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ON THE PROBLEM OF RATIONAL FISHING FOR  
THE NORTHEAST ATLANTIC HORSE-MACKEREL

Abstract

The possible horse-mackerel yield from the Celtic Sea and northern Bay of Biscay is estimated as 260 thous. tons based on the calculation of the stock abundance and biomass by V.P.A. on the assumption that the natural mortality rate is 0.28, the total mortality rate is 0.8, and the optimum fishing mortality rate is 0.4.

Résumé

Le calcul de l'abondance et de la biomasse du stock par la méthode V.P.A. ayant le coefficient de mortalité naturelle 0.28 et celui de mortalité totale 0.8 permet d'estimer le volume de la prise possible du chinchard dans la région la mer Celtique et dans la partie nord du golfe de Gascogne à 260 mille tonnes à partir de la valeur optimale de mortalité par pêche égale à 0.4.

### Introduction

At present, no precise and well-grounded estimate of the possible horse-mackerel yield from the Northeast Atlantic can be found either in the ICES Research Documents or in any published paper available. The tentative catch size suggested by ICES is of the order of 120 thous. tons. We believe that the estimate suggested is considerably understated.

In the given paper our estimate of the possible horse-mackerel yield from the Celtic Sea and northern Bay of Biscay is presented.

### Materials and Methods

The calculation of the optimal fishing intensity was made using the previously published data on the growth, mortality rates, length-age composition, and catch statistics for the area in question (Feodorov, Nazarov, 1979; Nazarov, 1978; Nazarov, Malkov, Feldman, 1978).

The values used in the calculations were as follows: 1) growth parameters from the Bertalanfy's equation,  $K = 0.2047$ ,  $L_{\infty} = 40.00$  cm,  $t_0 = 1.3471$ ,  $W_{\infty} = 594.05$  g; 2) age in the beginning of optimal exploitation determined from the equation of Kutty and Gasim (1968),  $t'_p = 4.32$  y, with the corresponding body length,  $L_c = 27.4$  cm, and weight,  $W_c = 150.0$  g.

Hence, the ratio  $L_c/L_{\infty} = C = 0.685$ , and  $M/K = 1.37$ , since the natural mortality rate is 0.28.

The abundance of the exploitable part of the stock and fishing mortality rates were calculated by V.P.A. (Schumacher, 1970).

### Results

Based on the assumption that the horse-mackerel stock inhabiting the Celtic Sea and northern Bay of Biscay is a separate population we estimated the absolute abundance and biomass of its exploitable part using the previously determined values of natural mortality rate (0.28), and total mortality rate for older age groups (0.8).

Between 1972 and 1976, the horse-mackerel abundance varied from 5.22 to 11.54 billions, 8.24 billions on the average. The stock biomass changed from 1.02 to 1.36 mill tons, 1.8 mill. tons on the average (Tables 1, 2).

The mean weighted fishing mortality rate on the fish of 3 years old or older fluctuated between 0.05 and 0.37.

From the exploitation rate values  $(\frac{E}{F+M})$  with varying fishing mortality rates calculated using the tables of Beverton and Holt (1966) and the known ratios  $L_c/L_\infty$  and  $M/K$ , and then by plotting  $E$  versus  $Y/R$  the yield per recruitment estimates were found for each given value of  $F$ .

As is evident from the analysis of the data made according to the Rikhter's method (1970, 1977), the optimal exploitation level is achieved at  $F = 0.4$  (Table 3).

On the assumptions that the recruit abundance to the fishing stock is not subject to considerable fluctuations due to natural reasons; that the stock size at present approximates its average level; that the 3 year old fish at first spawning will not be yielded; that the fish of 4 years old and older with the biomass averaging 900 thous. tons will be taken and that  $F=0.4$ , the possible horse-mackerel yield of 260 thous. tons can be recommended.

The results of the experiments on the selectivity of fishing gears using the chafers indicated that the fishing for horse-mackerel can be made with the trawl with the codend mesh size of 80 mm. The selectivity factor is 3.52, and the mean fish length at 50% selectivity is 29.3 cm. The selectivity factor for the codend mesh sizes of 50 and 55 mm (with the actual inside mesh sizes of 104.4 and 113.7 mm respectively) were 3.14 and 3.11. The mean fish length at 50% selectivity were 32.7 and 35.3 cm. The trawl with the latter mesh sizes are not suitable for the horse-mackerel fishing, for the fish of 40 cm or more are vulnerable to the trawl, and significant initial losses are not compensated for by the growth of the fish.

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Table 1  
The abundance (mill.sp.) of the exploitable part  
of the Celtic-Piscay horse-mackerel population  
estimated by V.P.A.

Age	Years of fishing				
	1972	1973	1974	1975	1976
2	4 230.0	488.3	1 200.0	-	633.4
3	3 957.8	3 711.2	348.9	868.9	316.1
4	1 961.2	2 501.5	3 008.5	227.9	470.6
5	624.8	1 677.1	1 857.5	1 894.2	335.8
6	338.4	462.4	1 268.4	1 221.2	1 657.5
7	197.1	221.3	307.0	822.8	920.2
8	140.0	107.6	138.9	194.8	660.1
9	65.8	63.8	54.1	78.3	124.0
10 and older	28.2	17.7	36.8	33.8	101.0
Total abundance	11 543.3	9 250.9	8 919.3	5 341.9	5 224.7

Table 2

The biomass (thous. tons) of the exploitable part  
of the Celtic-Biscay horse-mackerel population  
estimated by V.P.A.

Age	Years of fishing				
	1972	1973	1974	1975	1976
2	287.6	32.2	92.4	-	49.4
3	455.2	404.5	40.1	117.3	37.6
4	290.3	362.7	409.2	33.7	78.1
5	118.1	385.1	300.9	331.5	60.8
6	73.8	99.0	266.4	249.1	351.4
7	51.6	57.3	76.4	187.6	226.0
8	44.9	33.8	41.8	54.9	186.2
9	24.1	22.6	19.5	27.0	40.2
10 and older	12.7	7.5	15.1	14.3	41.3
Total biomass	1 358.3	1 304.7	1 261.8	1 015.4	1 071.0
Biomass of 4-10 year olds and older fish	611.5	868.0	1 129.3	898.1	984.0

Table 3

The increase (%) of yields and fishing intensity

Indices	Values of F									
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Fishing mortality rate	9.5	18.1	25.9	33.0	39.4	45.1	50.3	55.1	59.3	63.2
Increase of the fishing mortality rate	-	47.5	30.1	21.5	16.2	12.6	10.3	8.7	7.1	6.2
Growth rate Y/R of Celtic-Biscay population	-	47.3	19.2	8.9	5.5	3.8	2.8	2.0	1.2	1.3