ICSEAF 1987
Colln scient. Pap. int. Commn SE. Atl. Fish.
Pages 39-54

ASPECTS OF THE LIFE HISTORY OF THE GURNARD, CHELIDONICHTHYS CAPENSIS (CUVIER, 1829)

E. Macpherson
J. Mas Riera

Instituto de Ciencias del Mar, Barcelona, Spain

This paper presents some aspects of the life history of the gurnard, ***Chelidonichthys capensis,*** *off Namibia, where an area of major concentration is found between 27°00' S and the mouth of the Orange river, between the 200-m isobath and the coast. The estimated biomass varies between 24 303 and 36 100 tonnes, and a clear increase in average length with depth is observed. The diet of this species consists mainly of fish, stomatopods and decapod crustaceans, the proportion of fish increasing with predator length. The species is well adapted to oxygen deficient and depleted waters, and a significant correlation has been found between oxygen concentration on the bottom and fish density.*

Le document ci-après présente certains aspects du cycle vital du grondin du Cap, ***Chelidonichtys capensis,*** *au large de la Namibie où il existe un secteur de grande concentration de 27°00' de latitude sud à l'embouchure de l'Orange, entre l'isobathe de 200 m et la côte. La biomasse estimée varie entre 24 303 et 36 100 tonnes et on observe une nette augmentation de la taille moyenne avec la profondeur. Le régime de cette espèce se compose principalement de poissons, de stomatopodes et de crustacés décapodes, la proportion de poissons augmentant avec la taille du prédateur. L'espèce est bien adaptée aux eaux pauvres et très pauvres en oxygène et on relève une corrélation significative entre la concentration en oxygène du fond et la densité des poissons.*

*En este trabajo se presentan algunos aspectos del ciclo vital del rubio del Cabo (****Chelidonichthys capensis****), que se encuentra frente a Namibia, donde se ha constatado una importante concentración entre los 27°00' de latitud sur y la desembocadura del río Orange, entre la isobata de 200 m y la costa. La biomasa estimada oscilaba entre 24 303 y 36 100 t, observándose un claro incremento de la talla media a medida que aumenta la profundidad. La dieta de esta especie se compone principalmente de peces, estomatopodos y crustáceos decapodos, siendo mayor la proporción de peces, cuanto mayor es la tall del depredador. Esta especie está bien adaptada a las aguas pobres y con deficiencia de oxígeno y se observa una correlación significativa entre la concentración de oxígeno en el fondo y la densidad de peces.*

INTRODUCTION

Chelidonichthys capensis (Cuvier 1829) is a relatively common benthic species inhabiting the continental shelf, mainly at depths between 50 and 300 m, from northern Namibia to Natal (Heemstra 1982; Lloris 1986).

No literature exists on the life history, distribution, habitat or habits of **Ch. capensis**, despite its relative abundance in the area. In general, papers on the life history of gurnards are uncommon, dealing chiefly with feeding habits (Froglia 1976; Macpherson 1979 and 1983) or age and growth (Papaconstantinou 1982a and 1982b). In Southern African waters the data on this group of fish are very scarce and only some aspects of its systematics (Heemstra 1982; Lloris 1986) and dietary habits (Macpherson 1983) have been published.

This paper presents data on the distribution, abundance and feeding habits of gurnards, together with the relationships between some environmental variables in the bottom (namely, oxygen concentration, salinity and temperature) and fish density. The present study explores some demographic and biological characteristics which may improve existing knowledge of this interesting species.

MATERIALS AND METHODS

Specimens of **Chelidonichthys capensis** were collected on a series of cruises in January-February 1984, July-August 1984, July-August 1985, January-February 1986 and July-August 1986. The gurnards were caught from bottom trawls carried out in daylight during research cruises for hake biomass estimations (see Macpherson **et al.** 1985 and 1986 for sampling procedures).

In each trawl, data on total length, sex, number and total weight were obtained. Biomass was estimated using the same procedure as that outlined in Macpherson **et al.** (1985).

The number of full and empty stomachs is shown in Table 1, 48 % of them containing food. The stomachs were preserved in 70 % alcohol and prey were identified to the lowest possible taxon and weighed (wet) to the nearest milligramme. The original weight of prey items at the time of capture was calculated from total length, head length or otolith size by means of conversion formulae. The diet was then calculated as the percentage of the total stomach content weight attributable to each prey type.

Dietary data were pooled for samples collected within two areas, namely, 23°00' S to 26°59' S and 27°00' S to 30°00' S, corresponding to the two main distribution areas (see below). Only one depth strata, namely, 70-300 m, was considered and data were presented by 10-cm length groups for both the seasons sampled.

Oceanographic data were only determined during the 1986 cruises, when bottle and CTD devices were used to determine temperature, salinity and dissolved oxygen on the bottom. Oxygen analysis was carried out using the Winkler method. In this paper, only the data collected between depths of 70 and 320 m, along the coast, have been considered, corresponding to a slightly wider zone than the distribution area of **Chelidonichthys capensis**.

RESULTS

Distribution and abundance

The length distributions corresponding to the strata sampled are shown in Figure 1. As the differences in the length composition of each strata between cruises are minimal, data from all the cruises were pooled to show depth and/or latitudinal variations in the length frequencies.

Average length increases clearly with depth and, for the same depth range, also increases northwards. However, it must be taken into account that the 50-100-m strata between 23° and 28° S received inadequate coverage.

The 30-39-cm length group predominated at a depth of 100-200 m, while the 10-19-cm and 20-29-cm groups are more common at 50-100 m and the 40-49-cm length group was the most frequent in deeper waters (200-300 m). No significant seasonal differences were observed.

The abundance distribution for each cruise is given in Figures 2-6. One area of major concentration is evident from 27°00' S to the mouth of the Orange River, between the 200-m isobarth and the coast. A secondary major area is also found in July-August 1985, from 25°30' S to Walvis Bay. In general, abundance decreases with depth, the species being very rare below 300 m and north of 27°00 S.

Biomass

Biomass estimates from the five surveys are given in Table 2. The estimates in 1984 and 1985 (27 244 - 36 100 t) are slightly higher than in 1986 (24 303 - 26 473 t). Due to the scarcity of information on the fishery of this species it is very difficult to correlate biomass trends with the fishing effort in the area. However, the zone of distribution of the species, which overlaps with an important zone of hake recruitment (Macpherson **et al.** 1985 and 1986) and the apparent decrease in biomass suggest that some cautionary measures should be taken, though the necessity of future research to improve biomass assessments must be taken into account.

Diet

This species feeds on at least 20 different prey species, fish, stomatopods and decapod crustaceans being the most frequent prey items (Table 2 and Figure 7).

