

7. MONITORING OF INTERACTIONS BY DIET STUDY

7.1. Trophic studies of capelin and polar cod

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In the Barents Sea, diet data for capelin (*Mallotus villosus*) and polar cod (*Boreogadus saida*) (also called Arctic cod) were collected during the Joint Norwegian-Russian ecosystem surveys in August-September respectively during the period 2005-2011 and 2007-2011. IMR generally takes stomach samples from 10 fish at each station, while PINRO samples more fish (up to 50) at fewer stations. Because Russian data on stomach content are in wet weight and Norwegian data in dry weight, a wet weight/dry weight conversion factor of 5.0 was applied. The data are presented in dry weight in the figures.

The size of the capelin ranged from 6.5 to 19.5 cm and for polar cod ranged from 7-27 cm. In the Norwegian data, the fish is measured to the nearest 0.5 cm (rounding downwards), while in the Russian data the fish is measured to the nearest 0.1 cm, but in the data conversion they were rounded to the nearest 0.5 cm (rounding downwards). For analysis of the variation of diet by size, the following size groups were used: for capelin below and above 12 cm, and for polar cod below and above 17 cm. The diet data of capelin from 2005 is based on few stations compared to other years and is mainly from the north central and eastern parts of the Barents Sea.

Seven years of capelin diet was examined from the Barents Sea (Table 7.1.1), where capelin is a key forage species, especially of cod (*Gadus morhua*). In the Barents Sea, a pronounced shift in the diet from copepods to krill, mostly *Thysanoessa inermis* was observed in larger capelin (>12 cm), with krill being the largest contributor to the diet weight (Figures 7.1.1 and 7.1.2). In the Barents Sea, amphipods contributed a small amount to the diet of capelin except in 2012. The migration of capelin into northerly areas (>80 N) are observed in the recent years due to more ice free area. This may make capelin more accessible to the arctic amphipod, *Themisto libellula*.

Table 7.1.1. Mean Total length, and weight of capelin and polar cod in the Barents Sea. ND=no data.

year	Capelin		Polar cod			
	No. stomachs	Mean length (cm)	mean weight (g)	No. stomachs	Mean length (cmr)	mean weight (g)
2005	250	13,8	14,42	nd	ND	ND
2006	531	14,1	15,76	nd	ND	ND
2007	798	13,6	13,90	379	14,98	27,67
2008	636	14,2	15,56	330	14,56	24,79
2009	685	14,5	17,15	473	13,85	21,13
2010	250	14,6	16,70	335	13,23	19,13
2011	601	13,9	13,75	408	14,69	27,22

