

Northwest Atlantic



Fisheries Organization

Serial No. N5178

NAFO SCR Doc. 05/73

SCIENTIFIC COUNCIL MEETING – OCTOBER/NOVEMBER 2005

A Preliminary Estimate of Cod (*Gadus morhua*) Biomass in West Greenland
Offshore Waters (NAFO Subarea 1) in 2005

by

Marie Storr-Paulsen and Kai Wieland

Greenland Institute of Natural Resources
P.O. Box 570, 3900 Nuuk, Greenland

Abstract

A comparative study of cod catches at West Greenland from the German ground fish survey and the Greenland survey for shrimp and shrimp was carried out. The analysis was restricted to years with sufficient area coverage and regions included in both surveys. A close correlation between the two surveys estimates of cod biomass was found ($r^2 = 0.85$, $P < 0.001$). Linear regression analysis using data from 13 years suggested that the cod biomass of 21 349 tons estimated from the Greenland survey for 2005 corresponds to a cod biomass of 39 550 tons in the German survey. This indicates that although the biomass has increased concededly, the period of relative low cod biomass compared to the 1980s continued.

Introduction

Hvingel (2002, 2003) has incorporated the effect of cod predation into a model for assessing the stock of northern shrimp (*Pandalus borealis*) at West Greenland (Hvingel and Kingsley, 2002), and the results from this model has been adopted by STACFIS and the Scientific Council of NAFO since 2002 (Anon., 2004). No consistent time series of cod biomass exist for the different stock components and therefore Hvingel and Kingsley (2002) constructed a cod biomass series for West Greenland based on VPA estimates of stock size for East and West Greenland combined for the period 1955 to 1991 and separate survey indices for East and West Greenland offshore waters available since 1982. From 1993 and forward the cod biomass time series used in the model was derived from a German offshore cod survey in West Greenland waters alone. This survey is conducted each year in autumn (October-November) and its results are not available at the time the assessment for northern shrimp is carried out. Instead, information on cod abundance and biomass from a Greenland bottom trawl survey for shrimp and fish, which commenced in 1988 and which is carried out in summer (July-September), could be used to assess the actual impact of predation by cod on the stock of northern shrimp. The two surveys, however, do not survey exactly the same area and in some years, area coverage or data sampling has been insufficient in one or the other survey.

This paper presents an update of a comparison of cod biomass estimates from the Greenland survey for shrimp and fish and the German ground fish survey from the last year (Storr-Paulsen and Wieland, 2004). It provides a preliminary estimate of cod biomass in West Greenland waters for 2005 that is comparable to cod biomass indices from previous years for the area covered by the German survey and can thus be considered in the 2005 assessment of the northern shrimp stock at West Greenland.

Materials and Methods

The Greenland bottom trawl survey for fish and shrimps covers the offshore areas at West Greenland and has been conducted from 1988-2004. The area has been expanded through time and since 1992 the survey has covered the area between 72°30'N and 59°15'N (NAFO Divisions 1A-1F) from the 3 nautical mile limit to the 600 m depth

contour (Fig. 1) and the inshore area Disko Bay. The survey area is divided into NAFO Divisions, which are further subdivided into four depth strata (≤ 150 m, 151-200 m, 201-400 m and 401-600 m). The survey was originally designed as a shrimp survey and sampling of fish data was not complete in the period 1988-1991. Since 1992 the sampling of fish has improved and it is now considered as a combined survey for shrimp and fish (Storr-Paulsen and Jørgensen, 2004). The survey is designed as a stratified random trawl survey with a minimum of two hauls per stratum. The sampling period is July to September and throughout the entire time period the survey has been conducted by the Greenland Institute of Natural Resources with the research trawler RV *Paamiut*. Shrimp trawls with a high (10-12 m) vertical opening have been used, which were equipped with a heavy bobbin chain ground gear until 2004 (Skjervøy) or a rockhopper bobbin/rubber disc ground gear in 2005 (Cosmos 2600 trawl). Towing speed has always been about 2.5 knots (see Wieland and Bergström, 2005, for further details on the survey design).