Amphipods, small shrimps (**Pasiphaea semispinosa**) and small fish species (e.g., **Nematogobius bibarbatus**) constituted the most important prey in small predators (10-29 cm). The proportion of stomatopods (**Pterygosquilla armata capensis**), decapod crustaceans (e.g., **Solenocera africana, Goneplax rhomboides, Mursia cristimanus**) and fish (e.g., **Merluccius capensis, Cynoglossus capensis, Nematogobius bibarbatus**) increased with predator length. The diet of the biggest predators consisted mainly of fish, usually large ones (**Merluccius capensis, Cynoglossus capensis**).

The diets in the two zones was different, due mainly to the differences in the geographical distribution of the preys (see Macpherson 1983 and 1986 for distribution of prey species). In the northern area (23°00' S to 26°59' S), due to the low diversity in the benthic fauna, the diet mainly comprised fish, namely, **Nematogobius bibarbatus** and small **Merluccius capensis** (less than 25 cm), both very abundant in the area (Turon **et al.** 1986 and unpublished data). Seasonal differences, such as more hake in January-February, were due to the high recruit concentrations during these months (Macpherson **et al.** 1985 and 1986). In the southern area (27°00 S-30°00 S), as the benthic fauna is more diverse, the diet had a correspondingly higher diversity. As in the northern area, the proportion of **M. capensis** was higher in January-February than in July-August.

The majority of prey species were benthic organisms, though some pelagic species (e.g., **Pasiphaea semispinosa, Euphausia sp., Maurolicus muelleri**) were occasionally recorded and probably caught near the bottom.

Distribution and abundance compared with hydrographic data

The hypothesis, based on survey data, that **Chelidonichthys capensis** density was related to oxygen concentration, salinity and temperature of the bottom was tested by regression analysis and rejected at the 2 % level for all stations and sampling dates.

Oxygen concentrations varied from 0-4,3 ml/l during July-August and from 0-0,73 during January-February (Figures 8 and 9). In the latter period, the area near the mouth of the Orange River was not sampled. January-February showed lower oxygen concentrations than July-August, which could be related to upwelling events (Chapman and Shannon 1985); Bailey **et al.** 1985).

In January-February the highest catches (more than 200 specimens per mile) were obtained in oxygen-deficient waters (0,73 ml/l), though below 0,5 ml/l catches decreased severely (1-4 specimens per mile) or ceased altogether. In July-August, most catches were obtained in waters containing more than 2 ml/l, fish abundance decreasing in less oxygenated waters.

The abundance of **Ch. capensis** increased significantly as the oxygen concentration increased, $r=0{,}59$ ($P < 0{,}02$) for January-February and $r=0{,}64$ ($P < 0{,}01$) for July-August. The correlation coefficients of the regressions of salinity and temperature were very low ($r=0{,}003$ and $0{,}01$, respectively) and the hypothesis that these parameters were related to fish density was rejected.

DISCUSSION

The gurnard, **Chelidonichthys capensis,** is a benthic species found primarily in mid- and shallow-water areas of the continental shelf (at less than 300 m). As in many other species in the area (Macpherson **et al.** 1985), and other triglids (Papaconstantinou 1982), average length increases with both depth and lower latitudes.

The areas of major densities are found

around 28°-29° S, decreasing northwards. Therefore, the biogeographic discontinuity observed at 28° S (Olivar 1985 and unpublished data) hardly affects gurnard distribution.

Chelidonichthys capensis consume primarily benthic crustaceans and fish, some of which are buried in the bottom (**Pterygosquilla armata capensis**) or live in the epibenthic zone (**Cynoglossus capensis, Mursia cristimanus, Solenocera africana**, etc.). Survey results indicate that the proportion of fish in the diet increased with predator length, whereas that of crustaceans decreased. The seasonal and geographical changes in the diet seem to be only related to the distribution of the prey species. These data are consistent with other observations in triglids (Macpherson 1983 and references cited therein), although in **Trigla lyra** off northern Namibia the diet is based mainly on benthic crustaceans.

The analysis of the relationships between oceanographic variables on the bottom (salinity, temperature and dissolved oxygen) and gurnard density only show a significant correlation in the case of oxygen concentration. This relationship has been found in other benthic species. Bailey **et al.** (1985) showed that both the distribution and catch per unit effort of the Cape rock lobster, **Jasus lalandii**, off Namibia, may be related to oxygen deficiency. Burd and Brinkhurst (1985) found the greatest population density of **Munida quadrispina** at oxygen levels as low as 0,1 to 0,15 ml/l in British Columbia fjords. Leming and Stuntz (1984) indicated that shrimp and finfish were absent in the hypoxic zones along the inner continental shelf of Texas and Louisiana. Recently, Roel and Bailey (1987) pointed out the relationships between the physical environment and the distribution and abundance of hakes in the southern African waters.

The results of this study indicate that **Chelidonichthys capensis** is well adapted to living in "oxygen depleted" (2-5 ml/l) and "oxygen deficient" (less than 2 ml/l) waters (see Chapman and Shannon 1985 for terms), which cannot be inhabited by other fishes, especially north to 28°00' S. The high density of **Ch. capensis** in low oxygen areas and those of the highest oxygen levels in the same areas, indicates that this is an optimum habitat.

The small changes in population density distribution in response to oxygen concentration suggests that this species does not migrate clearly across the area and may in fact be a sedentary species. These aspects might also be a consequence of lower activity levels to conserve oxygen during deoxygenation, as Burd and Brinkhurst (1985) suggested for **Munida quadrispina**.

REFERENCES

BAILEY, G.W., C.J. de B. BEYERS and S.R. LIPSCHITZ 1985 - Seasonal variation of oxygen deficiency in waters off southern Southwest Africa in 1975 and 1976 and its relation to the catchability and distribution of the Cape rock lobster, **Jasus lalandii. S. Afr. J. mar. Sci.** 3: 197-214.

BURD, B.J. and R.O. BRINKHURST 1985 - The distribution of the galatheid crab **Munida quadrispina** (Benedict 1902) in relation to oxygen concentration in British Columbia fjords. **J. Exp. Mar. Biol. Ecol.** 81: 1-20.

CHAPMAN, P. and L.V. SHANNON 1985 - The Benguela ecosystem. Part II. Chemistry and related processes. **Oceanogr. Mar. Biol. Ann. Rev.** 23: 183-251.

FROGLIA, C. 1976 - Observazuioni sull'alimentazione dei giovani di **Trigla lucerna** della clase di etá o nel medio Adriatico (**Pisces, Triglidae**). **Arch. Oceanogr. Limnol.** 18, suppl. 3: 365-373.

