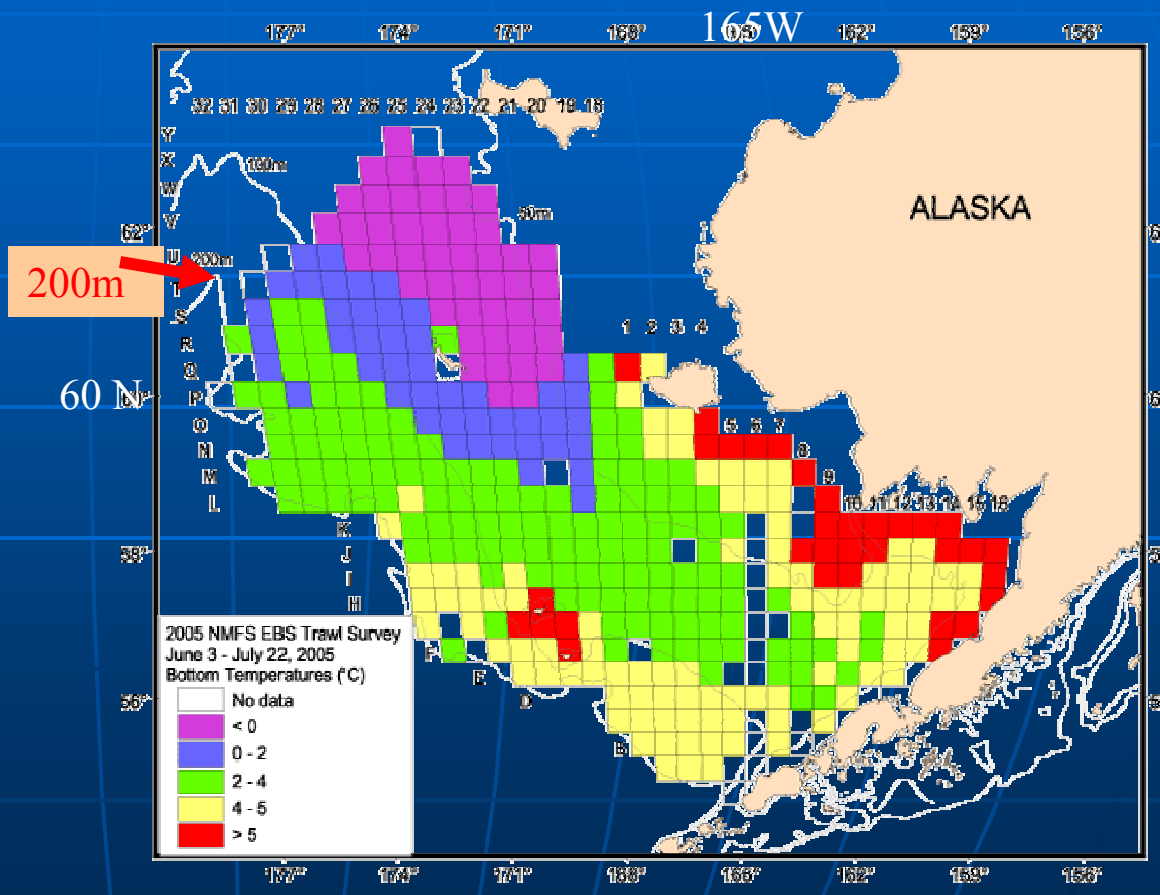


FIG. 6.10. Alaska statewide average annual temperature anomalies (°C), 1919–2005. [Source: NOAA/NCDC]

State of the Climate in 2005 Bull. Am. Meteorol. Soc.

