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BIOMASS INDICES AND RECRUITMENT LEVELS FOR HAKE AND OTHER COMMERCIAL SPECIES IN ICSEAF DIVISIONS 1.4 AND 1.5 FROM 1988 SURVEYS

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INTRODUCTION

The annual Spanish survey cruises in Divisions 1.4 and 1.5 to estimate biomass and recruitment level of Cape hakes and other commercially important species were carried out following the same program as in previous years (Abelló *et al.* 1988). The main target species of this research were: *Merluccius capensis, M. paradoxus, Lophius upsicephalus, Genypterus capensis, Todarodes angolensis, Austroglossus microlepis,* and *Helicolenus dactylopterus.*

The main purpose of the Spanish surveys like those run by other member countries (USSR, South Africa, etc.), is to collect data for use in the assessment of the different stocks.

The results presented in this paper are based on the data taken during cruises; Benguela XII (January-February 1988) and Benguela XIII (July 1988). The freezer trawler "CHICHA TOUZA", was used in both surveys, which covered ICSEAF Divisions 1.4 and 1.5. Scientists from the Sea Fisheries Research Institute at Cape Town cooperated on both research cruises.

METHODS

Seventy-four trawls were taken during Benguela XII and 70 during Benguela XIII (Figure 1). The sampling area covered the west coast of Namibia from 23° S to 30° S, with a maximum depth at the 500-m isobath. The sampling methodology suggested by ICSEAF and in use on Spanish surveys since 1983 was employed. (For a full description see earlier papers: Abelló *et al.* 1988; Payne *et al.* 1988, and references cited therein).

MAIN TARGET SPECIES

Merluccius capensis

The mean length of *Merluccius capensis* increases with depth. Figures 2 and 3 present the length frequency distribution found in each stratum for both cruises. The pattern observed consistently on previous cruises (Abelló *et al.* 1988; Macpherson *et al.* 1987) was again present.

North of 27° S, between 100-200 m, the mean length fluctuated around 29-34 cm, at 200-300 m the mean length was found to be between 34 and 51 cm, and from 300 m on, it was 41-52 cm.

The distribution pattern was as observed in previous years, i.e., very few individuals were caught at depths of more than 400 m; south of latitude 28° S, the mean length in each stratum is higher than in the north, with a mean size of around 45-58 cm between 100 and 200 m; at depths over 200 m the mean length is over 65 cm. This distribution pattern might be related to the existence of two different stocks. It should be pointed out that the general increase in mean length observed from shallower to deeper strata, is due not to an increase in the abundance of large specimens but rather to a decrease in the number of the smaller fish.

Distribution and abundance

The distribution of *Merluccius capensis* observed in these cruises was similar to that observed in recent years (Figures 4, 5 and 6). While the species was found over the entire area, *M. capensis* decreased in abundance as *M. paradoxus* became more predominant.

Size classes smaller than 30 cm (0-, 1- and 2-year olds) were found mainly in depths shallower than 200 m. The highest densities were found north of 25° S in January and around 27° S during the winter survey (Figures 4, 5, and 6). Individuals over 30 cm in length were found over the entire area in deeper waters, with the greatest densities at 23-24° S and 29° S.

Biomass

The biomass estimated was 447 727 t in January, and 369 086 t during the winter survey. These values are the lowest observed since 1983 (Table 1).

Merluccius capensis

Length frequencies

The mean length of this species was observed to increase with depth and, in deeper waters, to decrease with latitude. Figures 7 and 8 show the length frequency distribution observed in each stratum. A well defined pattern has been established in the area since 1983.

The mean length at depths of 100-300 m fluctuated between 20 and 35 cm. South of 27° S, the mean length ranged from 32 to 44 cm between 300 and 500 m; north of this latitude means of between 33 and 45 cm were found. An increase in mean length was also observed for this species, and again the reason is a decrease in abundance of the fish in the smaller length classes.

DISTRIBUTION AND ABUNDANCE

The distribution observed during the surveys was similar to that observed on previous cruises, with respect to depths over 200 m.

Size classes smaller than 30 cm (0, 1- and 2-year-olds) are mainly found south of 28° S in January and south of 27° S in July, usually at 100-300 m (Figures 9, 10 and 11). Individuals over 30 cm are found mainly in deeper waters. Peak abundance levels were recorded from 26° S to 29° S. An important concentration of specimens over 30 cm was found in January around 24° S.

