PRE-WINTERING ADULT CAPELIN (*Mallotus villosus*) FEEDING DYNAMICS OFF THE NORTHEAST COAST OF NEWFOUNDLAND AND LABRADOR

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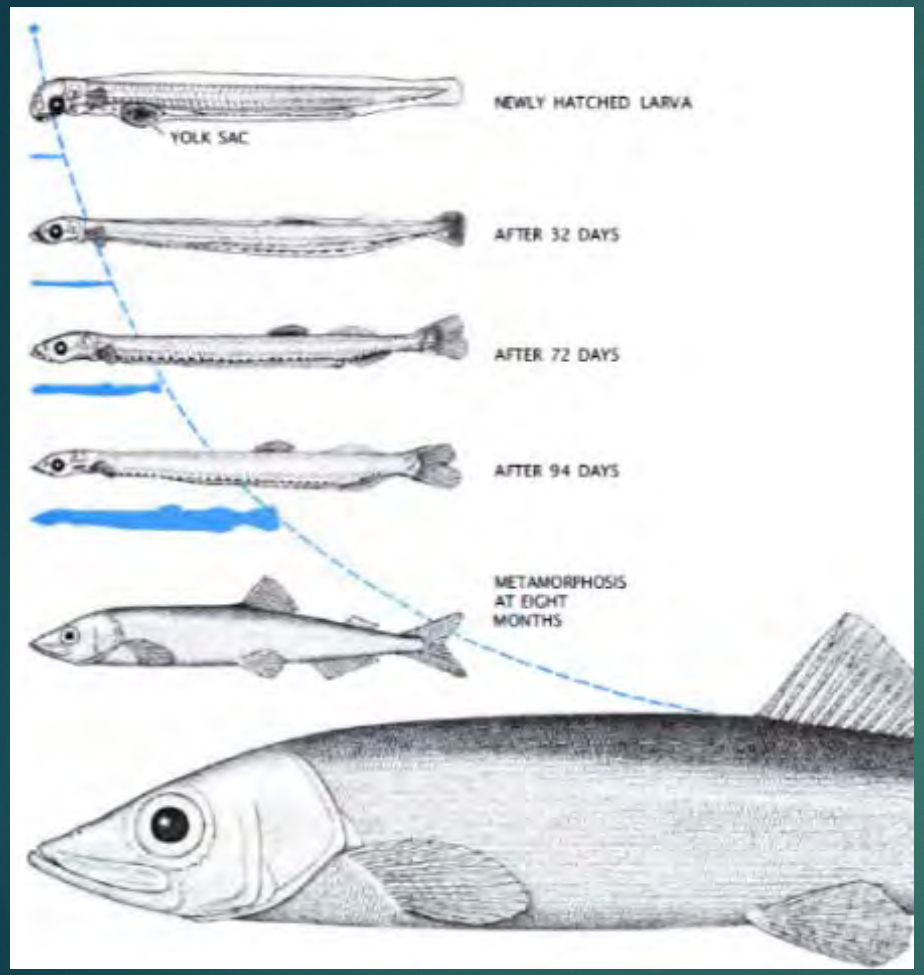
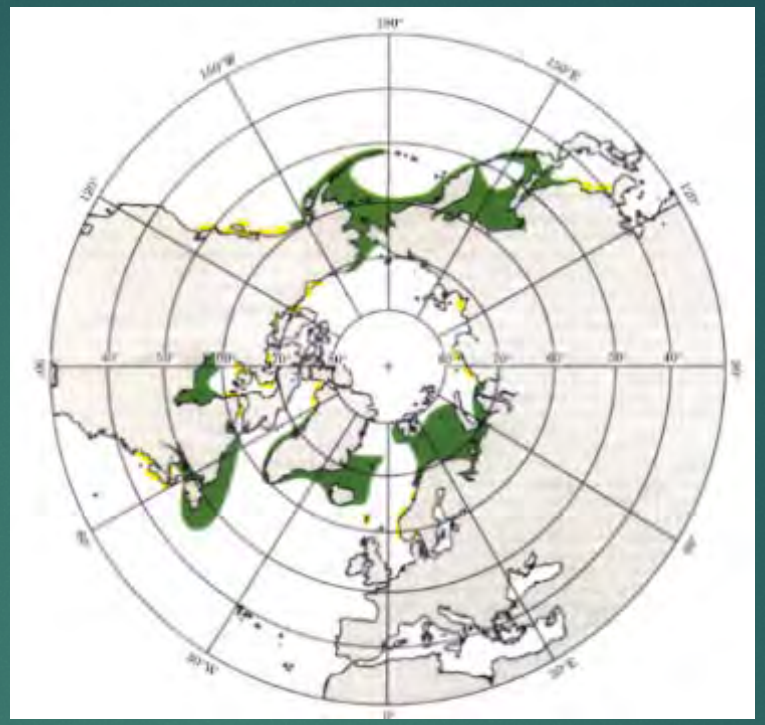
Introduction - Capelin



Frank and Leggett, 1991



Carscadden *et al.*, 2013

Boreal circumpolar distribution

Main forage species in NW Atlantic

Introduction - Capelin






It is the key prey for several marine species found in the NW Atlantic (piscivorous fish, mammals, seabirds)

Introduction - NL capelin

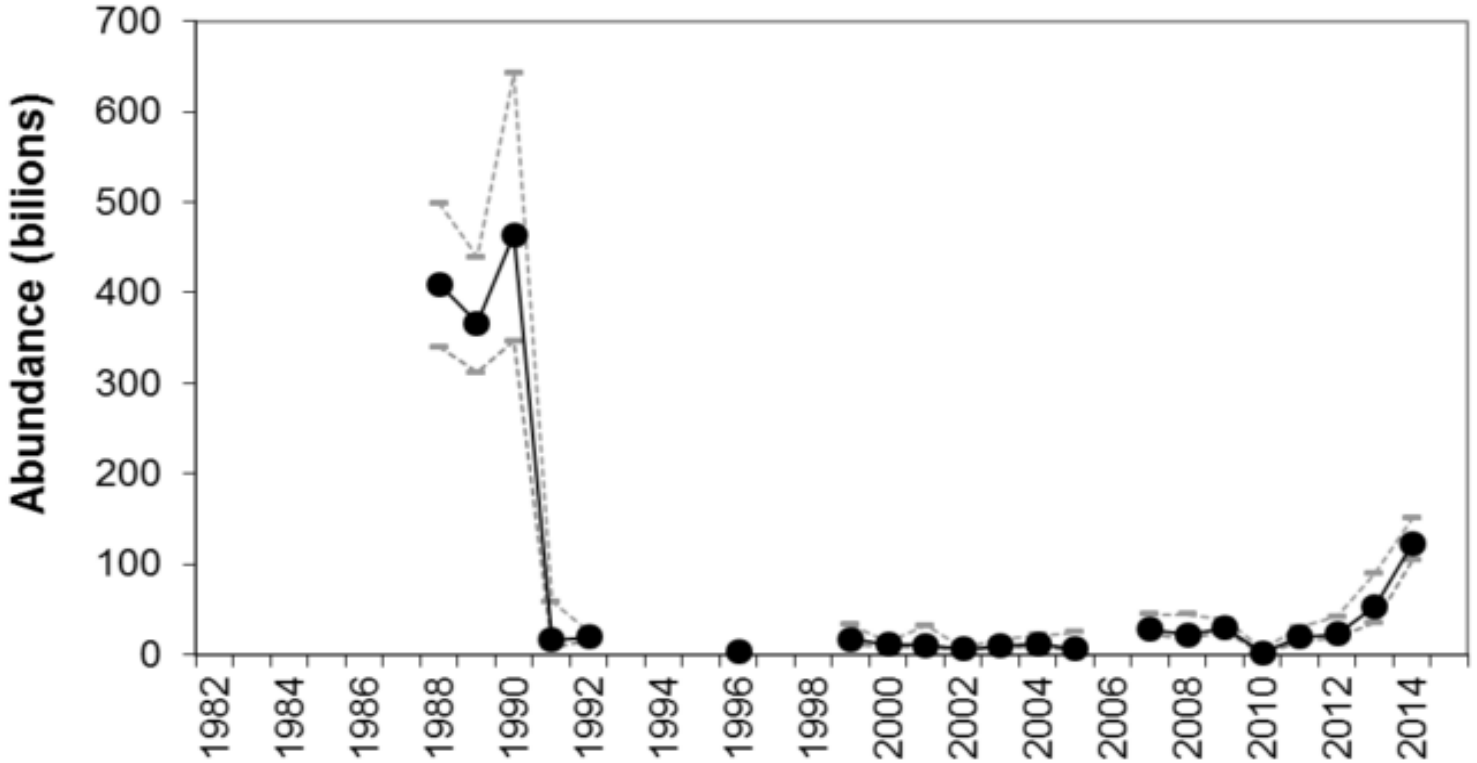


Figure 4. Index of offshore capelin abundance (line) with 95 % confidence intervals (broken lines) for an index area (mostly NAFO Div. 3L).

