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Conversion of Northern Shrimp (*Pandalus borealis*) Biomass, Recruitment and Mean Size from Previous Years (1988-2004) to the New Standard Trawl Used in the Greenland Bottom Trawl Survey at West Greenland in 2005

by

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Abstract

The Greenland Institute of Natural Resources has conducted annual stratified-random trawl surveys off West Greenland since 1988. In 1988 to 2004, a *Skjervøy* 3000 trawl equipped with a heavy bobbin footrope was used. This trawl was replaced by a 'rockhopper' *Cosmos* 2000 trawl with a bobbin / rubber disk ground gear in 2005. Calibration experiments carried out in 2004 and 2005 revealed size-dependent conversion factors, which have been used to convert the time series of survey estimates of biomass and abundance, as well as recruitment and mean size at age 2 from the previous years to the new standard trawl. The converted values were consistently higher than the original ones, except for female abundance and recruitment at age 2, which either remained either unchanged or decreased slightly. This, as well as variations in the annual differences between the converted and the original data series were related to the size-dependence of the conversion factors.

Introduction

Since 1988, the Greenland Institute of Natural Resources has conducted annual stratified-random trawl surveys off West Greenland between July and September to assess the *Pandalus borealis* stock biomass and recruitment. The objective of the survey is further to collect information on the size and sex composition of the stock.

The survey was conducted with the research trawler *Paamiut* (722 GRT) since 1991 and similar vessels in the years 1988 to 1990. Initially, a 3000/20-mesh *Skjervøy* bottom trawl with a twin cod-end has been used. Mesh size in the cod-end was reduced from 44 mm to 20 mm (stretched) in 1993, and the fine mesh cod-end has been used thereafter. From 1988 through 2003 the trawl doors were of the type *Greenland Perfect*, measuring 9.25 m² and weighing 2 420 kg. They were replaced in 2004 by *Injector International* 7.5 m² trawl doors with a weight of 2 800 kg to facilitate a change of survey trawl in 2005. In 2005, the *Skjervøy* 3000 trawl equipped with a heavy bobbin footrope was replaced by a 'rockhopper' *Cosmos* 2000 trawl with a bobbin / rubber disk ground gear.

Calibration experiments comparing the *Skjervøy* 3000 and the *Cosmos* 2000 trawl were conducted in 2004 (90 tows) and 2005 (50 tows), in which *Injector International* 7.5 m² trawl doors were used for both trawls and in both years. The calibration study followed the approach outlined by Lewy *et al.* (2004) and is described in more detail by Rosing *et al.* (2005). Mean conversion factors from *Skjervøy* to *Cosmos* trawl catches as obtained from the calibration study ranged from 0.7 to 1.4 for northern shrimp depending on size (Fig. 1), which prevented a simple conversion using a single multiplier.

This document provides a description on the conversion of survey estimates of total biomass and its relative standard error, fishable biomass, abundance of males and females as well as recruitment and mean length at age 2, and compares the converted time series with the original ones.

Material and Methods

In a first step, the original length frequency distributions from each station of the 17 years of the survey time series (1988 to 2004) were converted from the *Skjervøy* 3000 to the *Cosmos* 2000 trawl standard using the conversion factors shown in Fig. 1. Subsequently, converted catches (in weight) by station were computed using length-weight relationships for the respective years or periods as listed in Wieland and Bergström (2005). In some years, however, valid length frequencies were not available for all tows, which reduced the number of stations included in the analysis by about 3 observations per year on average.

The converted catches replaced the original ones and total biomass by survey region or for the entire survey area and its relative standard error were then calculated using the nominal swept area of each tow. The year-specific trawl parameters for the swept area estimation were taken from Wieland and Bergström (2005), which includes a few corrections of erroneous values used in previous analyses.

The converted length frequencies were further used to calculate annual indices of abundance of males and females as well as fishable biomass (all individuals ≥ 17 mm carapace length) aggregated for the entire survey area. Modal analysis (MacDonald and Pitcher, 1979) for the determination of the abundance of recruits and its mean length at age 2 was redone with the converted data using the previous estimates (Wieland, 2004) as initial parameters in the analysis with the MIX software (MacDonald and Green, 1988).