The German survey is as a stratified random groundfish survey covering the shelf area outside the 3 nautical mile limit and the continental slope down to a depth of 400 m off East and West Greenland between 67°00'N and 59°00'N (ICES area 14 and NAFO Div. 1BS-1F, Fig. 1). The Institute for Sea Fisheries, Germany, has conducted this survey annually since 1982. The primary target is cod, and the fishing gear used is a groundfish trawl rigged with a heavy ground gear. Towing speed is 4 knots. The survey provides swept area estimates of abundance (by age) and biomass (all ages pooled) for the East and the West Greenland offshore component, which form the primary basis for the evaluation of the status of the offshore cod stock (ICES, 2005).

Area coverage was incomplete in one or the other surveys the following years and areas:

- NAFO Div. 1A and 1BN have always been covered by the Greenland survey only,
- the southern NAFO Div. 1E and 1F were not included in the Greenland survey prior to 1992 and 1993, respectively,
- the northern areas, i.e. 1BS and NAFO Div. 1C, were not covered in the German survey in 1995 and in 2001 to 2003,
- the number of stations was insufficient in the German survey in NAFO Div. 1F in 1993, 1999 and 2002 and in NAFO Div. 1D in 1995 and 2002.

Consequently, new annual indices of cod abundance and biomass were calculated for the Greenland survey for all years since 1992 excluding areas for which no corresponding data have been available from both surveys.

Factors for converting cod catches from 2005 made with the Cosmos trawl to Skjervøy catches from the period 1998-2004 have yet not been available. However, the major difference between the two trawls is the ground gear, and Lewy *et al.* (2004) reported a conversion factor of about 2 for cod >25 cm length in a such a case. Hence, a preliminary conversion factor of 0.5 was applied to adjust the Cosmos trawl catches from 2005 to the Skjervøy trawl standard of the previous years.

Results and Discussion

Figure 2 shows the geographical distribution of cod density recorded in the Greenland survey for shrimp and fish in 2005. Highest densities were found in NAFO Div. 1D and 1E. In addition cod was fairly abundant in most of the catches taken in NAFO Div. 1F, but was present only in few catches taken outside the area that is usually covered by the German groundfish survey. The length frequency of cod in the Greenland survey is shown in Fig. 3 indicating a dominance (more than 60%) of fish between 20 and 33 cm length corresponding to age group 2.

Overall estimates of cod biomass are 43 074 tons for the entire surveyed area and 42 697 tons for the reduced area that corresponds to the German survey. Taking into account the change of the trawl in 2005, these values convert to 21 537 and 21 348 tons, respectively, for the previous standard trawl.

Cod biomasses estimated from the Greenland survey were considerably below the estimates from the German survey in the overlapping years and area (Fig. 4), and different trawl types and towing speeds might be the major causes for this. Despite pronounced differences between the two surveys at the upper levels of cod biomass, highly significant correlations ($r^2 = 0.85$, $P < 0.001$, $n = 13$) between the two data series were found, and the equation obtained by linear regression on a log-log scale (Fig. 4) is:

$$\log(\text{Cod biomass}_{\text{German Survey}}) = 0.8879 + 0.8568 * \log(\text{Cod biomass}_{\text{Greenland Survey}})$$

This equation gives an estimate of cod biomass for 2005 of 39 550 tons in NAFO Div. 1B (south of 67°N) to 1F and can be compared with the values from the German survey in previous years. The cod biomass index derived in this way for 2005 is more than 5 times higher than that for 2004, but this is still far below the level of cod biomass observed in late 1980s (Fig. 5).

