5.3. Monitoring the pelagic fish community

A major output from the survey is the stock size of key species in the BS ecosystem. Central to the stock assessment is the time series of stock size estimates by age. In most cases, time series of stock size indices are what actually enter the assessment, and it is important that the indices are calculated consistently from year to year.

5.3.1. Fish recruitment (0-group fish)

by D. Prozorkevich and E.Eriksen

The Barents Sea is a vital nursery area for several commercially and ecologically important fish stocks. Since 1965 surveys in August/September have provided annual information on the abundance and spatial distribution of pelagically distributed 0-group fish of these as well as several other species (e.g. Eriksen and Prozorkevich, 2011).

In August-September, the majority of the 0-group fish (5-7 months old) is distributed within the upper 60m. The survey only covered the Barents Sea and adjusted waters, therefore coverage is not complete for all species. For example, haddock and herring can be distributed farther west in the Norwegian Sea, saithe and herring are also found in the fjords along the Norwegian coast, and Greenland halibut which distributes deeper than 60m.

Abundance indices of 0-group fish

The aim is to map spatial distribution of 0-group fish and calculate the relative abundance indices for 10 fish species (Barents Sea capelin *Mallotus villosus*, Norwegian spring spawning herring *Clupea harengus*, Northeast Arctic cod *Gadus morhua*, Northeast Arctic haddock *Melanogrammus aeglefinus*, Northeast Arctic saithe *Pollachius virens*, redfishes *Sebastes spp*, Greenland halibut Reinhardtius hippoglossoides long rough dab *Hippoglossoides platessoides*, wolffishes *Anarchicas pp*, and polar cod *Boreogadus saida* and pelagically distributed Barents Sea Agonidae, Ammodytidae, Cottidae, Liparidae, Myctophidae and Stichaeidae. Figure 5.3.1.1 showed the stratified swept area in the Barents Sea, consisting of 23 strata (coloured areas). The stratas are combined into larger areas (North Western, Northern, Western, Central, Eastern and Coastal), based mostly on bathymetric and water features.

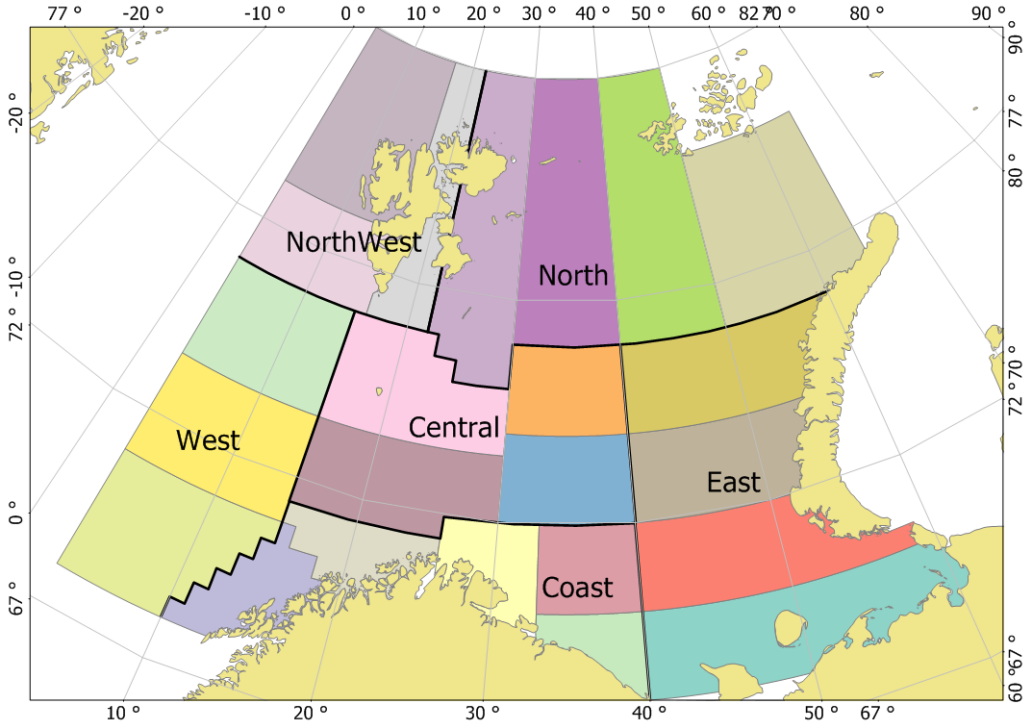

Figure 5.3.1.1. Stratified swept area in the Barents Sea. 23 strata were combine into larger areas (North Western, Northern, Western, Central, Eastern and Coastal) and used for 0-group fish biomass calculation (Eriksen et al. 2009).