Results and Discussion

Converted and original estimates of total biomass and its relative standard error, fishable biomass, abundance of males and females are shown in Fig. 2 to 5. The difference in total biomass between the converted and the original values amounted 4 % on average and was most pronounced in 1988 to 1990 (8-15%), in 2001 (7%) as well as in 2003 and 2004 (4-5%) (Fig. 2), i.e. in years in which either medium sized males and females dominated the length frequencies (1988-1990, 2003-2004) or small males were highly abundant (2001) (Wieland, 2004). The relative standard error attributed to the estimation of total biomass was almost not affected by the conversion (Fig. 3), except for a few years (1988-1990, 1992, 2002) in which the number of stations suitable for the conversions was lower than in the original time series due to missing length frequencies (two to eight tows per year without valid biological samples). The converted estimates of fishable biomass were between 3 and 20% (average: 9%) higher than the original ones (Fig. 4), which is related to conversion factors above 1.1 in most of the respective size range, i.e. >17 mm carapace length (Fig. 1). Similarly, the converted time series of male abundance exceeded the original estimates by 13% on average whereas female abundance remained almost unchanged (Fig. 5).

The recruitment index (abundance at age 2) based on the converted length frequencies did not change very much compared to the previous values (Fig. 6 upper panel), except for 1996 and 2001 (-15 and -8%, respectively), i.e. in years in which an exceptional high amount of individuals between 8 and 16 mm carapace length was observed (Wieland, 2004). However, mean size at age 2 (Fig. 6 lower panel) was not significantly affected by the conversion (Paired t-test, $P = 0.665$).

References

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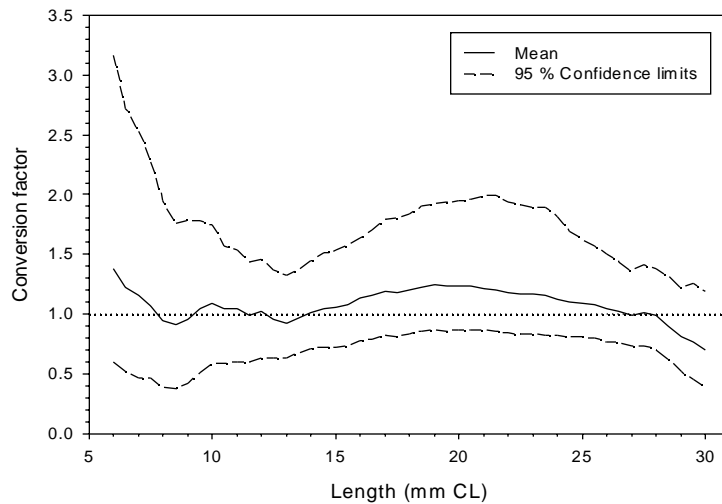


Fig. 1. Conversion factors for *Skjervøy* 3000 to *Cosmos* 2000 trawl catches of northern shrimp (mean and 95% confidence limits, 500 bootstrap replicates, with smoothing over 5 length classes of 0.5 mm CL (carapace length) to each side; Data from Michael Rosing (pers.comm.), see Rosing *et al.* (2005) for further details).

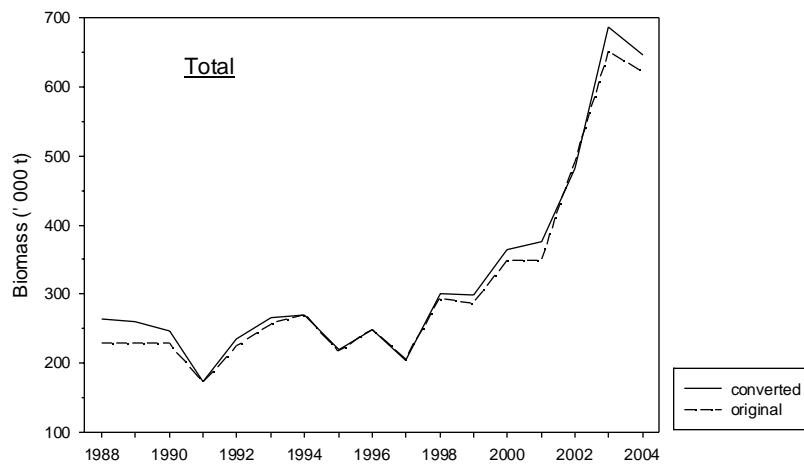


Fig. 2. Comparison of converted and original estimates of total biomass of northern shrimp off West Greenland, 1988-2004.

