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Study of Redfish Taken on Burgeo, Scatari, Saint-Ann and Saint-Pierre Banks during "Thalassa" Survey, 1970

by

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During the survey which R/V Thalassa carried out in the Northwest Atlantic, we collected many data on both species of redfish which exist in this area. As *Sebastes marinus mentella* (Travin, 1951) was taken more often than *Sebastes marinus marinus* (Linne, 1758), this study will deal specifically with the first species.

We will particularly deal with length frequencies according to age, weight frequencies according to length, distribution according to depth, and we shall attempt to see if several stocks exist in the surveyed area. This area extends from 45° to 57°30' N lat and 57°30' to 60°30' W long.

Figure 1 gives distribution of trawl hauls and shows the areas where redfish were taken. Of the 135 hauls made during the survey, 60 had redfish with the following yield distribution: 14 hauls had a total yield of 50-100 kilos/hr; 39 had 100-500 kilos/hr; 5 from 500 kilos and 1 ton/hr; 7 stations yielded more than 1 ton, one of these even yielding 6 tons.

There were two main problems encountered during this study; the first was due to the fact that two different type trawls were used: one, a Lofoten, (headline 31.20 m, bobbin groundrope 17.70 m, mesh of wings, back and belly 140 mm, codend 50-mm mesh (stretch mesh)); the other was a shrimp trawl (headline 33.30 m, rubber groundrope 39.50 m mounted on 37.50 m, mesh of wings, back and belly 60 mm, codend 40-mm mesh). Consequently, the results are difficult to compare and it was necessary to make a comparative study most of the time in order to obtain homogeneous results.

The second problem is of systematic as well as biological order. According to the authors, both species or subspecies exist in this area; even though it is fairly easy to differentiate between *Sebastes marinus mentella* and *Sebastes marinus marinus* when they appear in their typical form, one must not forget that there are several stages between both species and that very often only an advance meristic study can give an indication of their exact taxonomic position. On the other hand, it is impossible to make a diagnosis until the fish is 15 cm long. Lastly, the problem of biological order was encountered: it is impossible to differentiate between male and female until the fish is 15 cm long.

Work and Sampling on Board

Most biological work was done on board. Measurements were made from the apex of the genial appendix, lower jaw closed, to the extremity of the longest caudal fin, and reduced to the nearest cm. Individuals were separated by sex and then weighed according to length and sex. Otoliths were set aside for study in the laboratory.

The distribution of 21,384 individuals thus measured is as follows: 9,801 in Div. 3Ps; 3,895 in Div. 3Pn; 6,688 in Div. 4Vn. Method of sampling was as follows: when number was less than 200 kilos, total number of fish was measured, the sampling thus decreasing with the importance of the haul. That is, the yield of sampling weight over total redfish weight (which was 1/2 per 500 kilos) became 1/9 per 3 tons.

Working up Results

Each measurement was worked up by calculating the average, variance, at regular and intermittent intervals. Also, each station was listed on a punch-card which also contained other information such as depth , hour, trawl type, associated fauna, age, bottom topography. These cards will be especially useful for a statistical study covering a series of years; but they can now give interesting results about the existence of a population in a given area at a given time of the year.

More than 1,500 otoliths were read; once broken, otoliths are put in modelling clay, then read by light reflection with a 20X binocular scope.

Length Frequency in ICNAF Areas

As previously stated, 21,384 individuals were measured; measurements allowed curve traces 1, 2 and 3.

Lengths varied from 6-55 cm; if one analyzes these curves, by section, one establishes that in Div. 3Ps two very distinct means appear, one at 16 cm and the other at 33 cm, and that total individuals between 6 and 28 cm represent 85.7% of population, while in Div. 3Pn the same individuals represent a little more than half the population, i.e., 55%; two means also appear, one at 15 cm and the other at 33 cm.

A great difference exists between these two sections and Div. 4Vn, where one mean clearly appears at 32 cm and where nearly the total population is found between 28 cm and 43 cm (82.4%).

Analysis of station cards shows that the presence of two means is essentially due to the fact that trawl hauls were made at different depths. For example, it is observed that in Div. 3Ps, 8 stations were occupied at depths more than 370 m; these stations produced individuals over 27 cm in length. If one does not take these 8 stations into account, the 33-cm mean disappears. It is the same in Div. 3Pn where of 9 stations occupied at depths more than 370 m produced individuals of 27-cm minimum length.

Figure 4 gives redfish length according to depth, such as we established after the 1970 survey. It is observed that length increases with depth up to approximately 400 m; then length is stable at an average of approximately 35 cm. This curve does not take into account fishing zone or sex.

Length/Weight Curves

Weight by length and sex was done on board. Data thus collected enabled us to find the coefficient Q and exponent "n" in equation $W = Q_x L^n$. W is weight in grams, Q is a constant, L is length in cm. To solve this equation, one must first change the logarithmic expression:

$$\log W = \log Q + n \log L$$

then use the system of two equations with two unknowns, for example:

$$\log W_1 = \log Q + n \log L_1$$

$$\log W_2 = \log Q + n \log L_2$$

where one derives:

$$\frac{\log W_1 - \log W_2}{\log L_1 - \log L_2} = n$$

which then enables easy calculation of Q. Figures 5, 6, and 7 give curves which we obtained, and Table 1 gives the values of parameters Q and "n" for male and female of different sections.

In comparing these data with those of the Fishing and Freezing Society of St. Pierre from local surveys, we establish that Q and "n" simultaneously both take optima values at depths of 200-300 m. This means that in this zone the redfish have better reproduction conditions. It is also in this zone that Sandeman (1969) finds an instantaneous reproduction maximum coefficient $\frac{dl}{dt}$.

Von Bertalanffy Curves

$$l_t = l_\alpha (1 - e^{-k(t - t_o)})$$

where l_t is length at age t, l_α is maximum theoretical length, k is a constant, and t_o is theoretical age where $l_o = 0$. l_α, k and t were calculated using Walford's graphic method. This method is much less precise than that by Thomlinson and Abramson (1961) but it is much quicker and easier to use. We find the following values for the different parameters:

Div. 3Pn

Depth more than 300 m:

males	$k = 0.116$	$l_\infty = 44$	$t_o = 3$
females	$k = 0.105$	$l_\infty = 45$	$t_o = 1.02$

Depth of 200-300 m:

males	$k = 0.162$	$l_\infty = 44$	$t_o = 4.5$
females	$k = 0.08$	$l_\infty - 44$	$t_o = -0.7$

Div. 4Vn

Depth more than 300 m:

males	$k = 0.06$	$l_\infty = 48$	$t_o = -4.3$
females	$k = 0.105$	$l_\infty = 48$	$t_o = -1$

Depth of 200-300 m:

males	$k = 0.138$	$l_\infty = 46$	$t_o = 4$
females	$k = 0.091$	$l_\infty = 47$	$t_o = 0.8$

Div. 3Ps

Depth of 200-300 m:

males	$k = 0.07$	$l_\infty = 45$	$t_o = -0.9$
females	$k = 0.06$	$l_\infty = 47$	$t_o = -2.4$

Depth of 100-200 m:

males	$k = 0.09$	$l_\infty = 48$	$t_o = 2.4$
females	$k = 0.08$	$l_\infty = 48$	$t_o = 0.8$

These parameters were calculated by the empirical method without considering environmental conditions. The Von Bertalanffy parameters calculated, taking into account relative factors, generally give contradictory results.

