Age reading from Northeast Arctic cod otoliths through 50 years of history

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Extended abstract

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Historical Northeast Arctic cod data on mean length or weight-at-age and the proportion of mature fish at age, presented at the Arctic Fisheries Working Group in 2001, showed significant temporal trends. For instance, a weak trend for the 5-6 years age groups, indicating an increase in weight-at-age of individuals over the studied period. The trend was stronger for older age groups. An increasing maturation rate was observed for fish of age 4 years and older. The observed temporal trends in biological characteristics required further study in order to find out possible causes.

Researchers faced the question whether the observed changes of biological indices actually occurred in the populations, or were they simply artifacts caused by differences in the fish ageing now and before? In order to answer this question the authors evaluated the possible discrepancies in fish age determination as well as spawning zones numbers by contemporary age readers and the previous generation of specialists. Such discrepancies could influence the interpretation of historical series.

To determine possible variations in age reading between contemporary and historical time period, randomly chosen samples from the period 1940-1980s were re-read in 2003 by two groups of experts. The studied otoliths (N=646) were selected from seven different years spanning almost 4 decades (1947-1982). All original samples were taken in March in Lofoten during fisheries on the spawning grounds. To ensure that the otolith samples of Northeast Arctic cod are not mixed with coastal cod, only otoliths coded as 'Northeast Arctic cod' from the longline fishery samples were selected. Since the maturity ogives used in the ICES assessment change rather abruptly during 1980-1982 for some age groups, otolith samples from each of these years were selected as well. Additionally, the quality of old otoliths being stored in paper bags for more than 50 years was assessed.

Microsoft Access and Microsoft Excel software were used for the data analysis. The values for between-reader biases and their significance levels were determined using one-sample Wilcoxon rank sum test. Coefficients of variation and other statistical indices were calculated using "Age reading comparisons" software. Information on cod weight was not available for all otolith samples, and length data were analysed instead. The significance level of the effect of different age-readers on variability in estimated mean length of fish was calculated using Student's t-criteria.

Although some year specific differences in age determination are seen between historical and contemporary readers, there was no significant effect on age readings discrepancies on length (size) at age (Fig. 1). The analysis of discrepancies in cod age readings made by different generations of specialists indicates that it cannot explain the temporal trends observed in the biological parameters. If the "errors" of historical age reading data observed by the present readers are to be corrected, this would lead to a strengthening of the observed biological tendencies, i.e. a further and more pronounced increase of the growth rates during the studied period.

A small systematical bias in the spawning zones detection was observed, demonstrating that the age at first maturation determined by the present readers is younger than that determined by the historical readers (Fig. 2). The difference was largest in the first sampled years (≈ -0.6 in 1947 and 1957), and it decreased with time (≈ -0.28-0 in the 1970-1980s). The presented bias in determination of age maturation by age readers could hence only explain a small part of the observed changes in mean age of 50% maturation from the 1940s to present.The study shows that the cod otoliths could be reliably used for age and growth studies even after prolonged storage.

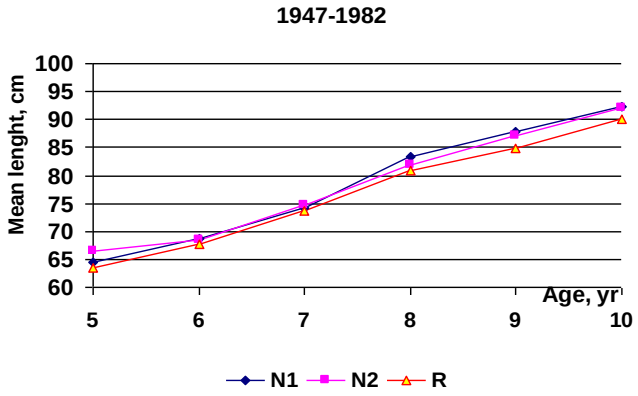

Figure 1. Length-at-age relationship when pooling the data from all years 1947-1982 depending on the age determined by the historic Norwegian readers (N1) and the Norwegian (N2) and Russian (R) present readers. The discrepancies in mean length-at-age were highest in 1967, and lowest in 1980 (see also Fig. 2).

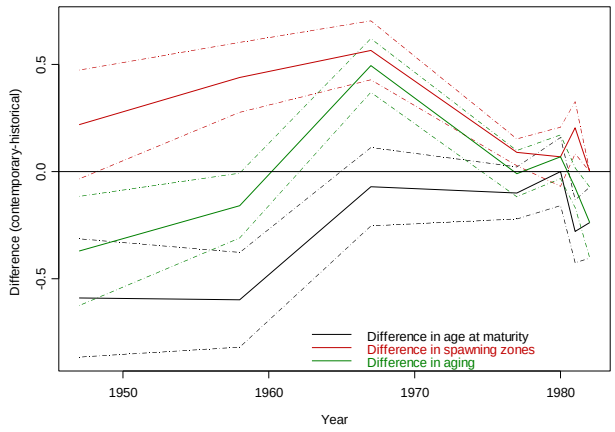

Figure 2. Mean differences in age at first maturity (black (lowest) line) and number of detected spawning zones (red line). The green line shows how the discrepancies in total age of the sampled otoliths varied over the years 1947-1982 (ref. Fig. 1). The broken lines are the corresponding 95% confidence intervals.