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GIANT HERRINGS IN THE ARCHIPELAGO SEA - A GROUP OF FAST-GROWING CANNIBALS

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Abstract. In the commercial herring catches of the Archipelago Sea (SW Finland), exceptionally large herrings (length > 30 cm) are sometimes found. As the reason for the large body size is unknown, we investigated the growth and food composition of these herrings. The alternative hypotheses studied were: (1) fish are big just because they are old, and (2) fish are big because they grow faster. The samples were taken from trapnet and trawl catches and fish were also collected by rod jigging. In the trapnets, large herrings were not found at all, which suggests that they do not spawn with the main population. Large herrings caught by trawl were usually old, whereas those caught by jigging were relatively young individuals which had grown faster than on average. The food of the fast-growing fish consisted mainly of juvenile herrings. It thus seems that the 'giant herrings' can really be separated from the main population according to their growth pattern. Better growth is probably a result of more profitable feeding habits. Giant herrings were caught in the same place in the inner Archipelago Sea every autumn during the years 1986-89. This indicates that the shoals of giant herrings move regularly in the sea area.

INTRODUCTION

In the commercial herring catches of the Archipelago Sea, exceptionally large herrings are sometimes found. According to local fishermen, these herrings are rare and can be caught by coarse gillnets, trawling or rod jigging. The proprotion of large fish in the catches is small, but because of their size, they suit well for the needs of the herring industry. In old literature, these large Baltic herrings are mentioned several times (e.g. Lundberg 1875, Heincke 1898, Schneider 1908, Hellevaara 1914, Kanerva 1930). In these studies, both old age and fast growth have been used as explanations to the existence of exceptionally large fish. Parmanne (1990), on the other hand, didn't observe in his material herrings that would have been exceptionally large or fast-growing. The aim of our study was to determine if a group of 'giant' herrings exists in the Archipelago Sea, and, if so, why are they bigger than normal herrings and what is their food composition.

We are grateful to local fishermen who assisted in sampling the fish. We also thank our team for help and encouragement, especially Jan Eklund who helped with age determinations. The Archipelago Research Insitute of the University of Turku provided the equipment needed. This study was partly financed by the Ministry of Agriculture and Forestry of Finland.

MATERIAL AND METHODS

Study Area

The Archipelago Sea is an important herring spawning and fishery area. It is located in the southwest coast of Finland between the Baltic Sea Proper and the Bothnian Sea. The sea area is shallow and usually covered with ice during winter months. The salinity of the surface water is 6-7 ‰ and, because of the shallowness, no halocline is formed. The fish for study were selected from fishermen's trawl and trapnet catches or were self caught by rod jigging during the years 1986-89 (Figure 1). The mean length of herring catches in the Archipelago Sea is approximately 15-19 cm in trawls (Parmanne 1990) and 15-20 cm in trapnets (Rajasilta *et al.* 1993). In order to obtain and analyse only the possible giant herrings, fish over 25 cm in length were selected from trapnet and trawl catches.

Fish Treatment

Total length, weight, and gonad weight of fish were measured and sex was determined. The developmental stage of the gonads was estimated according to Kesteven (Lagler 1978). Otoliths were taken for age and growth determinations. Qualitative food analysis was also made. The age and growth determinations were made with a microscope using 25x magnification. For growth analysis, the otoliths were ground by hand with sandpaper and