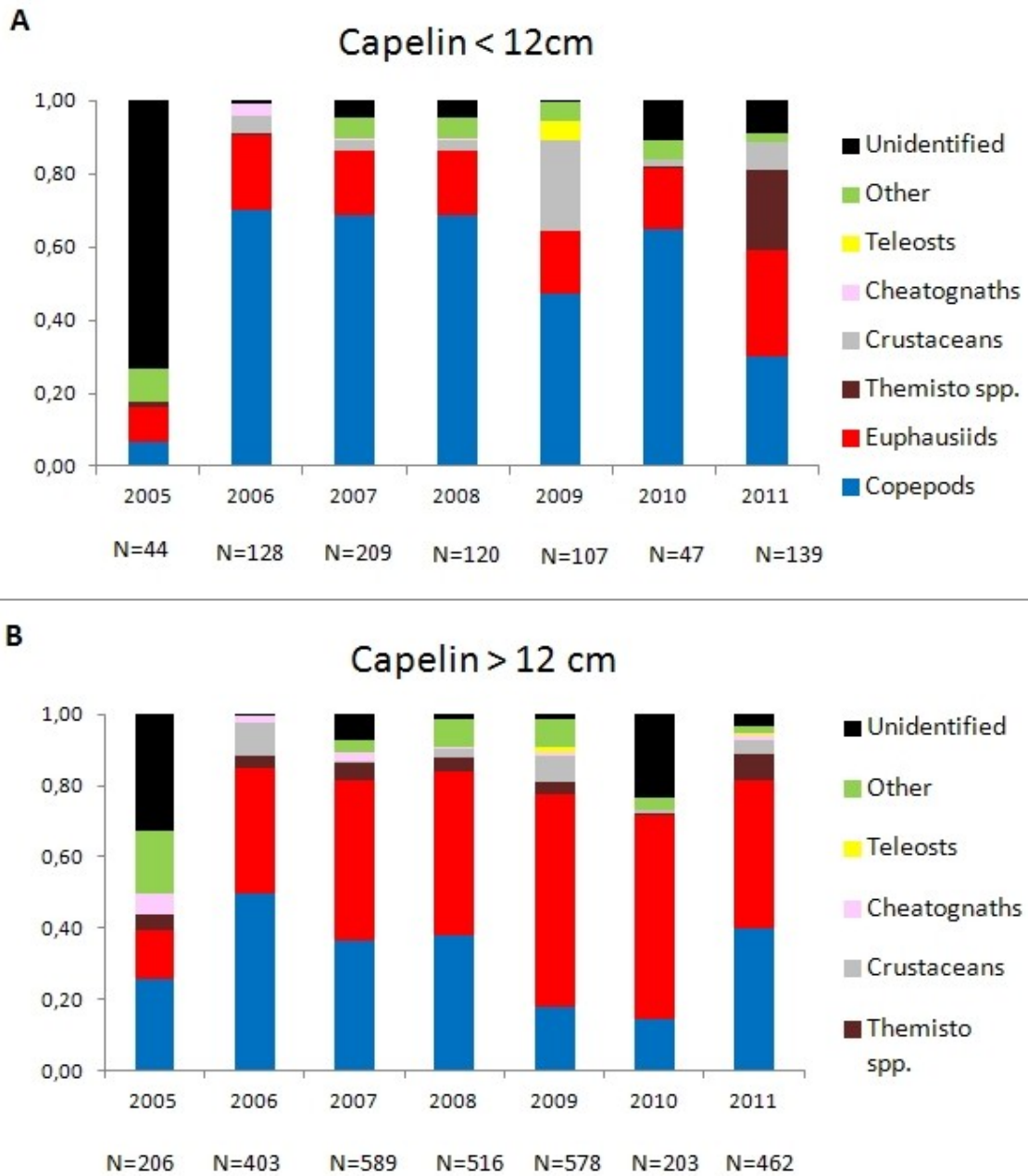


Figure 7.1.1. Inter-annual variation in diet composition (Partial Fullness Index) of capelin (above and below 12cm) in the Barents Sea.

