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**REPORT ON THE ICELANDIC ACOUSTIC SURVEY ON THE OCEANIC *SEBASTES*
MENTELLA IN THE IRMINGER SEA, IN JUNE 1991**

by

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ABSTRACT

An acoustic survey on oceanic redfish in the Irminger Sea, in June 1991, was carried out by Iceland. Appr. 60 000 n.m.² were covered. The stock size in the area surveyed was assessed to be about 720 000 tonnes.

The relative abundance based on echo indices was higher in the western part than in the eastern one of the area investigated. The species was observed to be densest in the 100 to 200 m depth layer, mainly within a temperature range of 4° to 5°C.

Females dominated in the eastern part while males were in majority in the western part of the area. The average length of oceanic redfish was 36.5 cm and the average weight, 639 g. Females were larger and heavier than males. The percentage visual abnormalities in the general appearance of the fish was higher for females than for males.

Introduction

The existence of a pelagic stock of *Sebastes mentella* in the Irminger Sea has been known since 1972 (Magnússon, 1972). The fishery on this stock of redfish (i.e. oceanic redfish) in the Irminger Sea and adjacent waters commenced in 1982. The total nominal catch reached its maximum level in 1986 with about 105 000 tonnes but the catch has declined since then and was about 23 000 tonnes, in 1991. The USSR fleet has dominated in this fishery from the very beginning until 1991. During this time period, the USSR conducted trawl-acoustic surveys which provided information on the abundance and distribution of the stock (Pavlov et al., 1989). The uncertainty in using the results of these acoustic surveys for assessment purposes has been pointed out (Anon., 1991). However, the acoustic approach is considered to be the most promising method for assessing the oceanic redfish stock at present.

The first Icelandic attempt to apply an acoustic method for the assessment of the oceanic redfish was carried out during a survey in April/May 1990 (Magnússon et al., 1990). The results were not satisfactory mainly because of the behaviour of the species at that time of the year and because of disturbing echoes from various living organisms in the sea such as e.g. Myctophids. According to the Soviet experience in this field, the conditions are much more favourable for acoustic measurements later in the year, e.g. in June/July because at that time the disturbing echoes are usually below 350-400 m depth while the ocean redfish is staying mainly above that level.

This paper reports on an acoustic survey (B 8/91) carried out by the Marine Research Institute (MRI) on the research vessel "Bjarni Sæmundsson" in the Irminger Sea, during June 6 to 26, 1991 (see also Magnússon et al., 1991). The Greenland authorities kindly granted permission to conduct research within the EEZ of Greenland.

The main aim of the cruise was to examine the feasibility of using acoustic methods for assessing the stock of the oceanic redfish in the Irminger Sea at that time of the year. Also, routine biological sampling was carried out during the cruise.

Almost 60 000 n.m² were covered between 59°N and 63°N on 8 transections (Fig. 1).

Material and methods

A 38 kHz Simrad EK500 split-beam echo sounder/integrator system was used for acoustic data collection (Bodholt et al. 1989). The equipment was thoroughly calibrated prior to the survey, using the standard target method. Instrument settings relevant to echo integration and target strength analysis are shown in Table 1.

During the survey mean integrated echo values per 1 n.m. were recorded for every 5 n.m. sailed, from 10 to 500 m depth, in 50 m depth layers.

In the course of the survey it became evident that integrator values were rather sensitive to the threshold used as the fish were only observed in very disperse condition. Using overlapping layers with different threshold values it was observed that with a volume backscattering threshold (Sv-threshold) of -72dB, a large part of disturbing echoes from smaller organism were removed. Trials on echograms consisting almost exclusively of redfish showed that a threshold of -79 gave about 10% higher readings. Lowering the threshold even more had very little effect. A threshold of -72 dB was adopted and consequently all integrator values were increased by 10% in the processing of the data.

In order to convert acoustic data to numbers of fish the mean target strength in the depth interval 100-200 m obtained from several TS measurements carried out on the Icelandic redfish survey in June/July 1992 was used (Magnússon et al. 1992).

A specially designed pelagic trawl (Gloria type, Hampiðjan, with maximum stretched mesh size of 32 m) with a vertical opening of 75-80 m was used. The codend was lined with a fine-meshed net (36 mm). The duration of the hauls was 1 hour.

