

Energetic value of prey species utilized by black guillemots (*Cepphus grylle*) on Cooper Island, an Arctic barrier island

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Background

- Arctic cod are a nutritionally valuable forage fish and favored prey of black guillemots feeding hungry chicks at their nesting colony on Cooper Island.
- As sea ice retreats further each summer, availability of ice-associated cod declines. To compensate, foraging black guillemots rely on more accessible prey like fourhorn sculpin from nearshore lagoons.

Objectives:

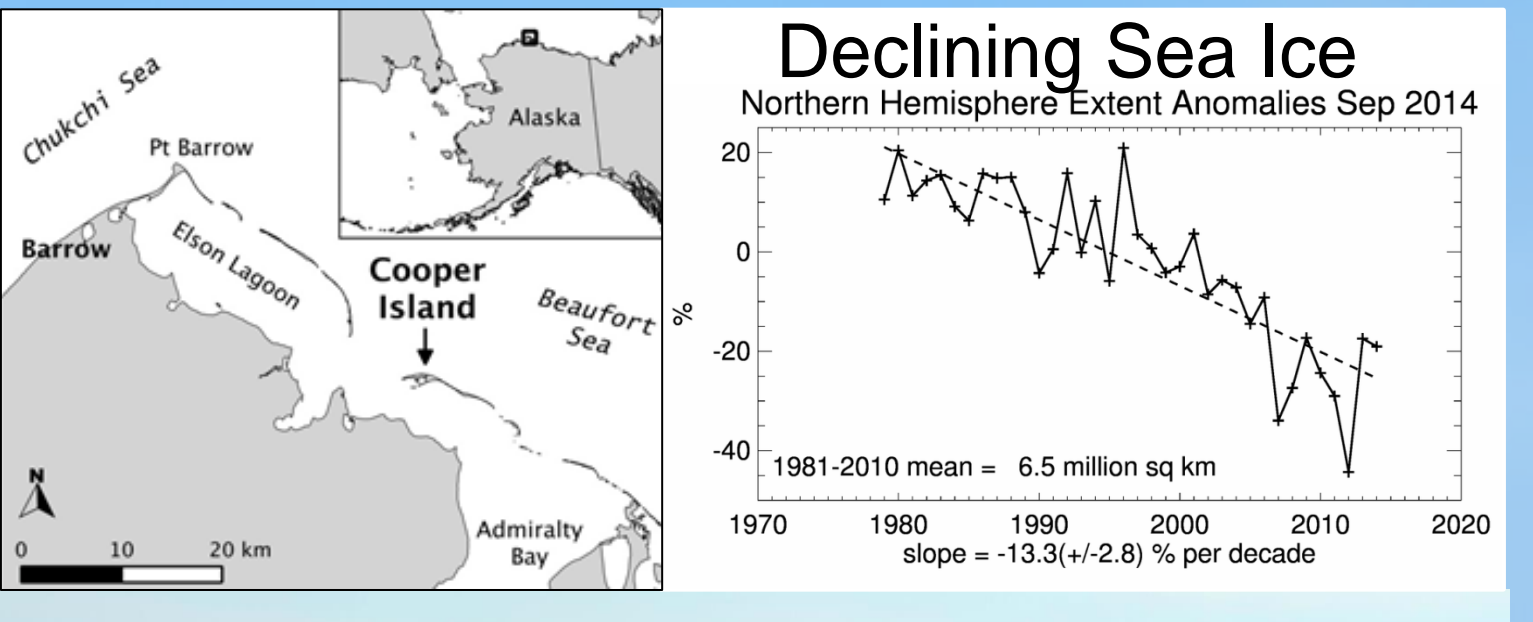
- Are fourhorn sculpin as nutritionally valuable as Arctic cod?
- Will black guillemots be negatively impacted by changes in prey availability caused by loss of sea ice?