Capelin diet 2010 and 2011 - PINRO/IMR

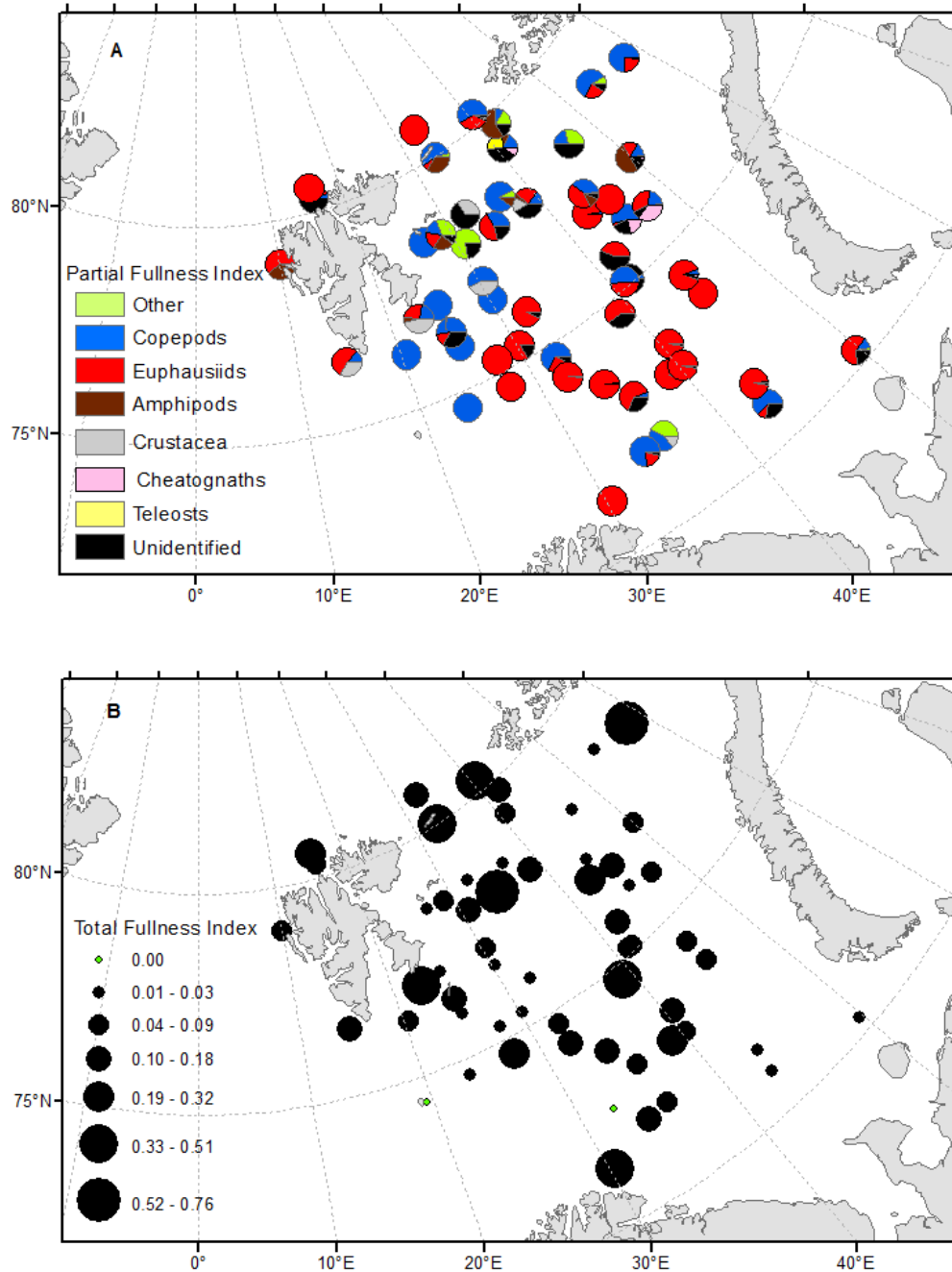


Figure 7.1.2. Distribution of a) Partial Fullness Index and b) Total Fullness Index of capelin in 2010 and 2011 in the Barents Sea.

The diet data from 2005 to 2011 indicate that polar cod mainly feed on amphipods (mainly hyperiids, occasionally gammarids), copepods and euphausiids, and to a lesser degree on other invertebrates. Large polar cod may also prey on fish (Figures 7.1.3 and 7.1.4). The contribution of fish to the diet weight is remarkably large in 2011 compared to previous years.

