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A revision of the abundance indices for cod and haddock from the Norwegian winter survey in the Barents Sea, 1983-1999.

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Introduction

In connection with the work on the new cod assessment model, Flexibest, all the survey indices for Northeast Arctic cod have been recalculated from the basic data. This was done because Flexibest uses survey indices on age and length basis, which could not be taken from existing survey reports. This document describes the revised time series for cod and haddock from the Norwegian winter survey in the Barents Sea (both bottom trawl and acoustic abundance indices).

Material and methods

The survey indices have been calculated using the methodology described in Jakobsen et al. (1997). Data from before 1989 have been adjusted, accounting for change of gear from bobbins to rock-hopper in 1989. This has been done using the methodology described by Godø and Sunnanå (1992) based on experiments by Godø et al. (1989) and Engås and Godø (1989). Also length-dependent effective fishing width is accounted for (Dickson, 1993; Aglen and Nakken, 1997). The calculations of bottom trawl indices are made from the spd3.14 data set (Q:\ressurs\mare\spd314.19xx) using the SAS-based program SURVEY4.0 made by Knut Korsbrekke. Afterwards, the corrections for gear change (rockhopper/bobbins) were made for each 5 cm length group, for the years before 1989. The mean length and mean weight at age are calculated without those corrections, and for 1983-1988, those are thus slight overestimates compared to the values for later years.

The acoustic indices are calculated from processed acoustic data and biological information from the spd3.14 data set using a Fortran program made by Åge Fotland. For cod, the acoustic indices are calculated by length group and then converted to age using the same age-length keys as for the bottom trawl data, while for haddock, the abundance at age is calculated using the age-length keys that were made for the original calculations. In the original calculations for cod and haddock, separate age-length keys were generated for the acoustic survey until 1993, while for later years, age-length keys from the SURVEY program were used.

The survey was started in 1981, but data for 1981 and 1982 are not available for calculations at present.

The timing of the survey and the vessels used, as well as the serial numbers in the data base, is given in Table 1. The reference for the original survey report is also given there. The area division (seven main areas with 23 strata) is shown in Figure 1, and the area covered in each year is given in Table 2. The number of trawl stations for each year and the number of fish sampled are shown in Table 3.

The bottom trawl and acoustic abundance indices for cod are given in Tables 4-5, together with the 'old' estimates and the ratio between these two sets of abundance estimates by age. The average length at age and weight at age is given in Tables 6 and 7. For haddock, the bottom trawl indices, length at age and weight at age are found in Tables 8-10. The acoustic abundance indices for haddock have not yet been recalculated.

In 1994, the mesh size in the codend was changes from 35-40 mm to 22 mm, which may lead to higher selection of 1-year-old cod. The survey indices are not corrected for this change.

Among the reasons for the discrepancies are changes in the strata system (before 1996 a system with 63 strata was used). Some corrections in the basic data (STUV-forms) have been made, and the computer programs used in the calculations have changed. Table 3 shows that the number of stations included in the calculations presented here and in the original calculations are somewhat different. Also, it is not

clear whether the correction for length-dependent effective fishing width have been made based on the raw data or is based on applying conversion factors calculated from the mean length at age.

The area coverage has changed during the years (Table 2). In these calculations, only areas ABCD are included for 1981-1992 (although a somewhat larger area was covered in some years), while all seven areas are included in 1993 and later years. In 1997 only one station was taken in area E and the area was not included in the calculations of bottom trawl indices. The indices for 1997 and 1998, when the Russian EEZ was not covered, have been adjusted. This is done by estimating the number of fish (age group by age group) in the Russian EEZ in 1996 and 1999, interpolating assuming a linear development in the proportion found in the Russian EEZ from 1996 to 1999, and then adding this number to the numbers found in the Norwegian EEZ and the Svalbard area in 1997 and 1998. In the calculation of the proportion found in the Russian EEZ the numbers found in the Svalbard area are left out since the coverage of this area also varies from year to year due to variable ice coverage.

In the previous calculations of acoustic abundance of cod wrong assumptions were made either about the target strength used (in 1983-1985) or about use of rock-hopper and bobbins gear (1989-1990).

For 1983, $C = 1.87 \times 10^6 l^{-2.18}$ was used, while in 1984 and 1985, $C = 3.13 \times 10^6 l^{-2.18}$ was used. In 1986-1992, $C = 2.49 \times 10^6 l^{-2.18}$ was used. However, these changes were not adjusted for in later survey reports and in Table 7 in Aglen and Nakken (1997), which list the value obtained with the C value used in the survey year for 1983-1985 instead of the value obtained with the 1986-1992 C value as the table headings indicate.

For 1989-1990, the error occurred because in the 1993 survey report (Korsbrekke et al. 1993), Table 6.2b, the 1989-1990 values which were calculated in the survey year are listed as calculated with 'Old (pre-1993)' target strength and bobbins gear, while they actually were calculated with old target strength and rock-hopper gear. This table was used in the calculations by Aglen and Nakken (1997), which was the basis for the indices previously used by the Arctic Fisheries Working Group.

For haddock, the same error seems to have occurred for the 1989-1990 values as for cod. The changes in C value were not done at the same time for cod and haddock, so possible errors in the pre-1989 abundance indices for haddock have not yet been identified.

Also, fish < 21 cm and < 11 cm (both cod and haddock) was excluded in the original calculations for 1983 and 1995, respectively, that is not done here.

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