



# Energetics of Arctic Fish

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## Introduction

- Changing seascape in the Arctic:
  1. Temperature in Arctic increasing at 2X rate as rest of globe
  2. Arctic susceptible to change from erosion, increased vessel traffic and associated development, oil exploitation and potential for spills
- Changing conditions in Arctic may effect fish communities and fish health
- How is the Arctic food web currently structured and how might it change in the future?

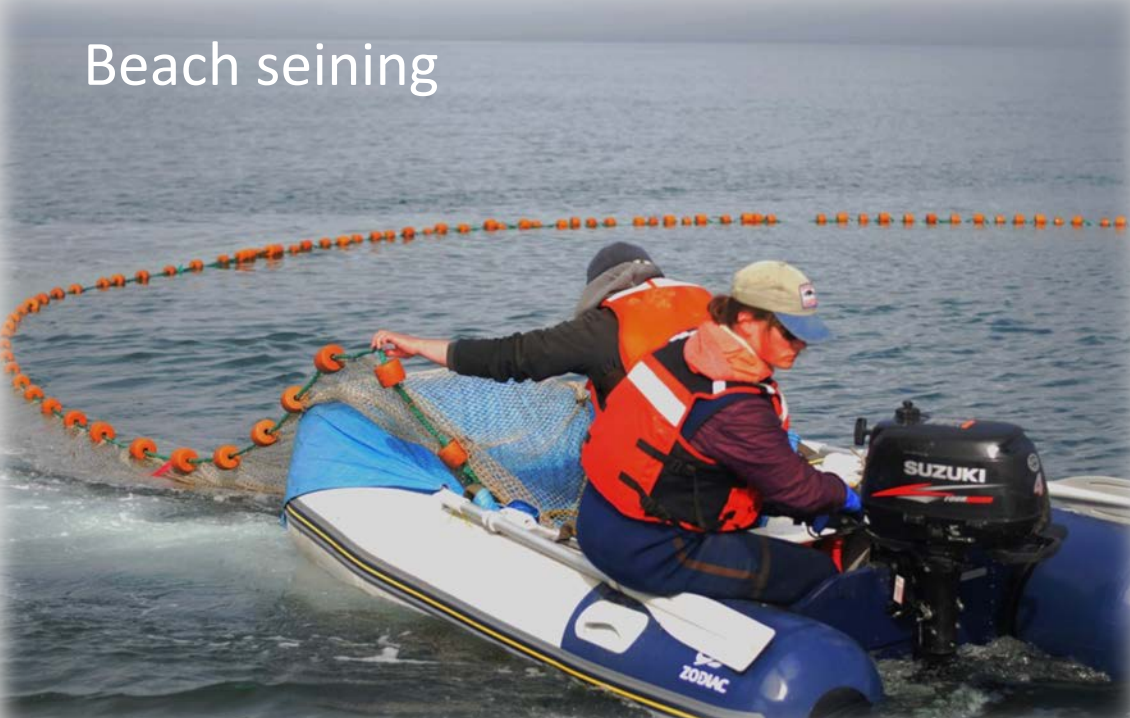
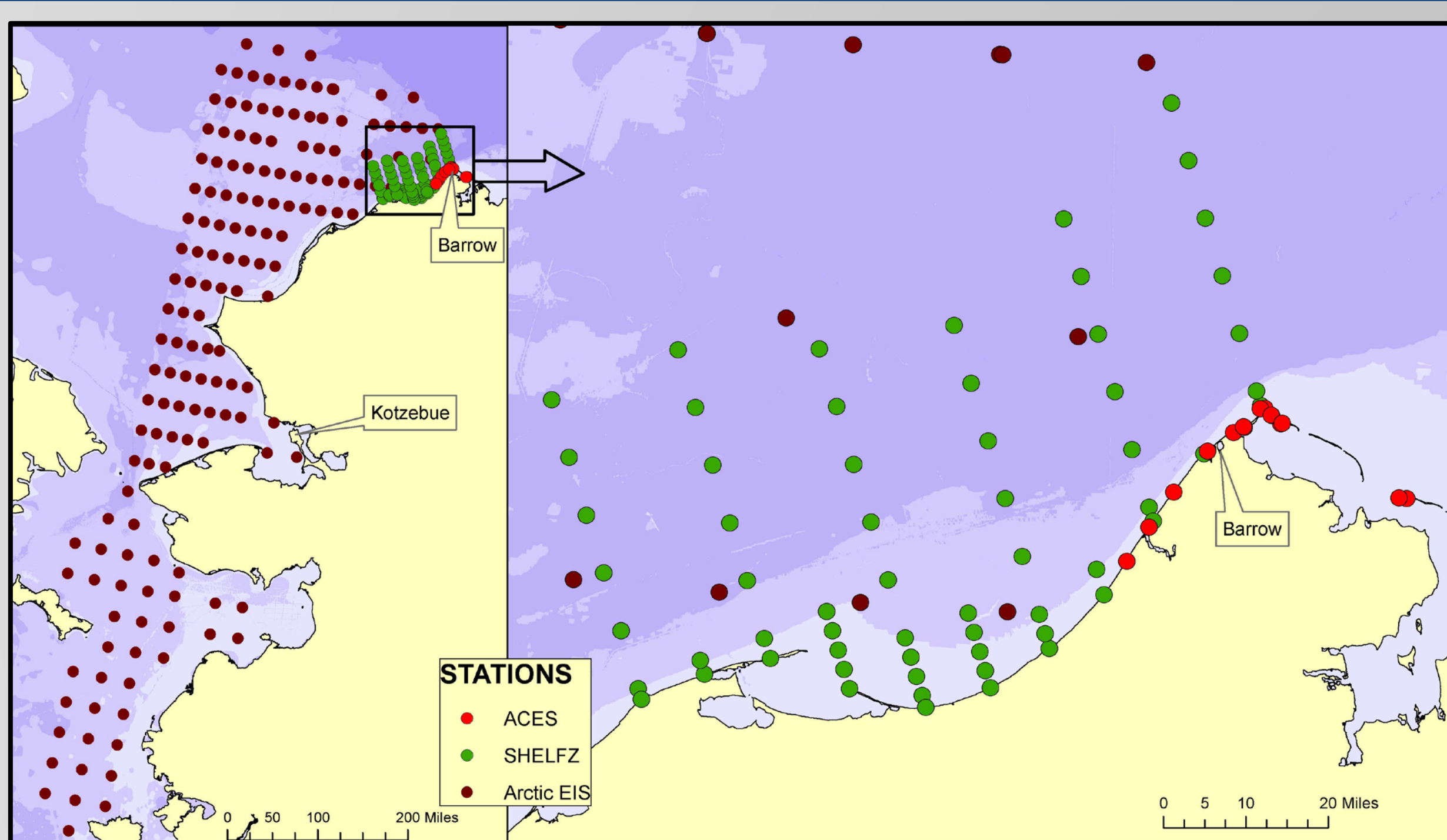
## Objectives