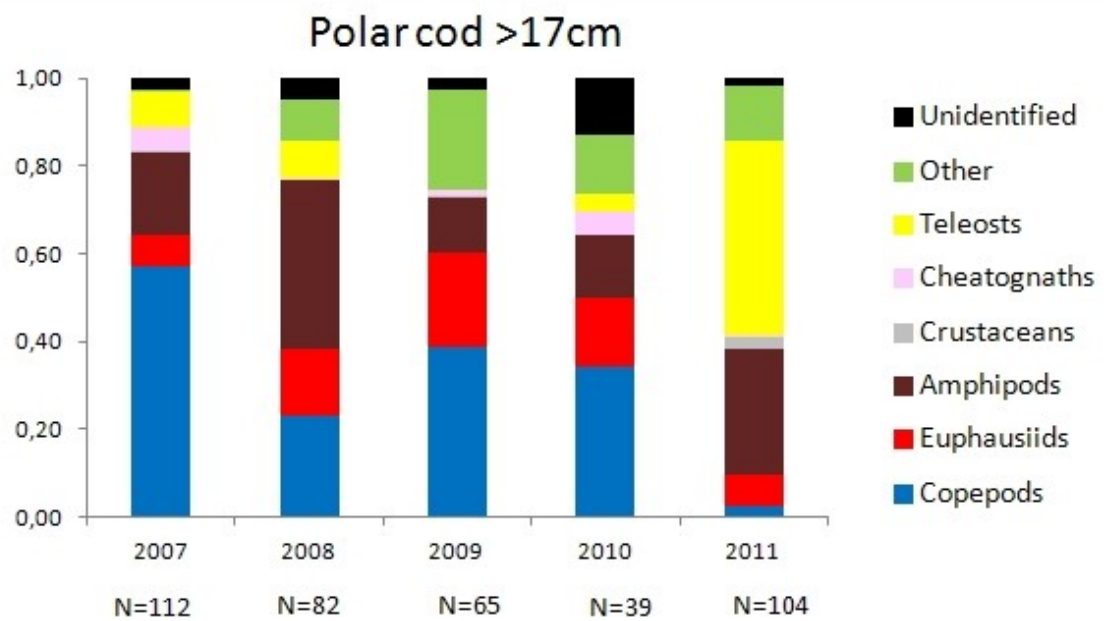
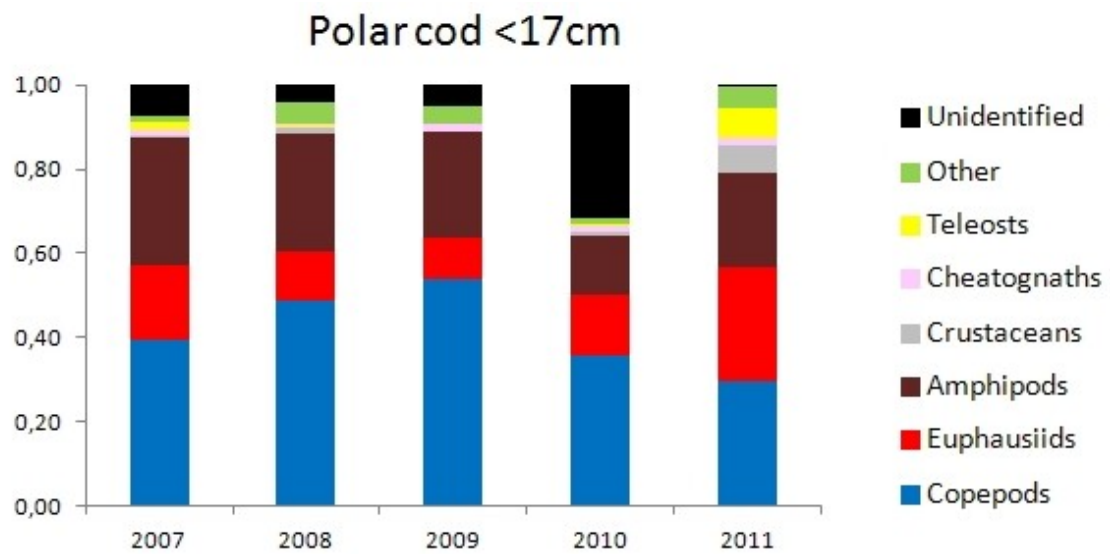


Figure 7.1.3. Inter-annual variation in diet Composition (Partial Fullness Index) of polar cod (above and below 17cm) in the Barents Sea.