HEEMSTRA, P.C. 1982 - Taxonomic notes on some triglid and peristediid fishes (**Pisces, Scorpeniformes**) from Southern Africa. **Copeia** 1982(2): 291-295.

LEMING, T.D. and W.E. STUNTZ 1984 - Zones of coastal hypoxia revealed by satellite scanning have implications for strategic fishing. **Nature** 310: 136-138.

LLORIS, D. 1986 - Ictiofauna demersal y aspectos biogeográficos de la costa sudoccidental de Africa (SWA/Namibia). **Monogr. Zool. Mar.** 1:9-432.

MACPHERSON, E. 1979 - Estudio sobre el régimen alimentario de algunos peces en el Mediterráneo occidental. **Misc. Zool.** 5: 93-107.

MACPHERSON, E. 1983 - Ecología trófica de peces en las costas de Namibia. I. Hábitos alimentarios. **Res. Exp. Cient.** 11:81-137

MACPHERSON, E., B. ROEL and B. MORALES 1986 - Evolución del reclutamiento de la merluza y distribución y abundancia de varias especies comerciales en 1985, en las Divisiones 1.4 y 1.5. **Colln. scient. Pap. int. Commn SE. Atl.Fish.** 13(II):113-136.

MACPHERSON, E., B. ROEL and B. MORALES 1985 - Reclutamiento de la merluza y abundancia y distribución de diferentes especies comerciales en las Divisiones 1.4 y 1.5 durante 1983-1984. **Colln. scient. Pap. int. Commn SE. Atl. Fish.** 12(II): 1-62.

OLIVAR, M.P. 1985 - Ictioplâncton del Atlântico Sudoriental. Tésis Univ. Barcelona. 890pp

PAPACONSTANTINOU, C. 1982a - On the biology of **Lepidotriglia cavillone** (Fam. **Triglidae**) of the Greek seas. **Talassographica** 5(1): 33-59.

PAPACONSTANTINOU, C. 1982b - Age and growth of grey gurnard (**Eutriglia gurnardus**) in the Pagassitikos Gulf (Greece). **Inv. Pesq.** 46(2): 191-213.

ROEL, B and G.W. BAILEY 1986 - Preliminary investigation of the relationship between hake and abundance and hydrological parameters in the Benguela system. This volume: 193-201.

TURON, J.M., J. RUCABADO, D. LLORIS and E. MACPHERSON 1986 - Datos pesqueros de las expediciones en aguas de Namibia durante los años 1981 a 1984 ("Benguela III" a "Benguela VII" y "Valdivia I"). **Datos Inf. Inst. Inv. Pesq.** 17: 11-344.

TABLE 1. Diet composition as percentage of total weight of stomach contents of **Chelidonichthys capensis** by different length groups

Latitude	January-February								July-August				
	23°-26°59' S			27°-30° S					23°-26°59' S			27°-30° S	
Predator Size (cm)	30-39	40-49	50-59	10-19	20-29	30-39	40-49	+50	20-29	30-39	40-49	30-39	40-49
ARTHROPODA													
Amphipoda					50,0	5,4	0,6					33,4	7,9
Euphausiacea													
Euphausia sp													
Mysidacea													
Lophogaster sp						2,6							
Stomatopoda													
Pterygosquilla armata capensis					32,5	43,6	17,7	1,5		18,2	15,3	22,0	31,1
Decapoda													
Pasiphaea semispinosa				100	4,1								
Solenocera africana						4,8	9,5						
Callianassa australis						1,7							
Macropipus australis											1,9		
Goneplax rhomboides						4,2	14,5						
Mursia cristimanus						1,5						33,3	18,2
MOLLUSCA													
Bivalva	2,0												
Cephalopoda													
Todarodes sagittatus			26,3										
Sepia sp						6,2						11,3	
PISCES													
Merluccius capensis		95,9	73,7			1,3	39,2	48,5		6,5			
Coelorhynchus fasciatus	27,7												
Nematogobius bibarbatus	70,3	1,5			13,4				100	75,3	74,5		17,4
Paracallionymus costatus						7,5	4,1						25,4
Pterothrissus belloci											8,3		
Lophius upsicephalus		2,6											
Cynoglossus capensis						4,3	10,4	50,0					
Maurolicus muelleri						0,9							
Unidentified						15,8	4,2						
TOTAL STOMACHS	11	11	3	23	27	122	41	7	2	74	33	21	12
TOTAL EMPTY STOMACHS	4	6	-	12	9	60	21	1	1	32	8	15	5

TABLE 2. Biomass estimates of **Chelidonichthys capensis** from the different cruises

Cruise	Biomass (tonnes)
January-February 1984	36 100
July-August 1984	27 244
July-August 1985	31 476
January-February 1986	26 473
July-August 1986	24 303