Arctic cod (*Boreogadus saida*)



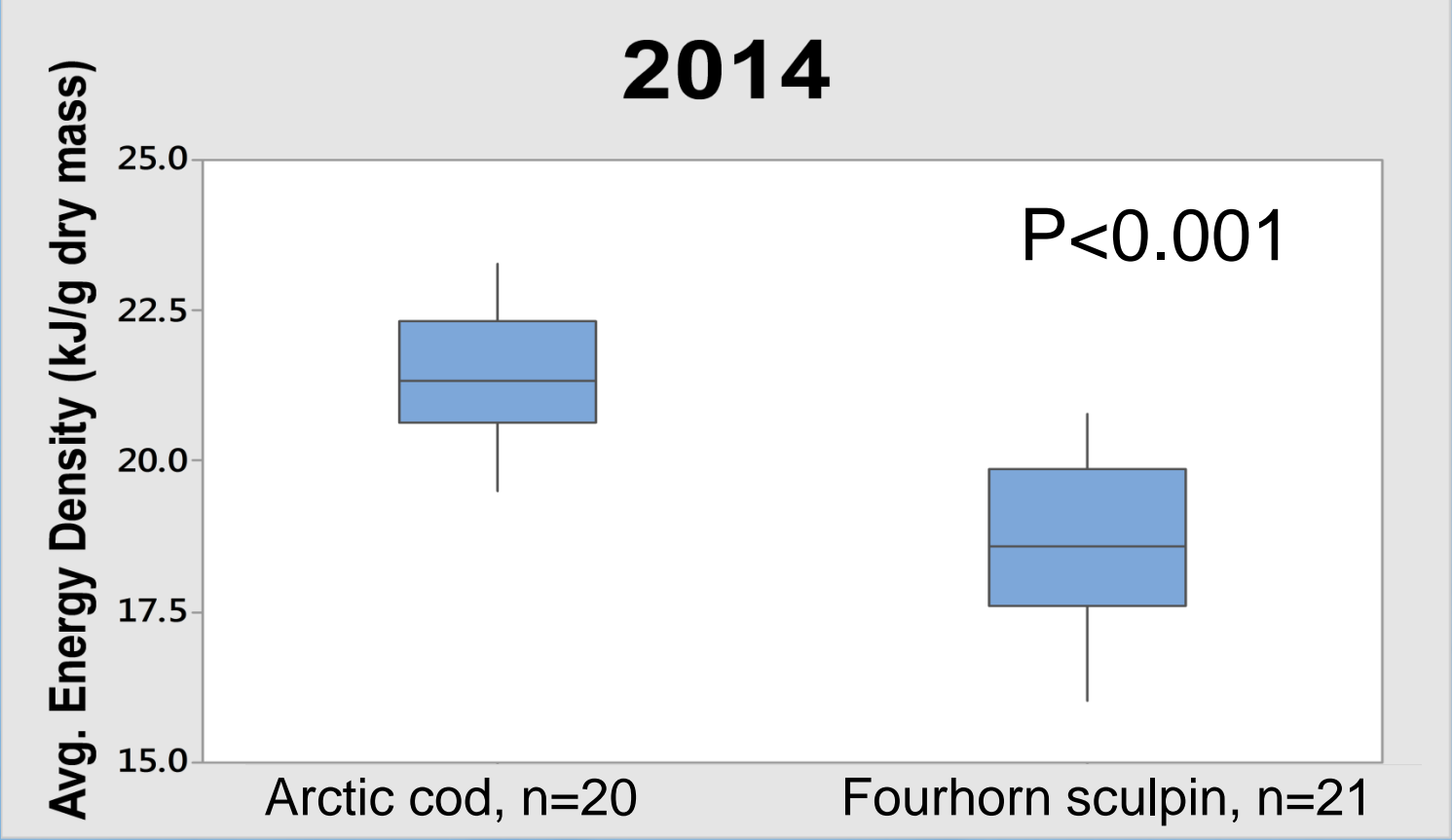