- Collapse in the early 1990's in NW Atlantic
- In parallel - delayed spawning, maturity at younger age (age truncation)
- Capelin population has been shown to be mainly driven by bottom-up (resource dependant) mechanisms (Buren *et al.*, 2014; Mullowney et al. 2015).
- Diet studies on adult capelin diet over the years

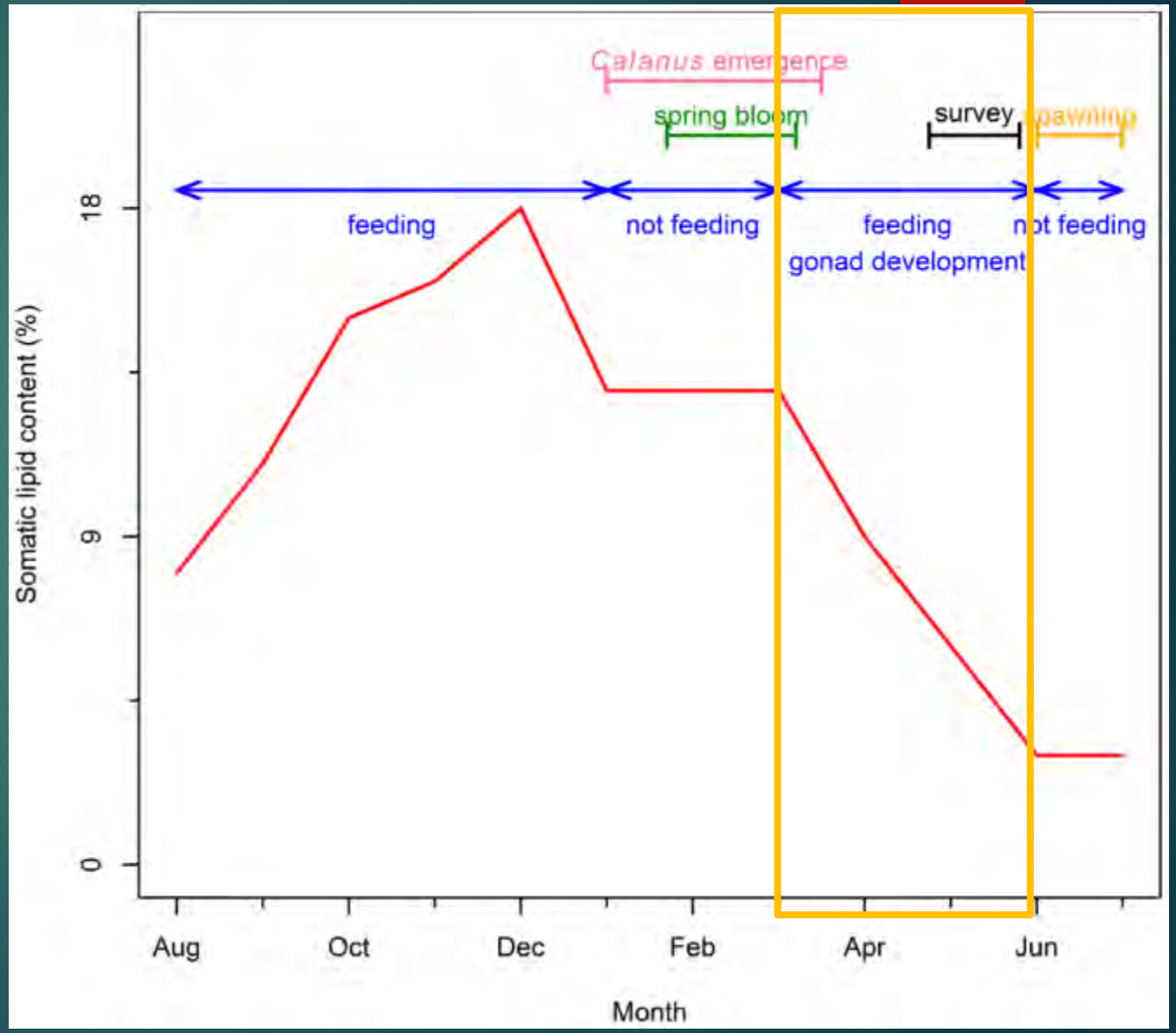
Introduction - capelin adult diet

NL capelin stock diet: focus on the relevant pre-spawning period (spring)

Spring - main prey:
Copepods and euphausiids – northern Grand Banks 1987-90 (Gerasimova, 1994)

Copepods and hyperiid amphipods – several areas of offshore NL 1999 (O'Driscoll et al. 2001)

Copepods main prey, lower contribution of hyperiid amphipods and euphausiids – east NL 2004-08 (Dalpadado and Mowbray, 2013)

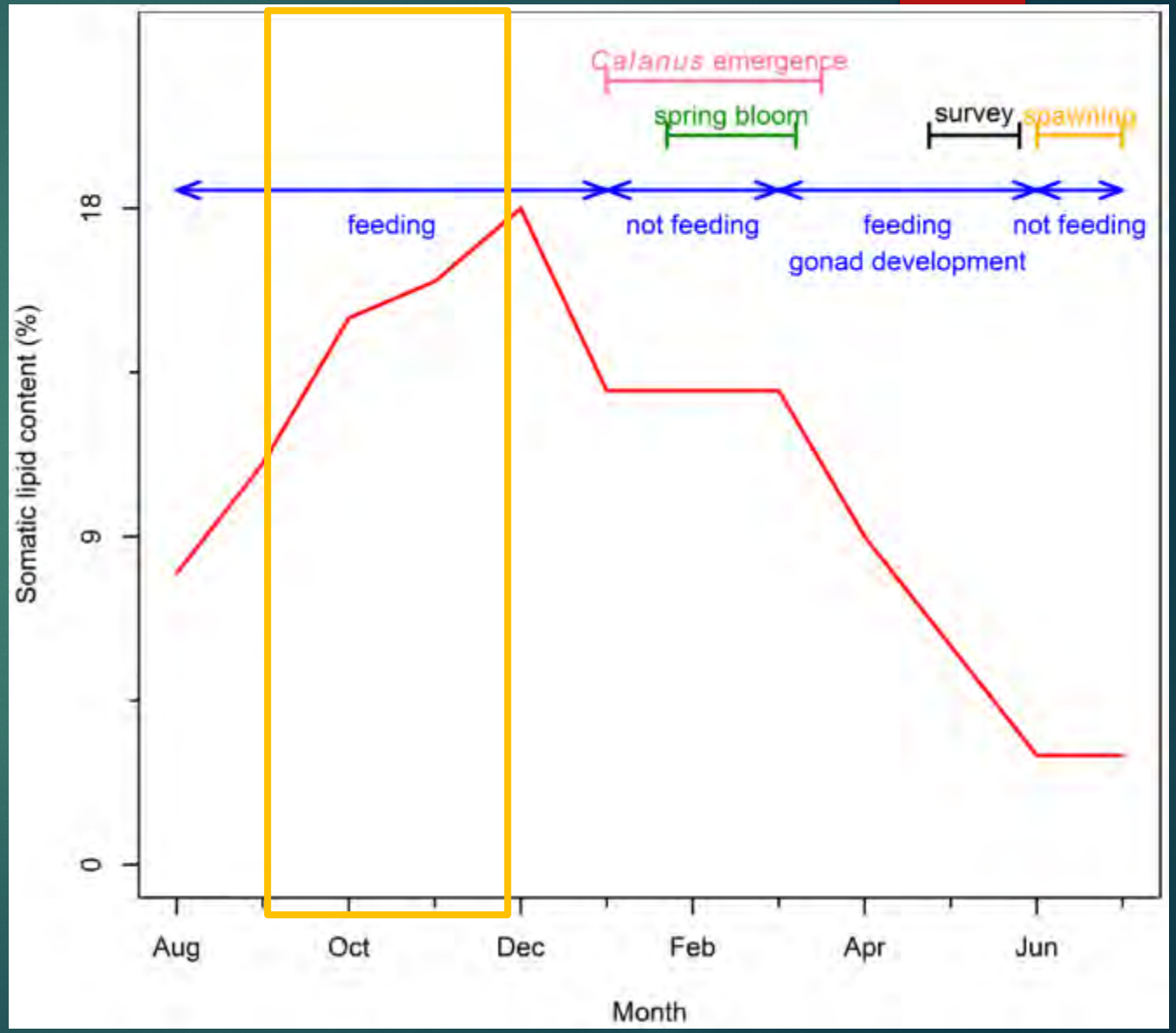


Introduction - capelin adult diet

Capelin autumn diet has only been characterized offshore Labrador sector (Chan and Carscadden, 1973).- copepods being the main prey

Autumn feeding has been shown to be crucial for overwinter survival and affect gonadal development during spring (Winters, 1970; Campbell and Winters, 1973).