Describe energetics of nearshore Arctic fish in terms of:

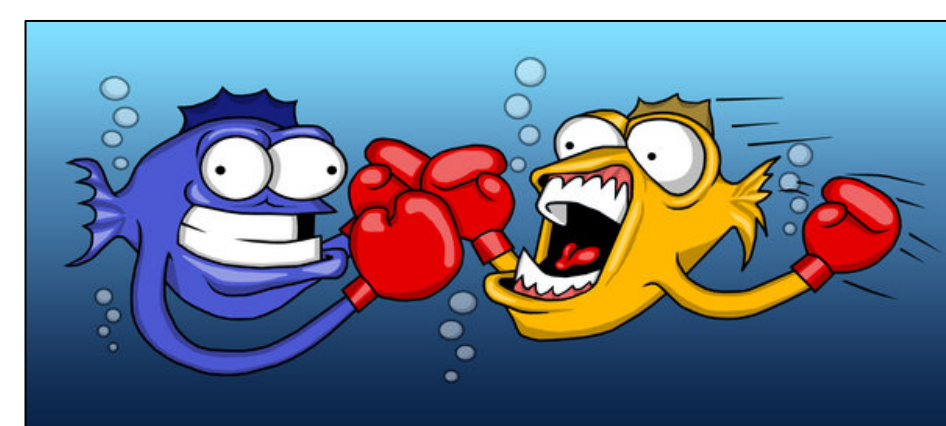
1. prey quality for marine mammal and seabird predators and subsistence consumers
2. body condition for survival and recruitment