Production curves (Fig. 8, 9, 10) were established for each ICNAF division, according to arbitrary depth sections (100-200 m, 200-300 m, and more than 300 m). These curves are rather inaccurate, partly because our observations are not yet numerous enough and were made during one period of the year only, and partly because we have only a few old individuals which does not enable us to know precisely the maximum or assymptotic lengths.

However, it appears in these curves that the difference in production between male and female is much more pronounced in the 200-300 m zone than in the deeper waters.

It must be noted that the assymptotic length is different in both zones. Between 200 m and 300 m the length is quickly reached; the higher production coefficient easily explains this phenomenon, but the maximum length is approximately 43-45 cm, whereas, in deep water this length is reached much more slowly and remains stable at 48 cm. Therefore, at a certain time, there is a great modification in the production rate of shallow water stock; according to Sandeman (1969) this is due to the fact that shallow-water fish reach maturity several years before deep sea fish. The production, therefore, ceases because the fish give all their energy to reproduction requirements, while deep-sea fish continue to increase, remaining immature.

We, therefore, should fine two very distinct stocks by length, one from shallow water and the other from deep water. Both stocks should, however, have similar age characteristics. But the curves we were able to trace show differences.

Between 200 and 300 m, the mean for male as well as female is found under 10 years (Fig. 11); for depths more than 300 m, it is found at 12 years. On the other hand, a very great dispersion in female of the first zone can be noted.

Conclusion

In addition to several populations existing according to depth, the different results obtained, particularly analysis of variance, show that different stocks exist in the survey area.

We could, in a very broad sense, define at least three different stocks. One is found between Cabot Strait, the axis of the Laurentian Channel, and the southern shores of Burgeo Bank; another on the western shores of St. Pierre Bank; and the third, on Scatari and Saint-Ann Banks. At the entrance to Cabot Strait, there is an interpenetration of Burgeo and Scatari stocks; the Laurentian Channel, however, must play the role of a biological barrier, as Sebastes marinus marinus which is found east of the Channel, is absent on the west.

TABLE 1. Values of parameters Q and "n" for different divisions.

		4Vn		3Ps		3 Pn	
Parameter	Depths	Male	Female	Male	Female	Male	Female
Q	100-200			0.0147	0.0119		
	200-300			0.0192 v	0.0151	0.0181	0.0190
	300	0.0175	0.0220			0.0103	0.0192
"n"	100-200			3.106	3.147		
	200-300			3.270	3.200	3.274	3.293
	300	3.216	3.340			3.078	3.276

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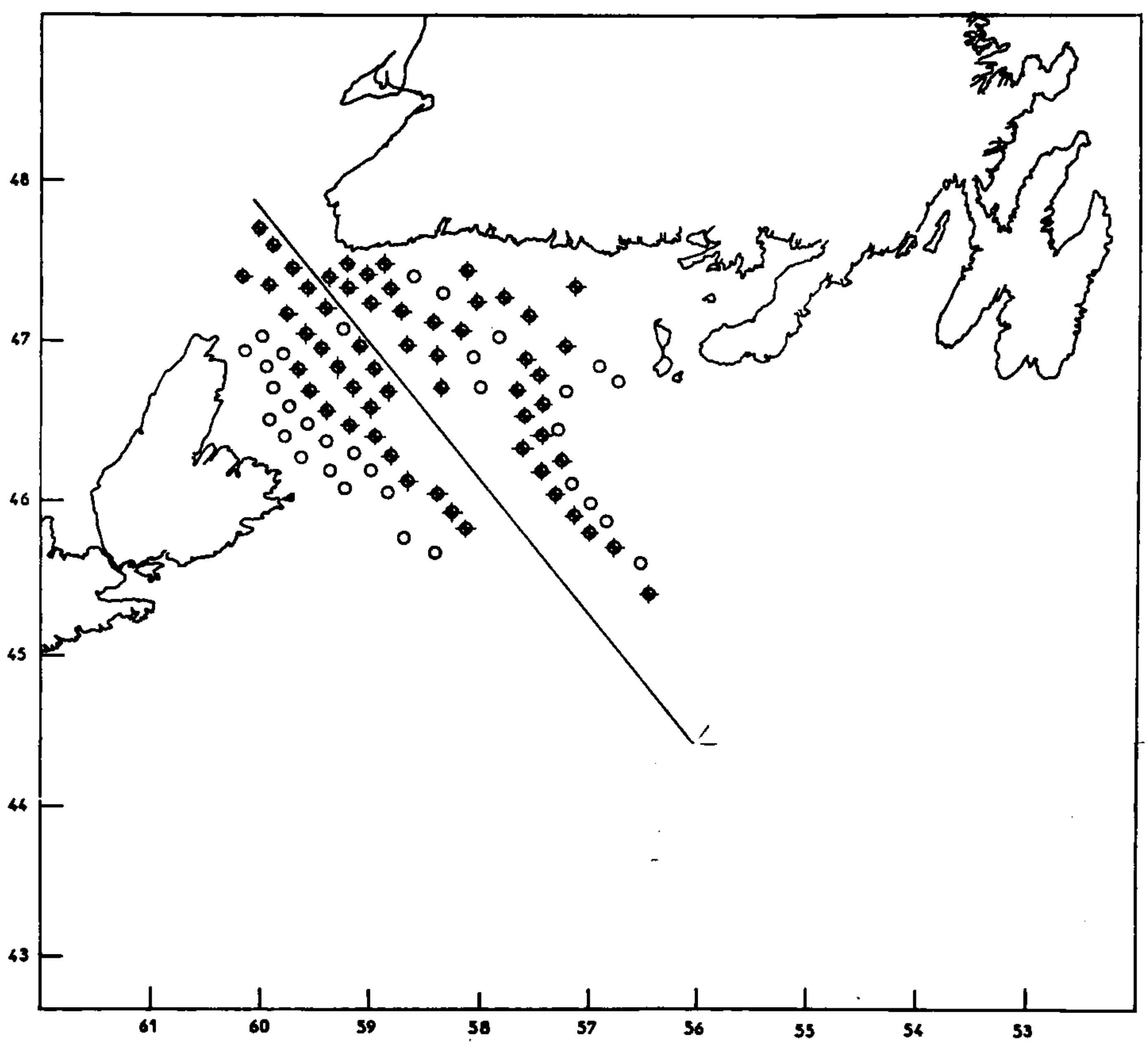

Chart 1. Distribution of trawl hauls during 1970 survey. Black circles show redfish catch areas.

