INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

Serial No. 871
(D. c. 8)

Document No. 23

ANNUAL MEETING - JUNE 1961

Mesh-Measurement Gauges for Cod-Ends

by H. Bohl[1)]

Among the measures taken for the protection of endangered fish stocks, the establishment of minimum mesh sizes is of particular importance. One of the tasks of fisheries science is to obtain, by selectivity experiments and thorough stock investigations, the knowledge required for a reasonable establishment of the sizes of regulation meshes.

In all selectivity experiments measuring gauges, by means of which the mesh size can be determined exactly, are indispensable. These gauges are important not only for scientific work, but also for the enforcement of the legally prescribed minumum mesh sizes in commercial fisheries.

The technique of measuring meshes has improved greatly during the last decade, leading from the yard-stick over the measuring plates - generally tapered at one side - to the modern pressure gauges. The following considerations were taken into account:

1. "The distance between the inside edges of opposite corners of a mesh when it is stretched so that its sides lie parallel to each other" (16) is, with regard to the selectivity of a net, the only really useful measure of the mesh size. Other characteristics of the mesh size - for instance, the number of knots per a length-unit or the mean length of several neighbouring legs of meshes including the knots - are unsatisfactory. Thus the yard-stick cannot be used as a measuring instrument.

2. Principally, a certain effort is required for any mesh measurement, in order to stretch the mesh. Owing to the elasticity and distensibility of the net twines, the measuring pressure must be uniform and controllable; otherwise different measuring results are unavoidable because the gauges cannot be handled consistently. Therefore, the simple measuring plates without pressure indicators are also obsolete.

Thus circumstances required the design of a gauge which could precisely control the pressure used for the measurement. This concept was first realised in a simple way by the United States. They inserted a dynanometer spring into the handle of a measuring plate, which spring was compressed to a pressure mark during measuring.

In this form the first pressure gauge (8) was introduced into the ICNAF area. It could be proved by the British and the Dutch that substantially more consistent results could be obtained with the ICNAF gauge than with the simple measuring plates working without pressure control (2, 3, 11).

The development of the ICNAF gauge, however, was not yet the final step. Other pressure gauges were designed - at first in Scotland and also in other countries - all of which differed from the ICNAF gauge. With all of these gauges, the mesh is stretched during the measurement by a force which does not, like the ICNAF gauge, exert pressure vertically

1) Institut für Netz- und Materialforschung, Hamburg.

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towards the mesh-level, but longitudinally in the direction of the mesh-axis. In this way the direction of the pulling effort occurring in the meshes of the towed cod-end is duplicated.

It would also be useful to adapt the amount of effort to be used for the measurement to the conditions of the trawl fishery. Very little, however, is known about these conditions at present. According to German investigations (13), the stresses to which the individual legs of mesh in the anterior part of the net are exposed during towing under "normal" conditions fluctuate between 2 and rarely more than 10 kg. At the anterior edge of the lengthening piece, stresses of 3 to 5 kg have been measured. These values, which do not take into consideration high waves and heavy catches in the net, were, of course, insufficient to establish the measuring pressure. Therefore, there remained only the possibility of an arbitrary standardisation of the measuring pressure. After lengthy discussions, the Mesh Selection Working Group of ICES agreed in December 1960, that a pressure of 4 kg1) is most suitable for double manila, double hemp, double cotton and thick, single manila, as used in trawl cod-ends. When lighter and thinner twines are used, a lower pressure may be necessary In any case, the pressure used for mesh measurements should be mentioned in publications (16).

It has been proved that the longitudinally-acting pressure gauge measure more uniformly and accurately than the vertically-operating ICNAF gauge. Most of these investigations, however, are limited to a comparison of measuring results from the ICNAF gauge and the Scottish gauge (7, 9, 11, 15). Intensive German investigations also consider, in addition to these two types, a number of other important pressure gauges. The purpose of these comparative investigations is to do preliminary work for the necessary standardisation of the mesh-measuring gauges.

It could be shown that the pressure gauges now in use are not of equal value. On the basis of the consistency of the results achieved by various operators, in a series of experiments (6) the Scottish gauge (11 had greater accuracy of measurement than the Lowestoft gauge (1) and the Polish gauge (14). The ICNAF gauge had the most varying results. For a better understanding of these statements, the results from the comparative measurements carried out with the Scottish gauge and with the ICNAF gauge are shown in the table on page 3. In another comparison, the prototype of a hydraulic measuring gauge developed by the United States Fish and Wildlife Service was tested (4). Although the measuring accuracy of this instrument was satisfactory, it could not be judged to be as favourable the Scottish gauge because of its present inconvenient shape and complic.. working method.

In 1959 C.J.W. WESTHOFF, Den Haag, chose the particularly well-disigned Scottish gauge for further improvement. By installing an automatic locking device, which ensured that the desired measuring pressure would not be exceeded, a precision instrument was developed, the accuracy of which was very satisfactory. Moreover, it was a relatively handy guage. The Comparative Fishing Committee of ICES did not hesitate in 1959, to recommend the WESTHOFF 1959 model as the standard gauge. Recent German investigations (5) proved that the WESTHOFF 1959 model meets almost all the qualifications of a standard gauge. The Mesh Selection Working Group of ICES was thus in a position to re-emphasise in 1960 the recommendation made in 1959.

As the participants of the ICNAF meeting will have the opportunity to see the WESTHOFF 1959 model and its construction plans, it is not necessary to describe the standard gauge in detail.