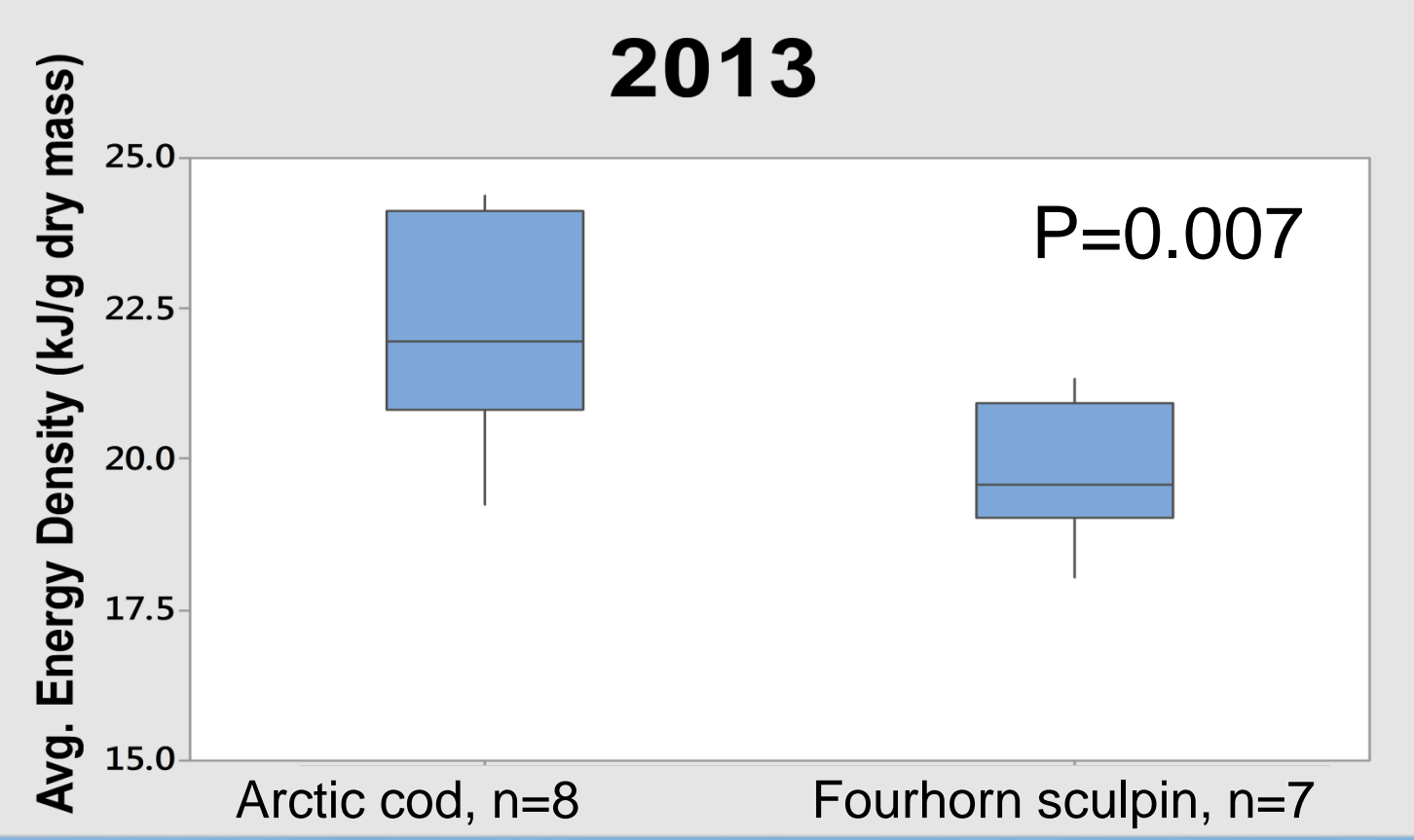
Fourhorn sculpin (*Myoxocephalus quadricornis*)