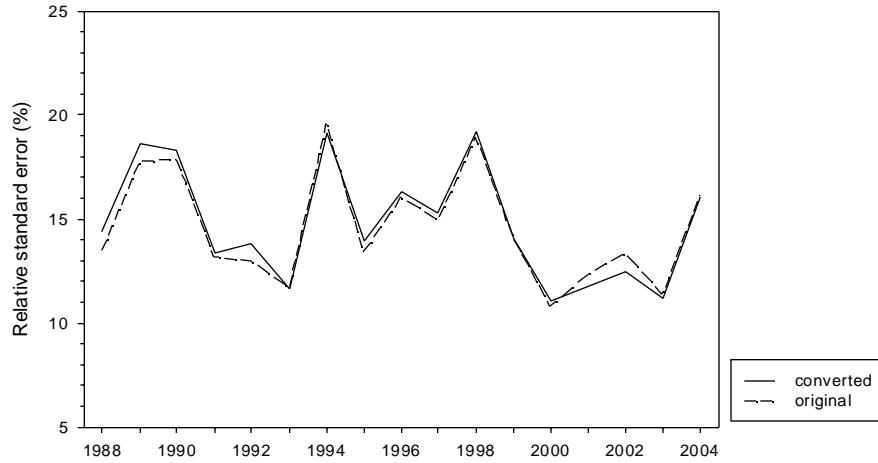


Fig. 3. Comparison of the relative standard error attributed to the converted and the original estimates of total biomass of northern shrimp off West Greenland, 1988-2004.

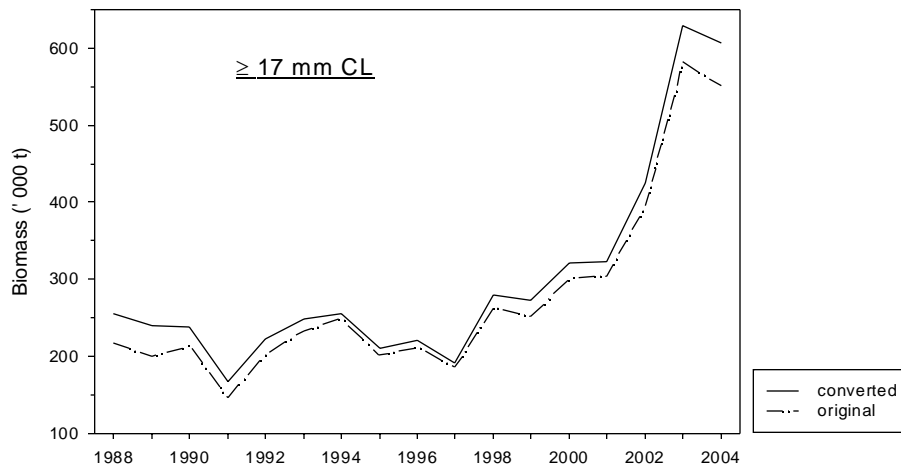


Fig. 4. Comparison of the converted and the original estimates of fishable biomass of northern shrimp off West Greenland, 1988-2004 (CL: carapace length).