Biomass

The estimated species biomass is shown in Table 1, the value for January being 41 594 t and for July 271 410. These abundance levels are clearly lower than the abundance estimated in 1987. The pattern of *M. paradoxus* biomass fluctuation is different from that observed in *M. capensis* in ICSEAF Division 1.5. Two aspects of the distribution of *M. paradoxus* are worthy of note: on the one hand, seasonal and spatial migrations are stronger in this species than observed in *M. capensis*, and on the other, the *M. paradoxus* extends as well into Division 1.6. Although a decrease in abundance with respect to 1987 was observed, it cannot be concluded that this decrease necessarily reflects a decrease in actual stock abundance, without comparing the Division 1.6 abundance in 1988.

RECRUITMENT LEVELS OF *MERLUCCIUS CAPENSIS* AND *M. PARADOXUS*

The results of both surveys show a decrease in recruitment strength for *M. capensis* and *M. paradoxus*. The recruitment level observed in *M. capensis* remained at the same low level observed in 1987.

The age structure follows the same trend as in 1987. As Abello *et al.* (1988) pointed out, the figures are quite unexpected because in many cases the different cohorts cannot be traced; this may be due to annual changes in availability at age.

Further, while a decrease in abundance of the oldest ages with respect to 1987 was observed, the abundance of age groups 4 and 5 remained at the same level as in 1987, which were the highest observed since 1983.

M. paradoxus age composition is also shown in Table 2. The abundance estimates for age groups under 4 years old are lower than observed in 1987. Age group 4, i.e., year class 1984, was again observed to be the strongest cohort in the whole history of the fishery; an appreciable "El Niño" event was recorded in that year. The recruitment level and abundance of age group 1 were the lowest observed since 1983 (Table 2). As in *M. capensis*, in *M. paradoxus* age structure, it is difficult to trace a particular cohort from year to year; in this case due either to changes in availability or in migratory behaviour, or very probably a combination of the two, which, further, are interdependent.

OTHER SPECIES

Lophius upsicephalus

Length frequencies

No significant changes were detected in the length distribution of this species (Figures 12 and 13). Once again evidence supporting the existence of two different stocks (Macpherson *et al.* 1986, 1987), one north of 27° S, and the other south of 28° S, was collected (Figures 14, 15 and 16).

In the northern stock mean size increased with depth and latitude.

Distribution and abundance

A distribution gap was found at 27° S latitude. In the northern stock the main concentration of adults was located north of 25° S and at depths of 200-300 m. Densities were found to be under 50 specimens/mile.

In the southern stock adults and juveniles were distributed along the same area. Abundance in this zone was also very low, less than 50 individuals/mile. This pattern was quite similar to the one observed on previous cruises (Abelló *et al.* 1988).

Biomass

Biomass estimates for this species calculated from data collected on the two surveys are given in Table 1: the figure for January was 54 528 t, while in July the estimated biomass decreased to 24 904 t.

Genypterus capensis

As in previous years the highest densities of kingklip were found near the mouth of the Orange river at depths between 100 and 200 m. Mean size increased clearly with depths. The species decreased in abundance with latitude as in previous years; north of 26° S only very low densities of the species, at depths greater than 400 m, were found.

Mean length increased with depth (Figures 17 and 18).

In January biomass was estimated at 12 237 t, while in July the value estimated was the highest for the winter season since 1983: 8 273 t (Table 1).

Austroglossus microlepis

This species was only found at depths shallower than 200 m, with the maximum concentration near the mouth of the Orange river. Biomass estimates from both surveys were the highest in the data series, 4 369 t and 3 257 t for summer and winter, respectively (Table 1).

Todarodes angolensis

The length frequency distribution for this species was found to be practically uniform over the entire area. The mean size was around 30-35 cm (mantle length). As recorded in previous years, this species was usually found at depths over 200 m. The biomass estimate in January was 29 442 t, and the figure estimated in July was the same as in 1987, 18 625 t (Table 1); this level of biomass is the highest observed in the data series.

Helicolenus dactylopterus

Usually found deeper than 200 m, this species may also appear between 100 and 200 m, south of 28° S. The same size distribution pattern observed in previous surveys, with an increase in mean size with depth, was detected in both seasons (Figures 21 and 22).

The biomass estimate for July, 9 444 t, was lower than the 1986 and 1987 figures, but still represented high abundance.