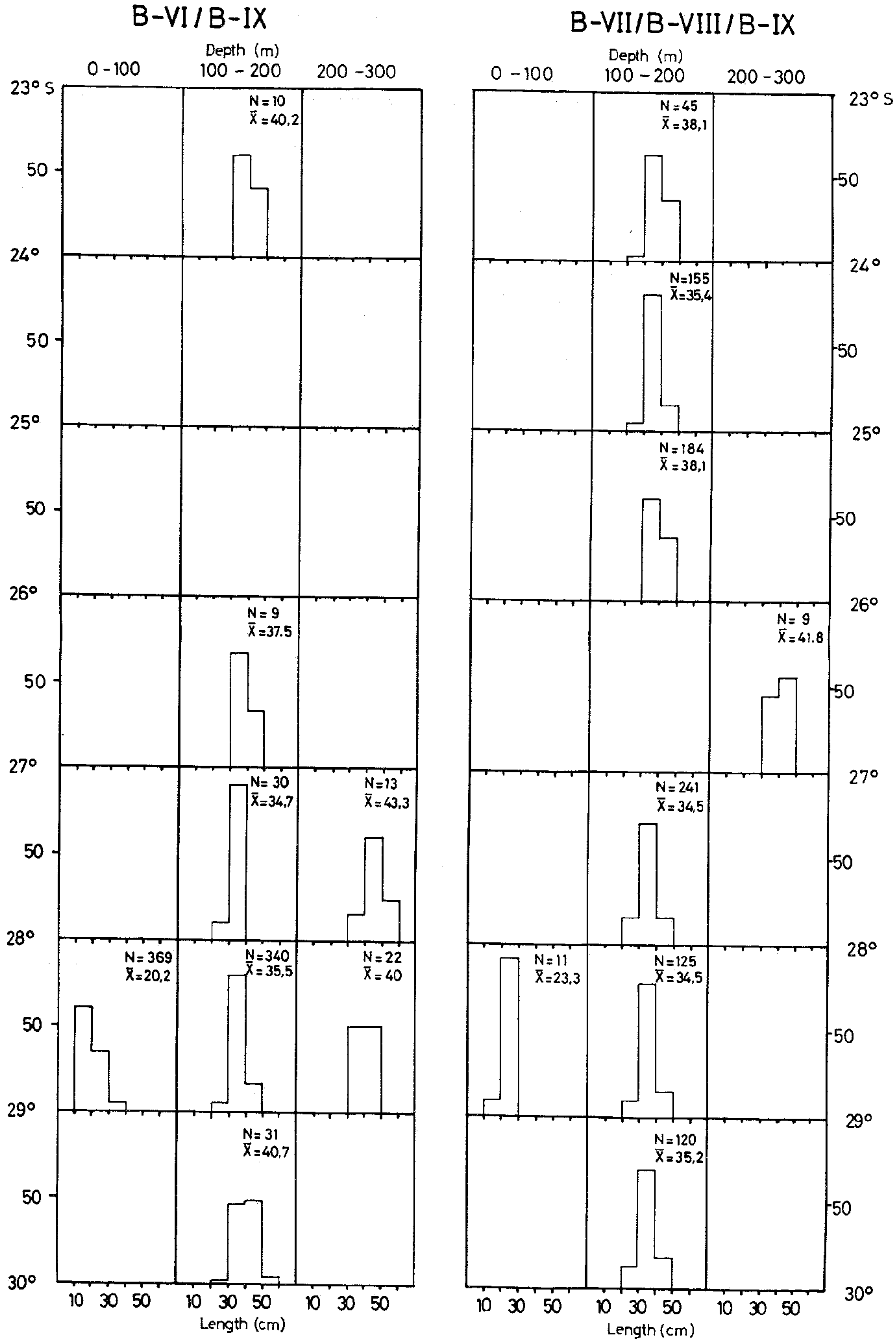

FIG. 1. Length distribution of **Chelidonichthys capensis** by stratum in January-February and July-August