Summary of Fisheries Effects

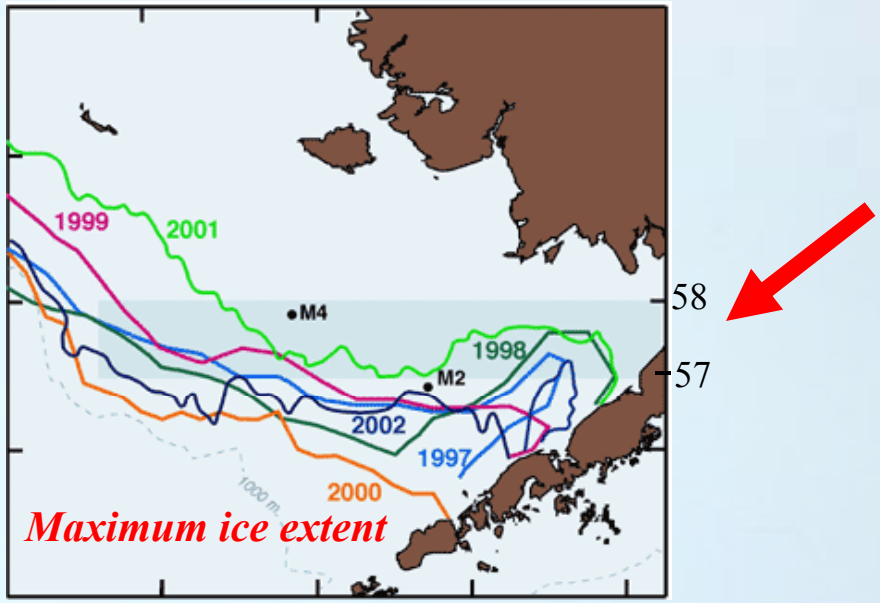
- **Increased subarctic habitat**
- **Increased pollock, cod and arrowtooth flounder abundance**
- **Decreased crab abundance**