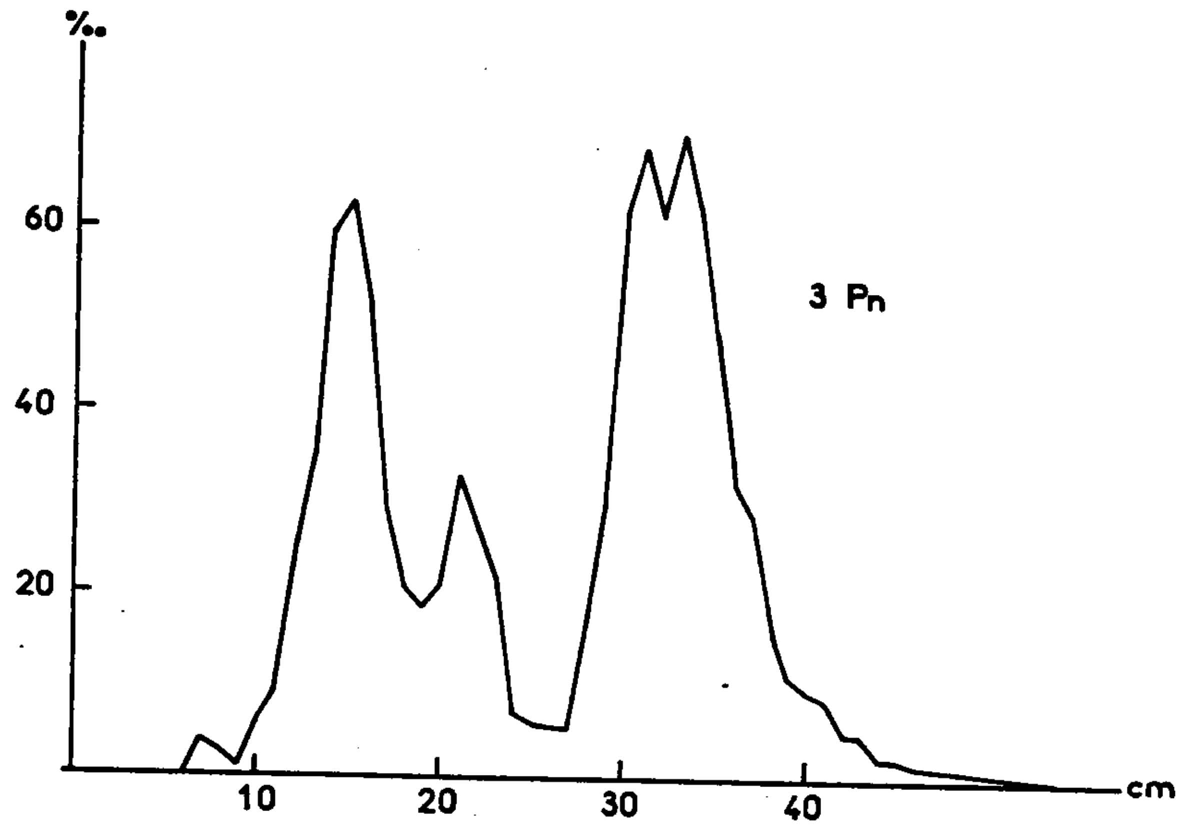

Fig. 1. Length frequencies in ICNAF Div. 3Pn.

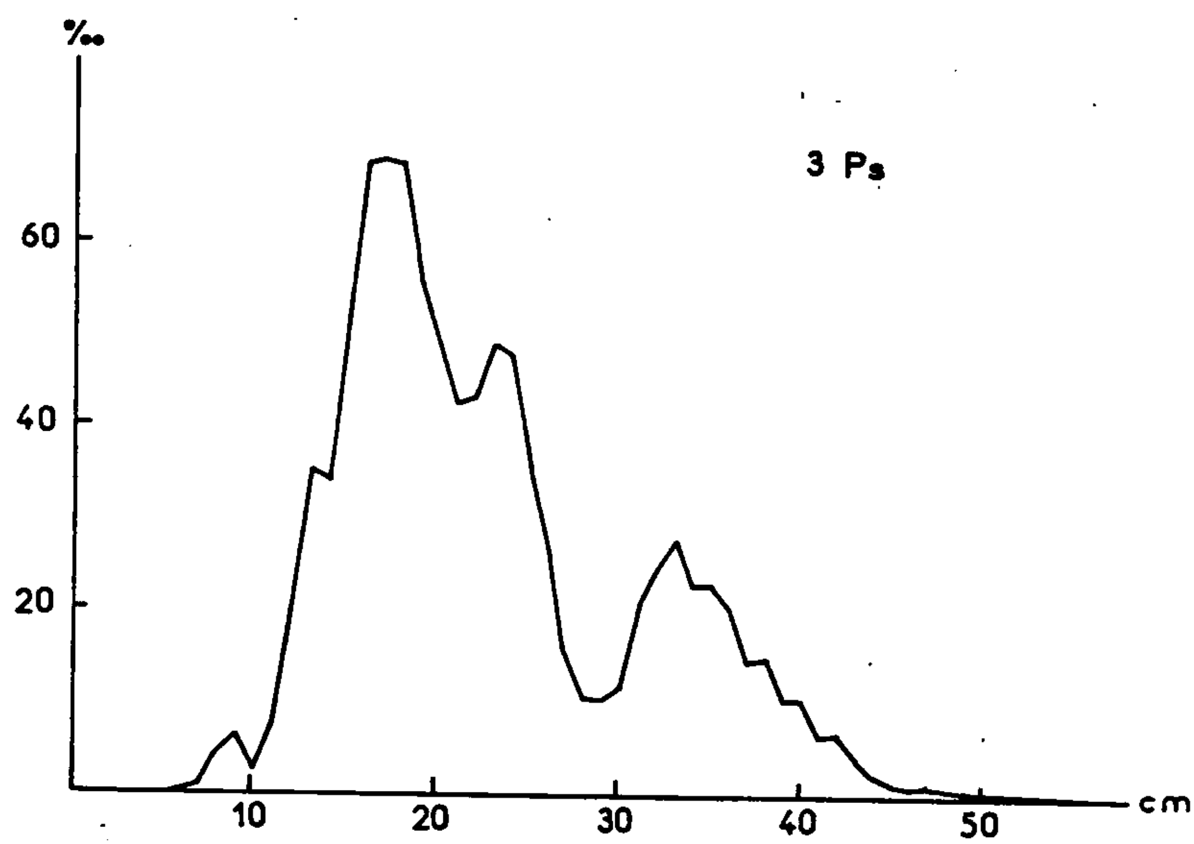

Fig. 2. Length frequencies in ICNAF Div. 3Ps.

