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FISHING UNIT MEASURES

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Fisheries science is a comparatively young branch of knowledge which has not yet developed unified methods of measuring even the most important quantities such as the fishing efficiency of the gear. It was not until quite recently that attempts to unify the international fisheries statistics were made by FAO ("Classification, definition and codification of fishing effort statistics", FAO Fisheries Circular N 229). According to this document the efficiency of fishing gear is characterized in terms of fishing time and fishing power. The following measures are used:

Fishing time: Number of hours fished; number of hauls, drags or sets made; number of days fished; number of days on grounds; number of days absent from port and number of trips made.

The number of hours fished is defined in different ways for different kinds of fisheries.

For trawl fisheries it is "the total number of hours during which the trawl was on the bottom and fishing".

For dory fisheries this is "the number of hours the dory fleet is absent from the mother vessel times the number of dories".

For other fishing gear this is "the number of hours the nets, seines, traps, dredges etc. were used in the fishing operations".

The definition of fishing time is much too relative. The number of days (24 - hour periods) fished includes the time required to prepare the gear for fishing, the time spent on the main fishing

operations such as the shooting (setting) and hauling in of the gear, the actual fishing and the removal of catch from the gear, as well as the searching time.

The number of days on grounds consists of the time spent on fishing and searching, as well as all the other time during which the fishing craft or gear was on the ground.

The number of days absent from port is counted from the day of departure to the day of arrival back in port and where the fishing ground is at a distance of more than 24 hours steaming from port the day of departure and the day of arrival are counted as one day absent from port, while where the fishing ground is close to the port both the day of departure and the day of arrival are counted as days absent from port.

The number of trips is defined as the number of voyages to fishing areas during which one or another gear was used for actual fishing.

Fishing power is measured, or, to use a more correct term, characterized by the type of craft (length, gross tonnage, main engine horsepower) and the type of gear (otter trawls, pair trawls, beam trawls, Danish seines, purse seines including ring nets, beach seines, drift gill nets, set gill nets, fixed gear, long lines, hand lines, dredges, harpoons and other gear). Neither the size of the gear nor any peculiarities in their use are taken into account.

It is easy to see that this system is nothing more than an arbitrary form for collecting statistical data. There is no scientific basis underlying this system of characterising fishing. It does not reflect the nature of fishing processes and cannot provide the adequate quantitative estimates of the fishing effect resulting from the use of one or another fishing gear.

Some specific units for measuring the effect of fishing are used in modern world fisheries particularly when all kinds of calculations are made for determining the effect of fishing on the stock. The following units are used in trawl fisheries:

the British unit, which is $\frac{\text{ton}}{\text{100 hours fished x average tonnage}}$;

the German unit, which is $\frac{\text{ton}}{\text{number of days fished}}$;

the Soviet unit, which is $\frac{\text{centner (100 kg)}}{\text{number of hours trawling}}$;

the Norwegian unit, which is $\frac{\text{ton}}{\text{24 hours fished x average tonnage}}$;

These units have all the disadvantages inherent in measures intended for a special limited purpose. They are usually not universal even within the group of fishing gear for which they are meant.

Of all these units the British unit is formally the most refined because it incorporates not only the fishing time but also the tonnage of the fishing vessel. However even this unit does not satisfy the present requirements.

In modern fisheries the vessels equal in tonnage use fishing gear different in size and towed at substantially differing speeeds. This depends on the horse power of the engines, the type of propulsion, design and material. Hence the tonnage and in general the dimensions of the vessel may only serve as an indireot indication of fishing efficiency.

The units used in the trawl fisheries of other countries are even less related to the fishing process. For other marine fishing methods the units of fishing efficiency have not been clearly defined at all. The modes of reporting fishing data differ not only between countries but even between areas of the same country.

From this it follows that at present no unified measures are available to measure the fishing efficiency and to compare data obtained by different fishing fleets,and different countries use different artificial conversion methods abounding in conditions and functions.

The chief cause of this situation seems to lie in the fact that attempts to work out the method of measuring the effect of fishing have so far been made without proper regard to the principles of fishing.