## Methods

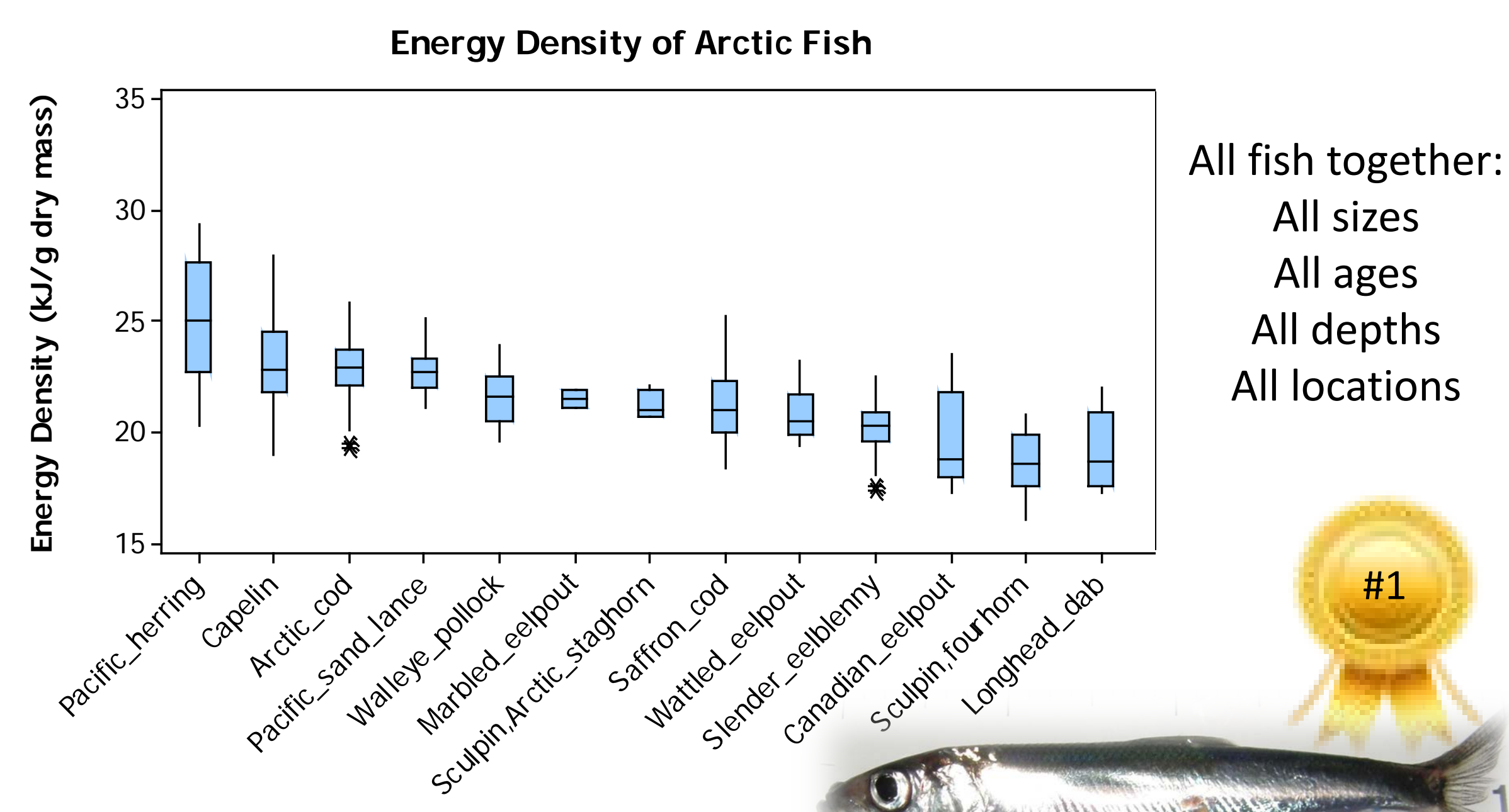
- Fish samples collected from several Arctic studies during ice-free summer months (July-September):
  1. **ACES** - Arctic Coastal Ecosystem Survey (2012-2014)
  2. **SHELFZ** - Shelf Habitat and EcoLogY of Fish and Zooplankton (2013)
  3. **Arctic Eis** (2012-2013)
- Chemical analysis of whole-body fish
  1. Caloric content (bomb calorimetry)
  2. Proximate composition (lipid, protein, moisture, ash)
  3. RNA/DNA (relative growth index)



## Results: Prey Quality

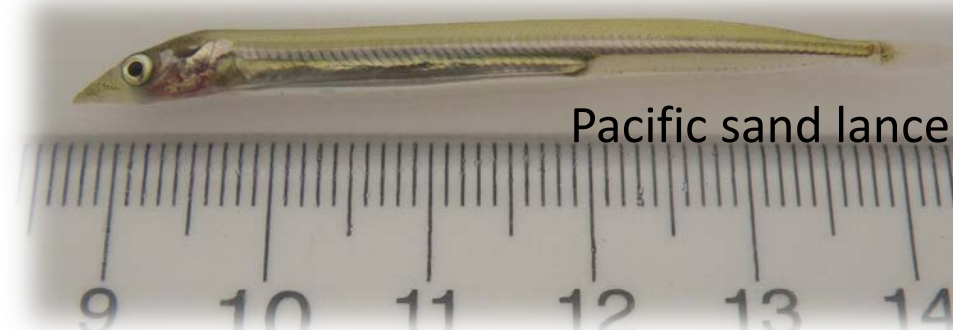


Which Arctic species are the top contenders as prey?