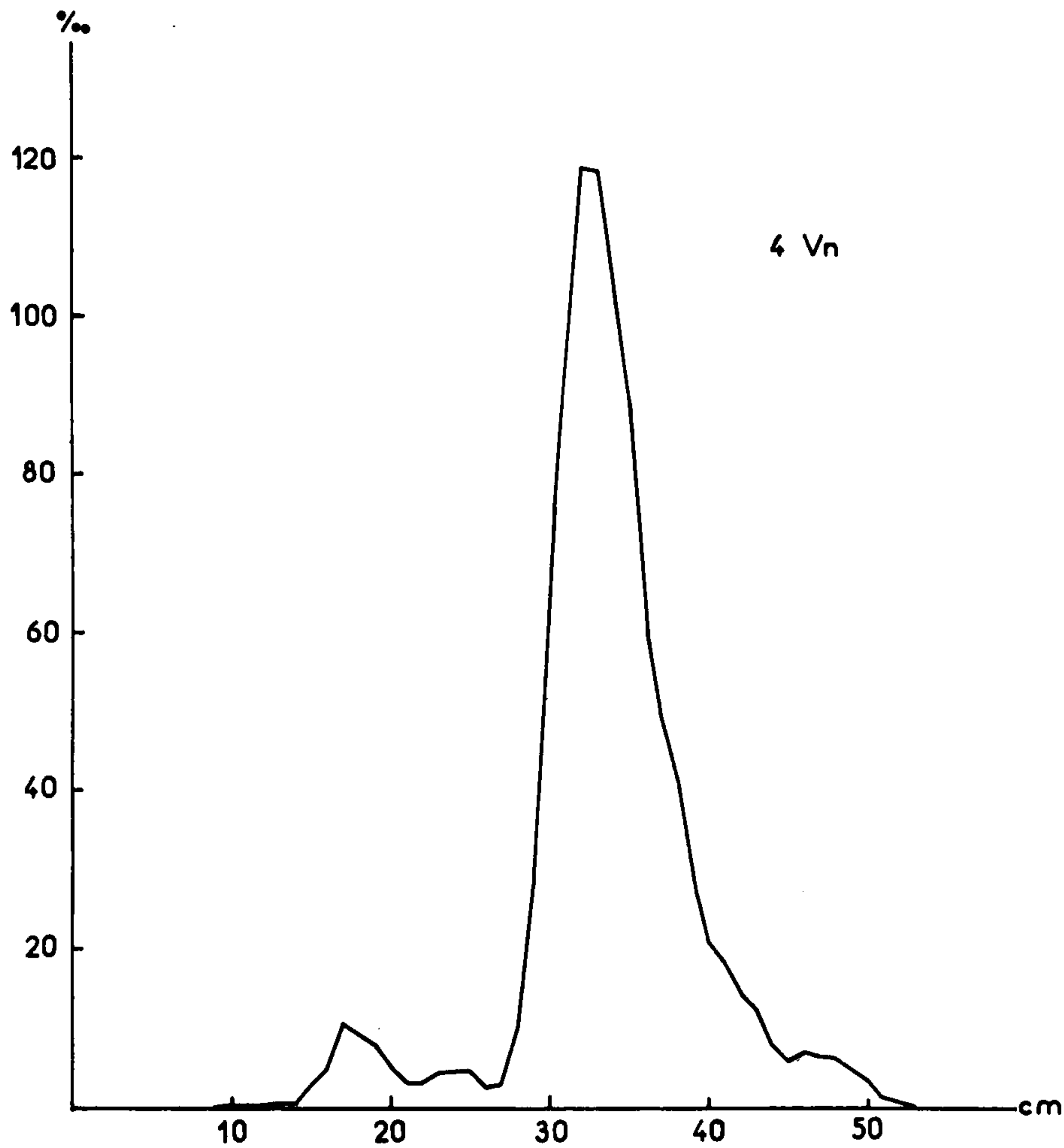

Fig. 3. Length frequencies in ICNAF Div. 4Vn.