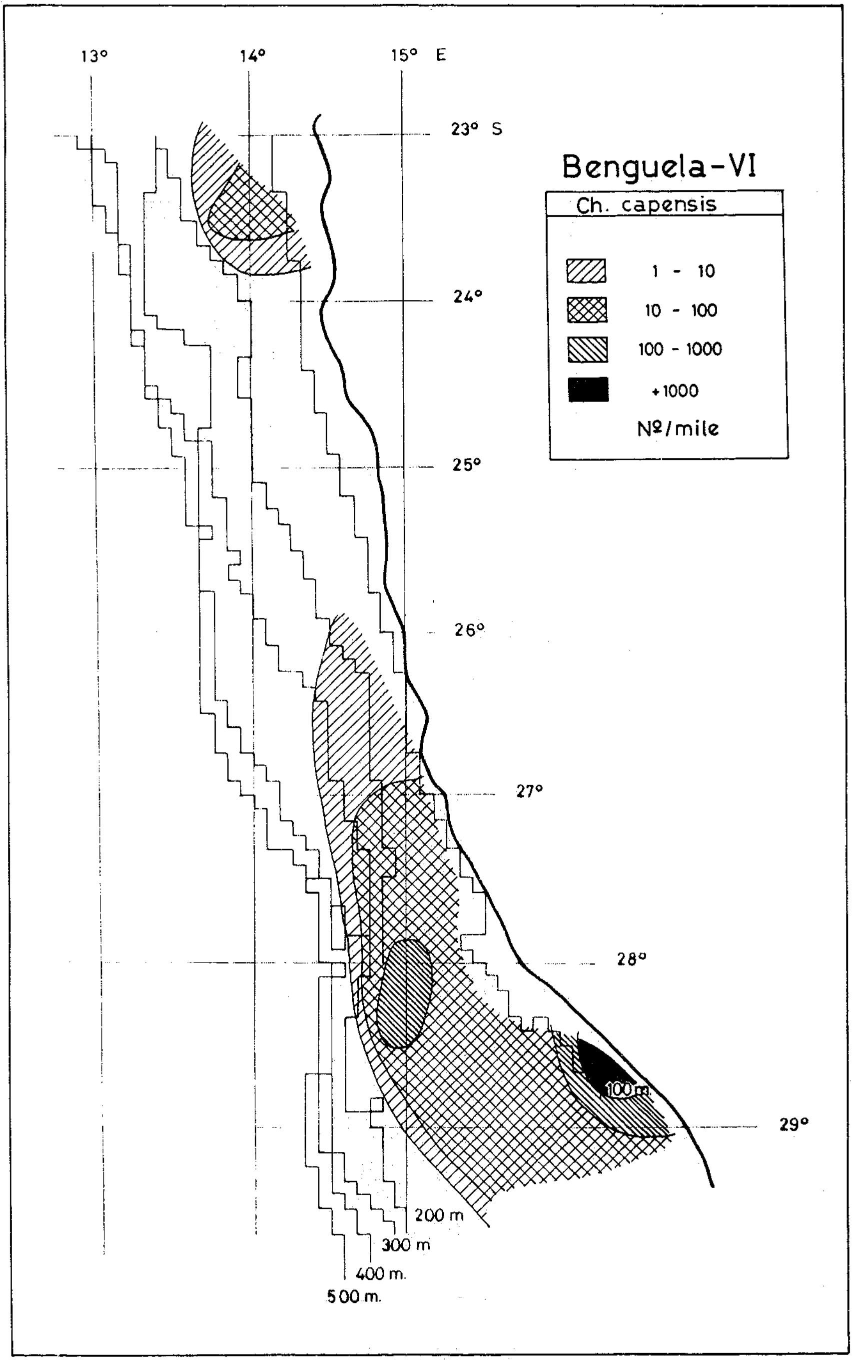

FIG. 2. Distribution of **Chelidonichthys capensis** in January-February 1984

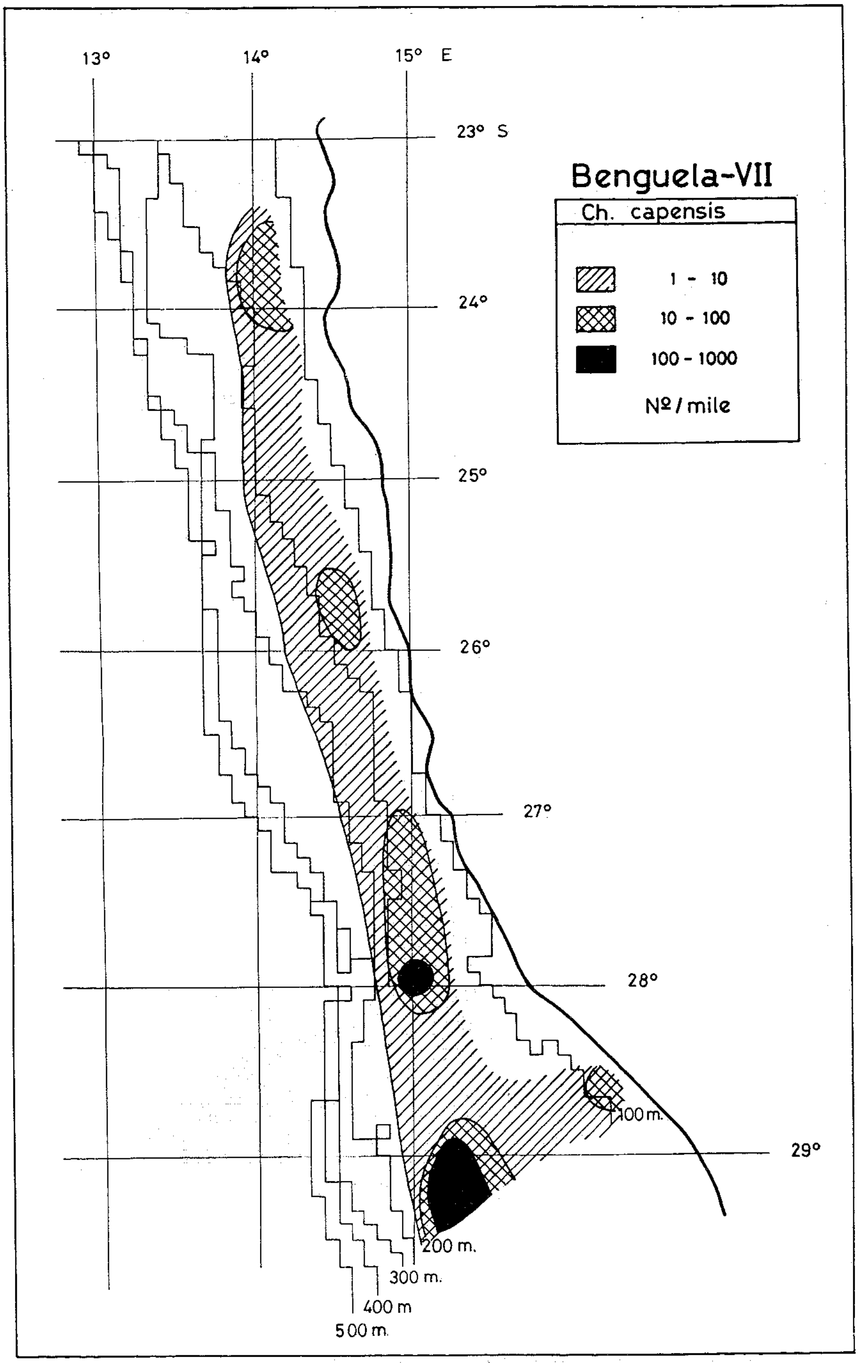

FIG. 3. Distribution of **Chelidonichthys capensis** in July-August 1984

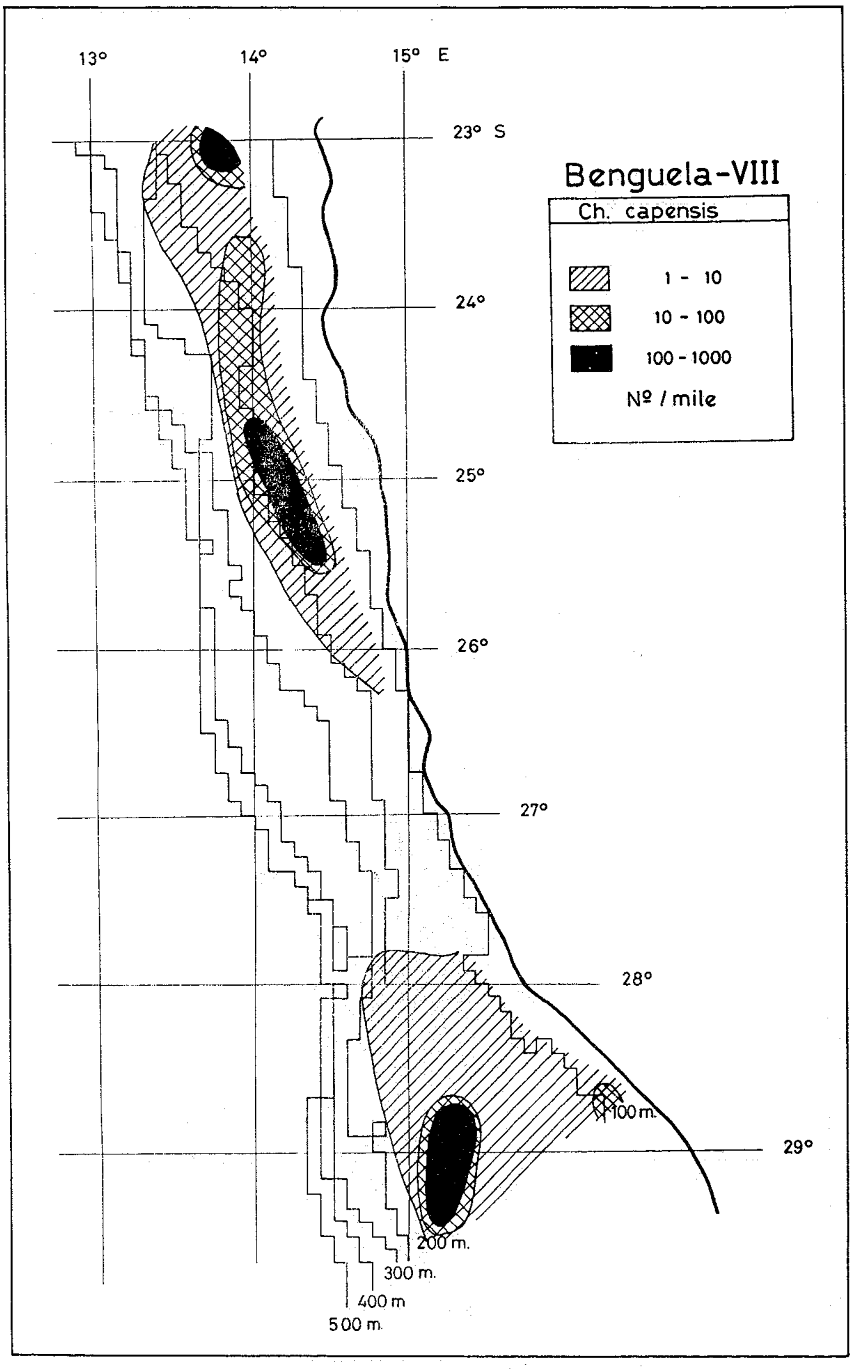