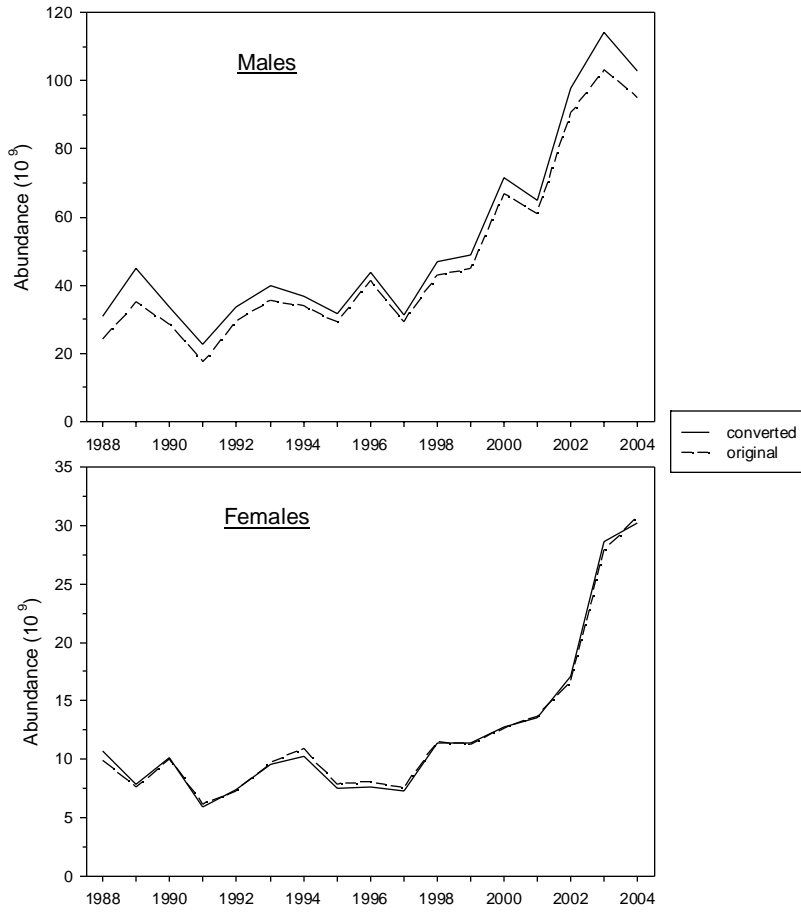


Fig. 5. Comparison of the converted and the original indices of male and female abundance for northern shrimp off West Greenland, 1988-2004.

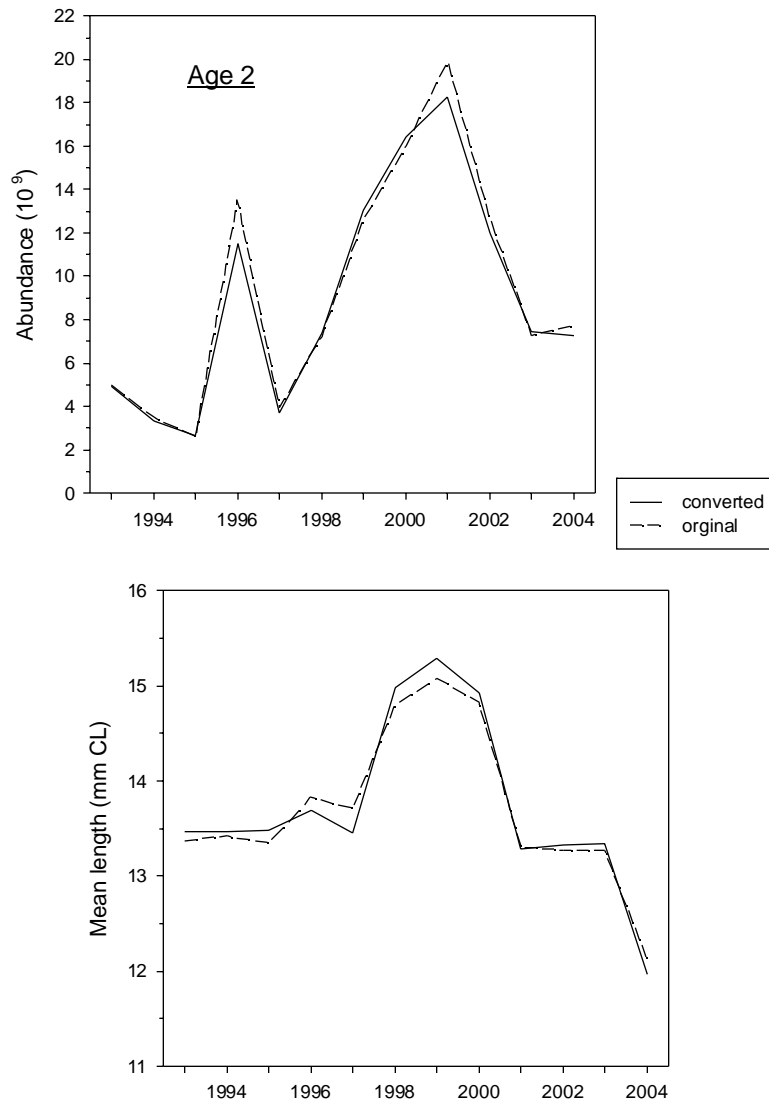


Fig. 6. Comparison recruitment and mean size at age 2 based on converted and original length frequencies for northern shrimp off West Greenland, 1993-2004 (CL: carapace length; mean length: weighted for abundance in the different survey regions).