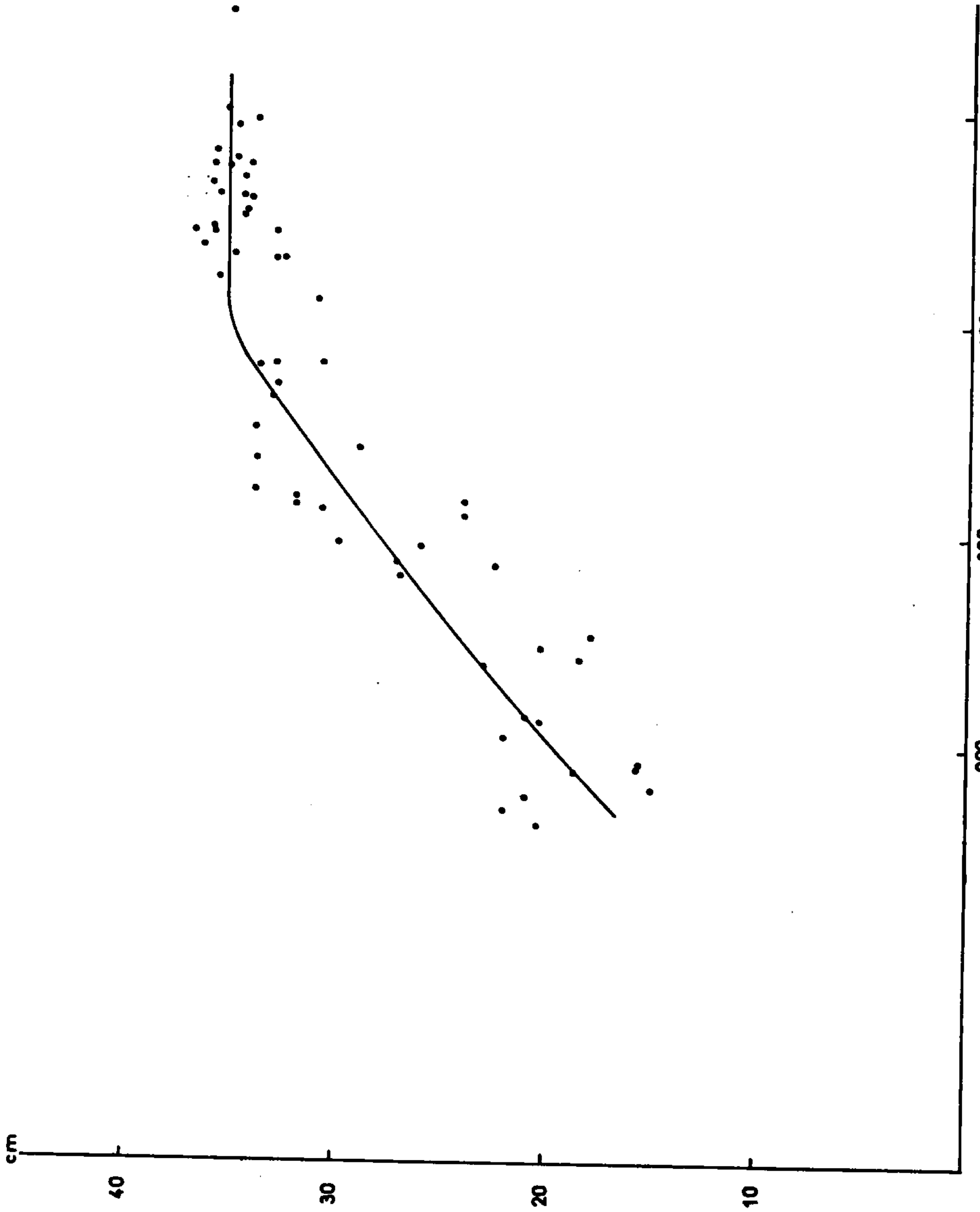

Fig. 4. Redfish length according to depth.

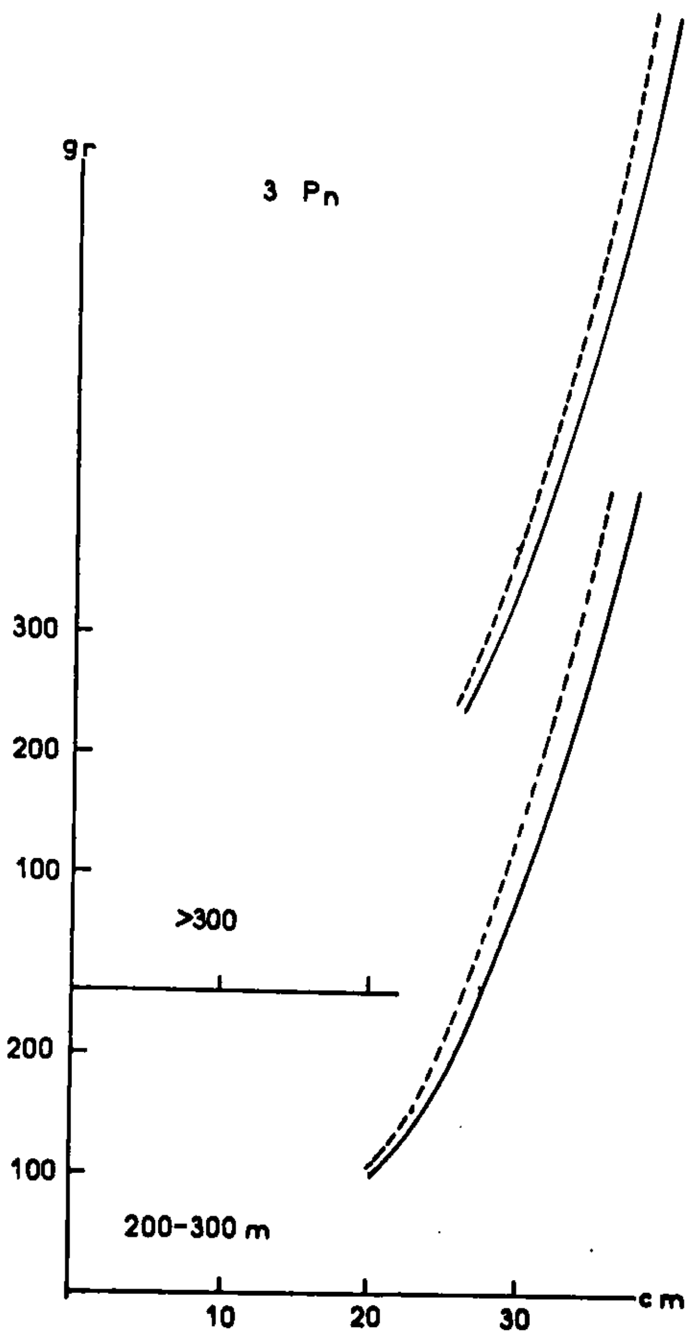

Fig. 5. Length/weight curves in ICNAF Div. 3Pn. Solid lines show male, and dashes indicate female.

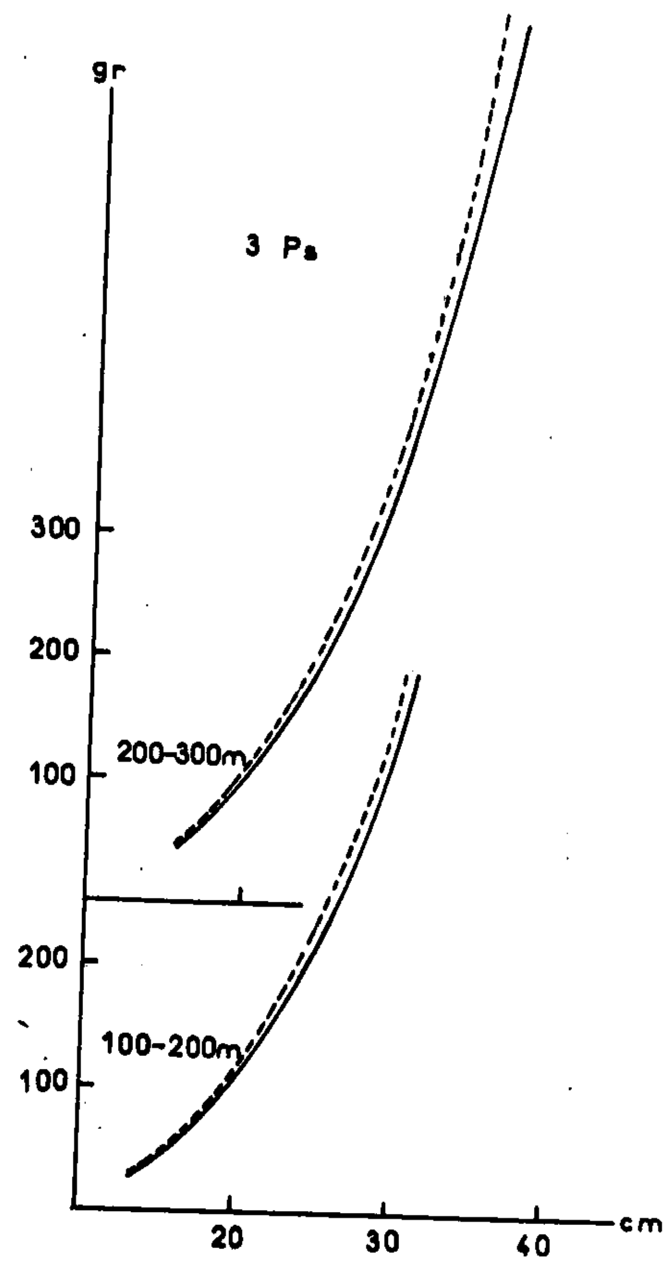

Fig. 6. Length/weight curves in ICNAF Div. 3Ps. Solid lines show male, and dashes indicate female.