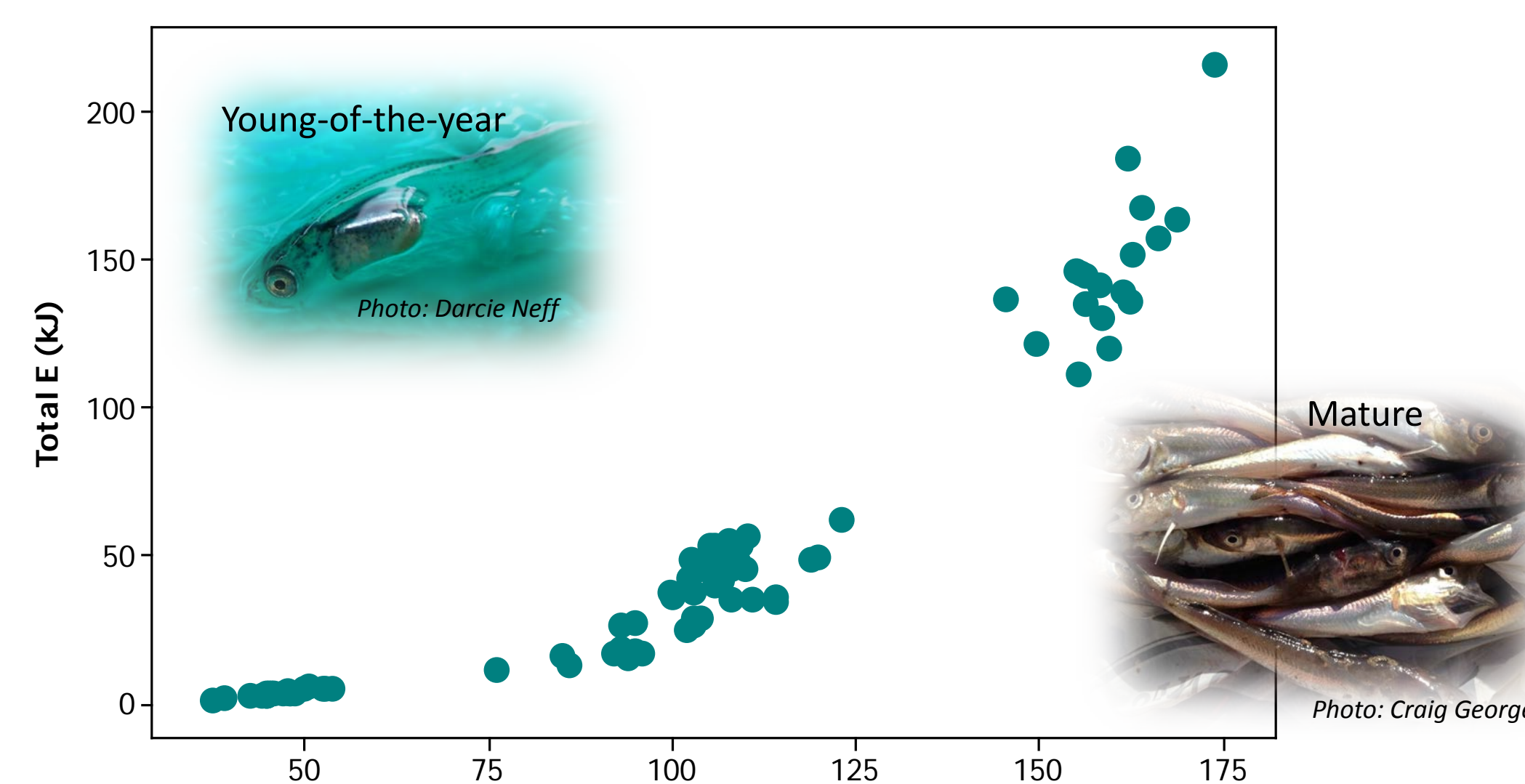
All fish together:  
All sizes  
All ages  
All depths  
All locations

Gram for gram,  
First prize goes to herring, the best prey item!  
Tied for second prize are capelin, Arctic cod,  
Pacific sand lance & Arctic staghorn sculpin.