A total of 29 hauls were taken in a range of 90 to 660 m depth mainly between 100 and 200 m depth.

A total of 4 116 specimens were measured and sexed of which a total of 1 722 specimens were weighed individually. Abnormalities in pigmentation and infestation by the parasite copepod *Sphyrion lumpi* were recorded of a total of 852 specimens. Observation on stomachs were carried out.

Zooplankton sampling was regularly carried out by means of a bongo net (100 m depth oblique) mostly 40 n.m. apart and the volume was measured by the displacement method. Simultaneously, temperature and salinity measurements were carried out by means of a CTD mostly down to 700 m depth.

The division of the survey area into an eastern and western part is defined by a

line through the following positions: 62°00'N 35°00'W and 59°30'N 37°00'W.

Results

A) Acoustic measurements

According to our estimation the stock size of oceanic redfish was assessed to be about 720 000 tonnes in the area surveyed which is only a part of the whole distribution area of the species.

Fig. 2 shows the relative abundance based on echo values. Several points should be emphasized:

1. The oceanic redfish was observed almost in the entire survey area, i.e. between 59°N and 63°N and between 28°W and 41°W.
2. At this time, the oceanic redfish was already most abundant in the western part of the Irminger Sea.
3. Acoustic traces showed the oceanic redfish to be mainly in 50 to 300 m depth with greatest densities in 100 to 200 m depth. Further, the species was more dispersed during the beginning of the cruise than later and then, it was generally abundant in 100 to 250 m depth.

Referring to previously published observations (Magnússon, 1983), the oceanic redfish "spawn" in greater depths i.e. mainly in 300 to 400 m and even deeper but ascend after spawning. The observations during this cruise and the fishing pattern of the fleet confirm this behaviour.

4. Experimental tows confirmed that jellyfish did not affect the echo values.
5. Echo traces originating from other fish such as Myctophids were observed, especially during the night time. With proper integration threshold, it was possible to exclude this disturbance to a great extent during the day, but to a lesser degree at night.

B) Temperature and distribution

The distribution of the oceanic redfish is closely connected with a certain range of temperature. It has been stated earlier (Magnússon, 1983) that the "spawning" takes place within a rather limited temperature range (5.5°-6.5°C) but this particular range seems to be preferred mainly at the time of the extrusion of the larvae. During this cruise in June, i.e. at a time when the "spawning" had more or less been completed the oceanic redfish were most abundant in temperatures between 4° and 5°C. Fig 3 demonstrates the temperature distribution according to depth on a section at 60°N between 29°21'W and 41°00'W. The temperature distribution changed rapidly between st. 351 and st. 352 (i.e. between 35°W and 36°W). The 4° to 5°C isotherms were dominant in 50 to 200 m depth and the 4°-4.5°C isotherms between 100 and 200 m depth. Compared to the abundance pattern (Fig. 2), it is obvious that the above described change in the temperature distribution coincides with the increased abundance of oceanic redfish.

Fig. 4 shows the horizontal temperature distribution in 150 m depth. A comparison with Fig. 2 reveals that the abundance pattern of the oceanic redfish follows more or less the isotherms at that level.

C) Biological information

Females were more abundant than males in the catches with an overall proportion of 62.8%. On the other hand, the proportion of sexes was somewhat variable in the different catches. Females were in majority at most stations, especially in the NE part of the area surveyed while males were in majority at few stations in particular in the SW part of the area. The stage of maturity of both sexes were as could be expected at this time of the year, i.e. the females had recently extruded their larvae (stage IV) while the males were maturing (stage II). Almost all the fish were mature.

The overall length distribution ranged from 29 to 48 cm but the bulk was within the range of 34-38 cm with the mean length of 36.5 cm (Fig.5). Females were larger (mean length 37.5 cm) than males (mean length 35.8 cm.) In general, the average length of oceanic redfish was less in the western part of the survey area, i.e. were the

males were in majority as demonstrated in the following Table:

B8/91. Oceanic redfish. Av. length (cm) by sex in the eastern and western part of the survey area.

Surv.Area Part	Males		Females		Total	
	No.	Av.l.	No.	Av.l.	No.	Av.l.
East	821	36.0	1916	38.0	2737	37.3
West	703	34.9	655	36.4	1358	35.5

The overall weight (Fig. 6) ranged from 300 to 1350 gr, the bulk being between 500 and 700 gr (av. weight 639 gr) which corresponds to a length range of 33-40 cm (av. 36.5 cm).