To what extent is autumn diet composition is different from that to spring?



Our study

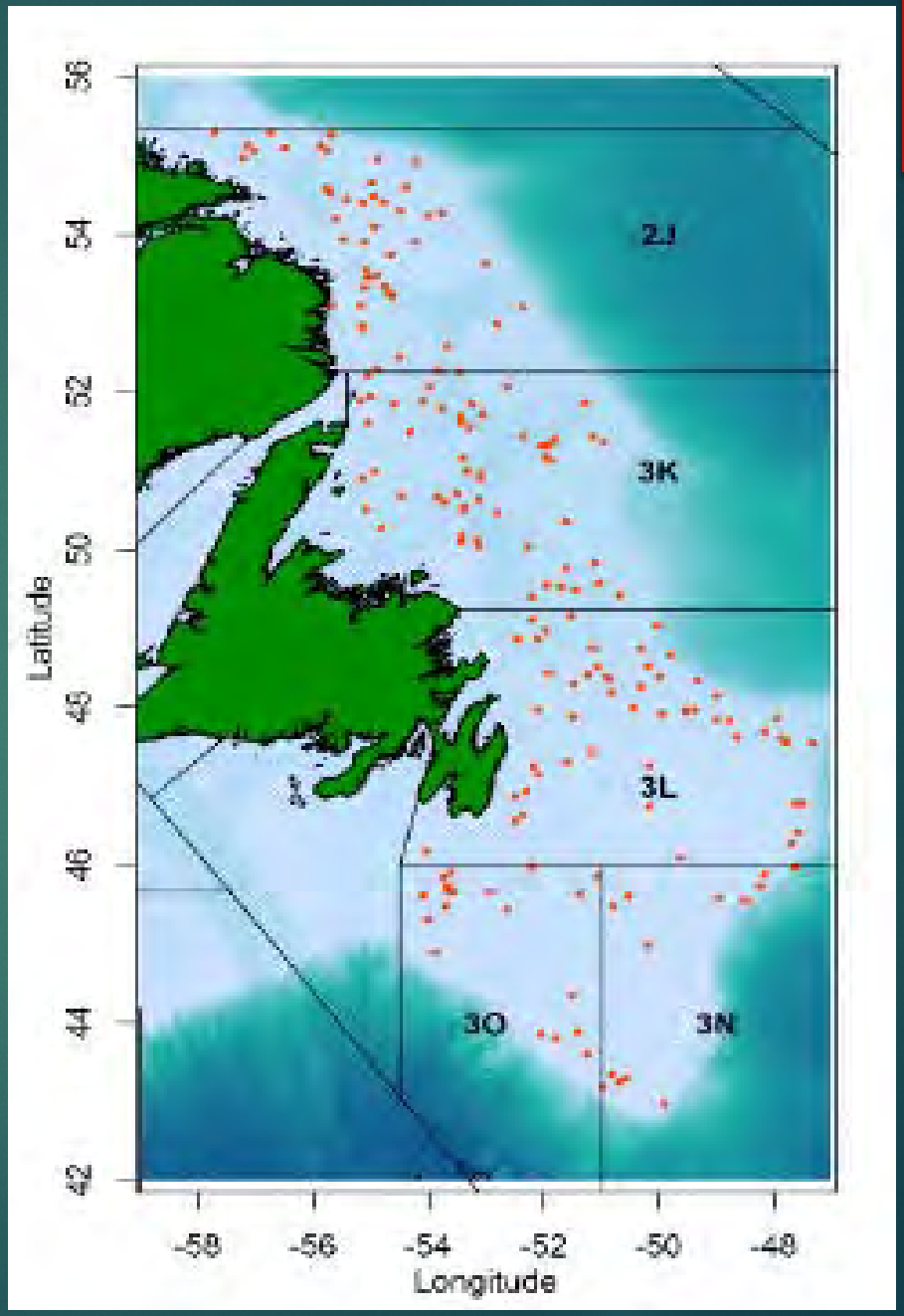
Characterize the prey taxa contributing to capelin autumn diet in an area covering the Northern Grand Banks and the Northeast coast of Newfoundland and Labrador (43-55°N, 58-47°E)

Objectives:

1) To assess the relative contribution of copepods, amphipods and euphausiids to the diet

2) To assess the presence of ontogenic diet shifts from late juvenile to adult stage

3) To assess if the contribution of the main prey taxa in capelin diet varies spatially



Methods

NE coast of Newfoundland and Labrador and northern area of the Grand Banks

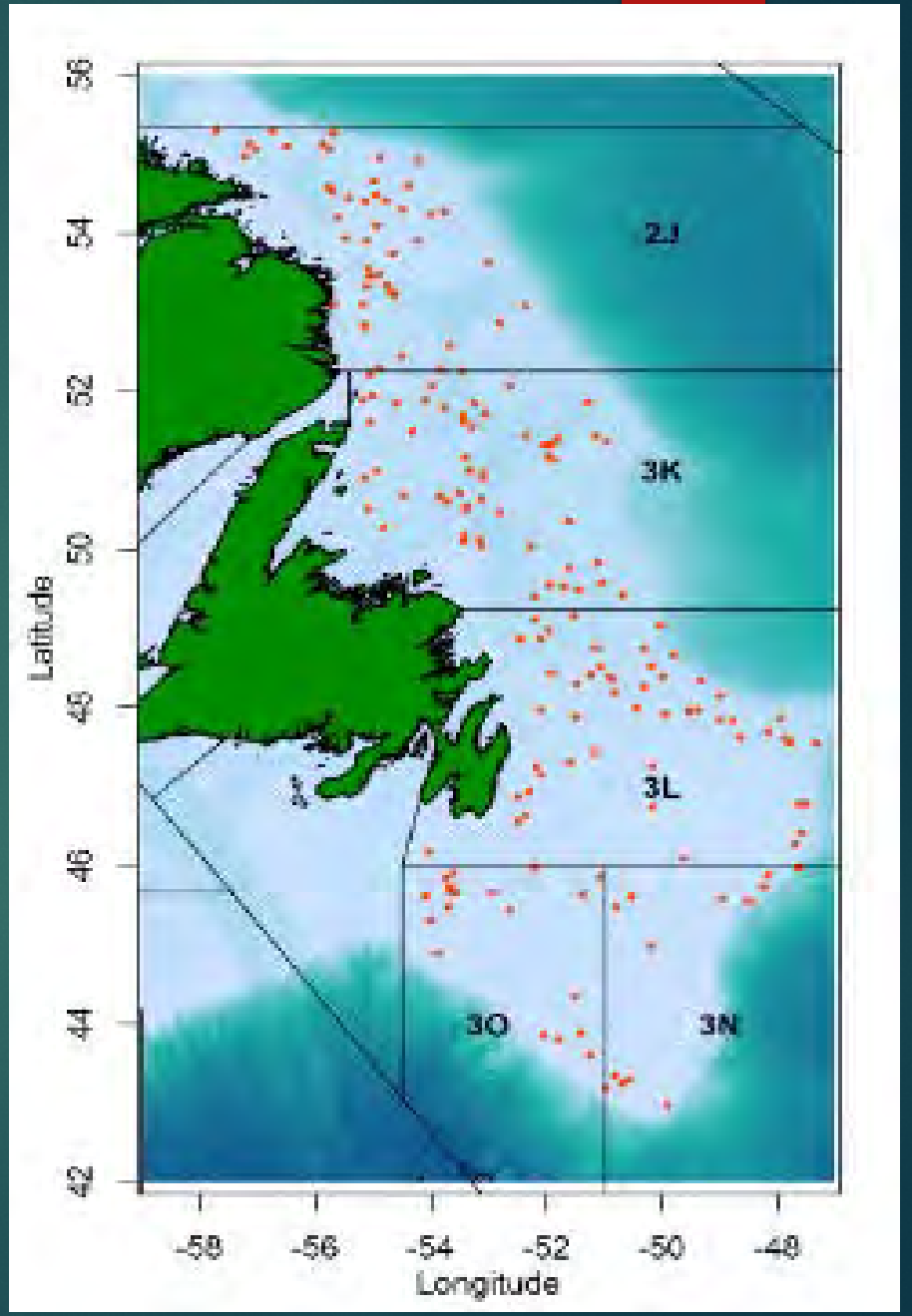
Ecological Research Initiative - ERI (DFO)
Autumn survey: September - December (2008-2012)

