

TRAWL SELECTIVITY FOR *CHAMPSOCEPHALUS GUNNARI*

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Abstract

Data on trawl selectivity for mackerel icefish (*Champsocephalus gunnari* L.), were collected in 1981 in the South Georgia area. The trawl bags tested were made of net webbing with 3.1 mm twine and 88.2 mm mesh size. Trawling speed was 3.5 knots. Icefish comprised 90 to 100% of catches. The logistic selectivity curves were calculated using the collected data. It was found that the selectivity factor for 88.2 mm mesh size was 2.81 and the 50% retention length was 24.8 mm (21.5 to 28.2 mm).

Résumé

Les données sur la sélectivité des chaluts pour le poisson des glaces (*Champsocephalus gunnari* L.) ont été recueillies en 1981 dans la zone de la Géorgie du Sud. Les poches de chalut examinées étaient faites de nappe de filet dont les fils étaient de 3,1 mm et le maillage de 88,2 mm. La vitesse de chalutage était de 3,5 nœuds. Le poisson des glaces formait de 90 à 100% des captures. Les courbes logistiques de sélectivité ont été calculées à partir des données recueillies. Il a été estimé que le facteur de sélectivité pour une taille de maillage de 88,2 mm était de 2,81 et que la longueur de rétention de 50% était de 24,8 mm (21,5 à 28,2 mm).

Резюме

Данные по селективности тралов в отношении ледяной рыбы (*Champsocephalus gunnari* L.) были собраны в районе Южной Георгии в 1981 г. Опробованные кутки были сделаны из сетного полотна с бечеей диаметром в 3,1 мм; размер ячеи 88,2 мм. Скорость траления - 3,5 узлов. Ледяная рыба составила 90-100% уловов. Логистические кривые селективности были рассчитаны на основе полученных данных. Было выявлено, что фактор селективности в отношении ячеи размером в 88,2 мм равнялся 2,81 и, что средняя 50%-ная длина удержания равнялась 24,8 мм (21,5 - 28,2 мм).

Resumen

Datos sobre la selectividad de arrastre para el draco rayado (*Champsocephalus gunnari* L.), se recopilaron en 1981 en el área de Georgia del Sur. Las bolsas de arrastre fueron hechas de un paño de red con un torzal de 3.1 mm y un tamaño de malla de 88.2. La velocidad de arrastre fue 3.5 nudos. Peces de hielo comprendieron entre el 90 y 100% de las capturas. Las curvas de selectividad logística se calcularon usando los datos recopilados. Se encontró que el factor de selectividad para una luz de malla de 88.2 fue 2.81 y la longitud de retención al 50% fue 24.8 mm (21.5 a 28.2 mm).

Rational fishery management with effective fishery regulations guarantees maximum possible yield while at the same time ensuring stability of natural resources and furthering conservation of fish stocks. In the wake of currently increasing fishing intensity the question at hand requires urgent attention. The conservation of juvenile fish is a scientifically based approach to the regulation of fishing activities which allows the stock to be maintained on a sufficiently high level for future exploitation.

In order to rationally exploit resources of the mackerel icefish (*Champsocephalus gunnari*) in the South Atlantic, it was considered necessary to develop measures for increasing the efficiency of fisheries management and to conduct integrated studies into the selective properties of trawls operating on concentrations containing fish of various size groups.

Experimental data on the selective properties of trawls for Antarctic fish were collected by scientists from the AtlantNIRO Research Institute; representatives of the VNIRO Research Institute assisted in processing these data.

Most fishing gear has selective properties. During periods of high fishing intensity the impact of the exploitation on the stock becomes a decisive factor. Establishing an optimal mesh size for commercial trawls is an effective way of guaranteeing that fishing activities are organized with a view to rational exploitation.

The quantitative and qualitative definition of the selective properties of trawls depends on a variety of technical parameters of fishing gear, hydrological conditions, biological features of the exploited species, the design of trawl bags, size, shape and physical-mechanical properties of net material and meshes, patterns of trawling, size of the catch and also characteristics of fish behaviour, the structure and size composition of exploited fish concentrations, morphometric parameters and physiological condition of fish.

In order to analyze the selective properties of trawls for *C. gunnari*, primary data were collected on the number of fish retained in trawl bags and the number passing through the net webbing. A thorough biological analysis of fish was conducted and their physiological condition was evaluated (Table 1). The data were collected on board the RV *Evrika* around South Georgia in September 1981, and assessment of the selective properties of trawl bags was carried out in accordance with standard methods (Treshchev et al., 1986). Trawl bags were made of net webbing with a twine diameter of 3.1 mm and an internal mesh size of 88.2 mm. Trawling speed was 3.5 knots. The duration of trawling varied from 30 to 60 minutes and catch weight did not exceed one tonne. *C. gunnari* accounted for 90 to 100% of the catch.

Processing the experimental data on the selective properties of trawl bags (establishing the analytical dependency of the retention of fish of various lengths, verification of the contingency between experimental and computed data, assessment of the bias at $l_{50\%}$ point) was carried out in accordance with the specially designed algorithm* on a mainframe computer using a program for "calculation of logistic selectivity curves" (Kaliningrad, AtlantNIRO, 1982):

$$\text{Logistic function } P = \frac{1}{1 - e^{-(a l_0 - b)}}$$

where P = retention of fish by trawl, %;
 l_0 = total length of fish, cm;
a, b = coefficients.

* Algorithm developed by senior engineer V.F. Ivanova

According to Pearson's test of contingency the curves described by this equation correspond with experimental points at $\beta = 0.95$.