As usual, the infestation of the fish was considerable not only by *Sphyrion lumpi* but also by furuncles and blotches situated on the skin and in the muscles. However, the general appearance of the fish had improved compared to April-May 1990.

74.1% of the total of 852 specimens with abnormalities were females. The infestation rate per haul varied greatly, i.e. from 28.1% to 76.9%. The fish were more infested in the eastern part of the survey area (50% of the fish examined) than in the western part of it (45%). The overall infestation rate of females was 36.3% and of males, 12.7%.

Of a total of 439 fish examined, 166 (37.8%) had everted and 144 (32.8%) had empty stomachs. 74 fish (16.9%) had some stomach content and 55 (12.5%) had a full stomach. The stomach content consisted of following components (no. of stomachs in parentheses):

Chaetognaths (50), Euphausiids (48), Amphipods (33), Calanoids (10), other Crustaceans (4), Gastropods (37), Squids (5), Myctophids (9), Jellyfish (9), not identified (14).

Concluding remarks

Since 1983, it is known that in the eastern part of the Irminger Sea, the extrusion

of larvae of oceanic redfish and of deep sea redfish (*Sebastes mentella* proper) overlap but differ in depth (Magnússon, 1983). During this cruise (B 8/91), hauls were taken in depths of 500 to 600 m at different localities. Deep sea redfish were present in all of the hauls. Thus, the distribution area of deep sea redfish in this region seems to be much more extensive than previously assumed.

It should be emphasized that during this survey only a part of the distribution area of oceanic redfish was covered. The distribution area extends much farther to the SW as has been demonstrated i.a. by Pavlov (1991). Therefore, the abundance estimate of 720 000 tonnes represents only a part of the spawning stock.

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Table 1. Instruments and settings in the redfish survey in June 1991.

The five last lines in the table refer to criteria used in the EK500 for single-echo selection. The sound velocity profile was set according to the known general hydrography in the survey area. This affects the time varied gain of the echo sounder.

Echo sounder/Integrator	EK500
Frequency	38 kHz
Transducer	ES38/29
Absorption coefficient	10 dB/km
Transmitted power	2000 W
Pulselength	1.0 ms (medium)
Bandwidth	3.8 kHz (wide)
3 dB beamwidth	7.3 degrees
Equivalent beam angle	-19.8 dB
Calibration constant for integration	24.2 dB
Calibration constant for target strength	24.2 dB
Integration threshold	-72 dB
Target strength threshold	-60 dB
Maximum echo length	0.7 · pulsewidth
Minimum echo length	1.4 · pulsewidth
Maximum phase deviation	2.0
Maximum gain compensation	3.0 dB