Capelin stomach extracted and frozen (-20°C) for analysis - Fisheries and Oceans Canada (DFO) in St. John's, Newfoundland

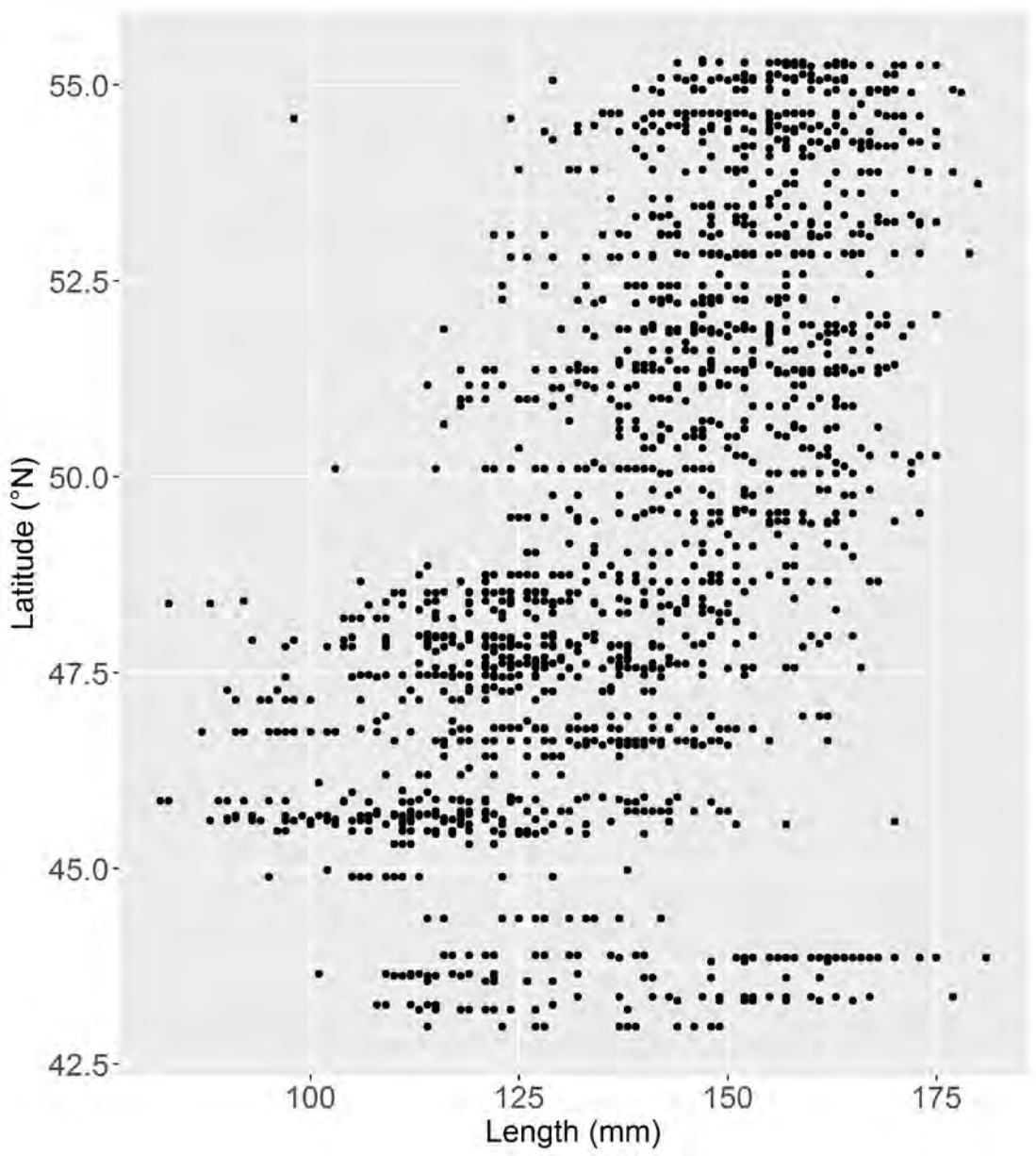
Capelin aged through otolith analyses by DFO

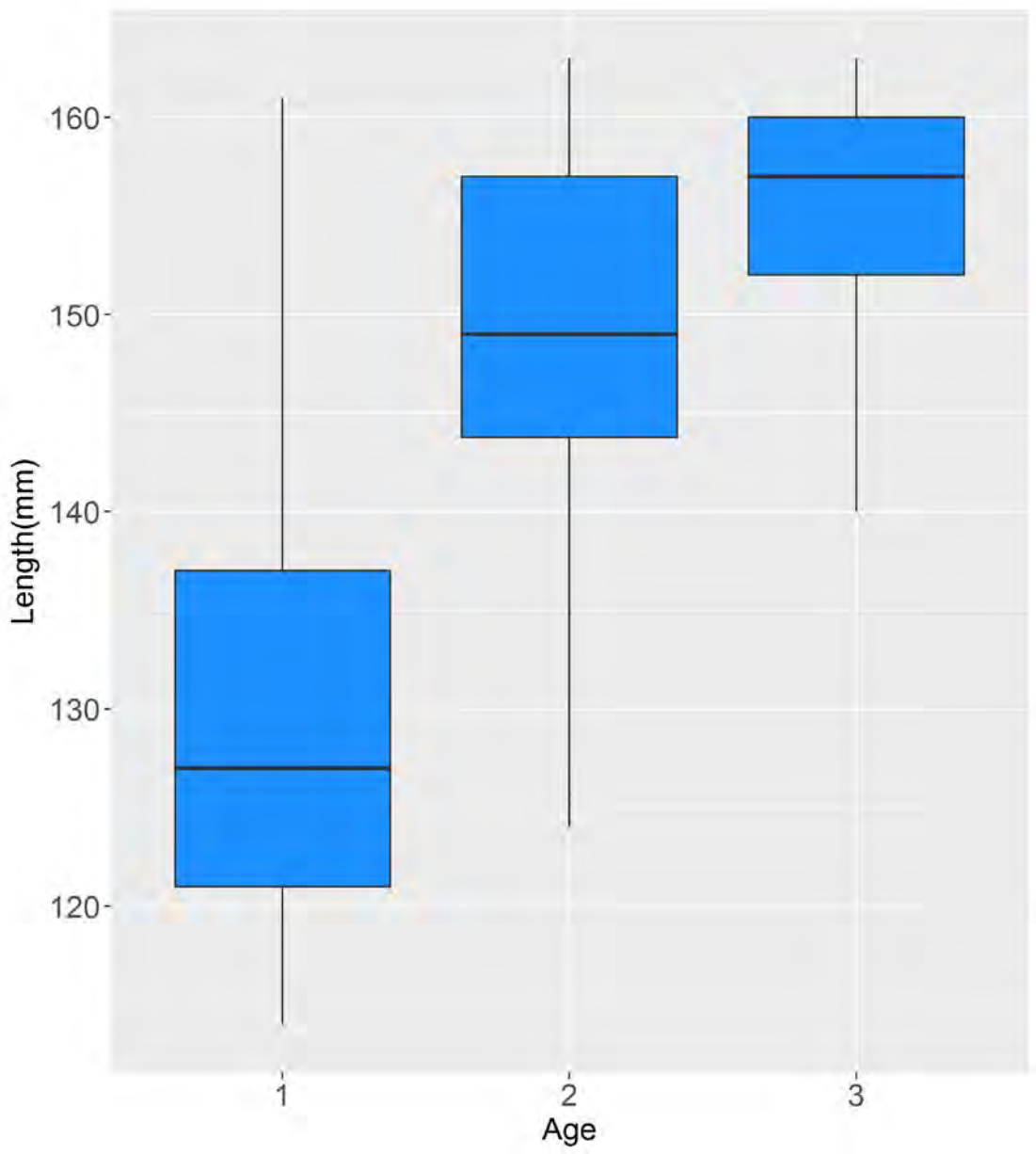
A subsample was preserved for diet compositions at each station where capelin were present