Adult guillemots at Cooper Island

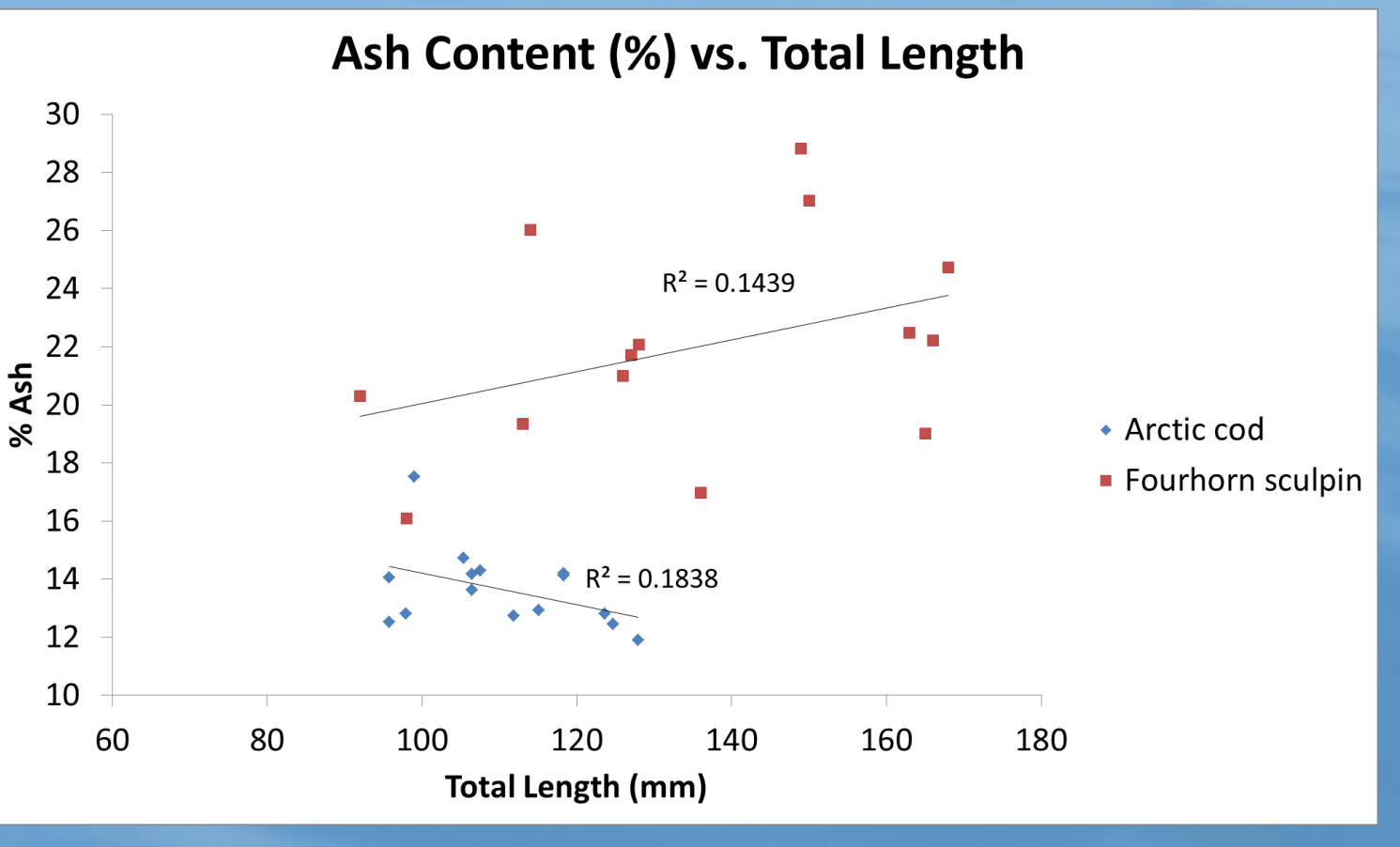