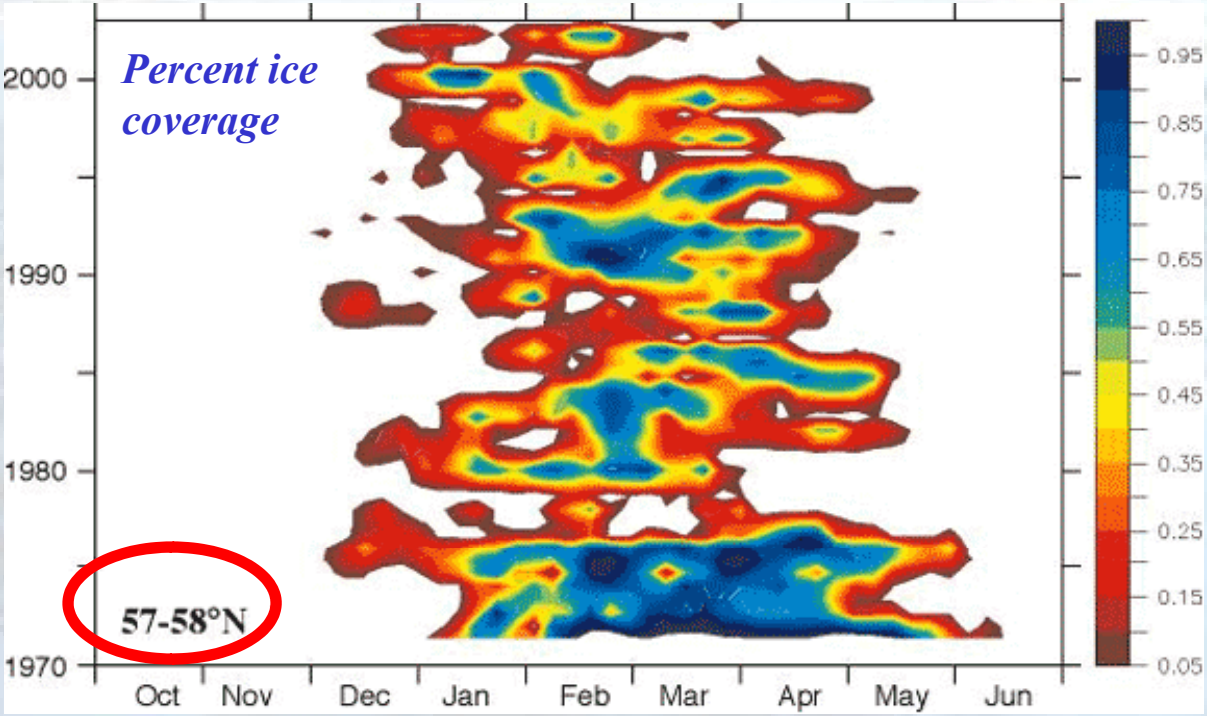


ICE

Location of ice extent

Loss of sea ice



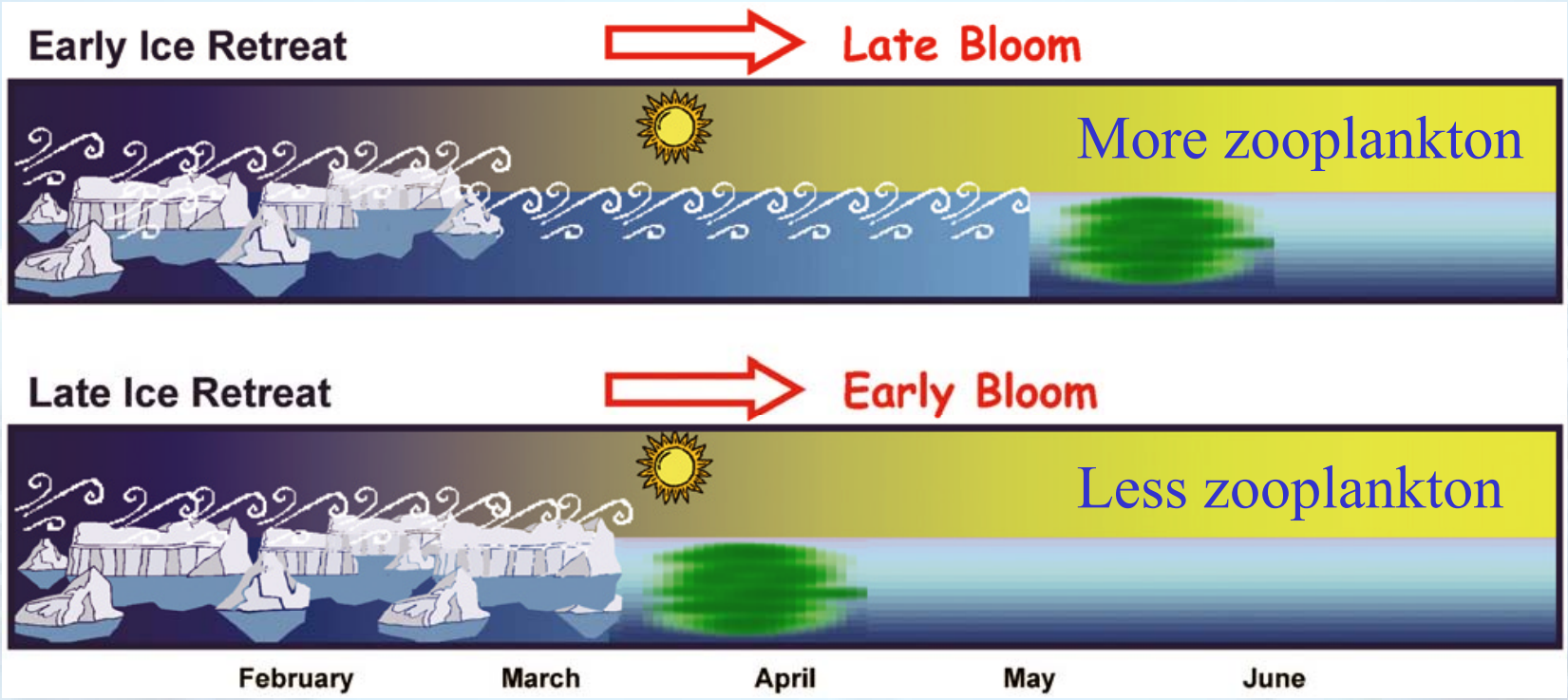


P.J. Stabeno, PMEL

Sea Ice → Physics → Biology

Ice Timing, Wind, Sun,

Nutrients & Temperature → Productivity