Within these subsamples, a proportion was analyzed prey were identified to the lowest taxonomical resolution

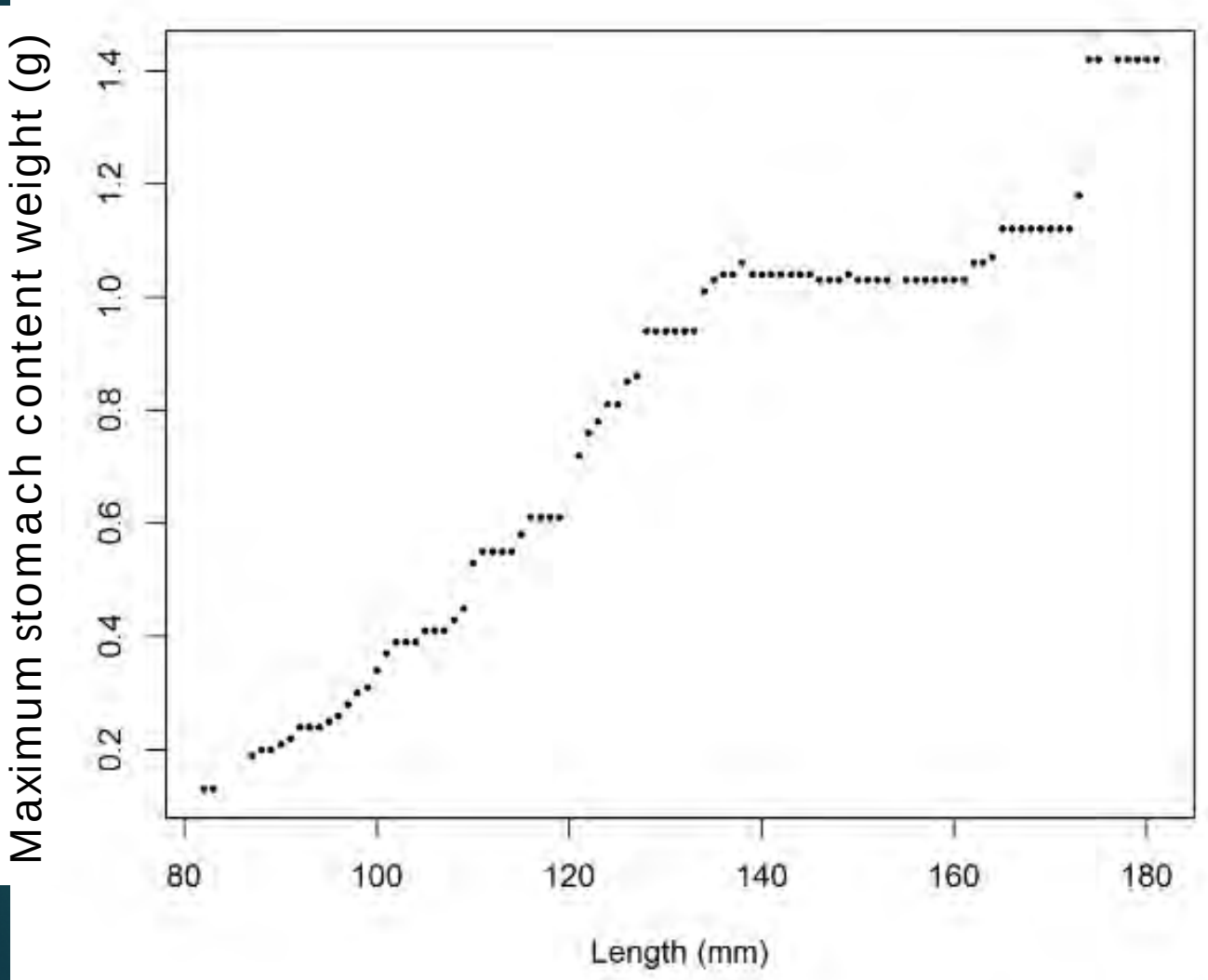


Results - Latitudinal distribution





Capelin adult diet



Partial Fullness Index (PFI):

$$PFI_{i,k} = \frac{W_{i,k}}{{L_k}^3}$$

Using the autumn capelin data (N=1810)

Cumulative distribution function (c.d.f)
99 percentile of values of total gut content weight for each 1 mm size class capelin = maximum stomach capacity

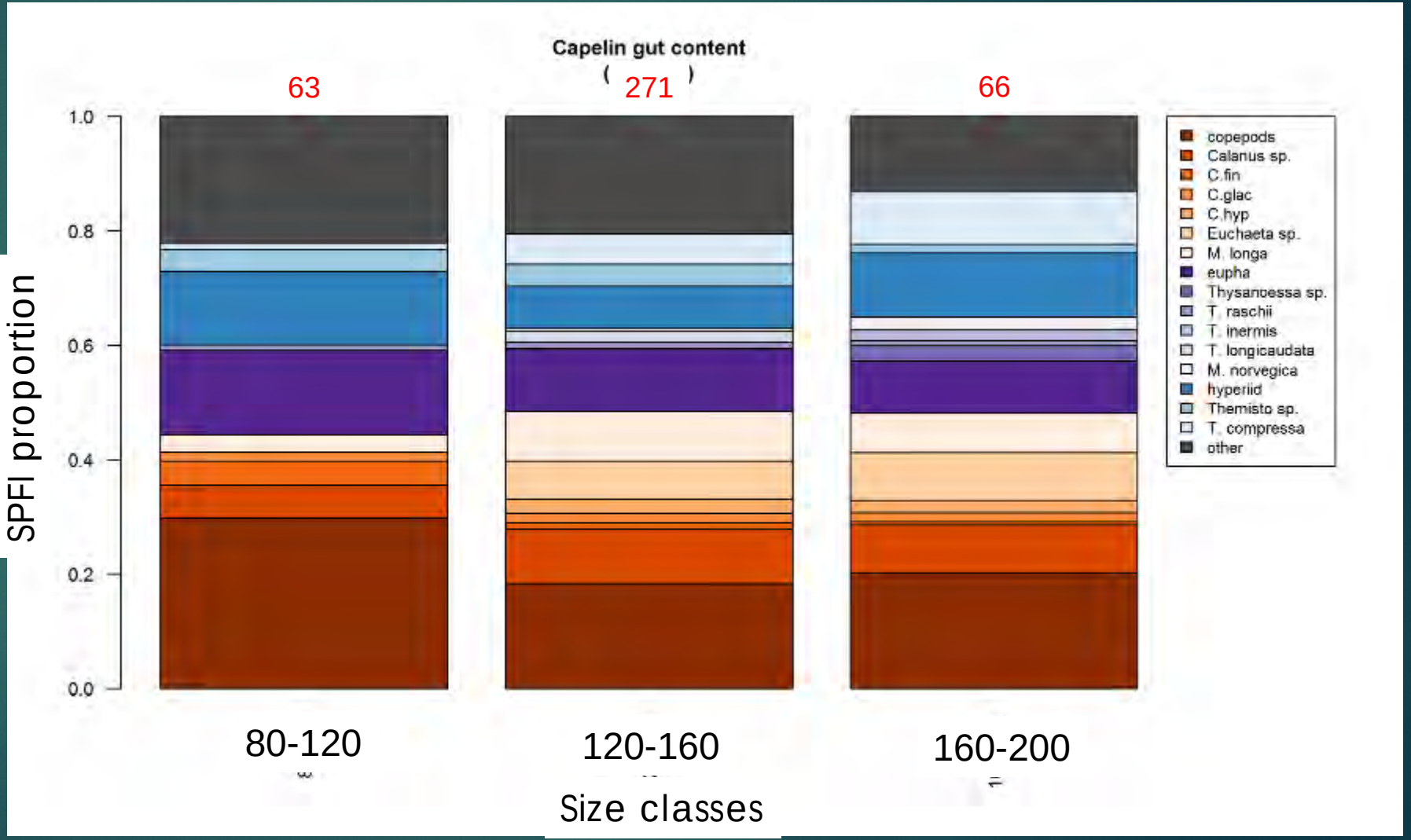
Stomach Partial Fullness Index (SPFI)

$$SFI_{i,k} = \frac{W_{i,k}}{ms_k}$$

Capelin adult diet

Copepods and amphipod contribution increased with size.