It seems that the problem of measuring fishing may be solved if, proceeding from a certain fishing gear classification, two

groups of units are established. The first group will include units intented for the technical characteristic of fishing gear while the second group will consist of units intended for determining their fishing efficiency. As the base value for the technical characteristic of the use of fishing gear let us adopt the concept of "fishing power" by which we shall imply the zone of action of a unit gear in the process of fishing. The fishing power for each gear group will be established in accordance with the classification of fishing gear (A.I.Treschev, 1958) based on the principle of action and specific features. Where the zone of gear action cannot be expressed directly proportional values will be taken to estimate the fishing power.

We shall now express "the fishing effort" as the fishing power of the gear multiplied by the time of their action. Then the fishing effort units which are different for different groups of fishing gear will be determined on the basis of units of fishing power.

Thus, "the fishing effort" and "the fishing power" in this system are not connected with the catch and characterize only the technical potentialities of the fishing gear. With the choice of appropriate units they assume quite definite dimensional expressions characteristic of each class or group of gear of the same type. The results of measurements obtained with the help of these units are universal within each class (group) of gear, i.e. are independent of their design, size or method of use.

As a unit for measuring the fishing efficiency in this case a unified measure may be taken for all classes and groups, manely the catch per unit effort. If the catch is averaged over a sufficiently long period of time then the unit of fishing efficiency for each class (group) of gear will accumulate all the peculiarities of the fishing process including fish behaviour, the organization, technique and tactics of fishimg. Unlike the measures used, such as catch per unit time, catch per unit tonnage etc. which are not connected with the principle of fishing the new measure of fishing efficiency will incorporate both the effect of fishing and the degree of perfection of the fishing technique. With the unchanged

fishing technique the fishing power remains the same and the fishing efficiency of the gear will change in proportion to changes in the stock. Considering that fishing efficiency is based on actual catch data over a long period of time it is also more accurate than other estimates arrived at theoretically on the basis of various assumptions concerning fish behaviour. Thus the fishing power, fishing effort and fishing efficiency have become interrelated. It is sufficient to know the definition of the fishing power unit adopted for a fishing method to be able to determine the units for measuring the fishing effort and fishing efficiency.

Within the groups referred to above the size, fishing power and other characteristics of different gear may vary considerably which may sometimes make the use of the units proposed not quite convenient. For example, the ~~other~~ otter trawls used by the BMRT- (big freezer trawler) and MRT- (small trawler) type of fishing vessels which are placed into the same group of gear differ significantly in the scale of their fishing characteristics and the measurement of these characteristics without applying a scale would not be convenient. In this connection it would be advisable to use the decimal system of the units for measuring the fishing characteristics, i.e. to use the one-tenth, one hundredth and one - thousandth fractions of the basic units listed in the table below. The following system of units is proposed:

name	purpose	abbreviation	fraction of the basic unit
Promm	measure	pm	1
Decipromm	of	dpm	1 : 10
Centipromm	fishing	cpm	1 : 100
Millipromm	power	mpm	1 : 1000
Promus	measure	pu	1
Decipromus	of	dpu	1 : 10
Centipromus	fishing	cpu	1 : 100
Millipromus	effort	mpu	1 : 100
Promef	measure	pe	1
Decipromef	of	dpe	1 : 10
Centipromef	fishing	cpe	1 : 100
Millipromef	efficiency	mpe	1 : 1000

The scale of the units in this system is chosen so that the annual cycle of the most efficient fishing gear is approximately equal to one unit of fishing power. For example, in trawl fisheries the power developed during the annual fishing cycle by the trawl used on the BMRT-type vessels is taken as the unit of fishing power. The annual fishing power of the RT-type vessels (25 m long trawl) is approximately equal to 0.12 fp and that of SRT-type vessels (23 m long trawl) is 0.1 fp, i.e. the fishing unit for Class II, Group A, Type 1-3 gear (~~other~~ trawl).

With this choice of the scale of the units the estimation of the total fishing power of the fleet becomes much simpler.

This method allows the determination in comparable units of the fishing power and other characteristics of fishing in earlier years. Of special interest is the use of this method to estimate the dynamics of fishing efficiency in relation to the dynamics of fishing effort in the most important fishing areas.