FIG. 4. Distribution of **Chelidonichthys capensis** in July-August 1985

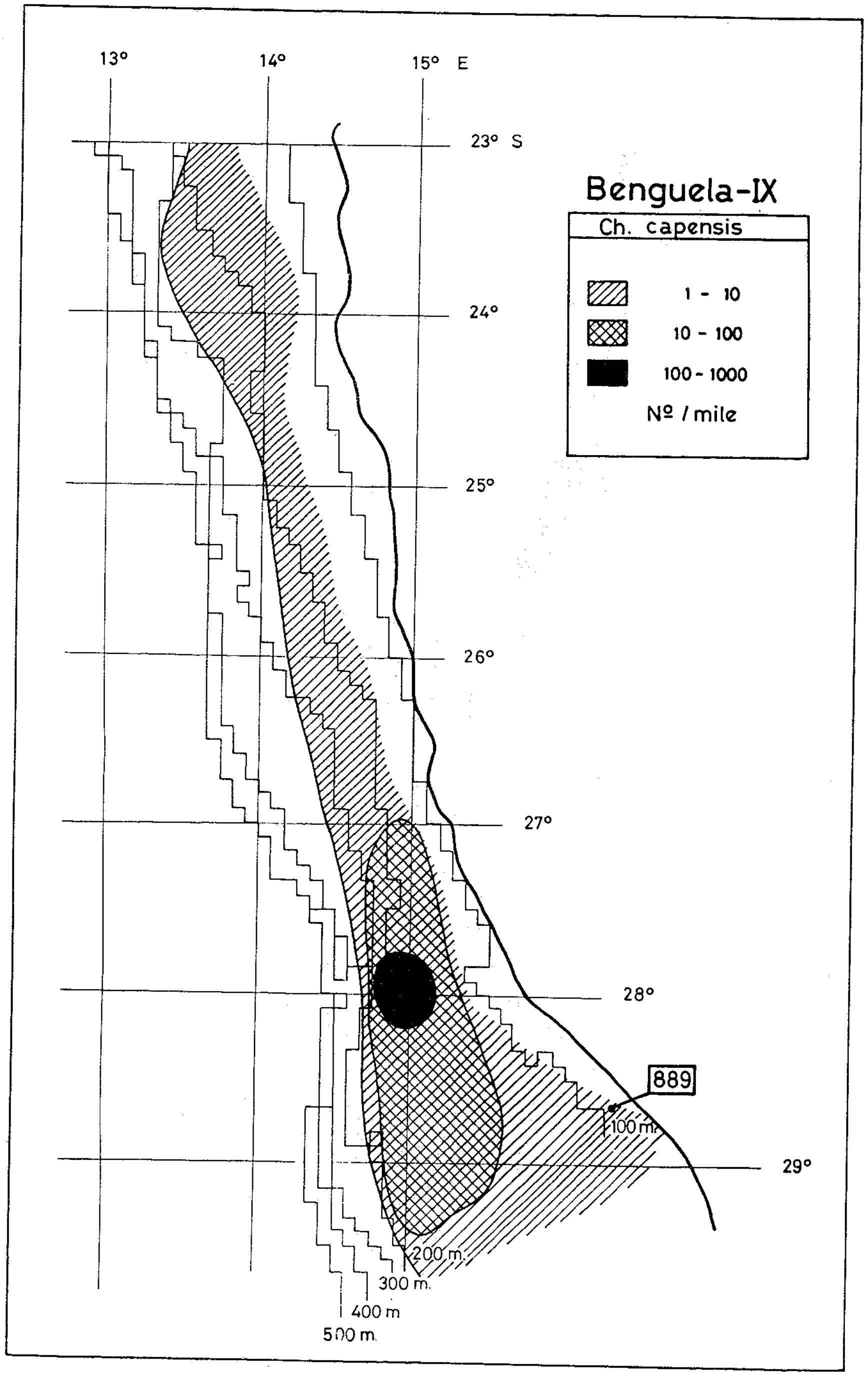

FIG. 5. Distribution of **Chelidonichthys capensis** in January-February 1986

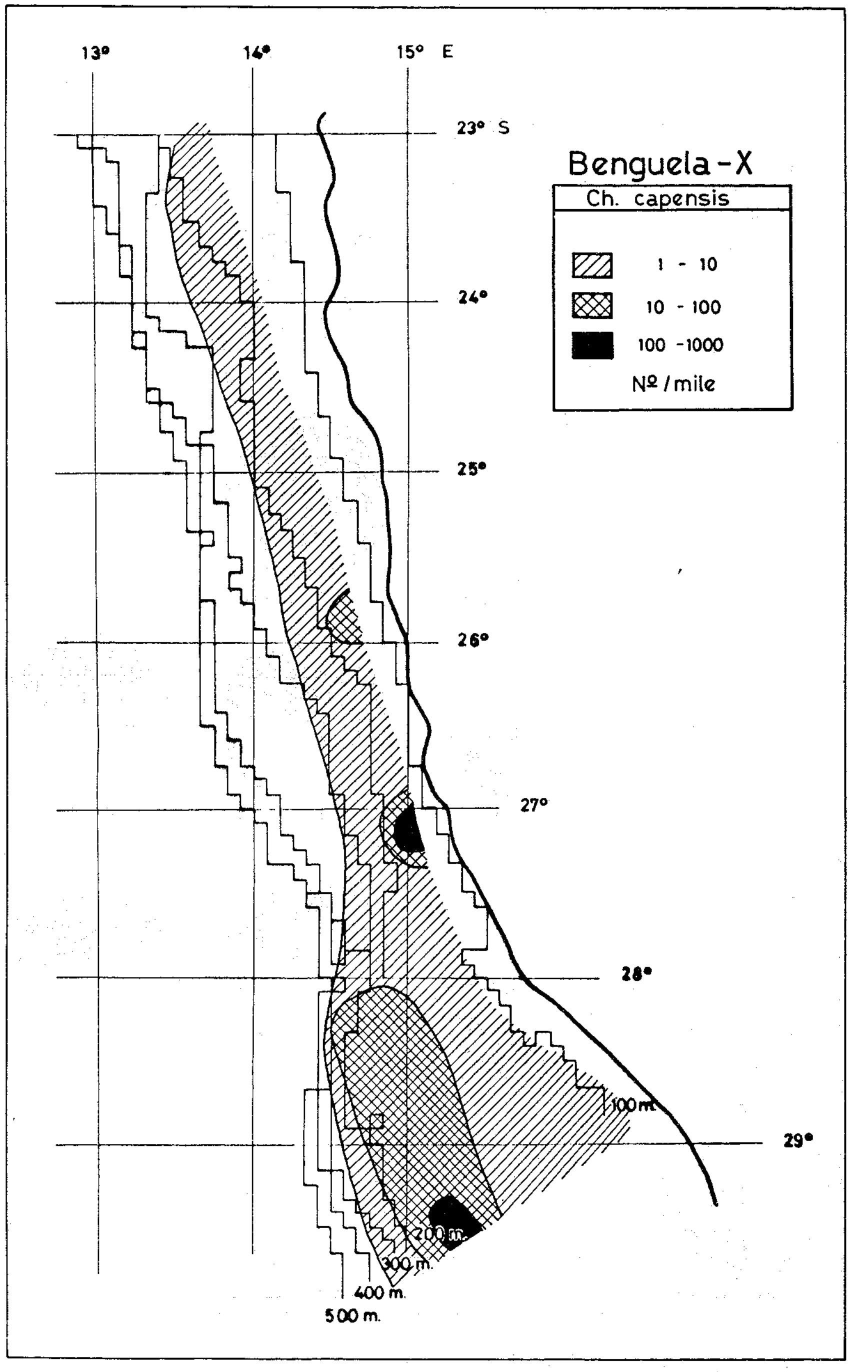

FIG. 6. Distribution of **Chelidonichthys capensis** in July-August 1986