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TABLE 1. Biomass estimates (t)

	Winter 1983	Summer 1984	Winter 1984	Winter 1985	Summer 1986	Winter 1986	Winter 1987	Summer 1988	Winter 1988
M. capensis	486 388	1 203 875	750 631	655 651	481 299	541 765	571 750	447 727	369 086
M. paradoxus	69 852	96 269	829 947	261 338	97 526	190 993	573 650	241 594	271 410
Lophius ups.	33 358	41 896	16 985	22 128	31 272	40 552	52 430	54 528	24 904
Todarodes s.	8 401	8 943	14 943	5 567	5 971	10 265	25 600	29 442	18 625
Genypterus c.	5 143	10 718	5 298	4 963	13 972	3 546	3 440	12 237	8 273
Austrog. mic.	3 530	3 260	767	2 486	2 972	1 069	2 580	4 369	3 257
Helicol. dac.	4 338	9 072	8 771	5 261	3 712	11 540	11 440		9 144

TABLE 2a. **Merluccius paradoxus.** Estimated number of fish at age (in millions)

	Age group										
	0	1	2	3	4	5	6	7	8	9	10
Winter 1983	-	453,06	56,64	10,69	1,46	0,83	0,31	-	0,04	-	-
Summer 1984	318,80	601,56	52,34	55,61	33,41	8,02	5,35	1,49	0,66	-	-
Winter 1984	68,82	6 266,48	2 615,96	149,63	105,42	14,95	4,70	1,70	0,19	0,01	-
Winter 1985	546,05	504,40	574,40	735,74	143,31	7,30	1,32	0,01	-	-	-
Summer 1986	-	26,50	34,94	39,78	5,03	2,06	1,42	0,89	0,86	0,22	-
Winter 1986	222,40	347,19	213,35	104,15	94,47	53,91	12,06	11,76	2,62	-	-
Winter 1987	920,00	1 823,00	1 562,00	1 271,00	154,00	190,00	12,00	-	-	-	-
Summer 1988	24,13	134,04	265,40	428,93	363,25	97,85	24,13	4,02	-	-	-
Winter 1988	-	253,8	689,2	742,9	299,9	46,5	6,2	1,4	1,0	-	-

TABLE 2b. **Merluccius capensis.** Estimated number of fish at age (in millions)

	Age group											
	0	1	2	3	4	5	6	7	8	9	10	11
Winter 1983	2 517,45	3 442,37	425,69	58,73	8,63	6,50	5,34	2,10	2,07	0,16	-	0,02
Summer 1984	456,81	4 940,89	5 435,03	961,01	72,13	27,43	24,96	12,56	5,33	0,95	-	0,46
Winter 1984	1 512,20	7 007,92	2 199,94	465,86	70,77	48,16	21,54	5,91	1,70	0,46	0,32	0,01
Winter 1985	1 126,02	1 268,59	1 970,76	830,61	43,33	34,16	13,43	14,15	6,51	0,69	0,42	-
Summer 1986	87,57	2 966,51	4 684,78	537,56	63,93	26,04	14,02	5,51	2,20	0,61	0,26	-
Winter 1986	161,68	4 722,32	4 994,49	229,41	38,43	14,47	3,42	0,36	0,11	0,03	-	-
Winter 1987	9,53	586,00	987,00	1 068,00	620,00	295,00	191,00	38,00	-	-	-	-
Summer 1988	2,23	33,39	623,20	787,91	189,19	209,22	238,15	142,50	-	-	-	-
Winter 1988	2,25	71,6	770,4	969,5	516,6	104,1	15,7	9,7	3,9	3,6	0,3	-