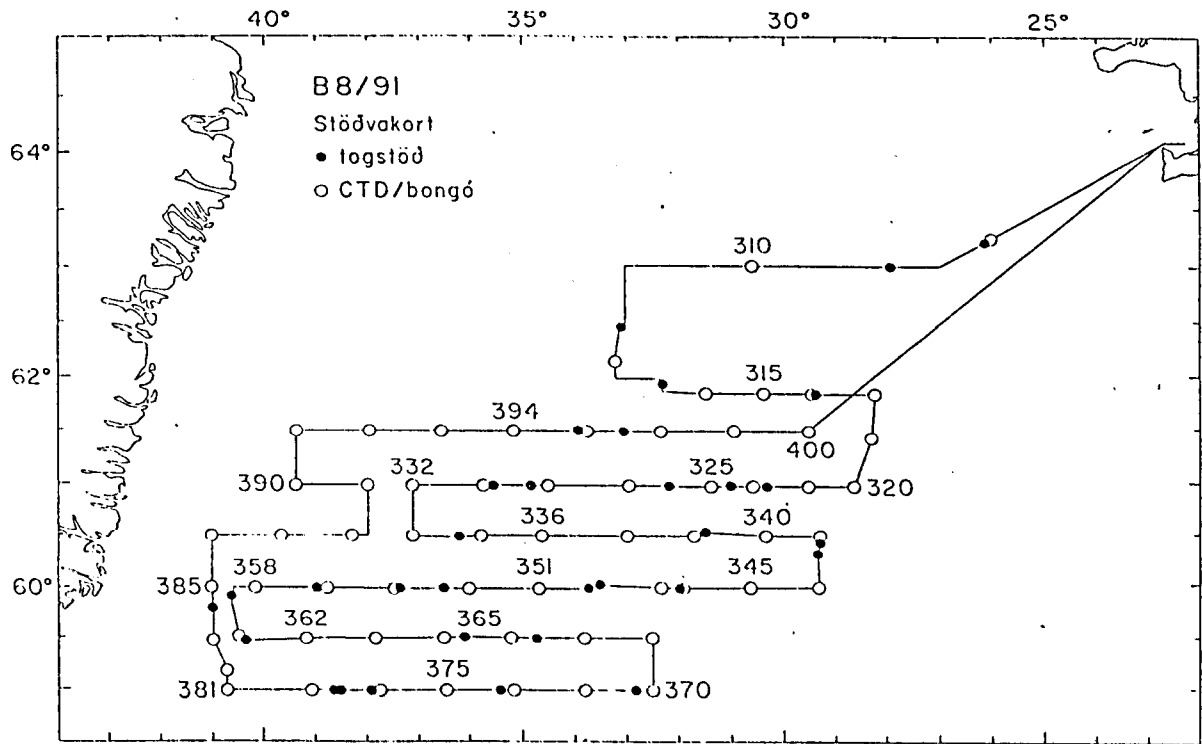


Fig. 1. Cruise B8/91 in the Irminger Sea, June 6-26, 1991. Cruise tracks and stations.

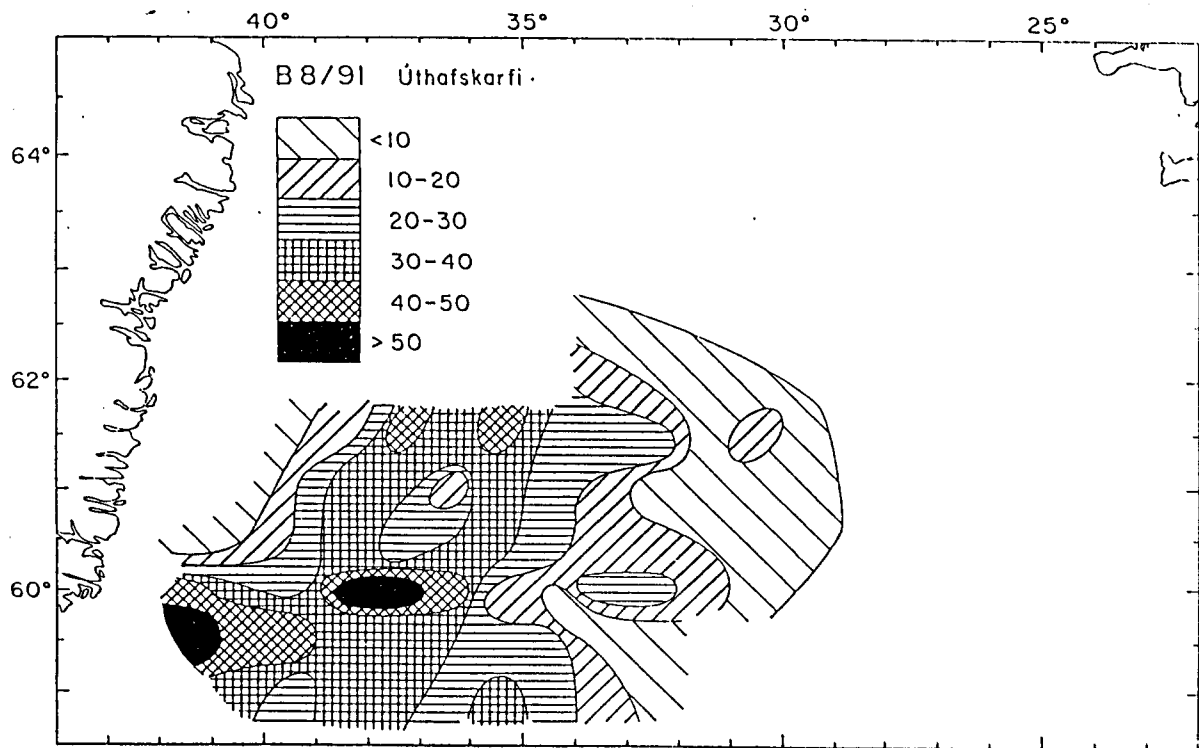


Fig. 2. Relative distribution of oceanic *Sebastes mentella* based on echo values.