**BUT,**  
Quality of predators' diet depends upon...

### 1. Size of Fish



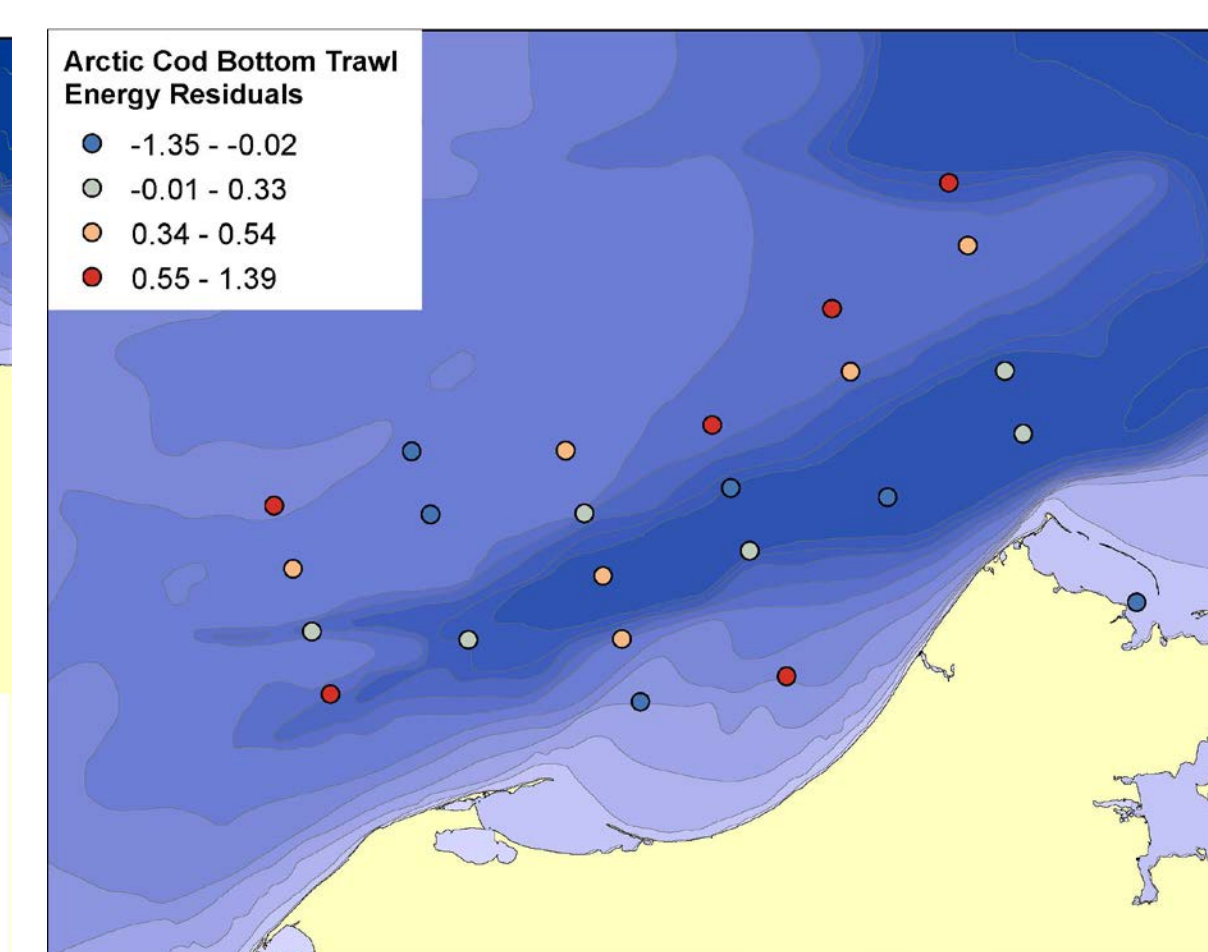