An important advantage of the proposed system of units for measuring fishing lies in the fact that it may be used to provide the basis for the quantitative characteristics of the operation of a fleet in working out future fishery plans on the basis of the rational exploitation of the stock and fishing technique.

The unification of fishing unit measures at present is equally important both for technical and biological purposes.

TABLE 1

U N I T S

for measuring fishing conducted with gear as classified by A.I.Treschev
(C.M., 1958, Comparative Fishing Committee, N 62)

Class, group and type of fishing gear	Fishing power (m)		Fishing effort (u)		Fishing efficiency (e)	
	Definition	Unit	Definition	Unit	Definition	Unit
II A, 1-3 (Otter trawls)	Volume of water fished per unit time. Defined as the product of distance between the otter boards by the vertical opening and by the path traversed per unit time.	$10^6 m^3$	Product offishing power by the time of trawling, i.e.the time during which the trawl warps are held by stoppers.	$10^6 m^3 hr$	Average catch defined as the ratio of catch per time fished to fishing effort in this time interval.	$\frac{100\ kg}{10^6 m^3 hr}$
II A, 4-8 (Pair trawls, beam trawls and towed seines)	Volume of water fished per unit time. Defined as the product of horisontal opening by vertical opening and by the path traversed.	$10^6 m^3$	As above	$10^6 m^3 hr$	as above	$\frac{100\ kg}{10^6 m^3 hr}$
II B, 1-5 (pursing gear of all types) II C, 1 - 5 (dragged gear of all types) IV C, 1 - 4 (surrounding nets)	Volume of water fished per one haul. Defined as the product of the area surrounded including drag ropes by the average height of gear in operating condition.	$10^3 m^3$	Product of fishing power by the number of hauls	$no \times 10^3 m^3$	as above	$\frac{100\ kg}{no \times 10^3 m^3}$
III A, 1 - 9 (stationary traps) III B, 1 - 2 (movable traps)	The area of guide wings defined as the product of total length by height.	$10^2 m^2$	Product of fishing power by the time fished measured in days (24 hour periods)	$10^2 m^2 x$ day	as above	$\frac{100\ kg}{10^2 m^2 x\ day}$
IV A, 1 - 4 (set gill nets)	The area of the net, the product of length by height and by the number of nets.	$10^2 m^2$	as above	as above	as above	as above

TABLE 1 (continued)

Class, group and type of fishing gear+	Fishing power (m)		Fishing effort (u)		Fishing efficiency (e)	
	Definition	Unit	Definition	Unit	Definition	Unit
IV B, 1 - 5 (drift gill nets)	Valume of water fished per one drift, i.e. the product of length by height, by the number of nets and by the path traversed defined as the distance in metres between the points observed at the beginning and the end of the drift.	$10^9 m^3$	The product of fishing power by the number of drifts.	no $\times 10^9 m^3$	Average catch defined as the ratio of catch per time fished to fishing effort in this time interval	$\frac{100\ kg}{no \times 10^9 m^3}$
III C (drifting traps)	Volume of water fished per drift, i.e. the product of horisontal opening by vertical opening and by the path traversed defined as the distance in metres between the points observed at the beginning and the end of the drift.	$10^2 m^3$	The product of f fishing power by the number of drifts.	no x $10^2 m^3$	as above	$\frac{100\ kg}{no \times 10^2 m^3}$
V A, 1 - 4 (hooked gear)	1000 hooks	no	The product of the number of hooks (in thousands) by the time fished (in days, i.e. 24 hour periods)	no 10^3 x days	as above	$\frac{100\ kg}{no\ 10^3 \times day}$
I A, 3 (automatsed lift nets) II D, 1 - 3 (oast nets) II E, 1 - 3 (lift nets)	The volume of water fished per one sinking. Defined as the product of the area covered by the path traversed during one sinking or surfacing.	m^3	The product of fishing power by the number of sinkings	no x m^3	as above	$\frac{100\ kg}{no \times m^3}$
I A, 1 (fishpumps)	Capacity with reference to water	$\frac{t}{hour}$	Capacity with reference to water multiplied by the time of operation in hours.	t	Average output with reference to fish in the time fished	$\frac{t}{hour}$

+ The table includes fishing gear at present used on a commercial scale.