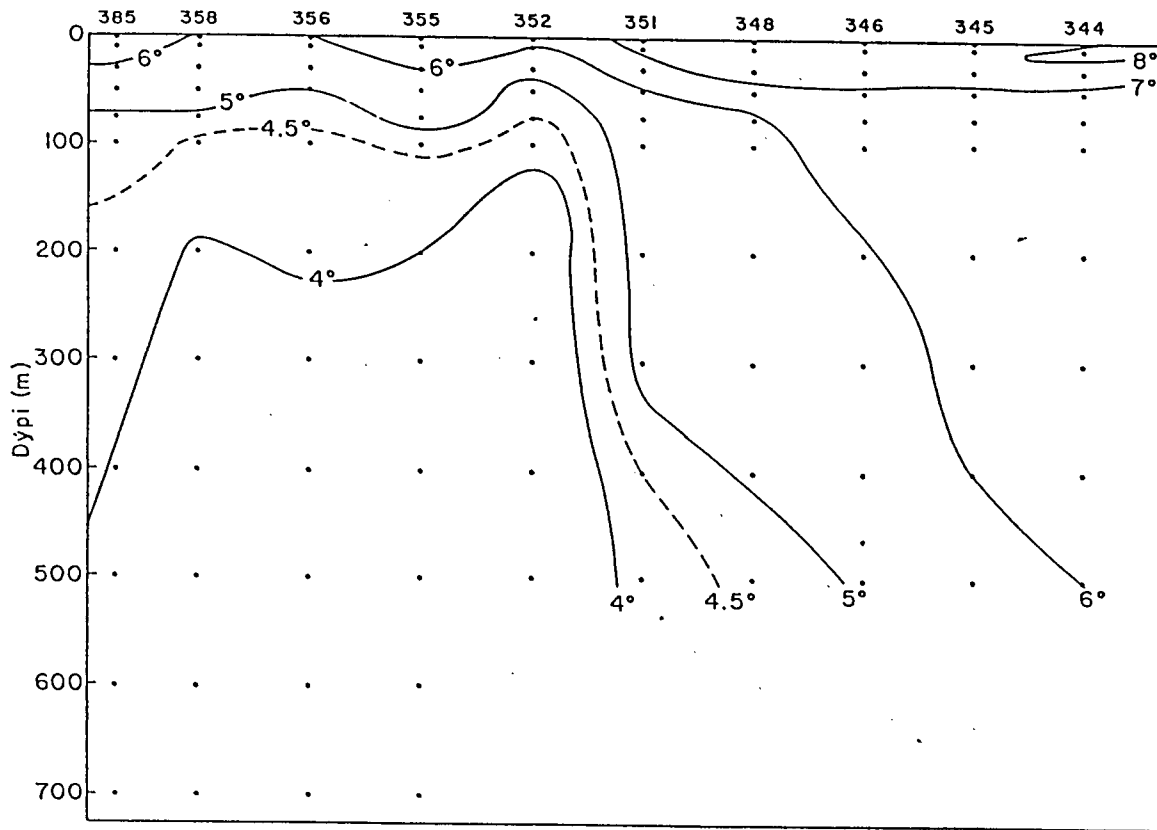


Fig. 3. Vertical temperature distribution ($t^{\circ}\text{C}$) on a section along the 60°N latitude between $29^{\circ}21'\text{V}$ (st. 344) and $41^{\circ}00'\text{W}$ (st. 385). Figures on the top are station numbers.