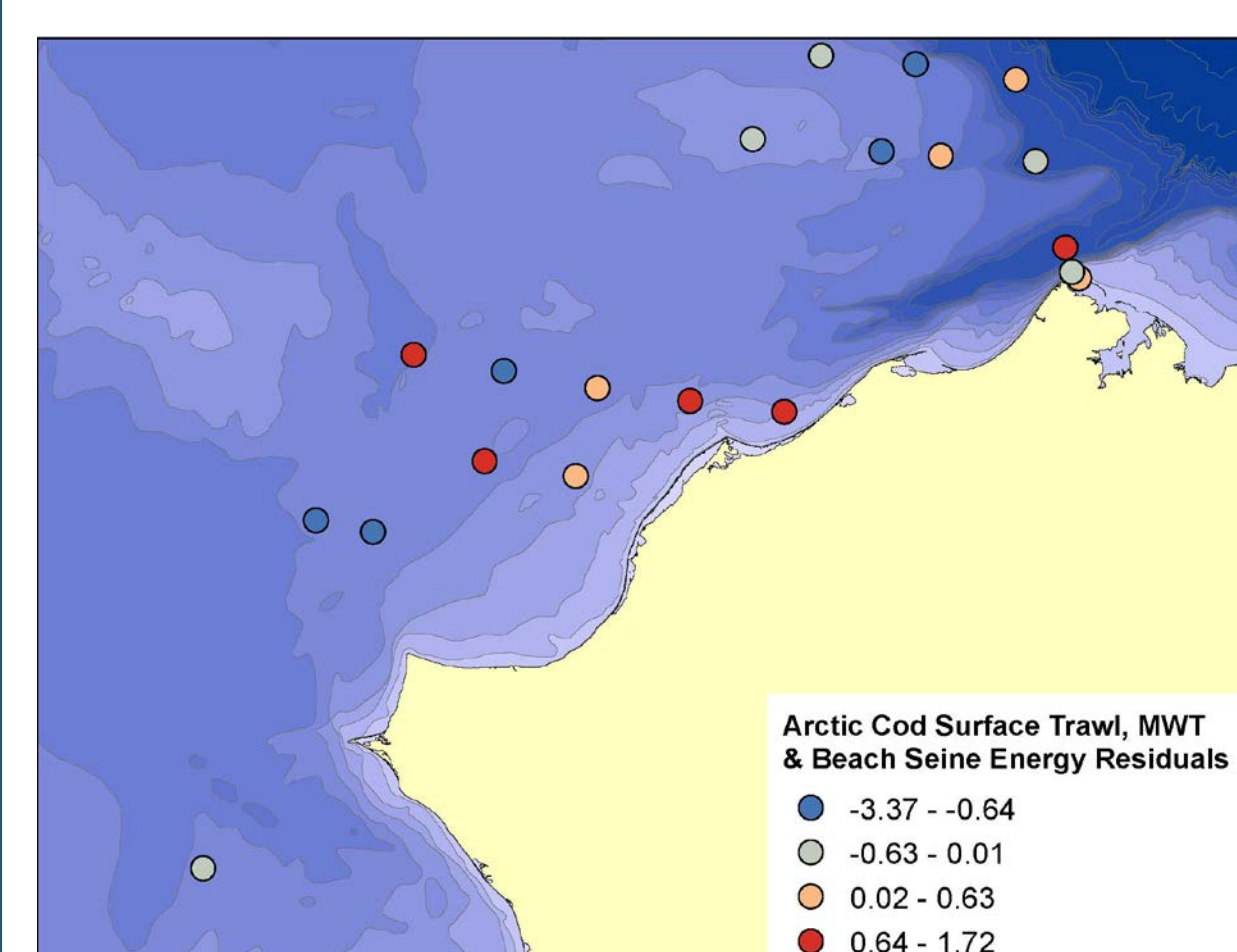
Total energy increases exponentially with fish size.