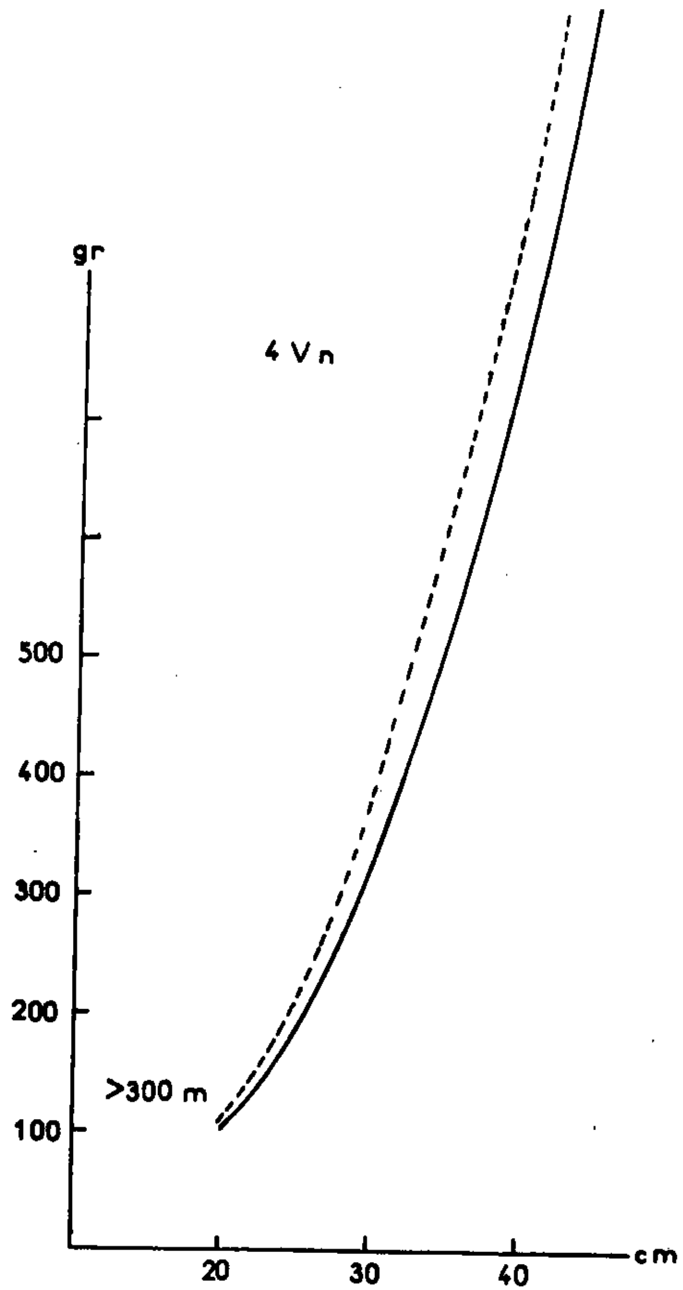

Fig. 7. Length/weight curves in ICNAF Div. 4Vn. Solid lines show male and dashes indicate fe le.

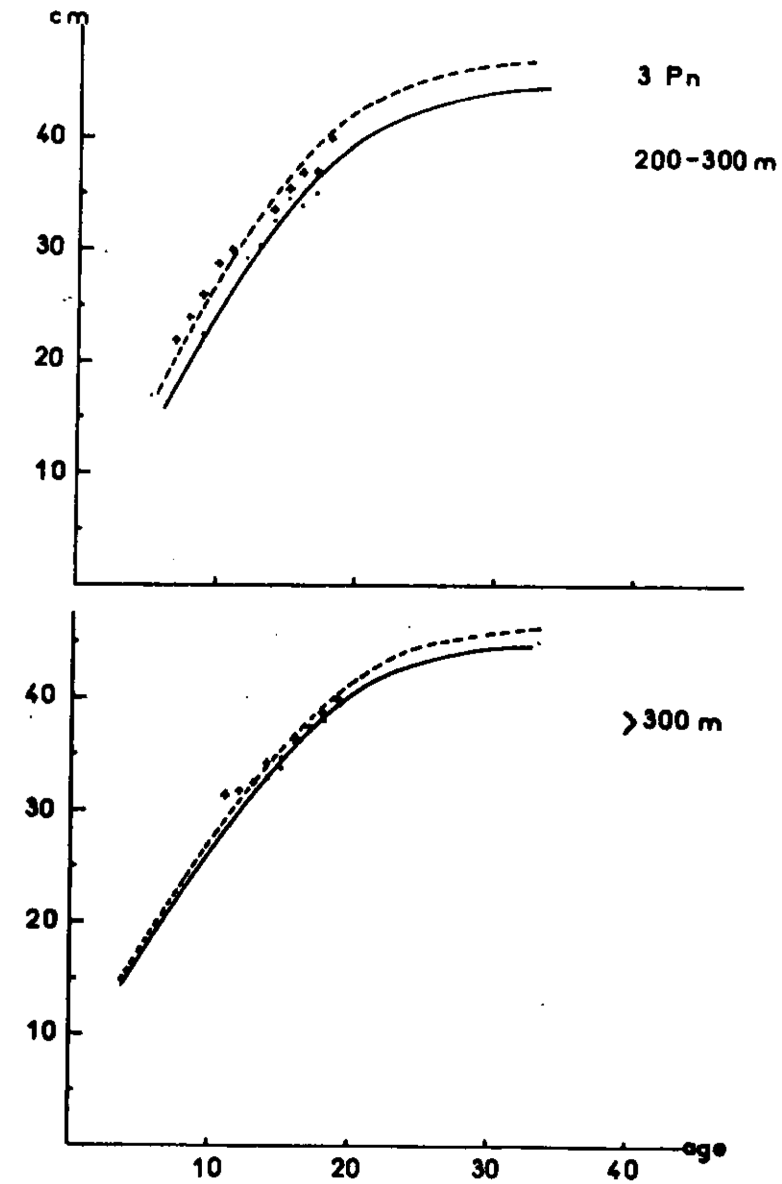

Fig. 8. Production curves in ICNAF Div. 3Pn, according to depth. Solid lines show m-'e, dashes indicate female.