Euphausiid contribution was predominantly higher in smaller capelin

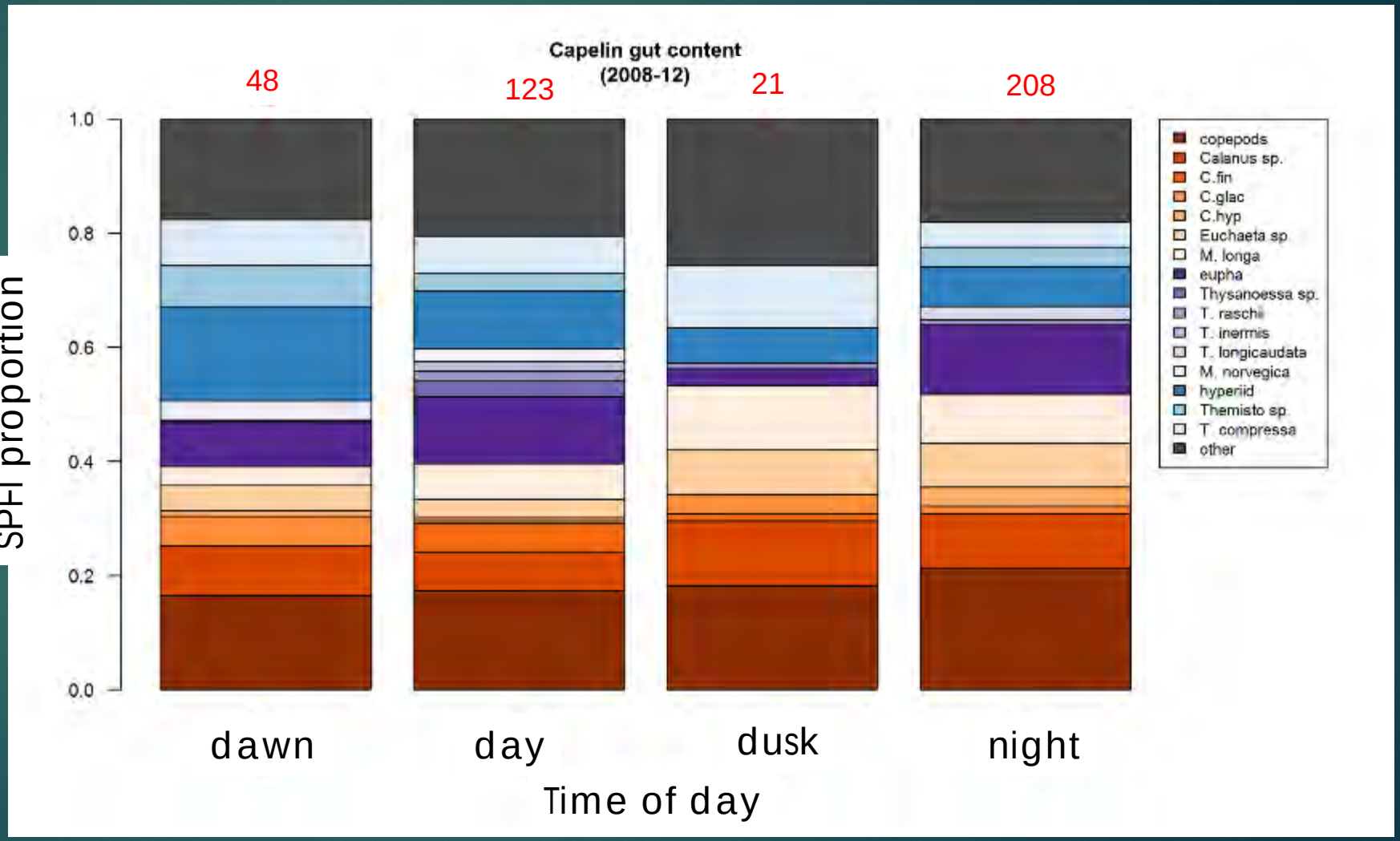


Capelin adult diet

Copepods contribution is higher during dusk and night

Hyperiid amphipod contribution higher at dawn

Euphausiid contribution is higher during the day and night

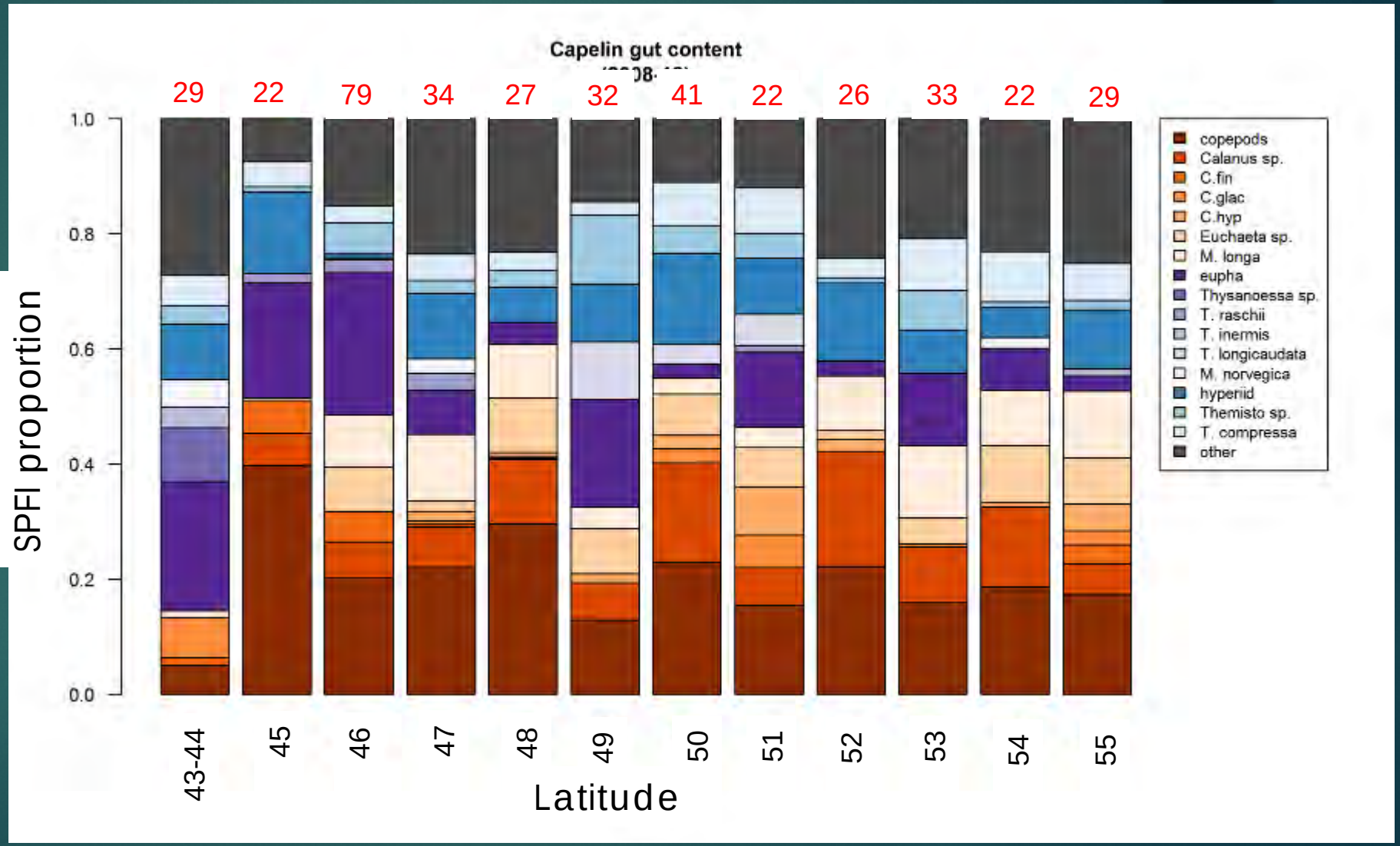


Capelin adult diet

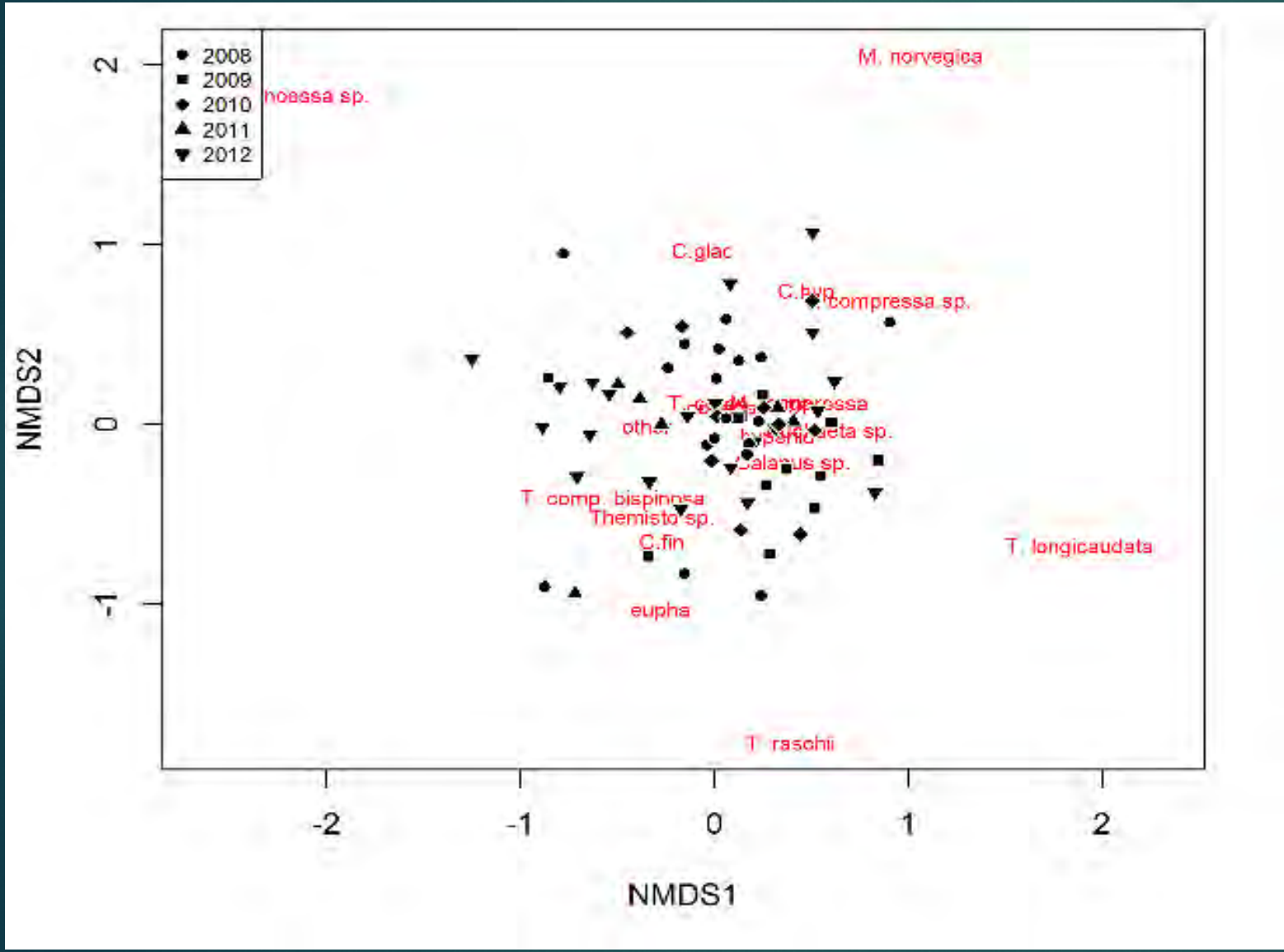
Euphasuiid contribution was higher at lower latitudes