### 2. Location

#### Energy Residuals of Arctic Cod

Surface/Midwater Trawls

Bottom Trawls

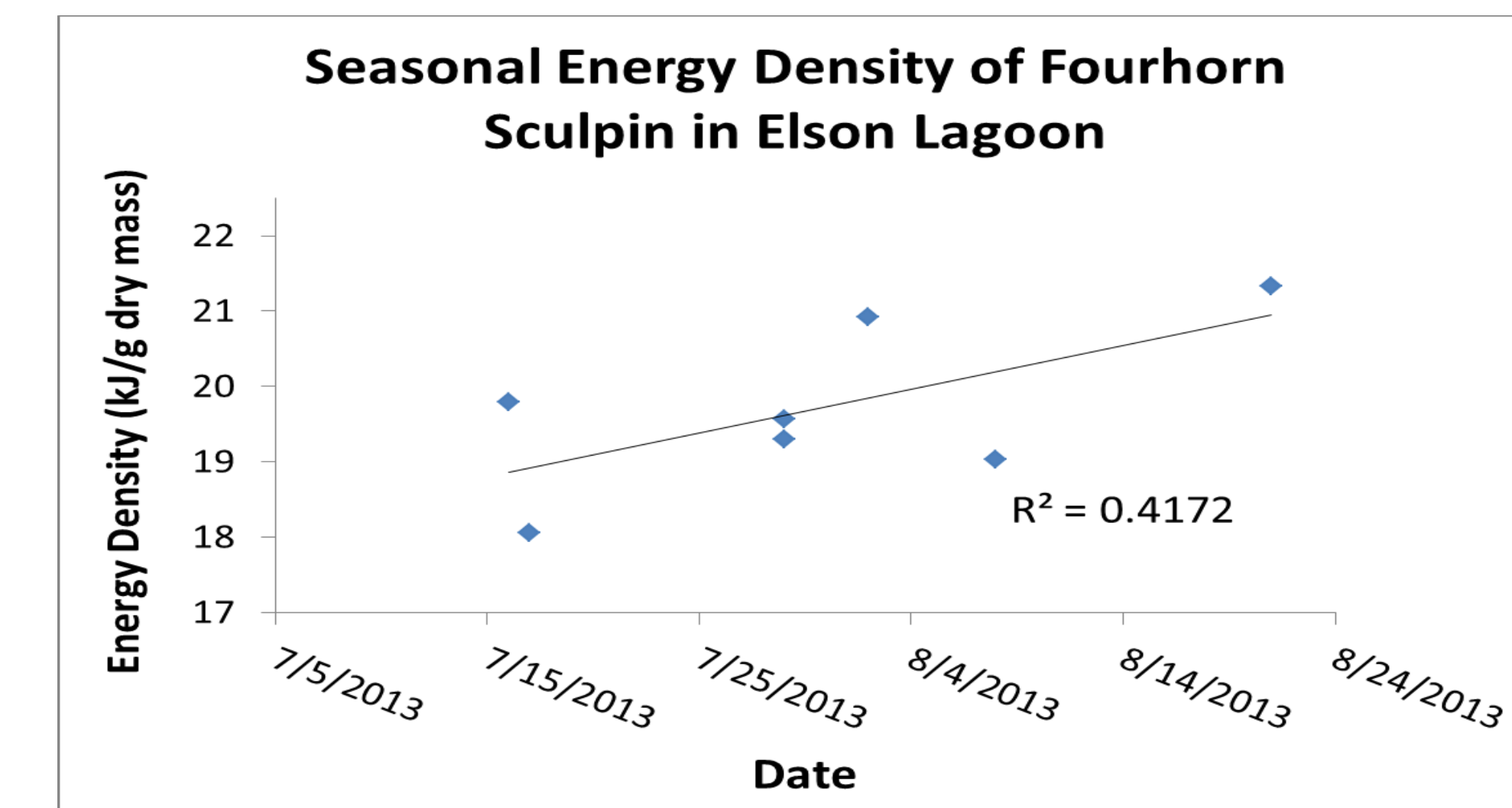


Corrected for fish size: plot of regression residuals of log(Total Energy) vs. Length  
 $R^2=0.96$        $R^2=0.91$

On bottom, cod higher in energy along edge of Barrow Canyon.

