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Beaver Harbour Herring Sampling Experiment

by

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Introduction

A sampling experiment to examine the variability of length samples was carried out on two herring landings at Beaver Harbour, N. B., on August 14 and 15, 1974. Beaver Harbour is located approximately 25 miles east of St. Andrews, N. B., on the western side of the Bay of Fundy. The catches sampled were processed as food.

When herring are unloaded from carrier boats at Beaver Harbour, they are pumped into large storage tanks prior to processing. Samplers from the St. Andrews Biological Station normally take a sample of about 200 fish per carrier by dipping a bucket in the top of one of the tanks. All undamaged fish are measured and 3 fish per 1/2 cm length group are retained for ageing and biological sampling.

In the fisheries literature (e.g. Gulland (1955)), such a sampling scheme is assumed to be random in the sense that each combination of 200 fish is equally likely to appear as a sample. The consequence of this assumption is a multinomial distribution for the number of fish in each length class in the sample.

Purpose

The Beaver Harbour experiment was designed to test two aspects of the multinomial hypothesis:

(1) Is there a trend in size composition from the top to the bottom of a storage tank? (bias)

(2) Is the multinomial estimate of within landings variation reasonable, or is there enough clustering of fish of similar sizes to inflate the within landings variance?

A secondary purpose of the experiment was to examine the validity of the current theory of age-length keys. This aspect will be described elsewhere.

Materials and methods

The usual St. Andrews herring sampling apparatus was used with the addition of a long-handled dip net for sampling the tank bottoms.

The statistical design was a two factor, crossed design replicated four times. One factor was the position in a tank from which a sample was taken (top or bottom) and the other was the landing (two landings were sampled). Samples were taken from four tanks for each landing.

On August 14, 1974, samples were taken from the landing of the *Fairhaven Queen*. On August 15, the landing of the *Sharonka* was sampled. All fish were caught off Long Island shore. On the first day, the experimenter was present while the pumping was in progress so that bottom samples were taken with a dip net while the tanks were filling. On the second day, the tanks were full when the experimenter arrived so that bottom samples were taken by opening the emptying doors of the tanks.

Eight samples of approximately 100 fish each were taken from each landing.

All undamaged fish were measured to 1/2 cm below and one fish per 1/2 cm group was retained for further measurements.

Observations and analysis

As is illustrated by the length frequency histograms, both landings were extremely homogeneous, with most fish within 1 1/2 cm of 28.5 cm in length. A t-test for the difference of mean lengths between landings was not significant. A difference of 0.2 cm would have been detected with probability 0.5 and a difference of 0.4 cm in mean length would have been detected with probability 0.95.

Several large (>30 cm) mackerel were found in the samples. They were much more abundant in samples from the tops of the tanks and may account for the smaller size of the top samples.

As is evident from the histograms of the combined top and bottom samples, any bias must be negligible. It was not considered worthwhile to examine the bias further.

The serial correlation between successive length groups within samples was calculated. No evidence of a non-zero correlation was found.

A chi-squared test was carried out for each landing to test the multinomial distribution hypothesis. The statistic was not significant in the case of the *Fairhaven Queen*, but was, in the case of the *Sharonka*, significant at the 95% level. Thus, there was some evidence that the multinomial variances were too small.

In the *Sharonka*, the variances observed in the numbers per 1/2 cm group were, on the average, 8% higher than those predicted by the multinomial model.

Conclusions

The test for bias was negative, but the length range of the catches was so limited that a mechanical sorting by length in the pumping process was not ruled out in general.

Bearing in mind the slight variation, even between landings in the lengths observed, the negative outcome of this experiment does not justify the multinomial hypothesis even though there is insufficient evidence to reject it firmly.

Reference

Gulland, J. A. (1955) Estimation of Growth and Mortality in Commercial Fish Populations. Fish. Invest. Ser. II, Vol. 18, No. 9.