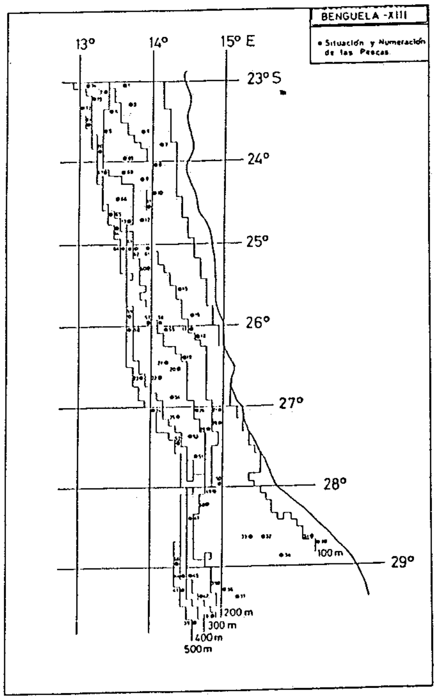


FIG. 1. Station grid

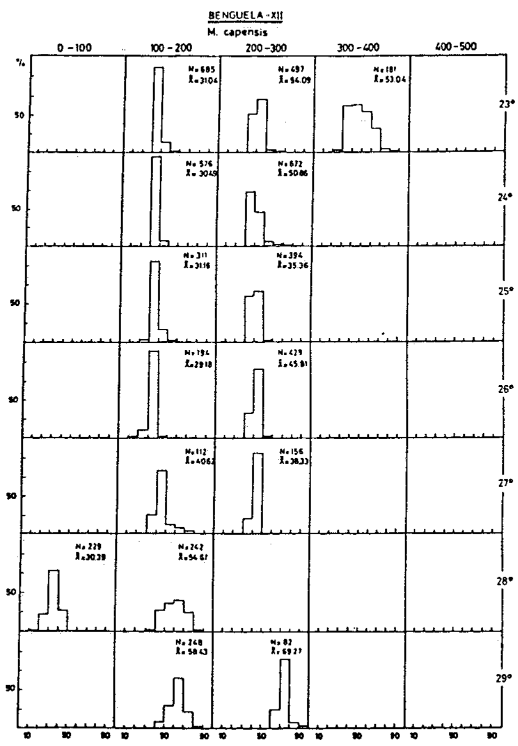


FIG. 2. Merluccius capensis length distribution, January-February 1988

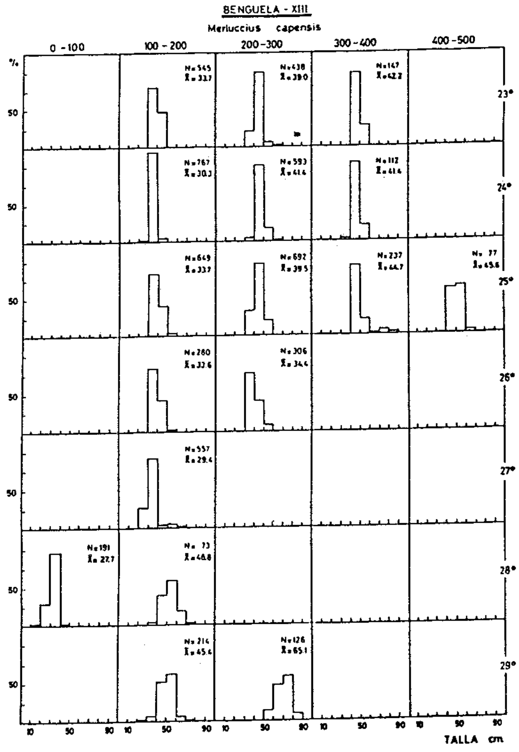


FIG. 3. **Merluccius capensis** length distribution, July 1988

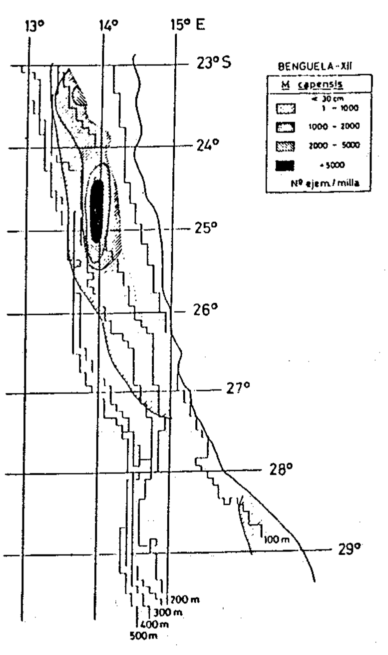


FIG. 4. Distribution of **Merluccius capensis** under 30 cm long, January-February 1988

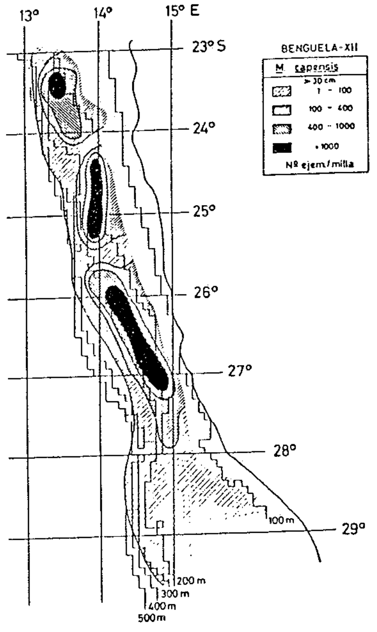


FIG. 5. Distribution of **Merluccius capensis** over 30 cm long, January-February 1988