References

- ANON. 2004. Scientific Council Meeting –October/November 2004. *NAFO SCS Doc.*, No. 20, Serial No. N5061.
- HVINGEL, C. 2002. Assessment, prediction and risk analysis of stock development: Shrimp off West Greenland, 2002. *NAFO SCR Doc.*, No. 157, Serial No. N4786.
- HVINGEL, C. 2003. Assessment, prediction and risk analysis: Stock development and production of northern shrimp off West Greenland. *NAFO SCR Doc.*, No. 73, Serial No. N4912.
- HVINGEL, C., and M. C. S. KINGSLEY. 2002. A framework for the development of management advice on a shrimp stock using a Bayesian approach. *NAFO SCR Doc.*, No. 158, Serial No. N4787.
- ICES. 2005. Report of the North Western Working Group. *ICES C.M. Doc.*, No. 2005/ACFM:21.
- LEWY, P., R. Nielsen and H. Hovgård. 2004. Survey gear calibration independent of spatial fish distribution. *Can. J. Fish. Aquat. Sci.*, **61**: 636-647.
- STORR-PAULSEN, M., and O. JØRGENSEN. 2004. Biomass and abundance of demersal fish stocks off West Greenland estimated from the Greenland shrimp survey, 1988-2004. *NAFO SCR Doc.*, No. 39, Serial No. N5125.
- STORR-PAULSEN, M., and K. WIELAND. 2004. A preliminary estimate of cod biomass (*Gadus morhua*) biomass in West Greenland offshore waters (NAFO Subareas 0+1) in 2005. *NAFO SCR Doc.*, No. 70, Serial No. N5040.
- WIELAND, K., AND B. BERGSTRÖM, 2005. Results of the Greenland Bottom Trawl Survey for Northern shrimp (*Pandalus borealis*) off West Greenland (NAFO Subarea 1 and Division 0A), 1988-2005. *NAFO SCR Doc.*, No. 74, Serial No. N5179.

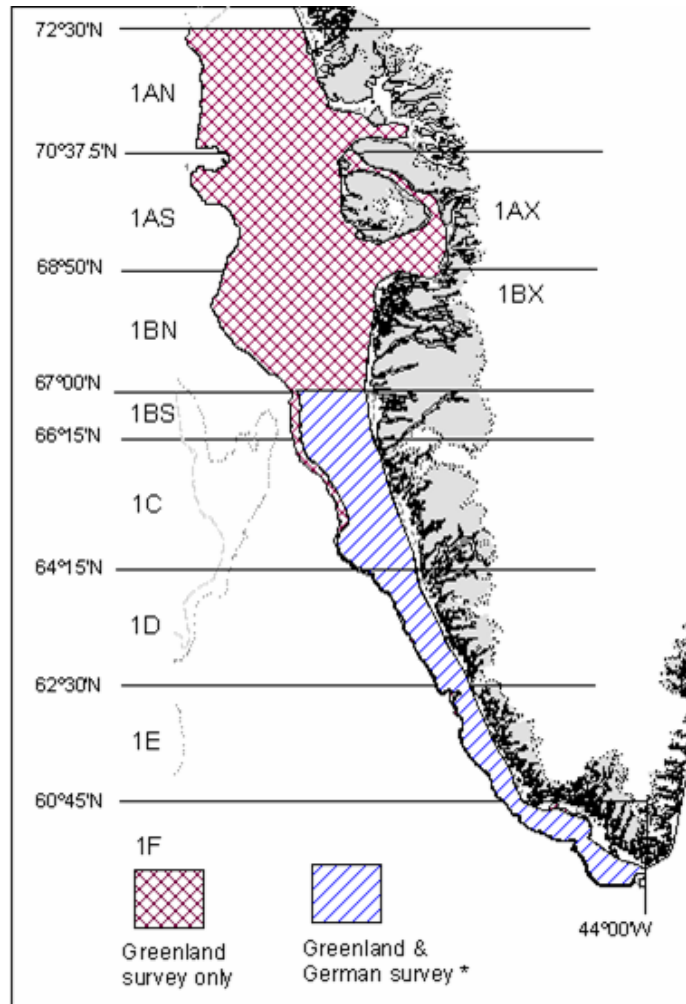


Fig. 1. Survey coverage for the Greenland fish and shrimp survey and the German ground fish survey in West Greenland offshore waters. (*: areas 1BS and 1C was not covered by the German survey in 1995 and in 2001 to 2003).