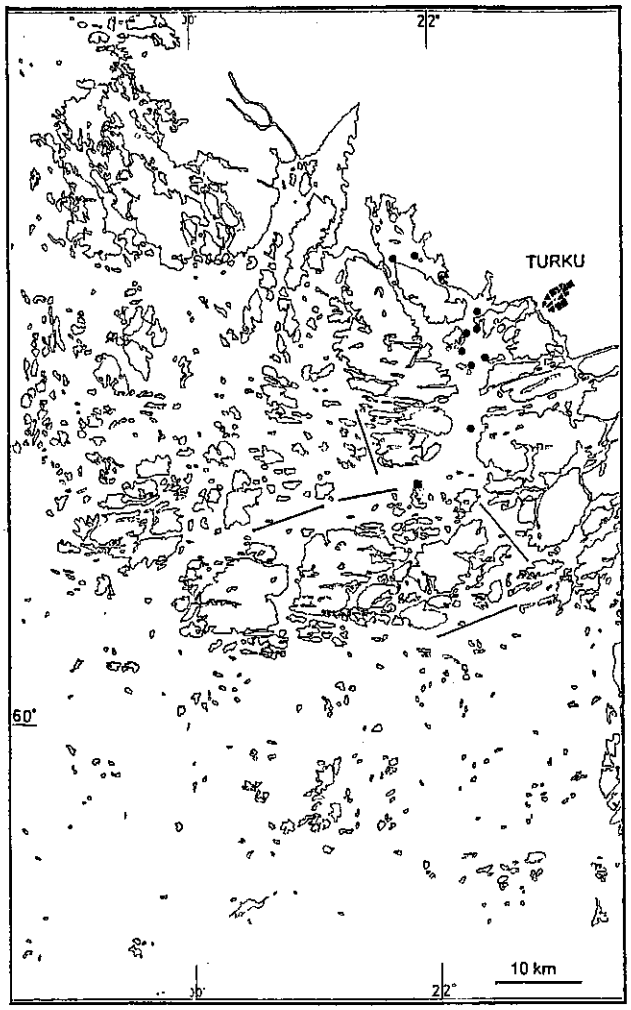

Figure 1. Map of study area and sampling stations. ●=trapnet samples, – =trawl samples, ■=rod jigging area.

rinsed with 3 % hydrochloric acid and fixed with euparal. The otolith length was measured from the nucleus to the edge of otolith. The relationship between fish and otolith lengths was then determined with regression analysis (Figure 2) and the back-calculation of length was then made using modified Lea's formula (Bagenal and Tesch 1978). Only fish caught by jigging were used for this. A large sample of trapnet herrings was used as a reference population for growth studies and their growth was estimated according to age and length data.

Statistical Analyses

The SAS software package (SAS Institute Inc. 1988) was used for regression analyses. The growth curves of herrings were compared by testing the regression lines with t-test (Sokal and Rohlf 1981).

RESULTS

The proportion of large herrings in trapnet catches was small: only 1.8 % of fish were over 25 cm and none over 30 cm. The best method to catch large herrings was jigging, as 95% of jigged fish were larger than 25 cm. The mean length of jigged fish was the highest in every age group studied. Large herrings caught by trawl were older than jigged fish of the same length group (Figure 3). Thus, the possible giant herrings were most likely to be found among the jigged fish and the back-calculation of length was made using only this group (Figure 2). We found clear differences in the growth curves of fish caught by trapnet and jigging rod: jigged herrings had a sharper growth curve (Figure 4) and also their linear growth was significantly faster ($t=5.147$, $p<0.001$) (Figure 5). Their gonads were maturing or ripe already in the autumn. The food of jigged herrings consisted mainly of juvenile herrings, although small amounts of crustaceans (*Gammarus sp., Idotea sp., Crangon crangon*) were also present.

DISCUSSION

The growth of trapnet herrings in the study area was similar to the usual herring growth rate off the Finnish coast. The growth of jigged herrings, however, was much faster. Corresponding fast-growing herrings have also been found off the Estonian coast (Rannak 1988). The growth rate of giant herrings seems to accelerate after their 2nd year of life. This may be due to improved feeding conditions caused by a change to a fish diet. It is mentioned in the literature that large herrings eat fish to some extent (e.g. Kanerva 1930, Koli 1984). In our material, large herrings from trawl catches had also eaten some fish, but the jigged giant herrings were strongly specialized and mainly cannibalistic. Cannibalistic feeding behaviour is common in fishes and in many fish species the cannibalistic forms are larger or even giant-like (Polis 1981).

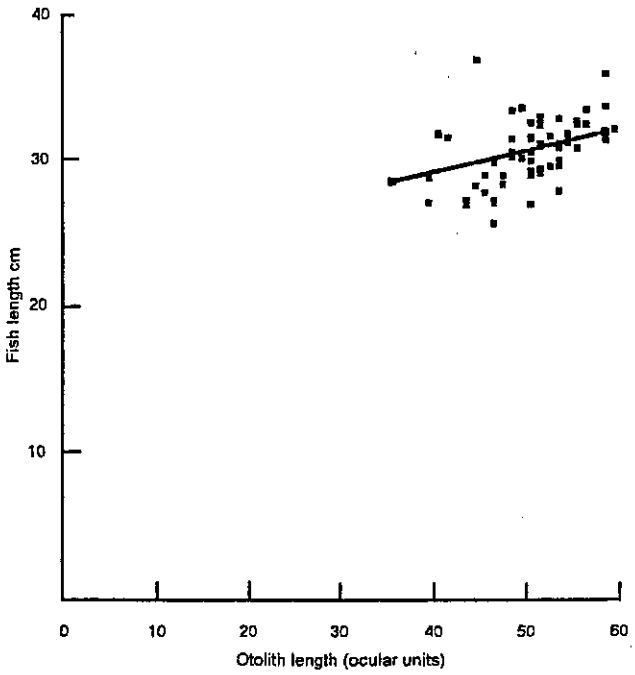

Figure 2. Regression line between length of fish and length of otolith for back-calculation of lengths. According to regression modified Lea's formula is $L_n-233=S_n/S\times(L-233)$