Contribution of amphipods was higher at northern latitudes

In overall, copepods had a high contribution



Capelin adult diet



Multivariate analysis to analyze variation of prey contribution with SPFI

Mean values of SPFI calculated per 5-mm size classes and trawl sets, within each year

Analysis of similarity (ANOSIM) ~ year, size, latitude, time of day, sex

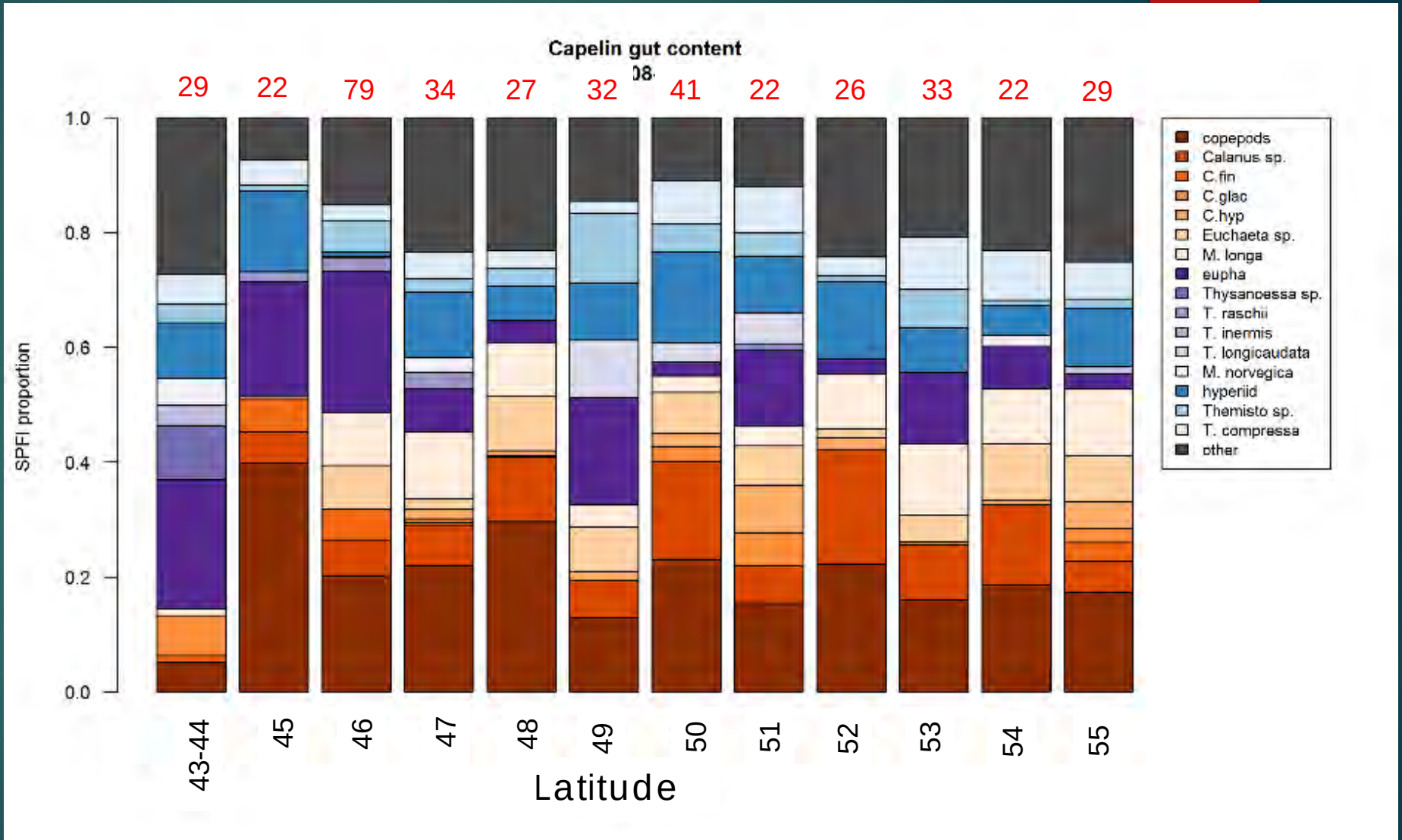
Variability in diet composition was explained by latitude ($p < 0.05$)