The computation of biomass indices is made using the stratified sample mean method of swept area estimates (Dingsør 2005, Eriksen et al., 2009).

The number of fish per square nautical mile, $\rho_{s,l}$, of length, l (in 1cm groups), at each station, s, are estimated by the following equation

$$\rho_{s,l} = \frac{f_{s,l} \cdot K_{Eff}}{a_s} \qquad (1)$$

where $f_{s,l}$ is the observed number of fish in lengthgroup l at station s, K_{eff} is the correction functions defined below (K_{eff} = 1 when not correcting for capture efficiency), and a_s is the swept area found by

$$a_s = \frac{d_s \cdot ws}{1852} \qquad (2)$$

where ws/1852 is the wingspread of the trawl converted into nautical mile and ds is the effective trawl distance found by total distance trawled divided by the number of depth layers.

The stratified swept area estimate, is given by

$$\bar{y}_{st} = \sum_{i=1}^{N} A_i \bar{y}_i \qquad (3)$$

where N is the number of area-strata, A_i is the covered area in the i-th stratum, and $\bar{y}_i$ is the average density in stratum i given by

$$\bar{y}_i = \sum_s \sum_l \rho_{s,l} / n_i \qquad (4)$$

where n_i is the number of stations in stratum i.

Capture efficiency of pelagic trawl is highly selective for 0-group fish (Godø et al. 1993; Hylen et al. 1995), and the selectivity depends on species and fish length. Length correction functions, K_{eff}, for trawl capture efficiency have been estimated by regressions between fish densities from simultaneous trawl and acoustic estimates of relatively "pure" concentrations (Mamylov 2004). By "pure" concentrations, we mean that only one species dominates the catches. Correction functions for three species types are:

K_{eff}gadoids = 17.065*exp(-0.1932*l)(5)

K_{eff}capelin = 7.2075*exp(-0.1688*l) (6)

K_{eff}herring = 357.23*exp(-0.6007*l) (7)

where l is the observed length in cm. Unfortunately, because of the requirement of "pure" concentrations, there are no correction functions available for other species.

Results are presented as spatial densities (per each station), which are available on the "FishExChange" database and the relative abundance index, which is available on "Sjømil" database. The results are reported to the ICES (AFWG) The Arctic Fisheries Working Group, The Research Council of Norway, Barentswatch portal and used for internal map production.

Biomass indices of 0-group fish (4 species)

The aim is to map spatial distribution of biomass of 0-group cod, haddock, herring and capelin and calculate the relative biomass indices.

Wide distribution and high numbers of the 0-group fish make these fish an important link in the energy transfer of the Barents Sea ecosystem, and therefore is important to estimate biomass of most abundant 0-group fish species (Eriksen et al. (2011).

The computation of biomass indices is made using the stratified sample mean method of swept area estimates (Eriksen et al. 2011). The biomass per unit area, b_s (kg per square nautical mile), at each station, s, is estimated by the equation

$$b_s = \frac{w_s \cdot 1852}{wsp * (td_s / dl_s)} \qquad (1)$$

where *ws* is the catch (kg) at station *s*, *wsp* is the effective wingspread of the trawl, td_s (nautical mile, nm) the total distance trawled at station s, and is the number of depth layers at station *s*. The stratified swept area biomass estimate is given by

$$EB = \sum_{i=1}^{N} A_i \bar{y}_i \qquad (2)$$

where N is the number of area-strata, Ai is the area covered in the i-th stratum, and $\bar{y}_i$ is the average biomass density in stratum i given by

$$\bar{y}_i = \frac{1}{n_i} \sum_{s=1}^{n_i} b_s \qquad (3)$$

where n_i is the number of stations in stratum i.

The capture efficiency of the sampling trawl differ between species and decreases with decreasing 0-group length, and therefore the capture correction factor were used for cod, haddock and herring biomass. These factors were found by calculating the ratio between abundance indices (with and without capture efficiency). For capelin, which is small and not herded to any extent by the net walls, we chose to calculate the biomass according to the effective wingspread of the trawl.

Results presented as the relative biomass index, which is available on “Sjømil” database. The results are reported to the ICES (AFWG) The Arctic Fisheries Working Group.