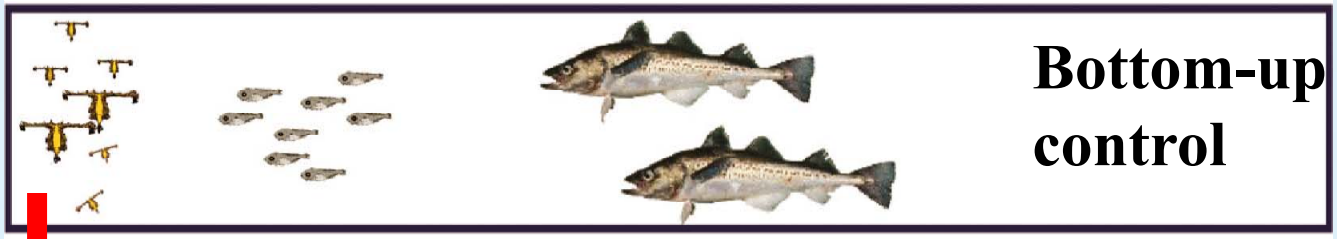


Oscillatory Control Hypothesis

Hunt, GL Jr., P. Stabeno, G. Walters, E. Sinclair, R.D. Brodeur, J.M. Napp, N.A. Bond. 2002. Climate change and control of the southeastern Bering Sea pelagic ecosystem. Deep-Sea Res. 49: 5821-5853.

