

International Council for the
Exploration of the Sea

C.M. 1963

Symposium on the Measurement
of Abundance of Fish Stocks

No. 28

On a Possible Calculation Method of the Absolute
Abundance of the Commercial Population *Sebastes
mentella* Travin in the Barents Sea



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The necessity of determining the abundance of a certain species of fish usually arises after it has become an object of fishing. The necessity of determining the value of the commercial extract and the extent of the influence of fishing on the stock arises as well. Most of the methods existing to determine a fish stock are based on statistics on fishery and on changes in the biological characteristics of fish populations. Experience gained so far has shown that no method of determining the abundance of fish stocks of various species was universal. The above-mentioned first of all concerns the attempt to determine the abundance of the commercial part of the *Sebastes mentella* stock of the Medvezinsko-Spitsbergen population.

It has been ascertained by investigations (Maslov, 1944; Magnusson, 1959; Sorokin, 1956, 1960, 1961 and 1962) that during a period of winter, spring migrations the *Sebastes marinus* population is divided into a spawning stock of females and a stock of wintering males.

In the Barents, Greenland and Norwegian Seas stocks of two redfish species, *Sebastes marinus* L. and *Sebastes mentella* Travin are exploited. Ways of migrations and areas of habitat of these two species differ considerably. Trawlfishing of *S. marinus* was started by Germany off the north-western shore of Norway. German trawlers fished mainly concentrations of pre-spawning females which made up an average of 75% of the total amount of redfish caught.

Commercial concentrations of males are observed to occur in Finmarkenskaya and Nordkinskaya banks in the Norwegian kennel. Fishing of males in these areas was sometimes highly productive but momentary and irregular. In Soviet trawlfishing *S. marinus* appeared only as a by-catch when cod was fished. Therefore, as far as the population of golden redfish is concerned, mainly females were fished.

Since 1952 when large concentrations chiefly represented by wintering males were found in the Kopytov region, fishing of *S. mentella* on a commercial scale began. The highest percentage of males is observed when catches are at their highest.

During a season of fishing 72 to 96% of the total number of redfish taken were males. From 1952 to 1960 the share of males in the catches made up 76% on an average. Females were practically not fished because the grounds of their pre-spawning concentrations and the places of the egg-laying were not primarily known. Therefore females (*S. marinus*) are mainly fished in one case and males (*S. mentella*) are mainly fished in the other case.

When the intensity of fishing reached such a level as to effect the abundance of redfish, the deficiency of females has to be formed (as a result of a one-sided extraction of mature females by fishing) in the *S. marinus* population inhabiting the Barents and the Norwegian Seas. One-sided extraction of males (*S. mentella*) of the Medvezinsko-Spitsbergen population has to result in predominance of females. The disproportion in the ratio of sexes can be revealed after unification of male and female populations at the time of coupling and fattening.

The ratio of redfish sexes in the period of coupling and fattening is studied. 56.7 thousand specimens of *S. marinus* and 228.2 thousand specimens of *S. mentella* were determined by sex. It is ascertained that there is a deficiency of females in the population of *S. marinus* and a deficiency of males in the population of *S. mentella*. With a view to the above-said and to the results of investigations carried out previously we came to the following conclusions:-

1. Natural ratio of redfish sexes (before fishing) is 1:1.
2. The disproportion of sexes is the result of a commercial extract.
3. The existing ratio of sexes (after commercial extract) in the population of redfish can be determined in the period of coupling and feeding and growing. Mass determinations of the ratio of males and females in catches by trawls are close to the actual ratio of sexes in the population.

Hence, knowing the ratio of sexes before fishing and having determined the number of males and females taken and the ratio of sexes in the remaining part of the population after fishing, we can form an equation and calculate the abundance of the commercial population of redfish.

Take the following designations:-

- x - total number of males and females before fishing;
- a - number of males taken;
- b - number of females taken;
- c - percentage of males before fishing;
- d - percentage of females before fishing;
- c¹ - percentage of males after fishing;
- d¹ - percentage of females after fishing.

Then the equation will be as follows:-

$$\frac{\frac{x}{100} \cdot c - a}{\frac{x}{100} \cdot d - b} = \frac{c^1}{d^1}$$

The abundance of the commercial part of the stock was calculated for the Medvezinsko-Spitsbergen population of S. mentella as the statistics of catches and observations for the change of the ratio of sexes are more systematic and reliable.

It should be noted that recruitment has not been taken into consideration in these calculations since for the time being they cannot be expressed in numbers. We assumed that the influence of these two factors were more or less equal during all the years.

Year	Ratio of sexes before fishing; in the period of fattening (%)		Number of fish caught (thousands)		Ratio of sexes after fishing, in areas of fattening (%)	
1959					70	30
1960	70	30	25956	20923	74	26
1961	74	26	13477	16147	76	24
1962	76	24	3740	4402	79	21

According to our calculations the commercial population of S. mentella in 1960 (before fishing) consisted of 65703 thousand males and 153308 thousand females or 200.2 thousand tons. In 1960 41.27 thousand tons or 20% of the calculated commercial population were caught. By calculating the data obtained in 1961 we got the following figure:- 530 thousand tons, and the commercial extract (calculated) in 1961 made up 5%. Analogous calculations according to 1962 data gave 82.45 thousand tons, while the calculated commercial extract in 1962 made up 8%. It is seen that the results obtained are contradictory and cannot be accepted unconditionally. However, the calculated figures of the absolute abundance of the commercial stock and the value of the commercial extract are of the same order and do not exceed the actual numbers.