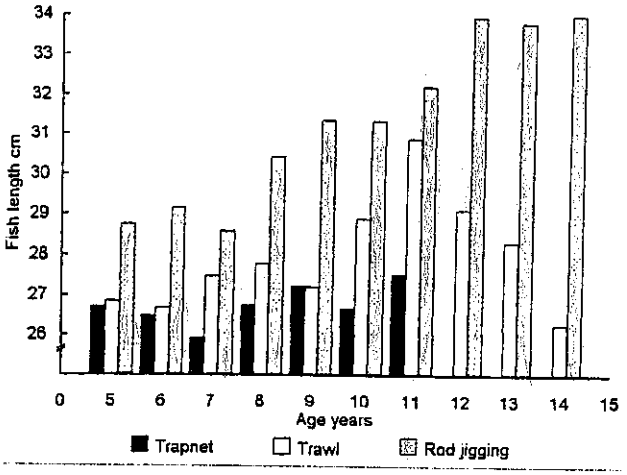

Figure 3. Mean lengths of different age groups in trapnet, trawled and jigged herrings.

The spawning time of giant herrings is not known but on the basis of the gonad maturation stages it could be in early spring. Herring spawn has been found in the Archipelago Sea as early as in January. The abundance of food throughout the year would make it possible for giant herrings to spawn earlier than the main population. The absence of giant herrings in trawl catches (Parmanne 1990) may be a result of their better condition and swimming ability. They can either avoid the trawl or swim away from the trawl net.

It seems that the 'giant herrings' can really be separated from the main population according to their growth pattern. Their better growth is probably a result of improved feeding habits. Giant herrings were caught in the same place in the inner Archipelago Sea every autumn during the years 1986-89. This indicates that the shoals of giant herrings move regularly in the sea area.

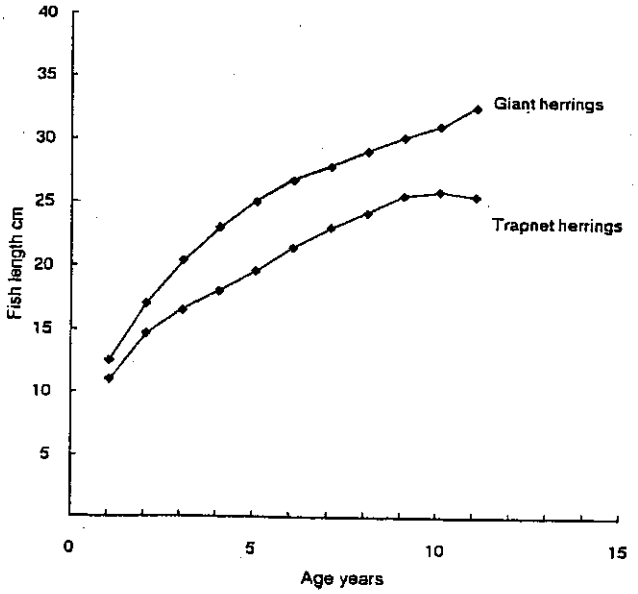

Figure 4. Growth curves of jigged and trapnet herrings. Curve for jigged fish was made using the back-calculation of length, curve for trapnet fish - according to age and length data.

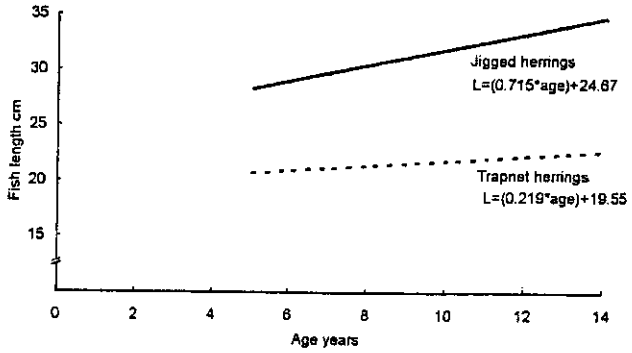

Figure 5. Regression lines between length and age of jigged and trapnet herrings. Regression was calculated using the area of linear growth of the growth curve.

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