Oscillatory Control Hypothesis

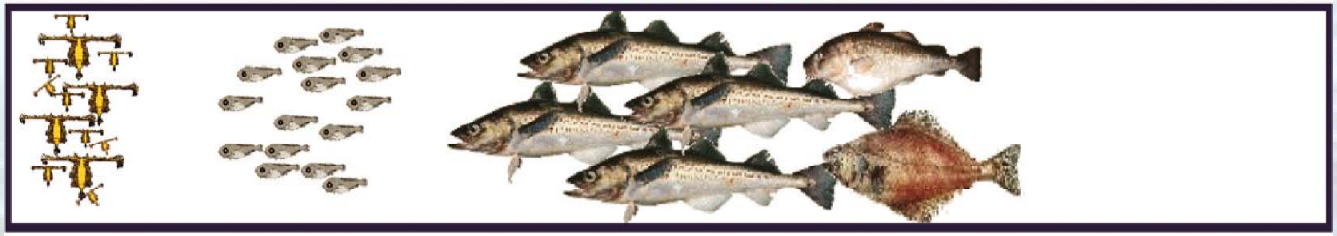
Early bloom favors benthic production



Bottom-up control

BENTHIC-PELAGIC SPLIT

Late bloom favors pelagic production



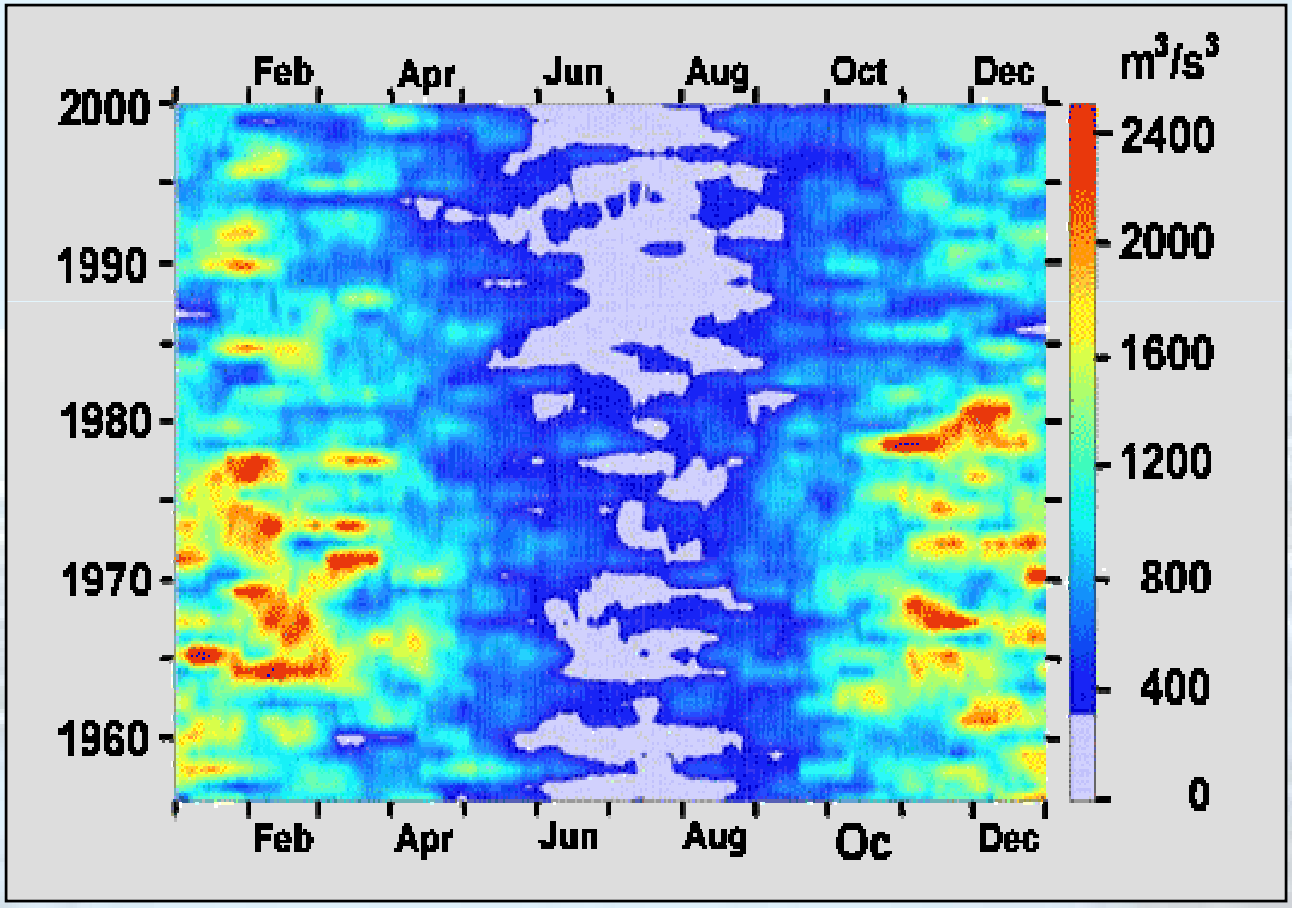
Top down control

Zooplankton Larval Survival Abundance of Piscivorous Adult Fish

Hunt, GL Jr., P. Stabeno, G. Walters, E. Sinclair, R.D. Brodeur, J.M. Napp, N.A. Bond. 2002. Climate