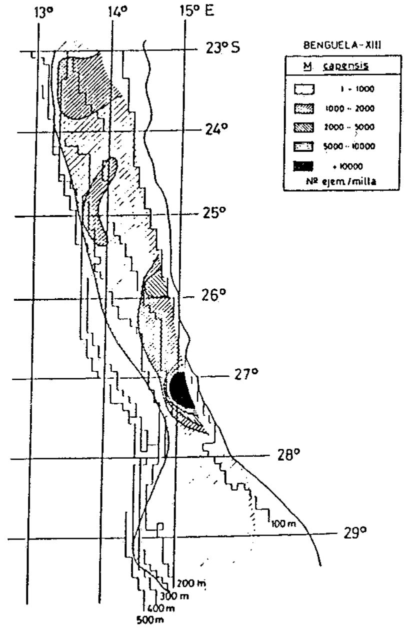


FIG. 6. Distribution of **Merluccius capensis**, July 1988

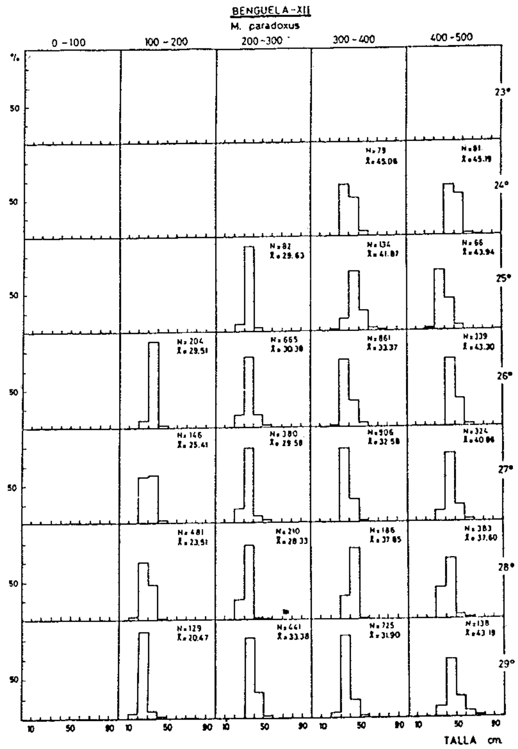


FIG. 7. **Merluccius paradoxus** length distribution, January-February 1988

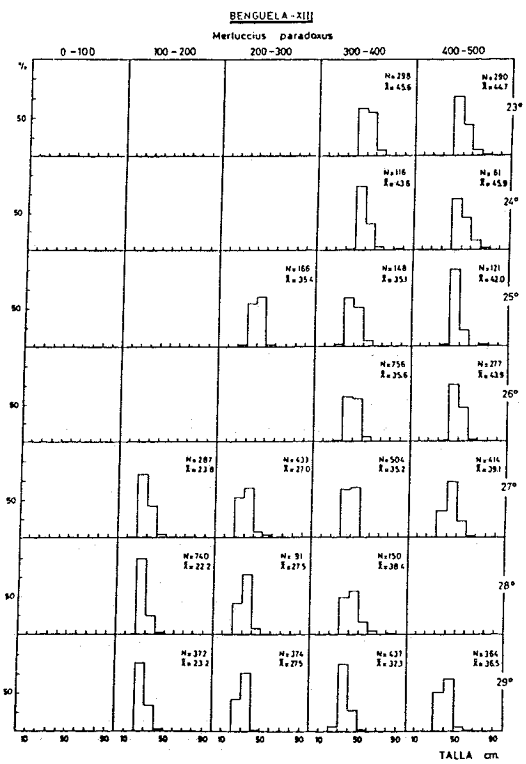


FIG. 8. **Merluccius paradoxus** length distribution, July 1988

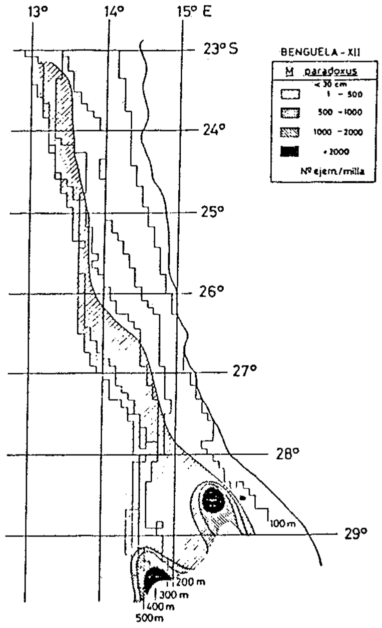


FIG. 9. Distribution of **Merluccius paradoxus** under 30 cm long, January-February 1988

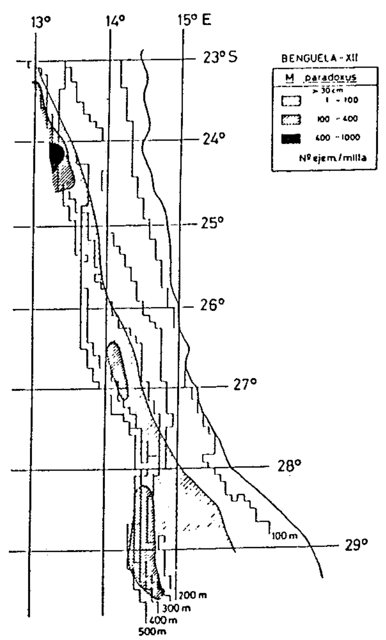


FIG. 10. Distribution of **Merluccius paradoxus** over 30 cm long, January-February 1988