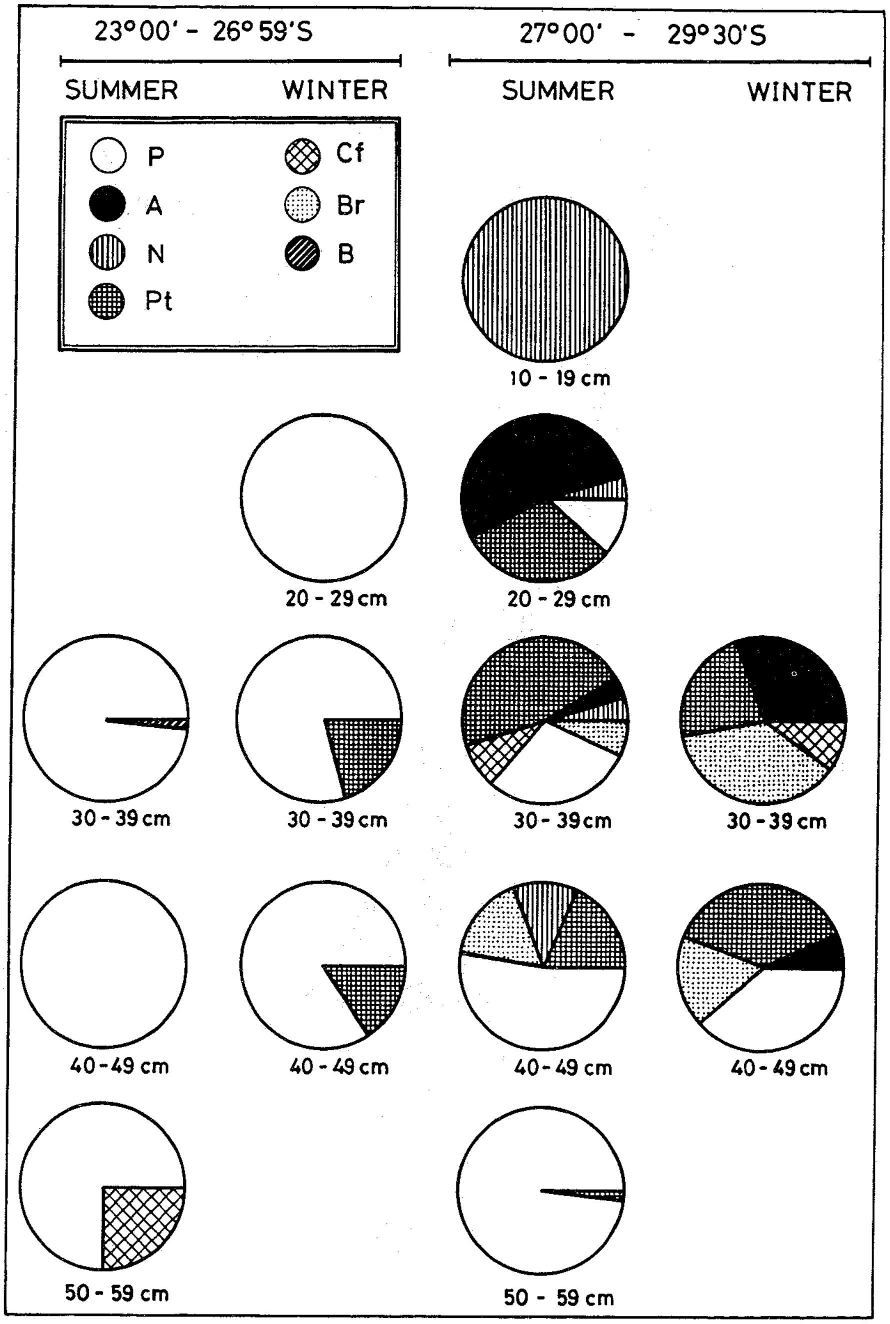

FIG. 7. Food composition (percentage by weight) of **Chelidonichthys capensis** with different lengths, areas and seasons. P=Pisces; A=Amphipoda; N=Natantia; Pt=Stomatopoda; Cf=Cephalopoda; Br=Brachyura; B=Bivalvia

