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Some proposals on the requirements and presentation of data for fish population studies

by

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A. GENERAL

During the past few years the importance and extent of fish population research, as the basis for fishery assessment, has been steadily increasing, for practically all areas and species covered by the I.C.E.S. Nearly all the major stocks of these fish are, however, fished by the fleets of several nations, and often by more than one type of gear. The areas of operation of the various fleets are sometimes similar but usually they cover somewhat different parts of the same stock. As a result it is difficult, if not impossible, for the research effort of any one country to obtain a true picture of the size-composition and age-composition of the stock and of the effects of fishing - by that and other countries - on it. Yet this is essential if reliable and accurate assessments are to be made - which is, after all, one of the primary aims of fish population research.

The need, in this connection, for detailed and up-to-date information on commercial catches and fishing efforts by all countries is well appreciated and progress is being made in making this kind of data available promptly and economically, as instanced by the recent issue by I.C.E.S. of its Statistical News Letter No. 1 for herring catches and efforts. Complementary to this information, and equally important for purposes of assessment, is a knowledge of the size-composition and age-composition of the catches of each of the fleets fishing on a stock. A certain amount of data of this kind is published in the Annales Biologiques, but the rapidly growing requirements of population research might be better served if this and other relevant information (e.g. research vessel sampling, where available) could be presented in a companion edition of the Statistical News Letter devoted especially to it. The purpose of this note is to put this proposal forward for consideration, and to discuss some of the questions that would arise in collecting and presenting material for such a publication.

1. Although both the size-composition and age-composition of the catch and population are needed, it is often much easier to sample in quantity for length rather than age. Moreover, the relation between age and length - (in effect, the growth rate) will be much the same for all fisheries based on the same stock, except in some cases for slight regional differences which would not be difficult to allow for. It would therefore be most useful to present length compositions separately from age-length keys when both are available, so that the latter can be used to convert length to age in fisheries where no direct age-determinations have been made.

2. Because of the marked differences often found between the size-composition of the catches obtained by different gears from the same stock (e.g. trawls and seines), or at different times and seasons, the material needs to be sub-divided according to gear, season and fishing ground so that each set of data refers to conditions which are, as far as possible, uniform. The choice of sub-division will depend upon the degree of variation of size-composition etc., within various parts of the stock, and also on the amount of data available. From what is already known about some of the major stocks, it would be possible to draw up a working plan suitable for most countries.

3. Since the main purpose in presenting stock data in the way proposed is that they could be put together and so give a better knowledge of the stock than if treated separately, it is clearly of great importance that they should be, as far as possible, of a standard form. This involves making the observations in a standard manner, as well as presenting them in a standard way. Otherwise, attempting to combine data of different kinds from different sources may give seriously misleading conclusions. The standard presentation of age-data, whether by year-classes or age-groups, seems to raise no problems, except possible for herring. They may be expressed as a percentage or, better, as numbers per unit effort. For length data there is some disagreement of method, which was discussed at the joint I.C.E.S. - F.A.O. - I.C.N.A.F. meeting in Lisbon last May. The remainder of this note is concerned with a re-appraisal of this question, including some recent test observations.

The length measured can be either the fork length or the total length, and can be recorded to the nearest centimetre, or to the nearest centimetre below. The various measures are not much different (fork length and total length are exactly the same for many species, e.g. plaice), and conversion of an individual observation from one scale to another can readily be done. However, the conversion of numerous or grouped data (e.g. converting the percentage of fish between 25 and 29 centimetres from one scale to another), is tedious. The choice between the method of recording (cm. below or nearest cm.) seems to be purely arbitrary; the practical difference is merely a matter of offsetting the scale relative to the measuring board and does not affect the actual measuring in the slightest. At the Lisbon Meeting it was generally agreed that the nearest centimetre should be used, and several countries at present using the other system, including England, agreed to change and thus make for greater uniformity.

The two lengths which may be recorded are so closely correlated as to give equally valid measures of the size of fish, but for some species definite differences in the practical method of measuring are involved. These differences may give an appreciable advantage in accuracy or speed of measuring to one or other method. Some investigation into this aspect of the problem in the case of haddock (where the absolute difference between fork length and total length is fairly marked) was carried out on board R.V. PLATESSA in July 1957. Four observers took part, three of whom had considerable experience of measuring fish to the total length, (but not to the fork length). The times taken to measure 47 haddock by each observer and method are given in the following table:

Observer		Total length	Fork length
A)	Experienced in	2 min. 9 sec.	2 min. 40 sec.
B)	using total	2 min. 20 sec.	2 min. 15 sec.
C)	length	2 min. 25 sec.	3 min. 15 sec.
D.	No experience	4 min. 40 sec.	4 min. 45 sec.