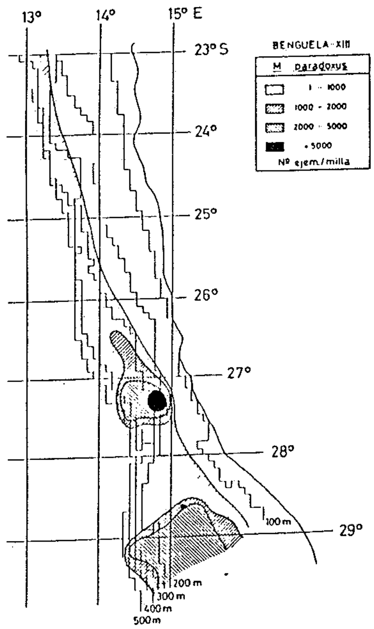


FIG. 11. Distribution of **Merluccius paradoxus**, July 1988

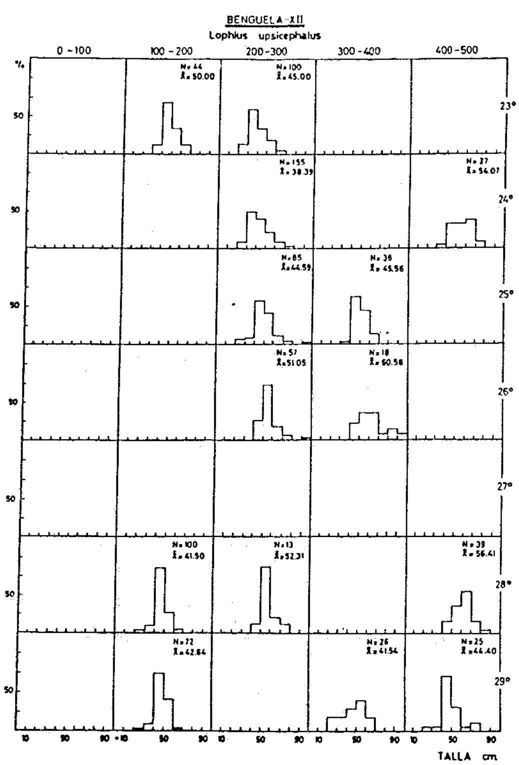


FIG. 12. **Lophius upsicephalus** length distribution, January-February 1988

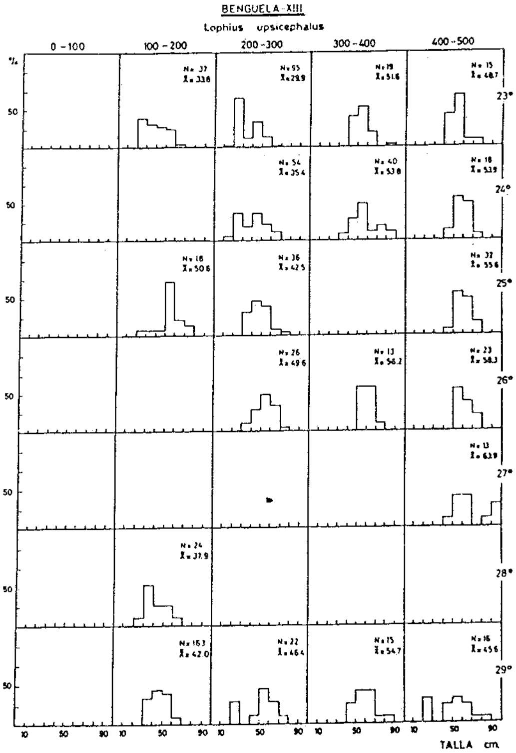


FIG. 13. **Lophius upsicephalus** length distribution, July 1988

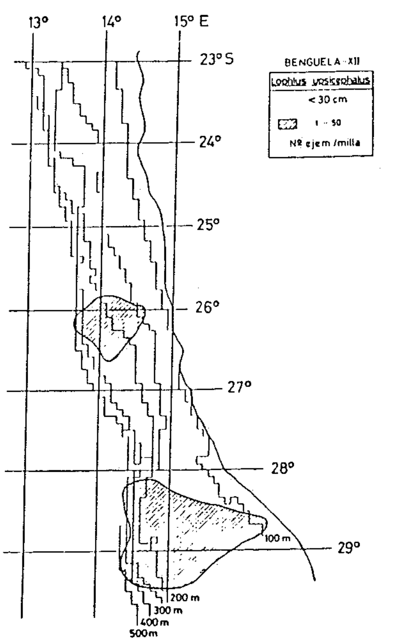


FIG. 14. Distribution of **Lophius upsicephalus** under 30 cm long, January-February 1988