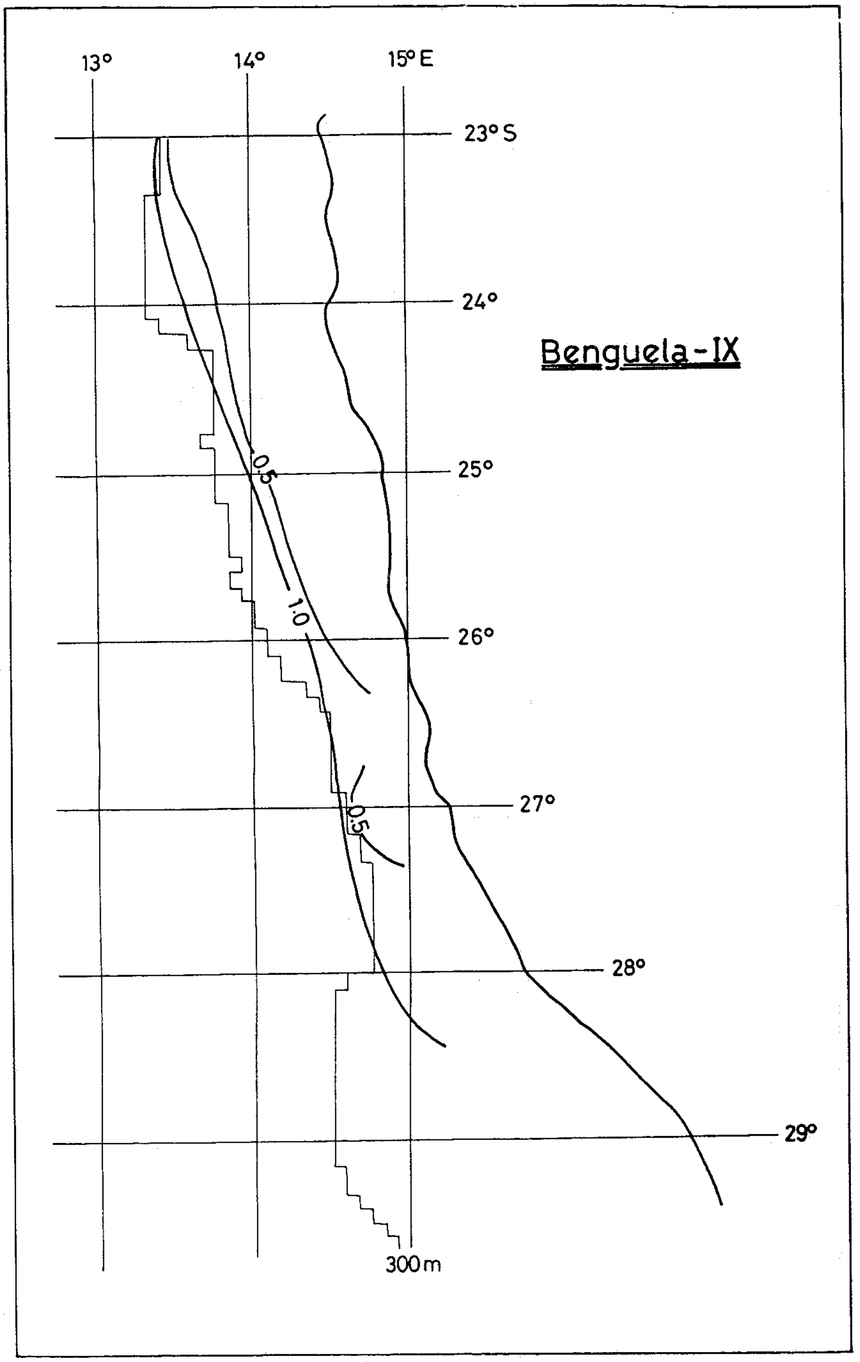

FIG. 8. Dissolved oxygen on the bottom during January-February 1986 (ml/l)

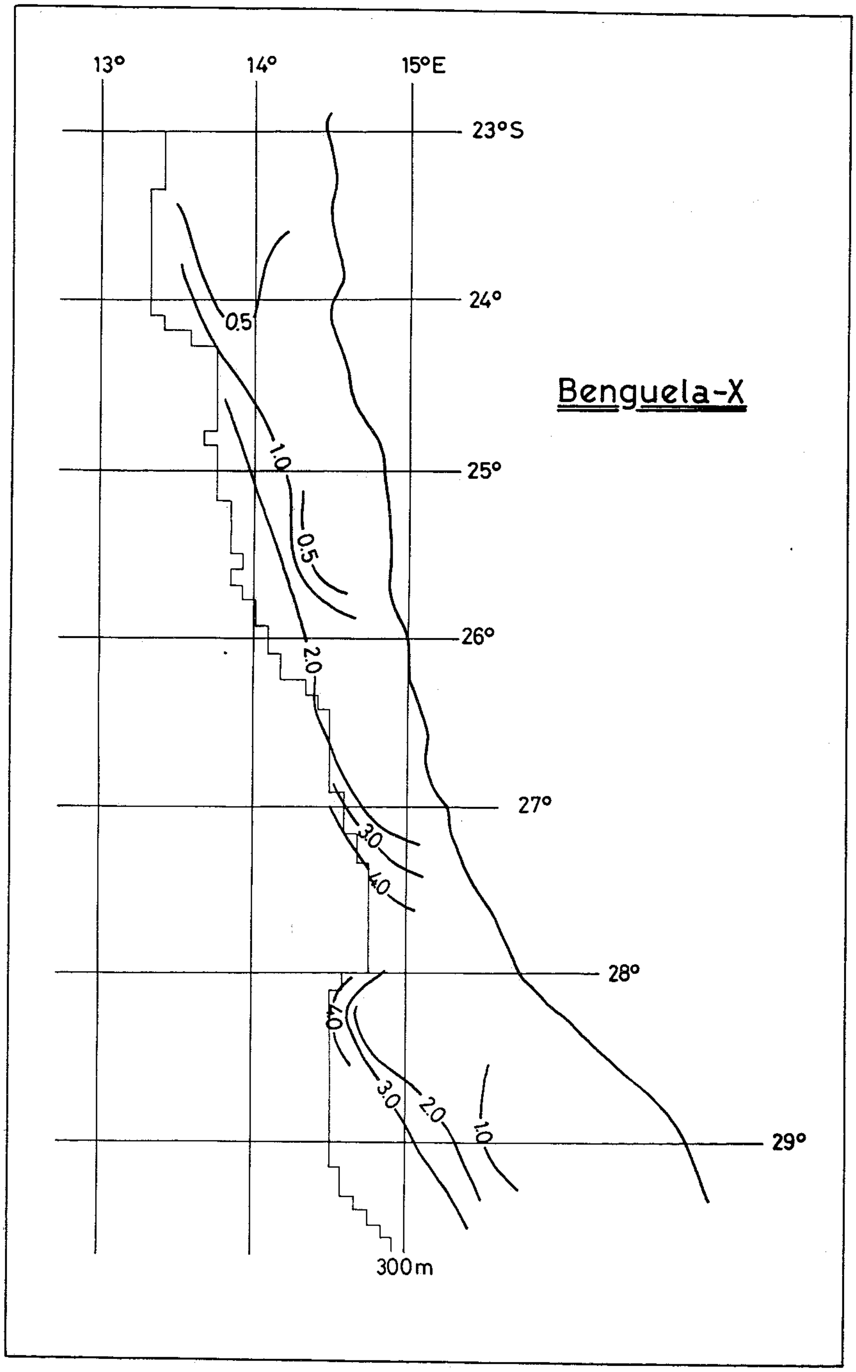

FIG. 9. Dissolved oxygen on the bottom during July-August 1986 (ml/l)