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The size of sample in calculating the length composition of herring in Polish commercial catches on Georges Bank during the period from August to October 1973

by

M. Giedz
Sea Fisheries Institute
Gdynia, Poland

Introduction

The estimation of length composition of herring catches was based on mass measurements carried out from August to November, 1973, in the region of George's Bank grounds. Measurements were taken immediately after hauling the trawls on board. The subject of the measurements was the overall length of herring with an accuracy of 0.5 cm. Intermediate lengths were evened to the lower limit of the class interval. Fish for measuring were chosen at random from individual hauls by mid-water trawls. The number of samples and specimens is given in Table 1.

The objective of this paper is to define the minimum size of sample required to ensure that the material collected is representative of the whole.

Method

The accuracy of determining the mean length of herring depends, among other things, upon the size of sample taken for assessment. The true length is unknown, therefore it is calculated on the basis of an initial sample which is accepted as being similar to the size of herring caught by a commercial vessel during the autumn fishing season.

It is assumed that the length composition of herring is similar to the normal. The estimating of the mean length of herring will be given error "d", which can be calculated from measurements of the initial sample. Accuracy of assessment is measured by the confidence limit in which confidence coefficient "a" must be assumed.

If "a" is relatively low, the assessment error will not exceed "d".

The number of fish in a representative sample is calculated from the formula:

$$n = \frac{N}{1 + \frac{Nd^2}{t^2S^2}}$$

where: n = number of fish in a representative sample

N = number of herrings caught

d = error

S² = variance

t = 1-a ; a = confidence coefficient.

Results and discussion

To determine the size of sample necessary to assess the length composition of herring catches, measurements were carried out on a commercial vessel during the autumn fishing season. These measurements were treated as preliminary samples and parameters necessary to assess herring length were calculated. In these calculations, the confidence coefficient of a = 0.05 was assumed.

Table 2 gives the results of calculations.

The size of a representative sample needed to assess the length of herring caught, determined on the basis of individual measurements, amounted to between 100 and 1500, with a relatively small variance, error and number of fish per sample /Table 2/.

This value can be taken as the sum of between 4 and 6 subsamples, each of which comprises at least 270 observations.

It can be seen from the data in Table 2 that there is very little variance between individual samples of from 270 to 400 fish: from 0.2 to 0.7. 270 can thus be accepted as a sufficient number of fish for a sub-sample.

The largest herring catches are from August to October, therefore observations covering length measurements must be carried out during that time. The following represent the values of variance in individual months:

August	from 0.18 to 0.70
September	from 0.25 to 0.65
October	from 0.16 to 0.52

This indicates that the herring population was well balanced and could be evenly sampled by taking two measurements every month. Table 1 gives the number of observations carried out to determine the length of herring caught. They were much higher than the number of fish per sample calculated on the basis of analysis. This illustrates that the samples taken on vessels from the Polish fishing fleet were fairly representative.

According to ICNAF recommendations, one sample of 200 fish should be taken every quarter, for every 1000 tons caught, to estimate the parameters of the fish population. As Poland's herring catches in the autumn season amount to about 40.000 tons, the number of fish from all sub-samples would amount to 8.000. During the period from August to October, 74 mass measurements consisting of over 24.000 observations were carried out. This is three times the number recommended.

Literature

1. Zasspa R. 1962. Badania statystyczne metodą reprezentacyjną. PIW. Warszawa 1962.

T a b l e I

The number of herring measured on board of the Polish fishing fleet during the period of August - November 1973 in the George Bank area

Month	August	September	October	November
Number of samples	20	37	17	3
Number of measurements in sample	272-441	299-401	305-407	385-397
The total measured in all samples	6750	12 174	5 778	1 168
Catch in numbers	16·10 ⁶	92·10 ⁶	130·10 ⁶	1,5·10 ⁶
Catch in tons. tons	2.6	16.2	19.7	0.2

Table II

The parameters of length distribution of herring stock in George Bank in 1973

No. of hauls	Month August				Month September				Month October				Month November			
	$N = 16 \cdot 10^6$	σ^2	d^2	n	$N = 92 \cdot 10^6$	σ^2	d^2	n	$N = 130 \cdot 10^6$	σ^2	d^2	n	$N = 1.5 \cdot 10^6$	σ^2	d^2	n
1.	3.8	0.4269	$12 \cdot 10^{-4}$	1352	3.8	0.4185	$12 \cdot 10^{-4}$	1325	3.8	0.2055	$6 \cdot 10^{-4}$	1301	3.8	0.5524	$14 \cdot 10^{-4}$	1300
2.	"	0.4514	$13 \cdot 10^{-4}$	1319	"	0.5168	$17 \cdot 10^{-4}$	1455	"	0.5965	$19 \cdot 10^{-4}$	1193	"	0.3614	$9 \cdot 10^{-4}$	1055
3.	"	0.2417	$7 \cdot 10^{-4}$	1312	"	0.4143	$12 \cdot 10^{-4}$	1312	"	0.1644	$5 \cdot 10^{-4}$	1249	"	0.5089	$13 \cdot 10^{-4}$	1487
4.	"	0.5274	$2 \cdot 10^{-3}$	1020	"	0.5413	$16 \cdot 10^{-4}$	1582	"	0.2595	$7 \cdot 10^{-4}$	1409	"	"	"	"
5.	"	0.1815	$5 \cdot 10^{-4}$	1379	"	0.2645	$7 \cdot 10^{-4}$	1436	"	0.324	10^{-3}	1231	"	"	"	"
6.	"	0.4061	$12 \cdot 10^{-4}$	1286	"	0.6555	$24 \cdot 10^{-4}$	1186	"	0.3042	10^{-3}	1156	"	"	"	"
7.	"	0.703	$22 \cdot 10^{-4}$	1214	"	0.5215	$17 \cdot 10^{-4}$	1166	"	0.3309	$11 \cdot 10^{-4}$	1143	"	"	"	"
8.	"	0.5291	$14 \cdot 10^{-4}$	1463	"	0.2785	$7 \cdot 10^{-4}$	1512	"	0.1852	$5 \cdot 10^{-4}$	1407	"	"	"	"
9.	"	0.3885	$12 \cdot 10^{-4}$	1230	"	0.2499	$8 \cdot 10^{-4}$	1187	"	0.5206	$15 \cdot 10^{-4}$	1319	"	"	"	"
10.	"	0.4389	$13 \cdot 10^{-4}$	1283	"	0.4751	$13 \cdot 10^{-4}$	1189	"	0.4140	$12 \cdot 10^{-4}$	1311	"	"	"	"

Terminology :

- N - number caught per month
- $t = /1-0,95/$ a = 0,05 confidence coefficient
- σ^2 - variance
- d - error
- k - number of measurements per sample
- n - required number of measurements per sample for estimating the herring population.