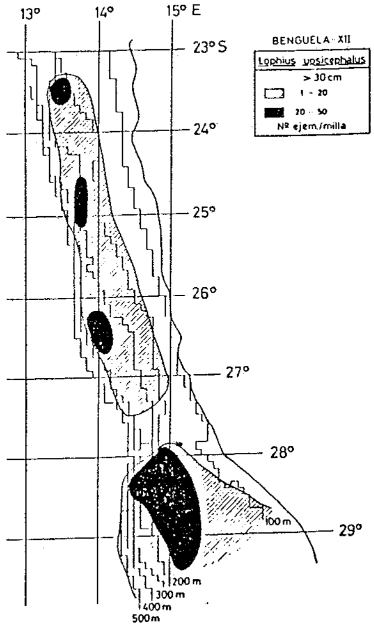
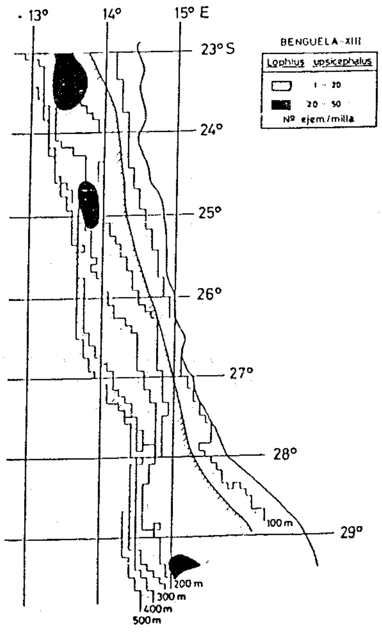


FIG. 15. Distribution of **Lophius upsicephalus** over 30 cm long, January-February 1988