change and control of the southeastern Bering Sea pelagic ecosystem. Deep-Sea Res. 49: 5821-5853.

Physics, Uncertainty #1: Extent of renewal of nutrients during the summer

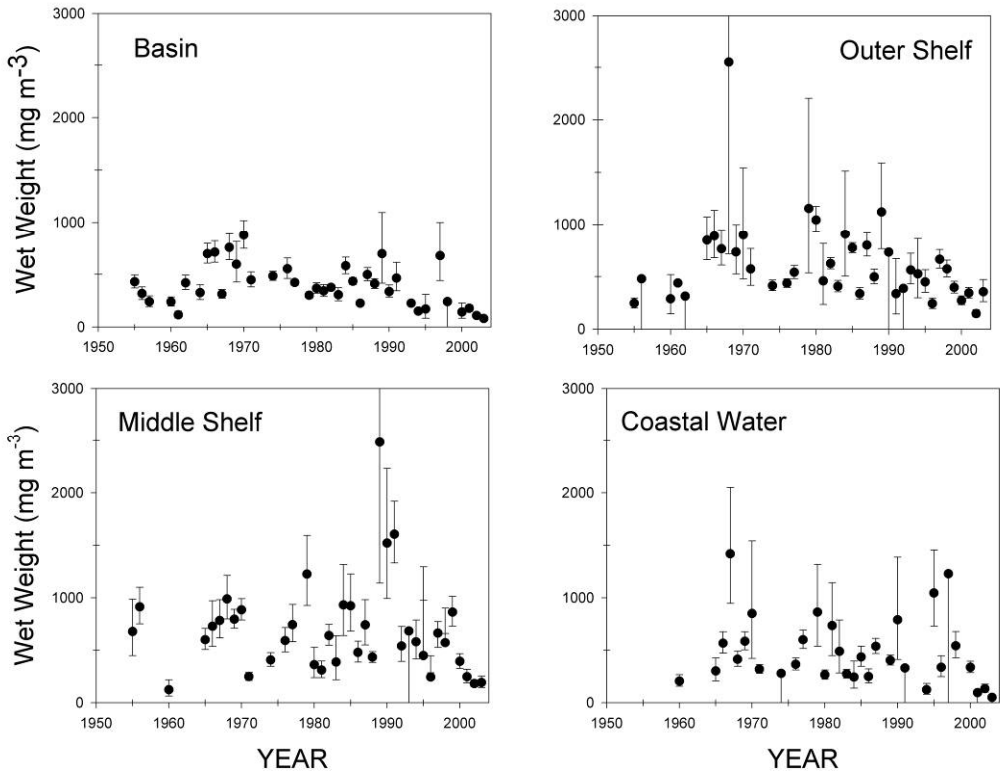
- Reduced winds
- Summer and fall winds renew photic zone nutrients depleted by spring bloom



P.J. Stabeno, PMEL from Hunt et al. 2002

Biology: Summer Secondary Production

Zooplankton biomass declining?



