

## ***Theme Session 1: Establishment and maintenance of long time marine data bases***

### **Variability in cannibalism in Northeast Arctic cod (*Gadus morhua* L.) during the period 1947-2006**

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#### **Extended abstract**

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Cannibalism is likely the most important and also the most variable cause of natural mortality for age 1-4 Northeast Arctic cod (Korzhev and Tretyak, 1992; Bogstad et al., 1994). It was shown previously that incorporation of the data on North-East Arctic cod cannibalism into the VPA model improves the overall quality of its assessment and accuracy of recruitment estimation (Kovalev and Korzhev, 2004). Nevertheless, for the younger cod age groups, there is an inconsistency in the time series of (VPA) number at age from 1946-present, as cannibalism is only taken into account in 1984 and later years, when quantitative stomach content data are available. To improve the understanding of the population dynamics of Northeast Arctic cod (especially stock-recruit relationships) it would be of great value to have estimates of the abundance including cannibalism through the entire time series.

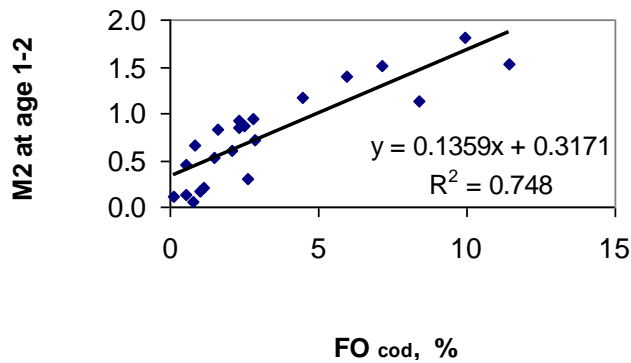
Long time series describing diet composition are available for the stock (qualitative stomach content data for 1947-2005 and quantitative data for 1984-2006). We intended to hindcast natural mortality of age 1-4 cod due to cannibalism based on combined qualitative data for 1947-2005 and quantitative data for 1984-2006, using the same approach as in the paper of Marshall et al. (2000) with regards to capelin abundance. The data obtained were analysed together with survey indices/XSA estimates for young cod, and abundance of capelin, the most important prey item for cod.

The mean frequency of cod occurrence in cod stomachs ( $FO_{\text{cod}}$ ) from the qualitative and quantitative data from 1984-2005 demonstrated similar patterns; the correlation between these  $FO_{\text{cod}}$  time series was strong ( $r^2 = 0.83$  for the southern Barents Sea and 0.89 for the Svalbard area). Spatial variations in cod cannibalism was large. Cannibalism was at a high level from 1947-1965 and then again in the mid-1990s. The high levels of cannibalism in the mid-1990s are comparable with those observed in the 1950s. The low  $FO_{\text{cod}}$  from the late 1960s to the end of the 1980s is possibly connected with cod switching on capelin predation mainly due to long-term increase in capelin stock biomass. This assumption coincides with a tendency for cannibalism levels to be inversely related to the capelin abundance.

The relationship between predator size and maximum prey (cod) size is close to a linear one; the predator length is in general at least twice the prey length. The proportion of cod in the

cod diet increases with increasing cod length based on the quantitative stomach content data base.

For the period 1984-2005,  $FO_{cod}$  from the qualitative stomach content data was related to the natural mortality induced by cannibalism for cod age groups 1-5. The correlation was positive and significant in all cases, with  $R^2$  values between 0.4 and 0.7 (i.e. Fig.1).



**Figure 1.**  $FO_{cod}$  in the southern Barents Sea vs. natural mortality for cod at age groups 1-2 for the period 1984-2005.

There are significant relationships between the abundance of cod at age 1-3 calculated by VPA, including cannibalism, and bottom trawl indices for the same ages cod obtained in the demersal fish survey in February; these indices are especially consistent for cod at age 1 and 2 ( $R^2=0.86$  and  $0.83$  respectively).

There is also significant correlation between the recruitment at age 1 calculated by VPA, including cannibalism, and the spawning stock biomass (SSB), but not a significant correlation between the recruitment at age 3 and the SSB. This indicates that cannibalism strongly modifies the year-class strength in the period before recruitment.

Further work is needed to calculate the consumption of cod at age 1-4 by predator-cod for the period 1947-1983 in order to make the whole VPA time series consistent. This will allow us to test stock-recruitment relationships for the entire time series with cod at age 1 and 3 as the recruitment age for their comparison as well as study relationships between cod cannibalism level and population/environmental factors to understand their nature and response mechanisms.

## References

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