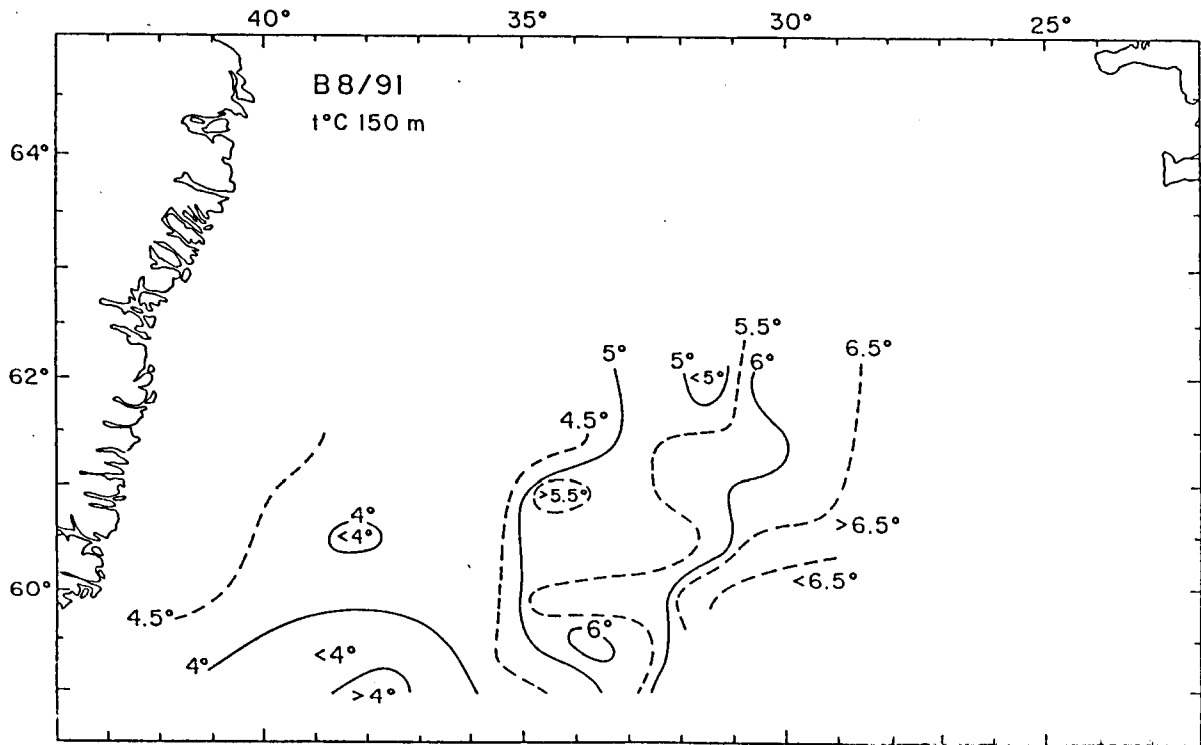


Fig. 4. Horizontal temperature distribution in 150 m depth.