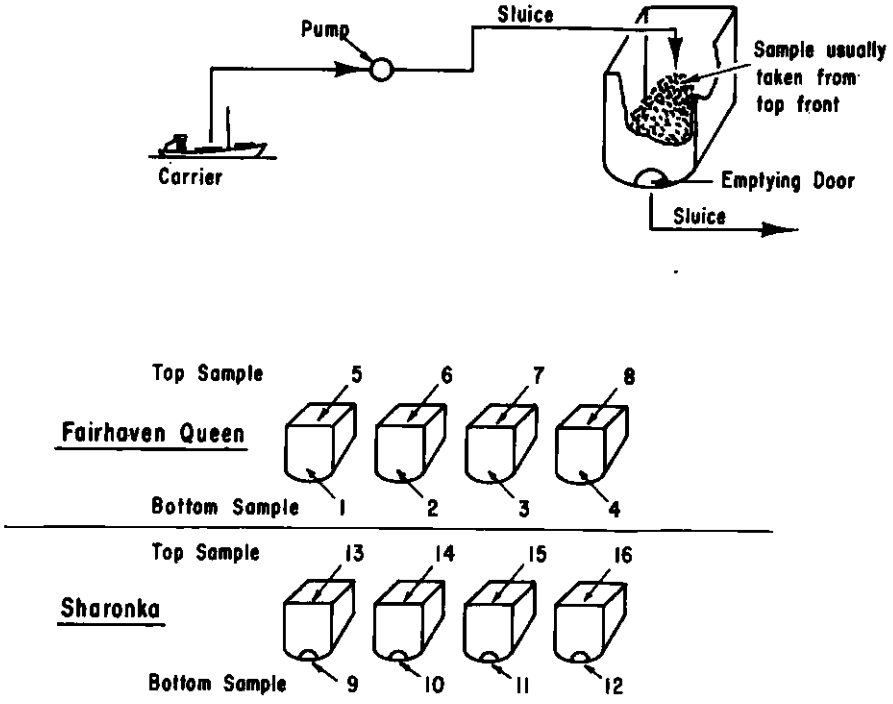

Fig.1 Sampling Design

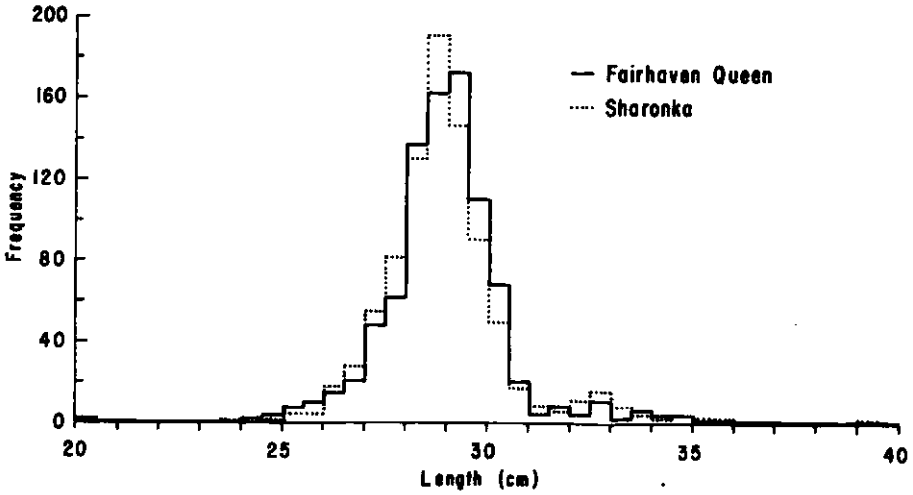

Fig.2 Length Composition of Two Landings

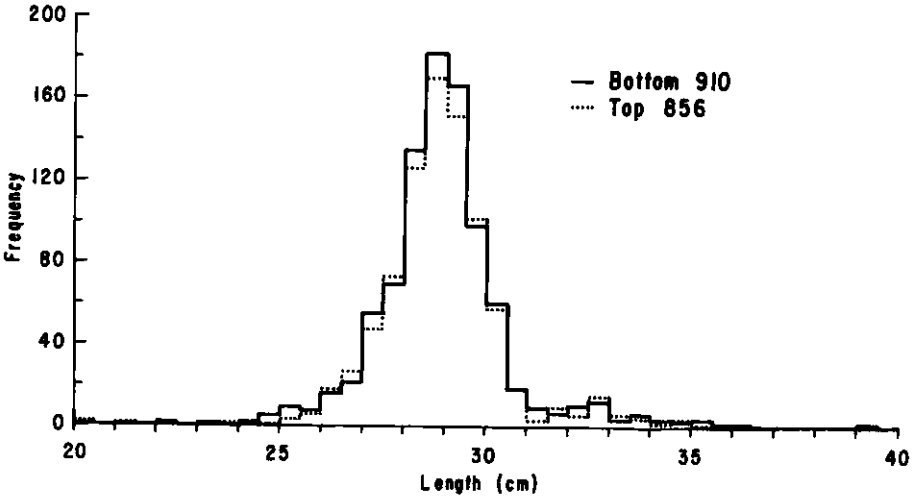

Fig.3 Comparison of Top and Bottom Samples