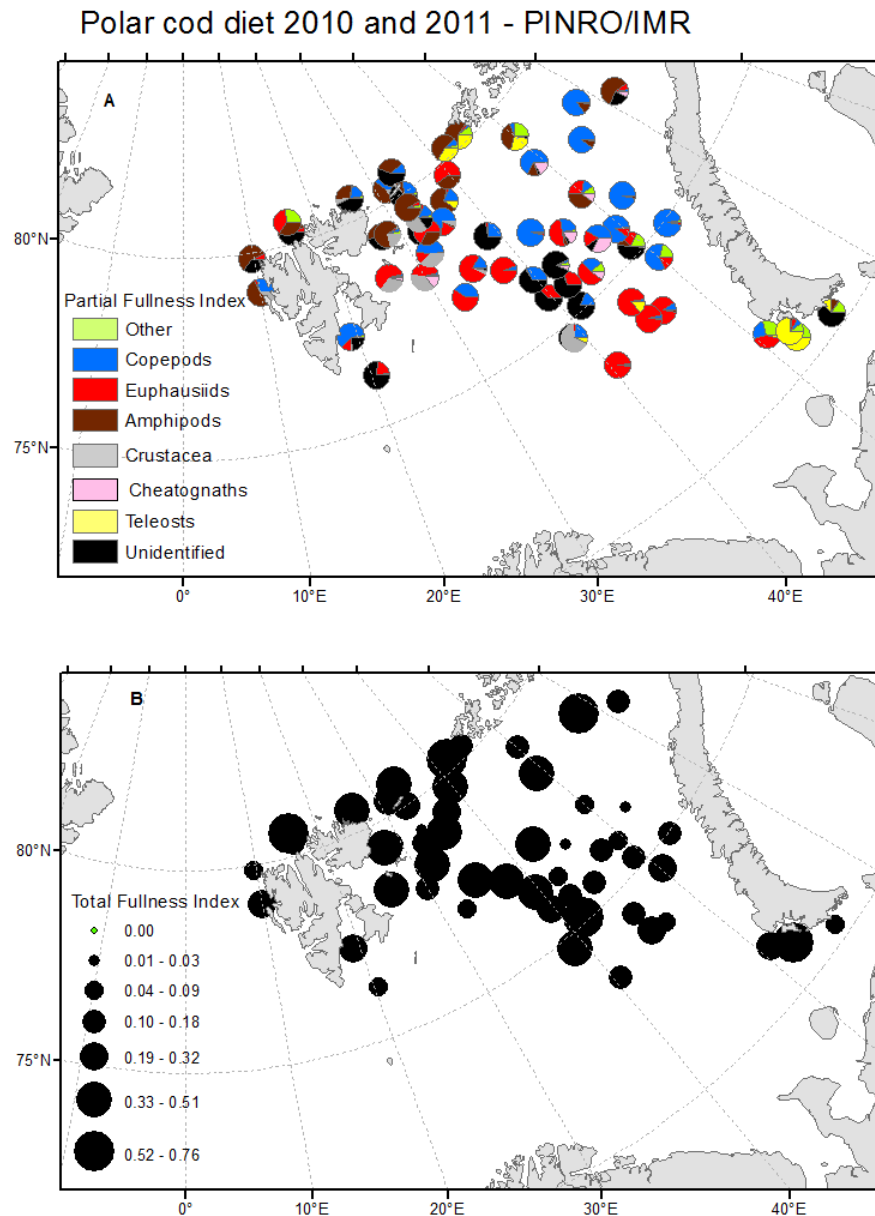


Figure 7.1.4. Distribution of a) Partial Fullness Index and b) Total Fullness Index of polar cod in 2010 and 2011 in the Barents Sea.

In general, a short efficient food chain (phytoplankton via *Calanus* or herbivorous krill to capelin). The extent of consumption of carnivorous zooplankton such as hyperiid amphipods and fish in polar cod may lengthen the trophic levels and thus reduce efficiency of energy transfer. The effects of warming and ice free conditions during summer may have impact on the distribution patterns of these two species in the Barents region and hence increase competition for food. In addition, the composition of *in situ* zooplankton may changes if the warming conditions persist. There are evidences already that the biomass of the arctic *Themisto libellula* has decreased during the last decade compared to the 3 preceding and the krill biomass has increased. In this project, we will focus on the climate effects on the trophic interactions between key planktivorous fish and zooplankton in the Barents Sea. We intend to specially focus on northward shifts and overlap in distribution in key predator-prey species, identify main feeding grounds, and explore the degree of diet overlap, and competition for food.