Latitudinal Variation in Energy Allocation of Juvenile Capelin

John Moran¹, Ron Heintz¹, JJ Vollenweider¹, and Kevin Boswell².

¹Auke Bay Laboratories
Alaska Fisheries Science Center
John.moran@noaa.gov

²Florida International University
Why do we care about capelin?

- The perfect prey item?
- Important predators on zooplankton.
- Indicator of change in the Arctic (a sea “canary” Rose 2005)
Why do we care about bioenergetics and growth?

- Quality of fish as food - Spatial and temporal variation within species. *Energy density ranges from 14.1 to 29.5 kJ/g dry wt. for capelin.*

- Energetics and growth = $\sum$ environmental variables

Better predictor of recruitment?

How to allocate energy?
Motivation:

How does energy content vary in juvenile capelin? and what can this tell us about the population?

High latitude fish need provisions for longer winter they should be fatter (Berg et. al., 2009 Atlantic salmon, Shutlz and Conover 1997 Silverside).

- Get student to run samples and analyze data.
- Student gets interesting results.
- Take project away from student, redo with better data.
Methods: Catch juvenile capelin from Bering, Chukchi, and Beaufort Seas using trawls and beach seines.

Minimize known sources of variation: age, size, season, year, etc.
Methods: analysis

- Sub sampled fish 50-100 mm.
- Energy density (kJ/g dry wt.) - Bomb calorimeter.
- Instantaneous growth - RNA/DNA ratio (increase in RNA, increase in protein synthesis).
Results: energy density

Latitudinal effects were unclear.

“Hot spot”
Unimak

60°N
(Stabeno et. al. 2012)

Same
Lat.

Near-shore
Results: data massaging

Starvation in lab.

Offshore Chukchi and Bering Sea north of 60° N
Results: instantaneous growth.

Latitude not as important.
Results: temp. important for growth.

~8-9°C water seems to be a good place to grow.
Results: energy allocation.
Still growing – not at “critical length”
Results: catch paradox

Lower energy density & RNA/DNA in warm near-shore near Barrow, highest fish densities.

CPUE (\# Capelin/km\(^2\))

Capelin are found -1.5 to 14\(^\circ\)C
Most often found -1 to 6\(^\circ\)C
*Rose 2005*

Barrow near-shore 11.2-11.8\(^\circ\)C
Consistent pattern during “warm” years

Latitude
Is Barrow a safe place? We don’t know.

- Thermal refuge from predators.
  - No obvious predators – marine mammals or sea birds.
  - No large fish captured in beach seine. Some bigger fish seen on ARIS.
- Lots of sand lance, juvenile greenling, and other similar sized fish.
- Strategy for rapid growth at the cost of efficiency?
Summary

- Juvenile capelin in the Bering and Chukchi tend to have higher energy density at higher latitudes (with some exceptions). (A reason for Kittlitz's murrelets to go north? - M. Arimitsu).
- In late summer juvenile capelin are still growing.
- Barrow near-shore - lower energy but high densities.
- Are we missing something in the near-shore?
Acknowledgements

- This project was supported by the Coastal Assistance Impact Program (CIAP) through the U.S. Fish and Wildlife Service, and the Bureau of Ocean Energy Management (BOEM). We thank the ArcticEis and BASIS projects PI’s, on-board scientists, and vessel crew. We also thank the North Slope Borough in Barrow for logistical and community support, including Drs. Leandra de Sousa, Todd Sformo, and Craig George for their beach seining and boat driving skills. Thanks also Elizabeth Parker, who conducted a pilot study of latitudinal variation in juvenile capelin condition upon which this project builds. Thanks also to the laboratory technicians who did the biological and chemical analyses of the samples, including Robert Bradshaw, Meghan Garrison, Elizabeth Parker, Ann Robertson, Stella Mosher, Ashwin Sreenivasan, and Eamon Conheady.
Results: energy allocation.

RNA/ DNA ratio and energy density suggest “critical length threshold” has not be reached.