Capelin adult diet

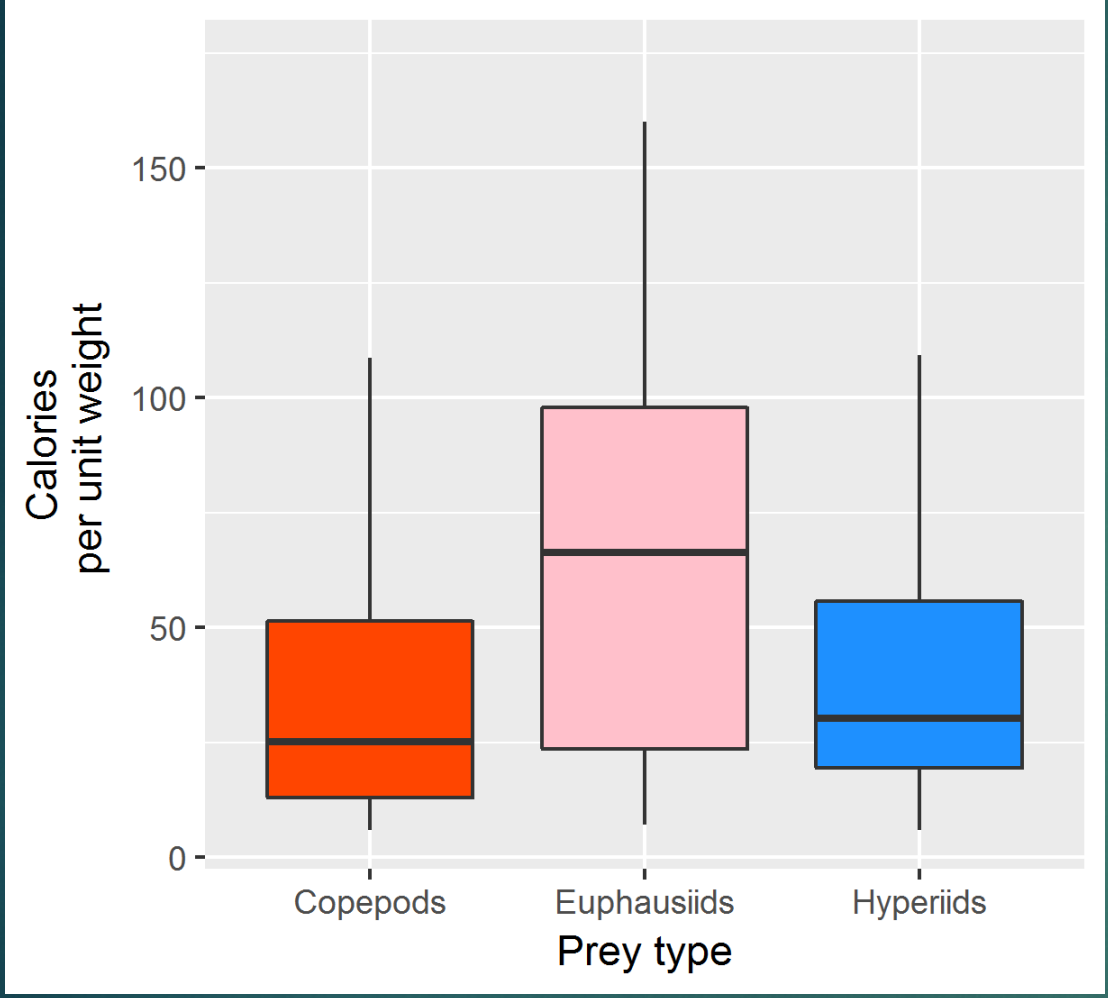
Copepods seems to be the main prey regardless of latitude.

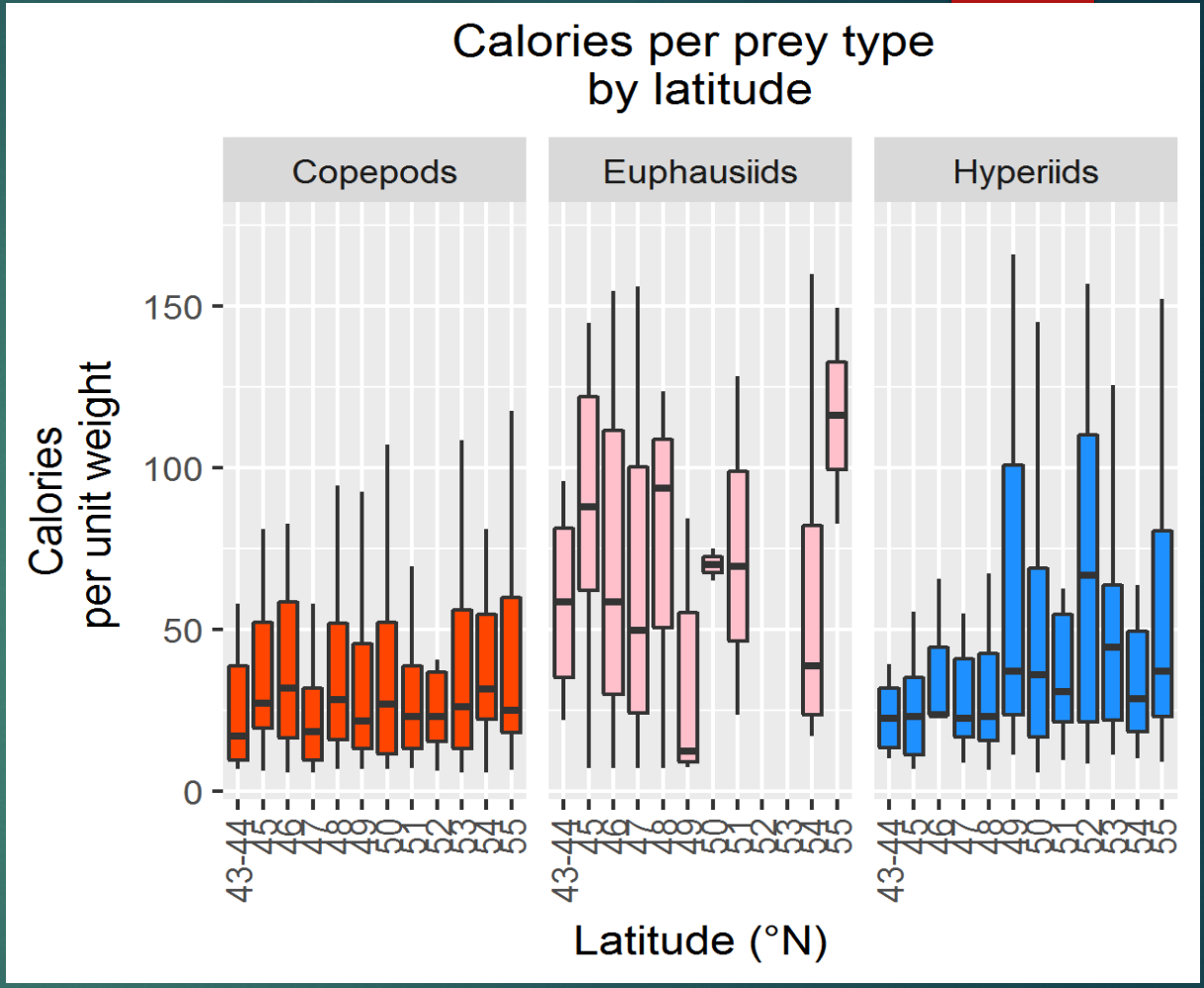
However, euphausiids and hyperiid amphipods contribution varies over a latitudinal gradient.

But…



Capelin adult diet – Calorific content





Calculating absolute calorific values for the major prey taxa using weight (g) found in literature: euphausiids present a higher calorie per unit weight despite lower contribution in northern latitudes. Amphipods are also a high energy prey item in northern latitudes.

Summary

- When looking at the relative proportion of prey contribution to gut content, results obtained for autumn feeding in this study do not differ much from results presented by Dalpadado and Mowbray (2013) for spring feeding.
- Copepods represented 50-60% of stomach weight, amphipods represented 20-25% and euphausiids contributed ~15%
- Latitude was the main factor explaining variability in diet composition. Contribution of euphausiids to diet composition decreased with latitude. Conversely, hyperiid amphipods contribution increased with latitude.
- Even though the relative contribution of euphausiids to stomach weight tends to decrease at higher latitudes, conversion of their absolute contribution to energy content using published conversion factors suggests an important role of euphausiids in the diet of capelin.
- Euphausiids are an energy-rich prey item that has been associated to a higher growth rate and somatic condition in Barents Sea capelin (Dalpadado and Mowbray 2013)

Conclusion

- There is a need to obtain energy density values from the Newfoundland and Labrador ecosystem and assess if the calorific content varies with latitude even within a given prey taxa
- This analysis is based on gut content (snapshot) and does not take into account the potential variability in digestive rate among prey taxa
- Given that copepods are smaller organisms than euphausiids, it is possible that they are digested rapidly. Their importance could have been underestimated in the context of the present study.
- For example, the importance of copepods has been demonstrated in the Barents Sea ecosystem when the collapse of capelin in the 1980s was related to a sharp decrease in *Calanus finmarchicus* abundance (Skjoldal *et al.*, 1992).

Acknowledgments

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