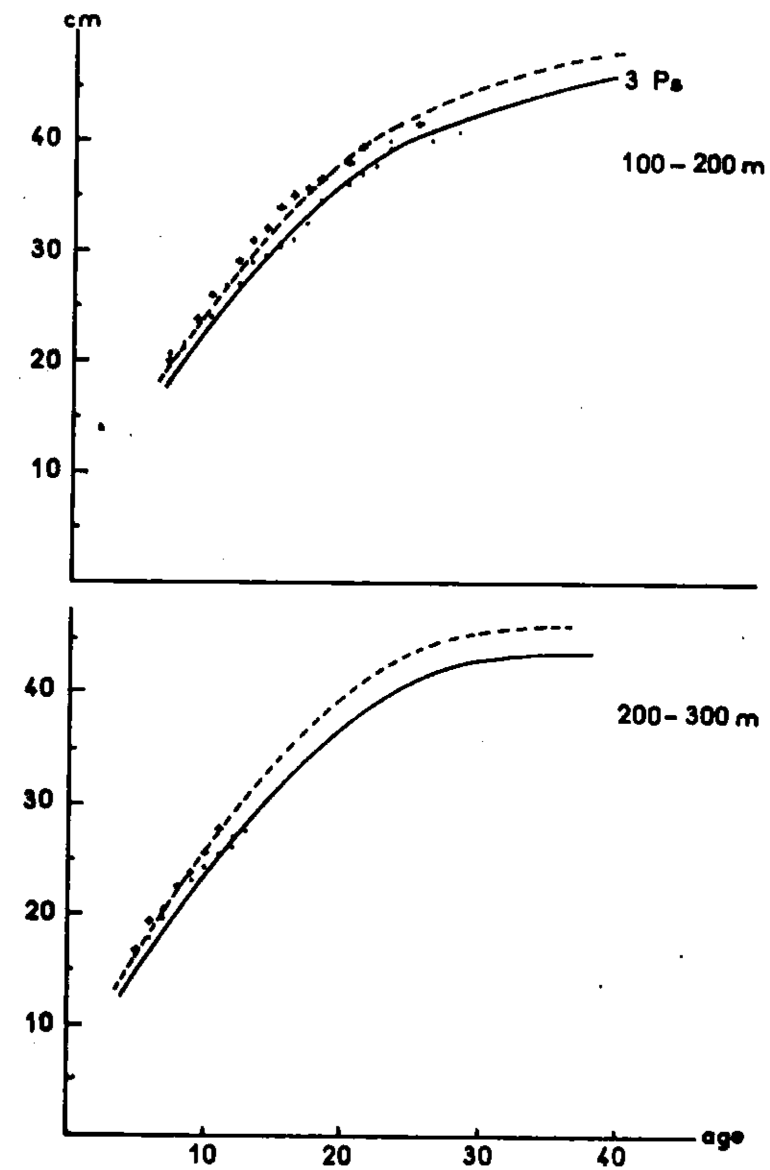

Fig. 9. Production curves in ICNAF Div. 3Ps according to depth. Solid lines show male, dashes indicate female.

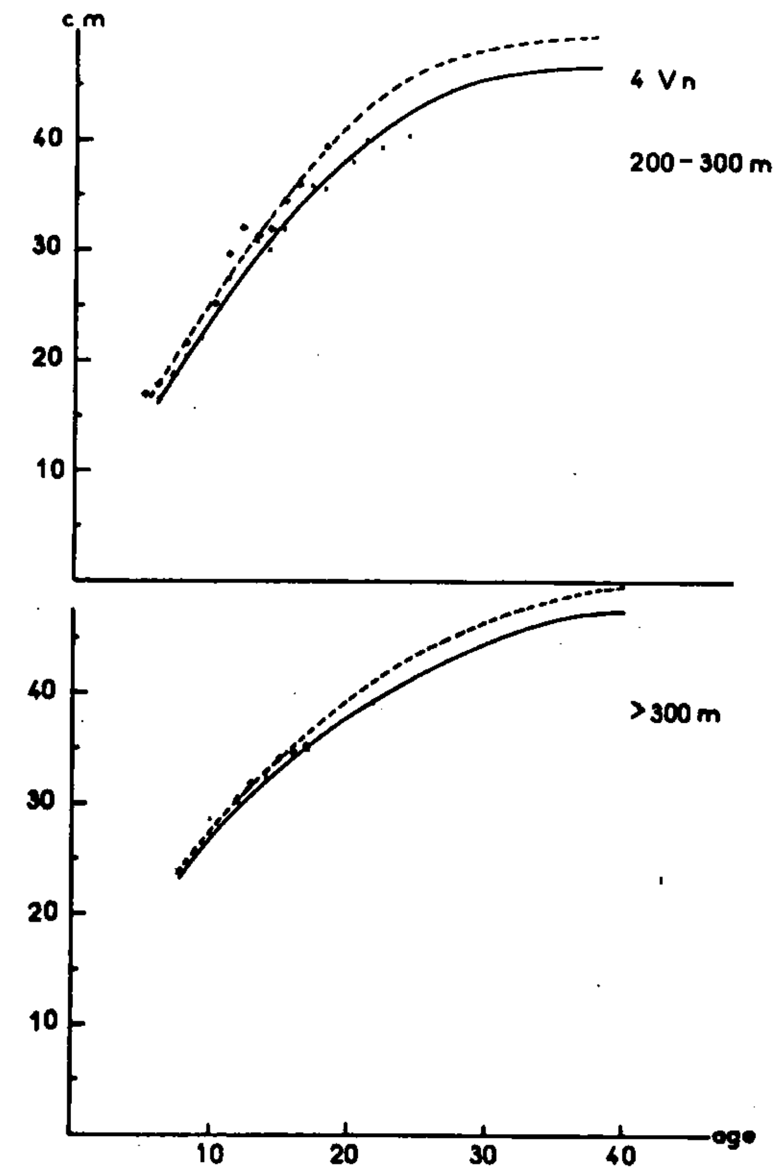

Fig. 10. Production curves in ICNAF Div. 4Vn according to depth. Solid lines show male, dashes indicate female.