After processing the experimental data the following final logistic formula was worked out for 88.2 mm mesh:

$$P = \frac{1}{1 - e^{(0.265L_0 - 6.58)}}$$

with a 50% retention point for 24.8 cm long fish (Table 2).

The results of experiments with 88.2 mm mesh size give the modal length of fish in trawl catches of 25 cm.

In order to obtain objective data it would be worthwhile conducting research in the major fishing areas. With a view to protecting juvenile *C. gunnari* from overfishing and providing a base for efficient fishing practices, the USSR introduced unilaterally in 1980 the "Fishery Regulations for Antarctic Waters" imposing higher levels of trawl selectivity for the Soviet fleet. In accordance with these regulations, the minimum mesh size in the retaining part of trawls, in particular for *C. gunnari*, was set at 80 mm. This increased mesh size has led to a reduction in the by-catch of immature fish.

Bearing in mind the difference in size composition of fish in various areas, it would seem useful to fix a minimum mesh size for each fishing area individually, which would ensure free passage through the mesh and a high rate of survival for juveniles.

CONCLUSIONS

1. An increase in the level of selectivity by means of using a larger mesh size in trawls (88.2 mm) and a decrease of fishing intensity, will lead to a lower rate of exploitation and a lesser impact on younger age groups of *C. gunnari*.
2. For 88.2 mm mesh size in trawl bags, the percentage of retained *C. gunnari* and selectivity coefficient are 58.9% and 2.81 respectively.
3. The efficiency of the regulations introduced by the USSR in the "Fishery Regulations for the Antarctic Waters" which stipulate higher levels of selectivity, will be secured if commercial trawls of all countries participating in the *C. gunnari* fishery will increase mesh size accordingly.
4. While estimating advantages and disadvantages for the fishery of a conversion to a higher level of trawl selectivity, it would be advisable to carry out selectivity separately in each fishing area.

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Table 1: Catch structure and biological condition of icefish off South Georgia - RV *Evrika*, September 1981.

| Size Composition | | | | | | | | | | | | | | | |
|------------------|-----|-----|-----|-----|-----|-----|------|------|-----|-----|-----|-----|-----|-------|-------|
| cm | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | Total | Mean |
| No. of specimens | 4 | 15 | 20 | 19 | 63 | 509 | 2229 | 1863 | 268 | 117 | 184 | 42 | 7 | 5340 | 25.56 |
| % | 0.1 | 0.3 | 0.4 | 0.4 | 1.2 | 9.5 | 41.7 | 34.9 | 5.0 | 2.9 | 3.4 | 0.8 | 0.1 | 100.0 | |

| Size Composition | | | | | | | | | | | | | | | | | | | |
|------------------|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| cm | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | Total |
| No. of specimens | 4 | 13 | 51 | 153 | 291 | 464 | 359 | 218 | 69 | 18 | 10 | 14 | 15 | 14 | 15 | 15 | 14 | 11 | 1743 |
| Mean weight | 45 | 50 | 64 | 70 | 81 | 93 | 104 | 120 | 137 | 157 | 179 | 185 | 202 | 229 | 275 | 303 | 325 | 346 | |

| | Stage of Maturity | | | | | | Fat Content (points) | | | | | Stomach Food Volume (points) | | | | | | |
|------------------|-------------------|------|-------|-----|------|-------|----------------------|------|------|-------|------|------------------------------|------|------|------|------|-------|------|
| | II | III | Total | II | III | Total | 1 | 2 | 3 | Total | Mean | 0 | 1 | 2 | 3 | 4 | Total | Mean |
| No. of specimens | 31 | 797 | 828 | 15 | 836 | 851 | 11 | 268 | 1400 | 1679 | 2.8 | 700 | 364 | 268 | 174 | 167 | 1679 | 1.3 |
| % | 3.7 | 96.3 | 100 | 1.7 | 98.3 | 100 | 0.6 | 16.0 | 83.4 | 100 | | 41.8 | 21.8 | 16.0 | 10.4 | 10.0 | 100 | |

Table 2: Selectivity parameters of trawls in relation to *Champscephalus gunnari* (September 1981).

| Parameters of trawl bag selectivity | Mesh size 88.2 mm |
|--|----------------------|
| 1. Length of fish, 50% of which are retained in the trawl bag ($l_{50\%}$) | 24.8 |
| (a) weight of one specimen, g | 80.0 |
| (b) age in years | 2.8 |
| 2. Selectivity range, cm (D_s) | 21.5 - 28.2 |
| 3. Selectivity coefficient (K_s) | 2.81 |
| 4. Modal length of fish, cm (l_m) | 25.0 |
| 5. Percentage of specimens retained in the bag | 58.9 |

Liste des tableaux

- Tableau 1: Structure des captures et condition biologique du poisson des glaces au large de la Géorgie du Sud - Navire de recherche *Eврика*, septembre 1981.
- Tableau 2: Paramètres de sélectivité des chaluts en ce qui concerne *Champsoccephalus gunnari* (septembre 1981).

Список таблиц

- Таблица 1: Состав уловов и биологическое состояние ледяной рыбы в районе Южной Георгии - НИС *Эврика*, сентябрь 1981 г.
- Таблица 2: Параметры селективности тралов в отношении *Champsoccephalus gunnari* (сентябрь 1981 г.)

Lista de las tablas

- Tabla 1: Estructura de la captura y condición biológica del pez de hielo frente al litoral de Georgia del Sur - RV *Eврика*, Septiembre 1981.
- Tabla 2: Parámetros de Selectividad de arrastres con relación a *Champsoccephalus gunnari* (Septiembre 1981).