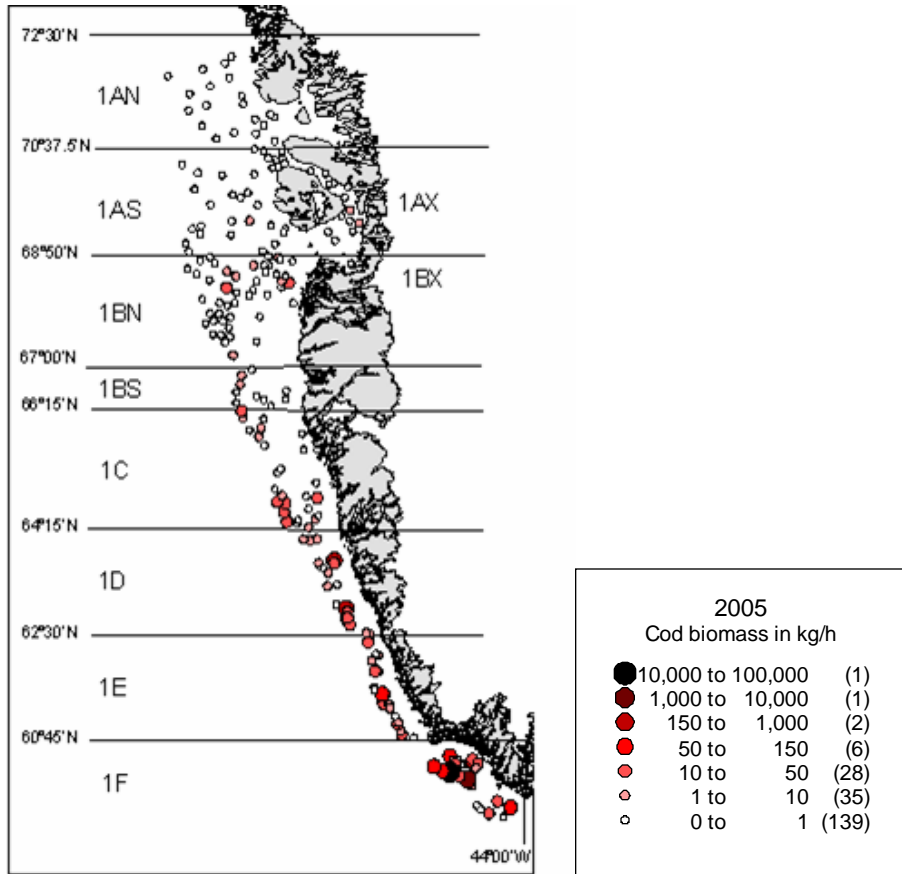


Fig. 2. Geographical distribution of cod density (in kg/h) in the Greenland Bottom Trawl Survey in 2005. Numbers in parentheses denotes number of tows.

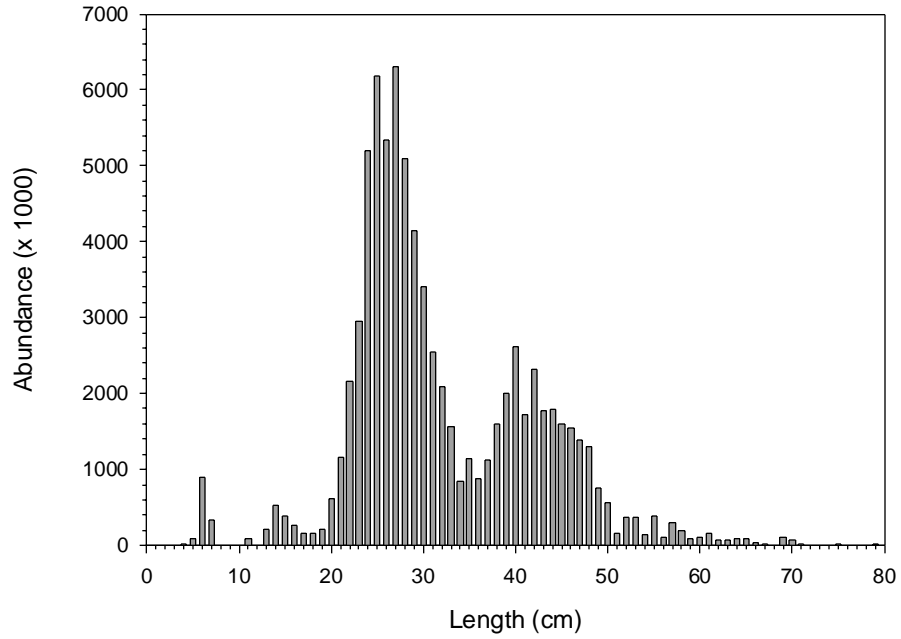


Fig. 3. Length frequency distribution of cod in the Greenland Bottom Trawl Survey in 2005.