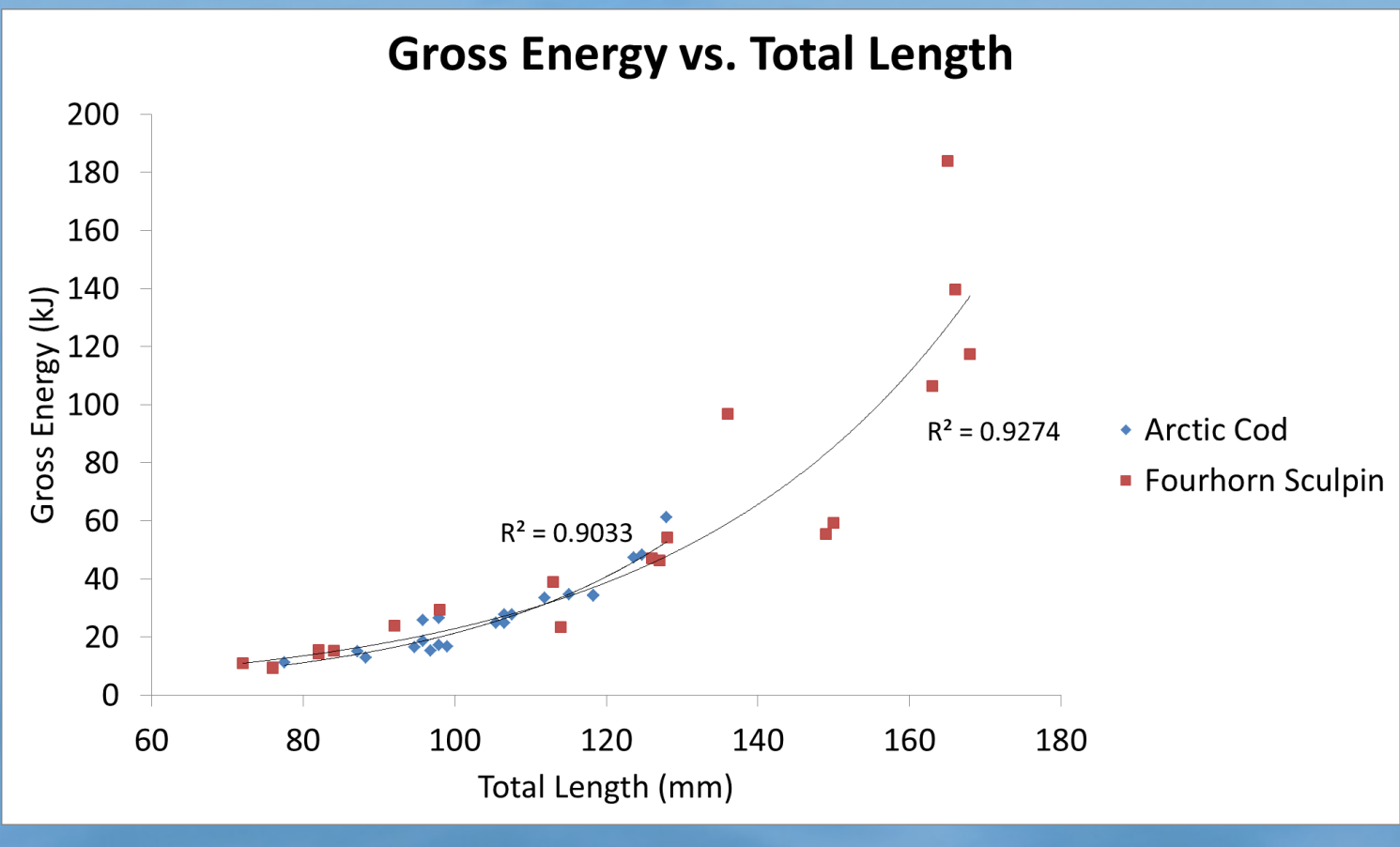
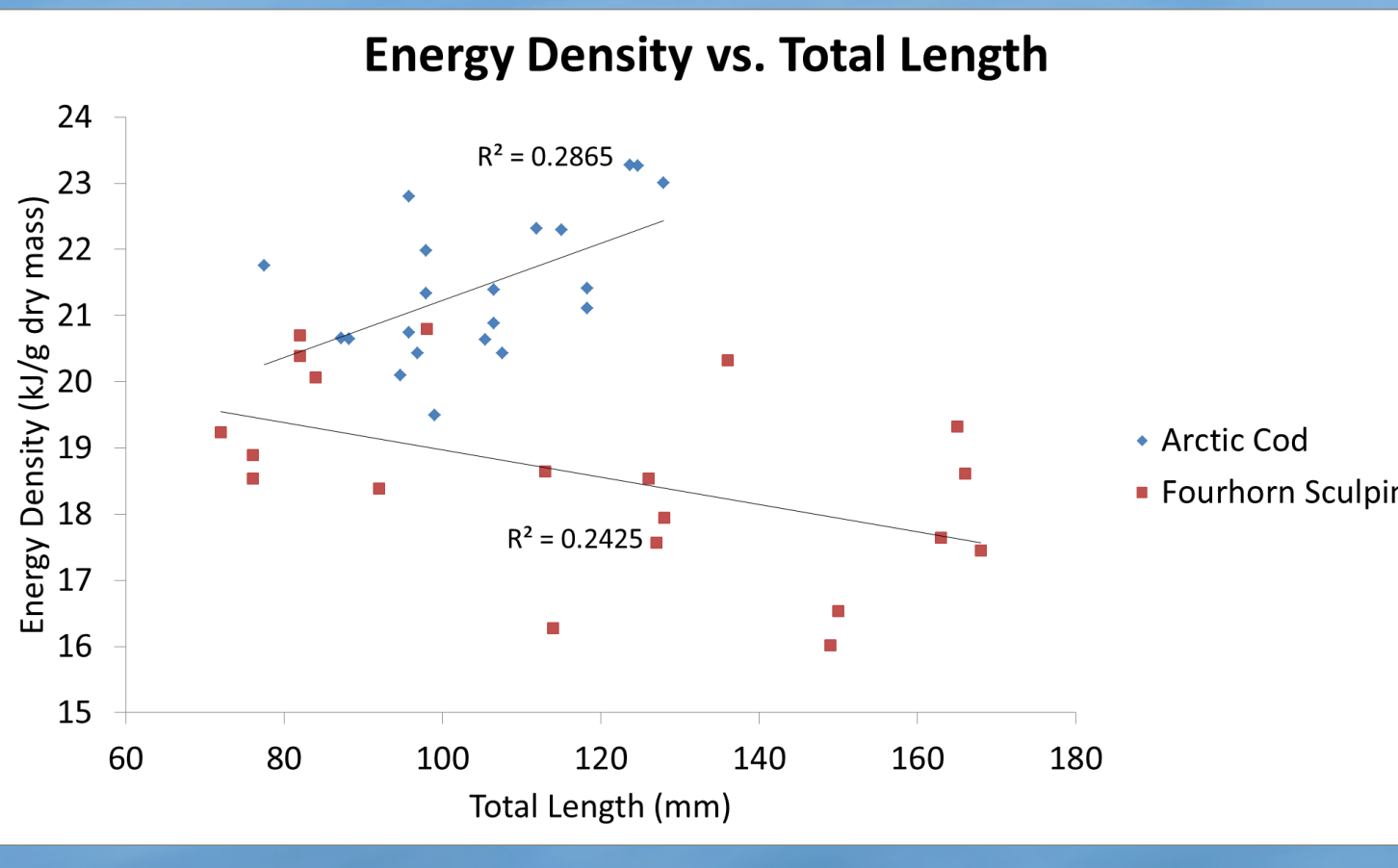
Results