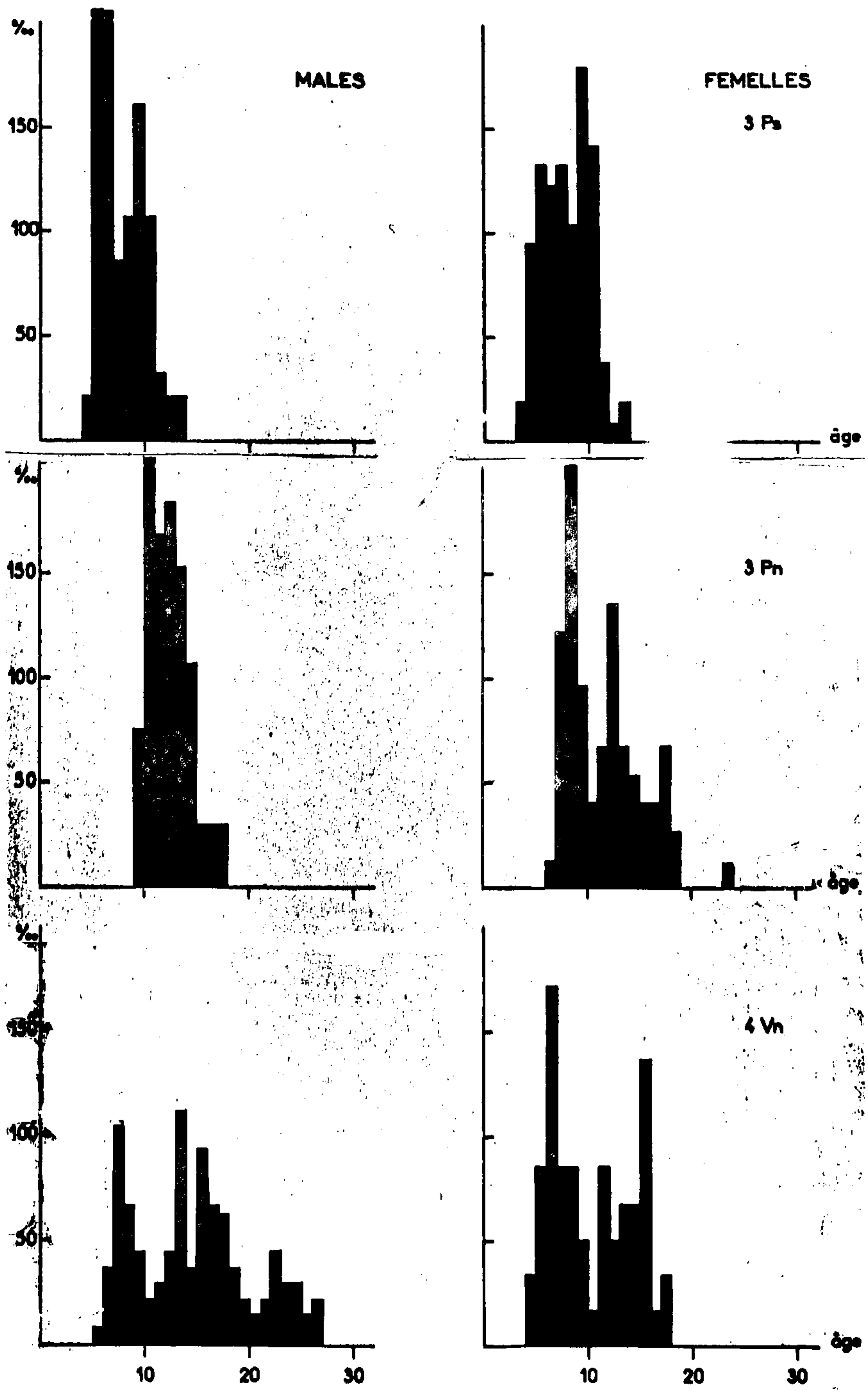

Fig. 11. Age frequency between 200 and 300 m.

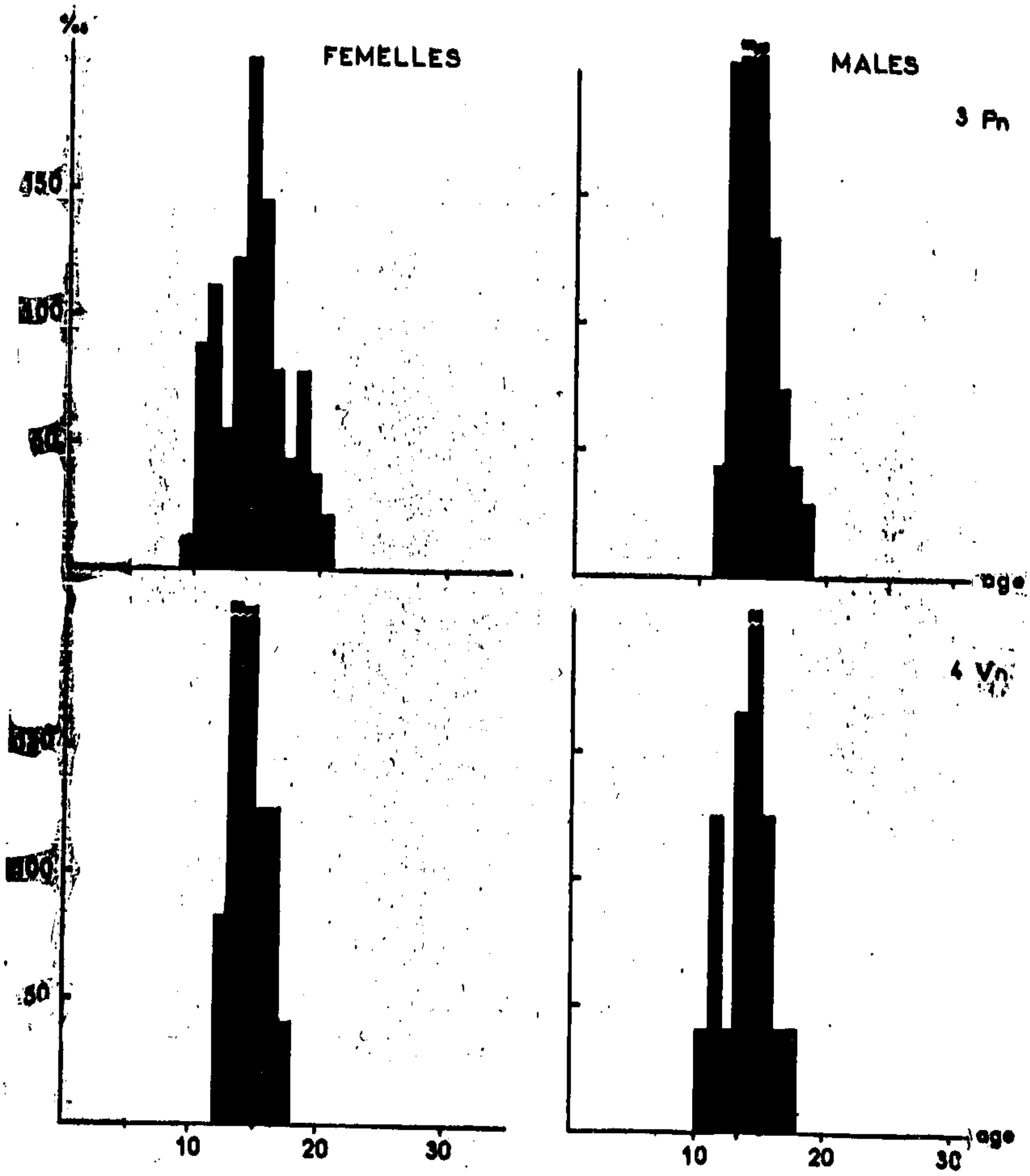

Fig. 12. Age frequency at depths more than 300 m.