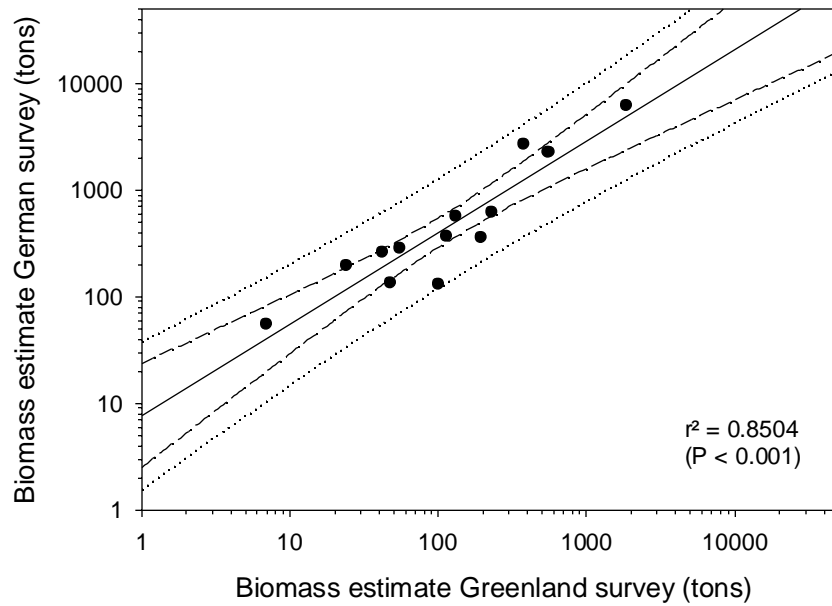


Fig. 4. Relationship between estimates of cod biomass in the overlapping area of the German Groundfish Survey and the Greenland Bottom Trawl Survey, 1992-2004. Dashed and dotted lines indicate limits of the 95% confidence and prediction intervals, respectively.

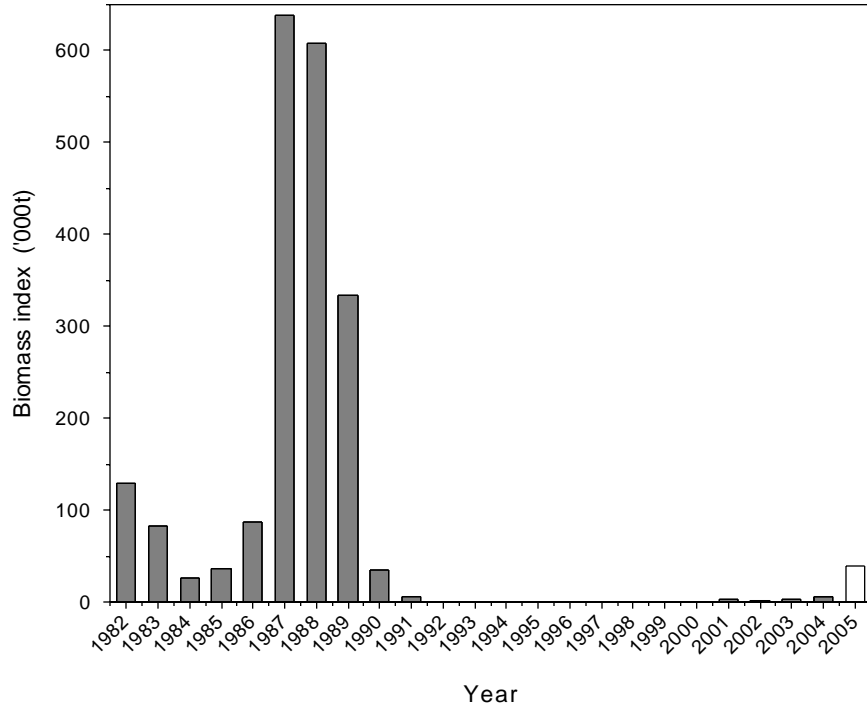


Fig. 5. Cod biomass indices for West Greenland offshore waters, 1982-2005 (1982-2004: original estimates from the German Groundfish Survey; 2005: converted estimate from the Greenland Bottom Trawl Survey).