The choice of the standard gauge did not stop the development of other mesh-measuring gauges. In the Netherlands, for instance, a gauge is under construction which is similar to the Allen Net Rule (12), and a new gauge is also reported from Israel (10). The continued efforts to

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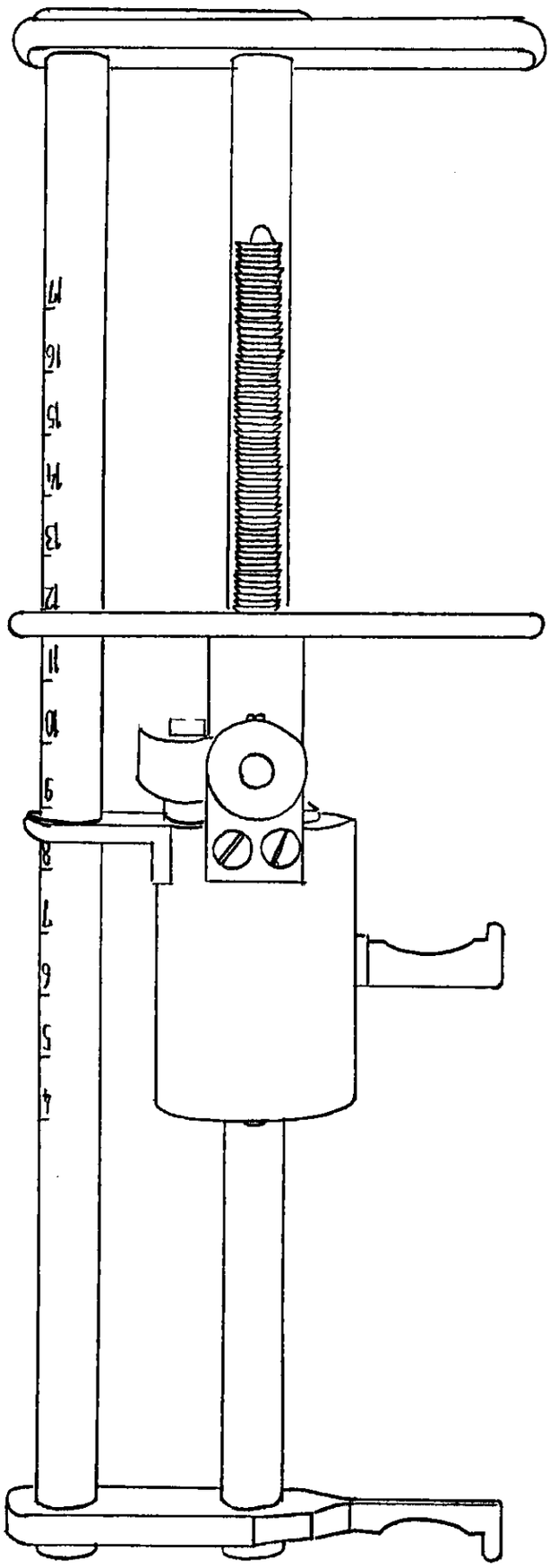
Gauge	Operator	Double Trevira (380 m/kg) $\bar{x} \pm m$	Combination	P	Double "Person" (210 m/kg) $\bar{x} \pm m$	Combination	P	Double Manila (163 m/kg) $\bar{x} \pm m$	Combination	P
ICNAF	A	100.66 ± 0.27	AB	+	98.69 ± 0.45	AB	+	131.50 ± 0.38	AB	0.05
	B	101.00 ± 0.28	AC	0.012	98.35 ± 0.42	AC	+	130.47 ± 0.36	AC	+
	C	101.64 ± 0.28	AD	<0.0002	98.83 ± 0.42	AD	0.001	132.23 ± 0.33	AD	<0.0002
	D	102.75 ± 0.29	BC	+	100.77 ± 0.44	BC	+	136.59 ± 0.31	BC	0.0003
			BD	<0.0002		BD	<0.0002		BD	<0.0002
			CD	0.006		CD	0.0015		CD	<0.0002
Scottish	A	101.93 ± 0.29	AB	+	99.18 ± 0.44	AB	+	129.01 ± 0.40	AB	0.045
	B	101.75 ± 0.29	AC	+	98.41 ± 0.44	AC	+	130.14 ± 0.39	AC	+
	C	101.65 ± 0.29	AD	+	98.29 ± 0.44	AD	+	129.35 ± 0.36	AD	0.03
	D	102.36 ± 0.28	BC	+	99.19 ± 0.46	BC	+	130.11 ± 0.32	BC	+
			BD	+		BD	+		BD	+
			CD	+		CD	+		CD	+

EXPLANATION OF THE TABLE:

Four operators (A-D) have carried out comparative measurements with three dry cod-ends made of various material, which had already been frequently used. Always the same rows of meshes (118 meshes) have been measured. The question, whether the individual average mesh size ($x \pm m$) differ either significantly or only incidentally, has been investigated for the six possible combinations by means of the t-method. All incidental differences (P - Probability ≥ 0.05) are marked by . For all significant differences, however, the P-values taken from R.A. Fisher's t-table have been inserted.



WESTHOFF 1959 MODEL (SCALE 1:1)

procure new high-quality instruments for mesh measurement may be useful, for the standard gauge cannot be considered completely efficient in any way. Moreover, the existence of the standard gauge does not mean that in future all measurements for scientific purposes have to be carried out with the WESTHOFF 1959 model. A different gauge can just as well be used, which, however, should be calibrated against the type chosen as standard, in order to guarantee the inter-comparability of different mesh measurements.

It would perhaps be very advantageous for international co-operation if ICNAF should decide to recognise the WESTHOFF 1959 model as the standard gauge.

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