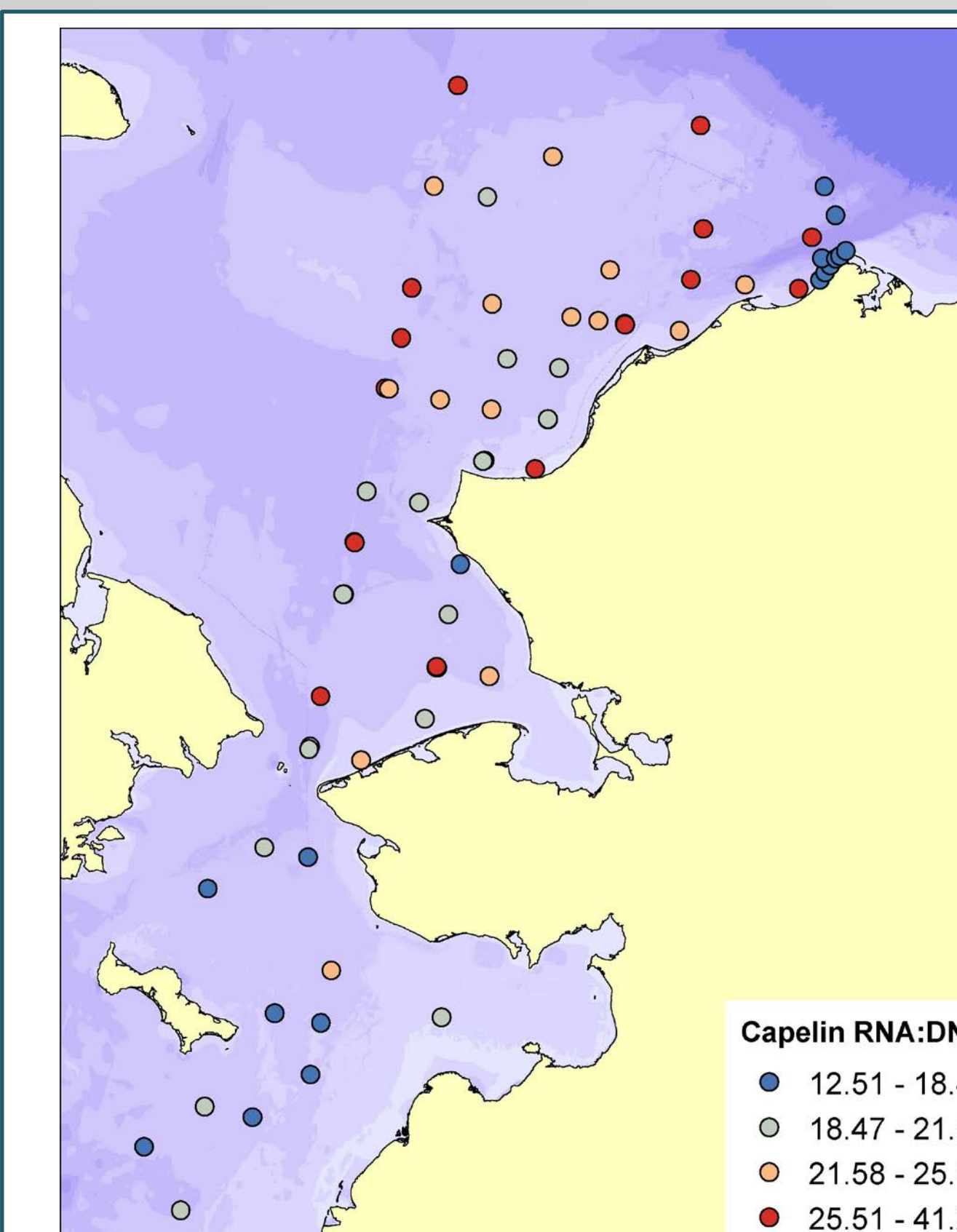
## Results: Prey Quality

### 3. Season



Fish assimilate energy rapidly from intense foraging over the brief Arctic "summer".

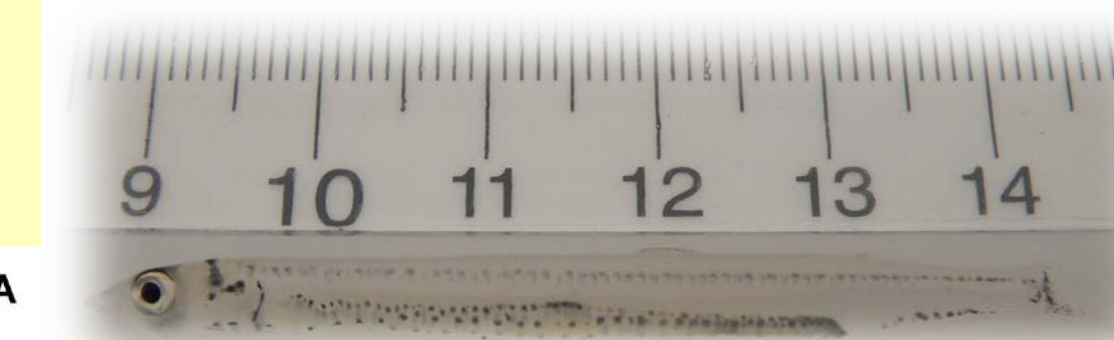
## Results: Condition for Survival



### Capelin RNA/DNA

No affect of size on growth rate,  $R^2=0.06$

Lowest growth nearshore in warmer water and in northern Bering Sea.



## Implications

- Changes in prey availability may have caloric implications for predators.
- Great spatial variation in fish condition, suggesting habitat quality of different water masses may contribute to survival/recruitment disproportionately.
- Preliminary analyses suggest wind and water temperature are important factors in fish condition

## Ongoing Work

- Relate variation in fish condition parameters to environmental variables (temperature, wind, prey)
- Examine seasonal effects on fish condition using opportunistic sampling during seasons with ice-cover

## Acknowledgements

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