It was very noticeable that Observer C in particular used more care in measuring to the fork length and his increased time is in part due to this, rather than to any added difficulty in measuring fork length. However all observers noted that when the tail was frayed the "fork" as such did not exist,

and a search had to be made for the shortest fin-ray - a lengthier process, than finding the longest fin-ray. This objection was partly offset by the fact that this shortest fin-ray lay parallel to the measuring ruler, and not at a variable angle to it, as is often the case with the outer fin-rays used for total length.

The relative accuracy of the two methods was estimated (perhaps in not the most sensitive manner) by computing the number of discrepancies between the cumulative frequencies of observers A and B, and also between C and D. These are given in the table:-

	Total length	Fork length
Between A and B	17	7
Between C and D	12	10

On this evidence the advantage is to fork length, but this is partly accounted for by the greater care taken in measuring fork length, as mentioned earlier.

In general the differences between the methods seem only slight, and with the amount of dissimilar data increasing every year it seems most desirable to adopt one or other method as standard now, even if detailed analysis should show it not to be exactly the best in every case.

For larger fish, e.g. cod, 1 cm. groups are too fine for most purposes, and some grouping is desirable. The grouping generally used by I.C.E.S. countries is 5 cm., i.e. 20-24 cm., 25-29 cm., etc.

In comparing and combining mixed sets of data, some measure of the confidence to be attached to each set is important. One obvious measure is the number of individual observations made (length measurements, age-determinations etc.). Statistical analysis has also shown that because of the big differences often found between samples, the number of samples taken greatly influences the accuracy of the data. Both measures (i.e. number of measurements and number of samples) should therefore, if possible, be reported.

SUMMARY

1). Some basic requirements for fish population analysis and fishery assessments are outlined. These are:-

(a) Uniform methods of fish measurement. If a uniform system is not used, the method used should be clearly stated.

(b) Numbers caught in each length-group by commercial fleet, sub-divided as far as possible by method of capture, area and season. The number

of measurements and number of individual samples should also be noted.

(c) Age-composition, as numbers per unit effort, either by research vessel, or commercial fleet. Again divided by method of capture, area and season, and giving number of samples used.

(d) Age-length relation, giving for fish of a given length-group, the proportion of each age. The number of fish examined at each length should also be noted.

Some examples of data for the English North Sea plaice fishery, arranged as far as possible to conform with the above requirements, are given as an appendix below.

2). It is proposed that these kinds of data could be made available most promptly and cheaply in a mimeographed Ichthyometric News Letter similar to that recently issued for herring statistics.

Table 1.

Estimated length - composition of total landings of plaice from the North Sea at Lowestoft in each month of the second quarter, 1956. Gear used was otter trawl. Length measured to the centimetre below.

Length group (cm).	Total Number Landed		
	April	May	June
20-24	3,161	7,087	3,526
25-29	703,702	399,761	305,847
30-34	596,727	500,216	480,592
35-39	181,315	162,583	157,757
40-44	42,319	38,495	62,921
45-49	12,353	14,794	31,435
50-54	3,176	5,116	18,139
55-59	513	1,123	6,888
60-64	70	237	2,995
65-69		72	101
70+			11
Total	1,543,336	1,129,484	1,070,212
Number of Ships Sampled.	31	33	31
Number of Fish Measured.	7,886	9,010	8,954

Table 2.

Age-length key for North Sea plaice based on fish landed by trawler at Lowestoft, April 1956 - March 1957.

Age-determination by otolith. Length to centimetre below.

Length (cms) \ Age	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XII +	Age Doubtful	Total Examined
25/29	22	139	170	15	12		1															359
30/34	3	32	156	54	71	23	14	7														360
35/39			33	38	94	61	50	59	14	8	3									3		360
40/44			1	9	61	34	40	42	24	11	9	6	2	2						19	2	243
45/49				2	14	20	39	57	49	19	13	9	6	4	2		1			35	5	240
50+					2		10	29	53	28	29	25	24	15	7	7	3		2	112	8	242
Total	25	171	360	118	254	138	154	194	140	66	54	40	32	21	9	7	4		2	169	15	1,804

Table 3.

North Sea Plaice. Catch per 100 hours fishing of each age-group, 1956. Based on trawl catches at Lowestoft.

Length Group (cm.)	LOWESTOFT TRAWL 1956		
	Numbers ('000)	%	No. per 100 hours
20-24	42	0.30	18
25-29	4,644	32.42	2,031
30-34	5,632	39.32	2,463
35-39	2,311	16.13	1,011
40-44	1,016	7.09	444
45-49	451	3.15	197
50-54	160	1.12	70
55-59	51	0.35	22
60-64	16	0.11	7
65+	1	0.01	1
Total	14,326	100.00	6,264
Weight of total catch (cwt.)	100,327		
Weight (cwt.) per 100 hours fishing	43.87		
Hours fishing	228,701		