Napp *et al*., Regulation of zooplankton standing stock and production in the southeast Bering Sea: Top-down v. bottom-up control and recent climate-related declines in a subarctic ecosystem. *Prog. Oceanogr.*, submitted.

Photos: M. Flint & T. Whitledge

Composition variable

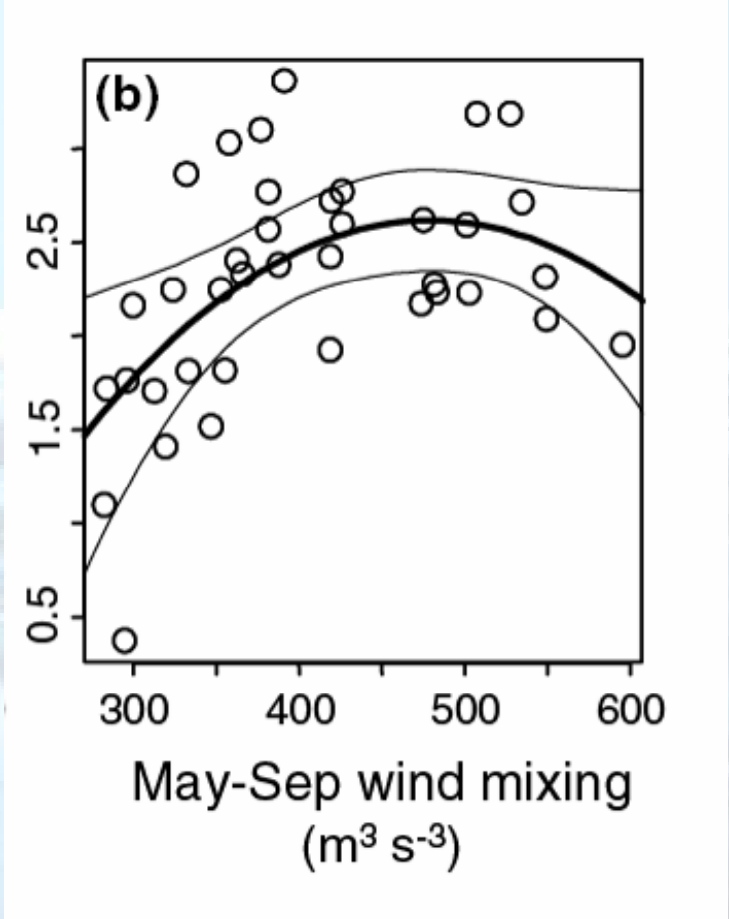
2000

2001

Reduced Summer Wind = Reduced juvenile fish survival

Pollock

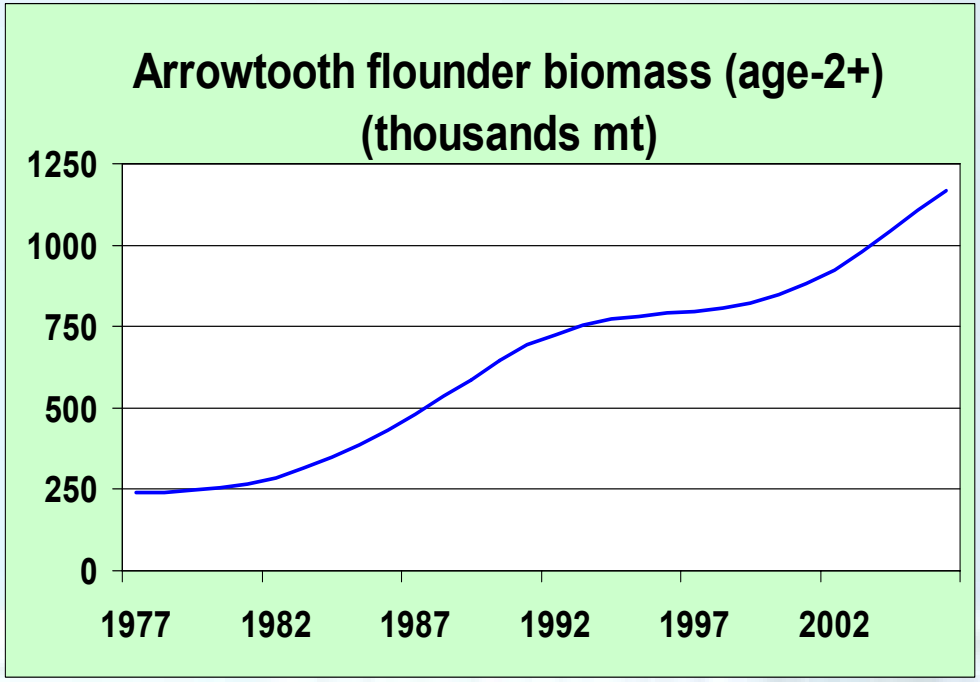
Juvenile fish and other small pelagic organisms need to gain sufficient energy during summer to survive the winter

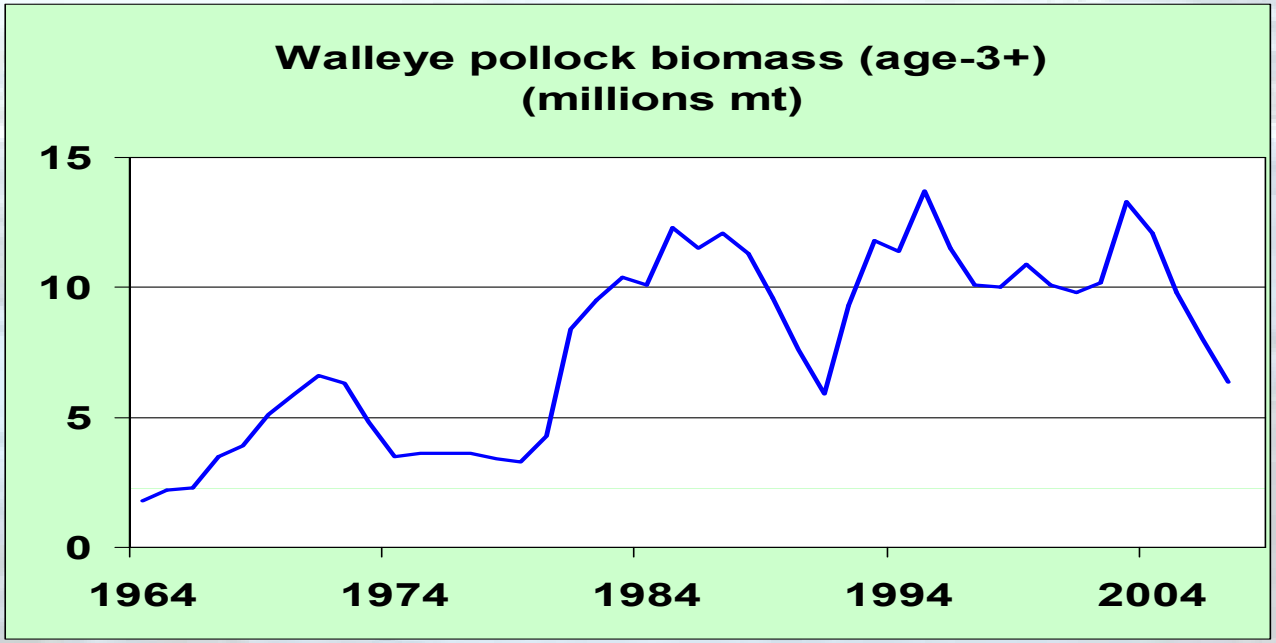


Mueter, F.J., C. Ladd, M.C. Palmer, B.L. Norcross. 2006. Bottom-up and top-down controls of walleye pollock (*Theragra chalcogramma*) on the Eastern Bering Sea shelf. Prog. Oceanogr. 68: 152-183.