Interannual Comparison:



- Average energy density of Arctic cod was 12% greater than fourhorn sculpin in 2013. (P=0.007)
- Average energy density of Arctic cod was 14% greater than fourhorn sculpin in 2014. (P<0.001)

Size Effects on Energetics (2014):



- Gross energy per fish does not vary greatly between species; prey of similar lengths provide similar total calories, regardless of species.
- Fourhorn sculpin had a higher ash content than Arctic cod, indicating lower digestibility.



High handling time: Video still of a guillemot chick struggling to consume a fourhorn sculpin. This fish took 2 minutes to consume, while Arctic cod are consumed almost immediately.



Low palatability: Fourhorn sculpin rejected by a guillemot chick accumulate in a nesting box on Cooper Island.

Summary

There are more costs associated with consuming fourhorn sculpin than Arctic cod.

- Gross energy per fish of a given length was similar, implying that guillemots don't need to consume larger sculpin to compensate for the energetic difference between species.
- Average ash content of sculpin was higher than cod, indicating a higher percentage of sculpin body mass is composed of bone, spines, and cartilage; sculpin are less digestible as a result.
- At-colony observation of chicks quickly consuming Arctic cod while rejecting fourhorn sculpin shows a substantial difference in the palatability of each species. Although sculpin and cod of a given length are similar energetically, guillemot chicks consuming sculpin receive fewer calories due to high handling time and low palatability.
- Climate-driven shifts in prey availability will negatively impact chicks at Cooper Island, as chicks incorporate fewer calories when Arctic cod become scarce and they are forced to consume sculpin.

Future Research:

- Energetic analysis of guillemot scat could provide more information on the amount of calories retained from each prey species (assimilation).
- Variation in Arctic cod energy: do cod collected in Elson Lagoon accurately reflect energetic condition of cod collected by birds near offshore ice in the Beaufort Sea?

Methods

- 2013:** Fourhorn sculpin were collected by beach seine (red) in lagoons near Cooper Island in July-August. Arctic cod were collected at the colony from returning guillemots.
- 2014:** Samples were collected by beach seine (red) and trawl (yellow) near Cooper Island in July and August.
- Fish of each species (70-165 mm) were analyzed for energy density and moisture content. Select fish collected in 2014 were analyzed for ash content.



2013-2014 Sampling sites near Cooper Island

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