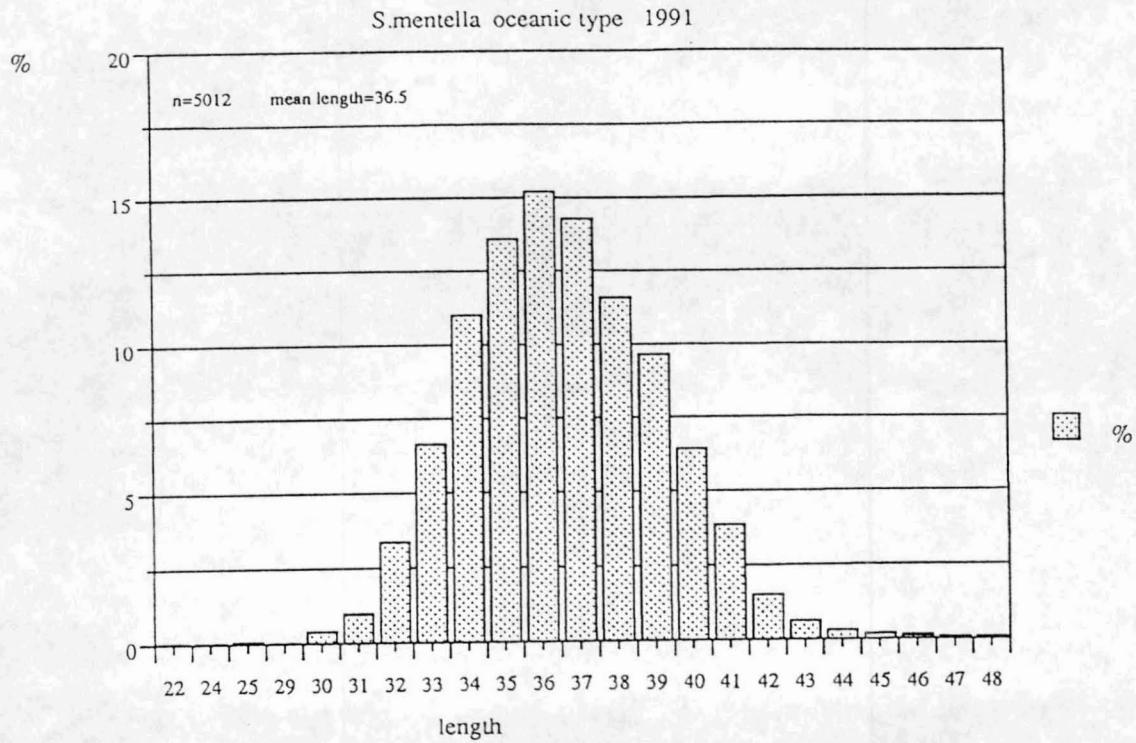


Fig. 5. Length distribution in percentages by cm.

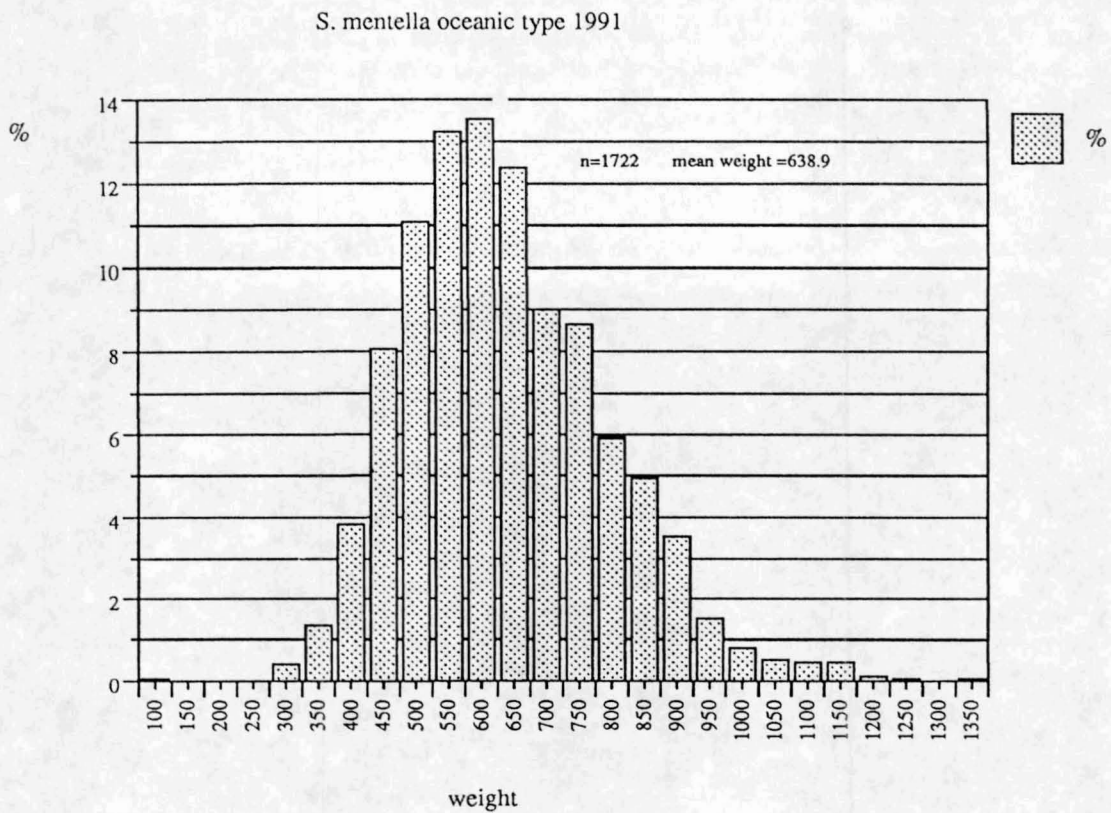


Fig. 6. Weight distribution in % by 50 gr intervals.