Biology, Uncertainty #2

Less ice means more top down control of ecosystem:
Arrowtooth flounder abundance is increasing in the Bering Sea



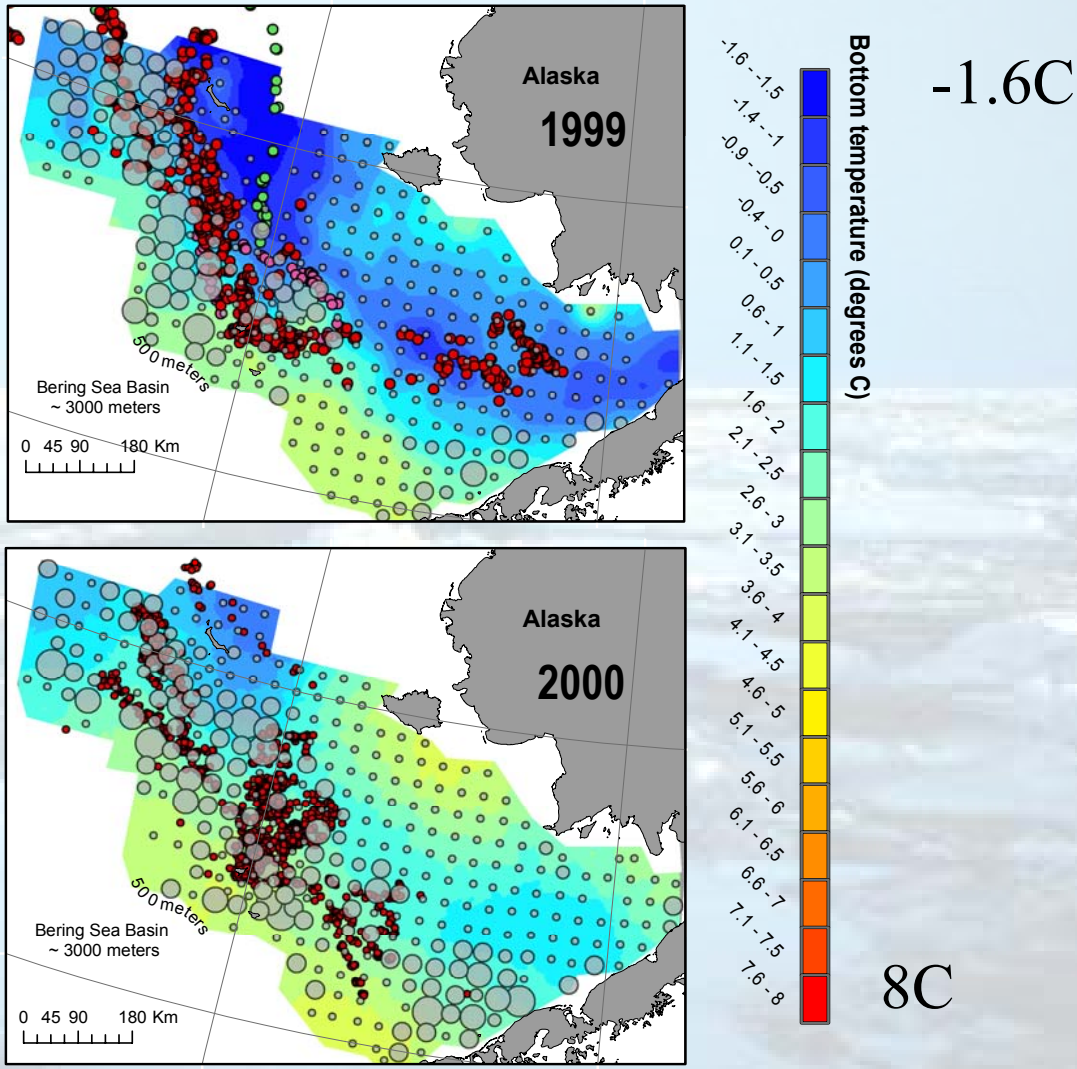


Bailey, K.M., Brodeur, R.D., Hollowed, A.B. 1996. Cohort survival patterns of walleye pollock, *Theragra chalcogramma*, in Shelikof Strait, Alaska: A critical factor analysis. Fish. Oceanogr. 5:1.

Biology: Which species will survive, which will disappear?

Location matters: surviving loss of sea ice depends on mobility

Pollock (●) respond to changes in ocean temperature, as do fur seals (●)



J. Sterling, AFSC