FIG. 16. Distribution of **Lophius upsicephalus**, July 1988



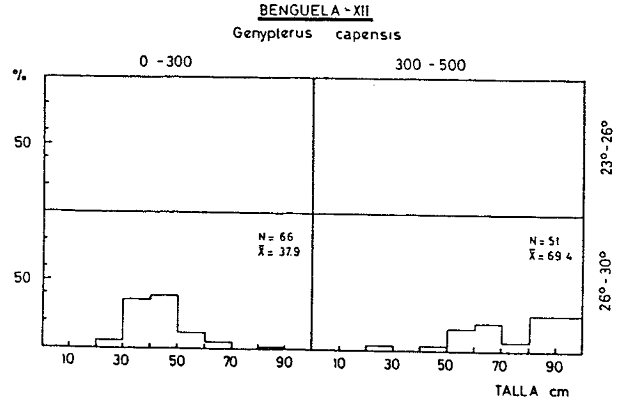


FIG. 17. **Genypterus capensis** length distribution, January-February 1988

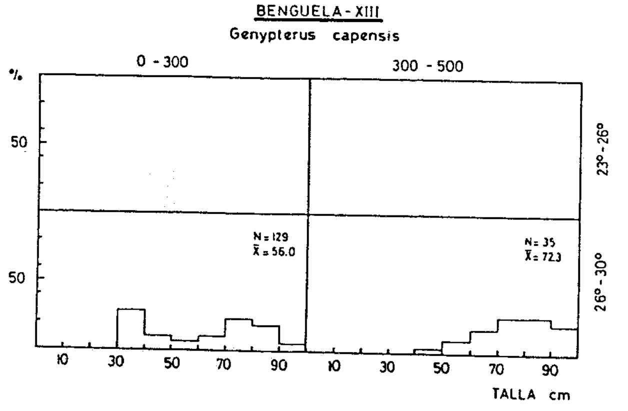


FIG. 18. **Genypterus capensis** length distribution, July 1988

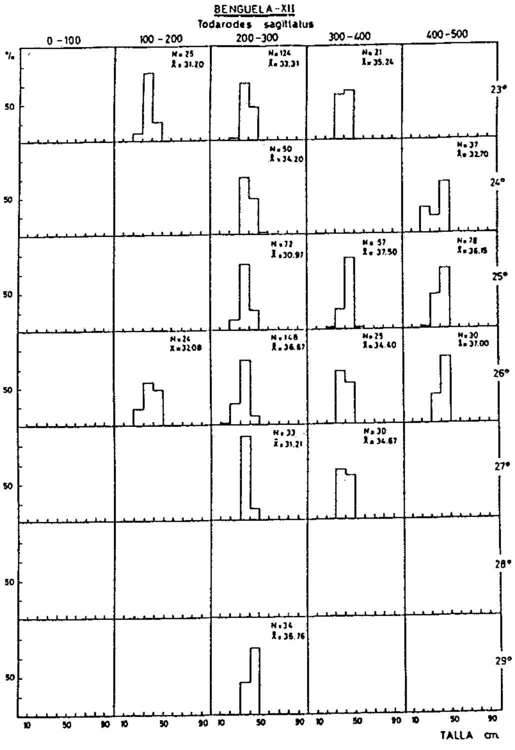


FIG. 19. **Todarodes sagittatus** length distribution, January-February 1988

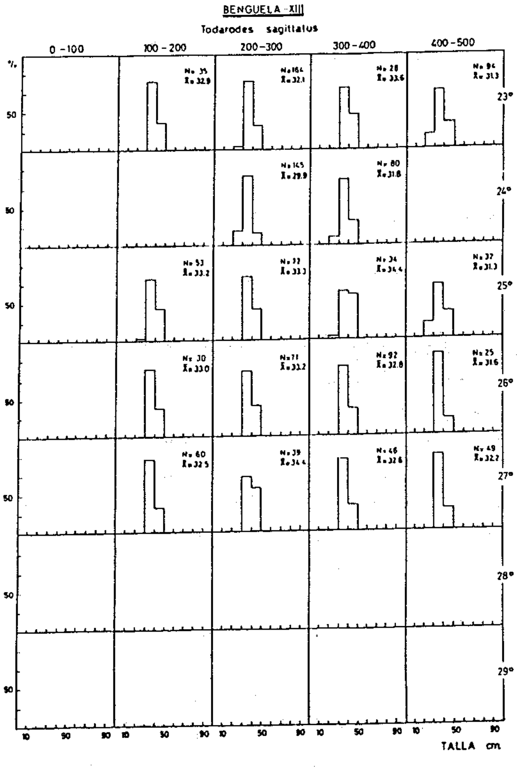


FIG. 20. **Todarodes sagittatus** length distribution, July 1988

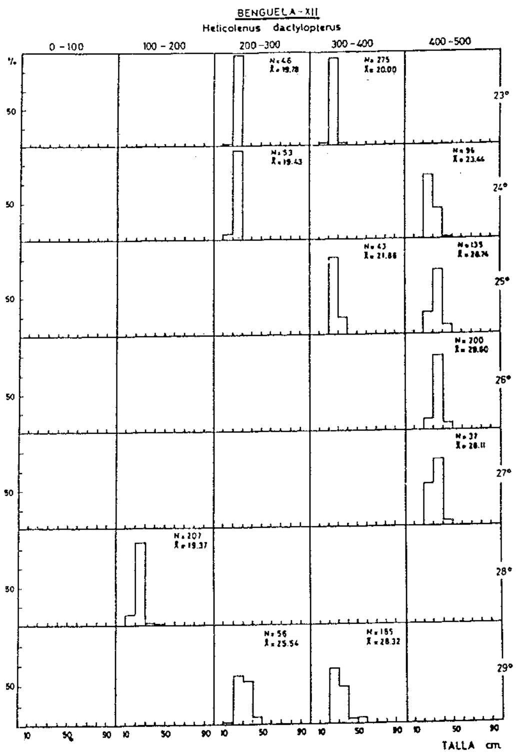


FIG. 21. **Helicolenus dactylopterus** length distribution, January-February 1988

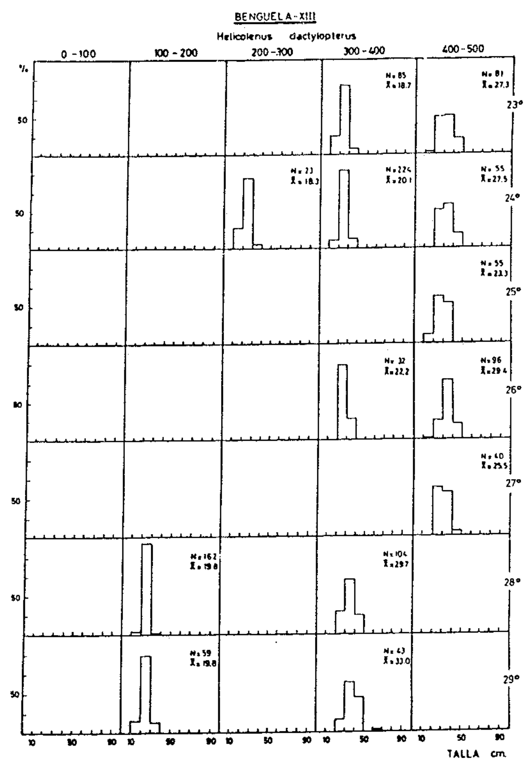


FIG. 22. **Helicolenus dactylopterus** length distribution, July 1988