Reports on surveys with the R/V Dr Fridtjof Nansen

A Survey on the Fish Resources at Sofala Bank - Mozambique

May - June 1983

Instituto de Invstigação Pesqueira - Maputo

Institute of Marine Research - Bergen

«Dr. Fridtjof Nansen»

The fishery research vessel «Dr. Fridtjof Nansen» belongs to the Norwegian Agency for Development Cooperation (NORAD). It was designed and built for scientific and exploratory investigations of fishery resources of developing countries, under a joint plan with the Fisheries Department of FAO based on a funding of operation to be shared by FAO and Norway.

REPORTS ON SURVEYS WITH THE R/V "DR. FRIDTJOF NANSEN"

A SURVEY ON THE FISH RESOURCES AT SOFALA BANK - MOZAMBIQUE

MAY-JUNE 1983

BY

L. BRINCA, V. MASCARENHAS, B. PALHA DE SOUSA, L. PALHA DE SOUSA, I.M. SOUSA, R. SÆTRE AND I. TIMOCHIN

INSTITUTO DE INVESTIGAÇÃO PESQUEIRA - MAPUTO

INSTITUTE OF MARINE RESEARCH - BERGEN

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CONTENT

1. INTRODUCTION

From August 1977 to June 1978 the Norwegian research vessel "Dr. Fridtjof Nansen" surveyed the waters adjacent to Mozambique. The results from this investigation were reported by SÆTRE and SILVA (1979). The report dealt with the pelagic and demersal fish resources as well as the crustaceans. It also included a brief description of the most conspicuous hydrographic features and some comments on whales.

"Dr. Fridtjof Nansen" returned to Mozambican waters in October 1980 and in September 1982 to carry out an investigation on the small pelagic fish and the shallow-water shrimp resources (BRINCA, REY, SILVA and SÆTRE, 1981, BRINCA, JORGE DA SILVA, SOUSA, SOUSA and SÆTRE, 1983).

The present report deals with a survey by the "Dr. Fridtjof Nansen" at Sofala Bank during the period 29 May–8 June 1983. The objective was

- to study the distribution and abundance of small pelagic fish,
- to study the distribution and abundance of shallow-water shrimps,
- to carry out oceanographic studies.

The program was executed by a joint team of Norwegian and Mozambican scientists.

2. METHODS

Details of the vessel, the fishing gears and the acoustic equipment are given in BRINCA *et al* (1983). Further details on the biological methods appear in the chapters 5–8 while Annex 1 gives details on the fishing operations. Fig. 1 shows the survey routes and the location of the stations.

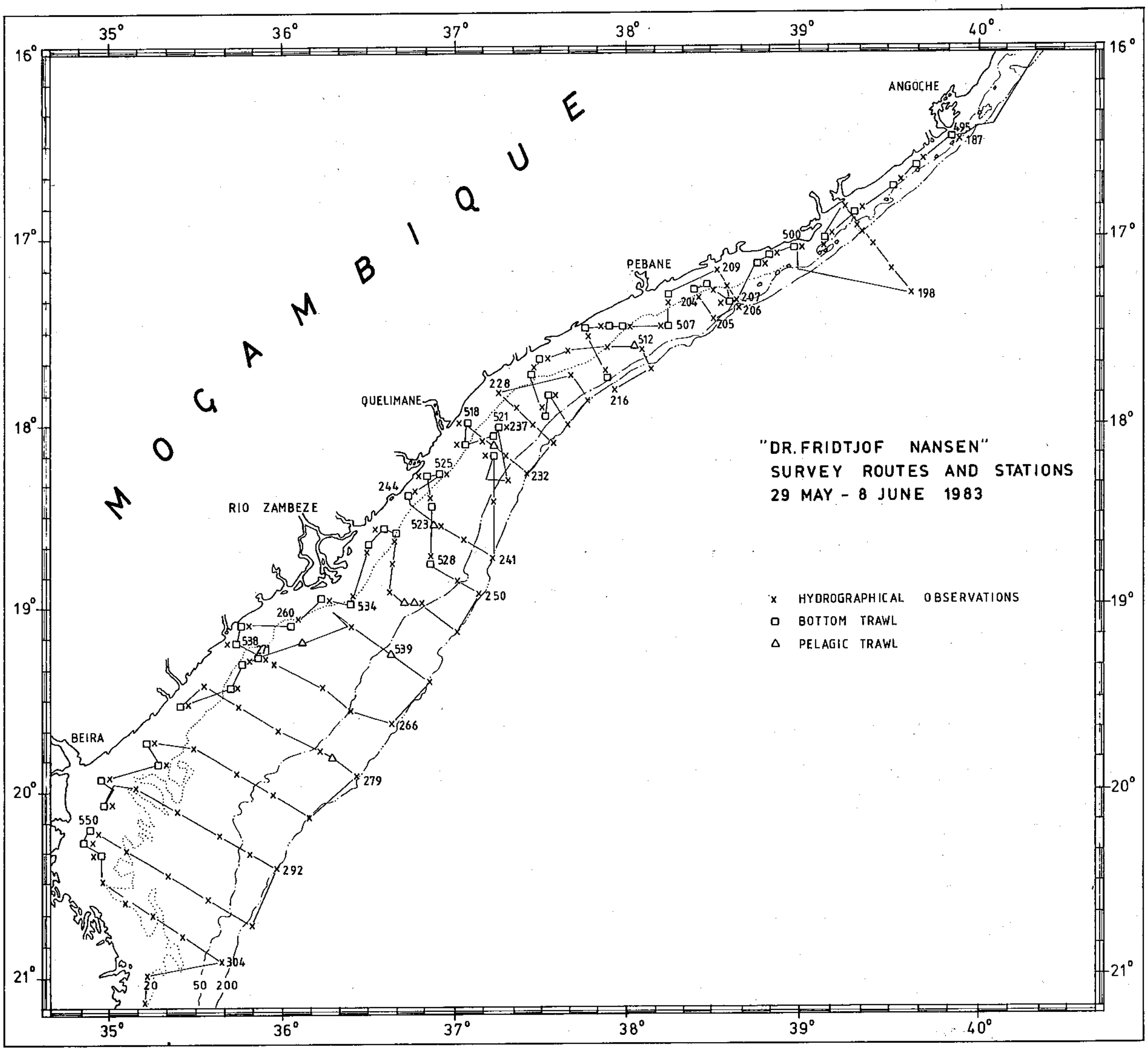

Fig. 1. Survey routes and grid of stations at Sofala Bank 29 May–8 June 1983.

3. HYDROGRAPHY

The hydrography of Sofala Bank will be reviewed in a report to be published in the very near future (JORGE DA SILVA, in press). Therefore, the present report includes only the oceanographic observations with no attempt on analysing the data. Figs. 2 and 3 give the surface temperature and salinity respectively. Fig. 4 shows the water colour according to the Forel scale and Fig. 5 the Secchi depth. Three vertical temperature sections appear in Fig. 6. The location of these can be found in Fig. 1.

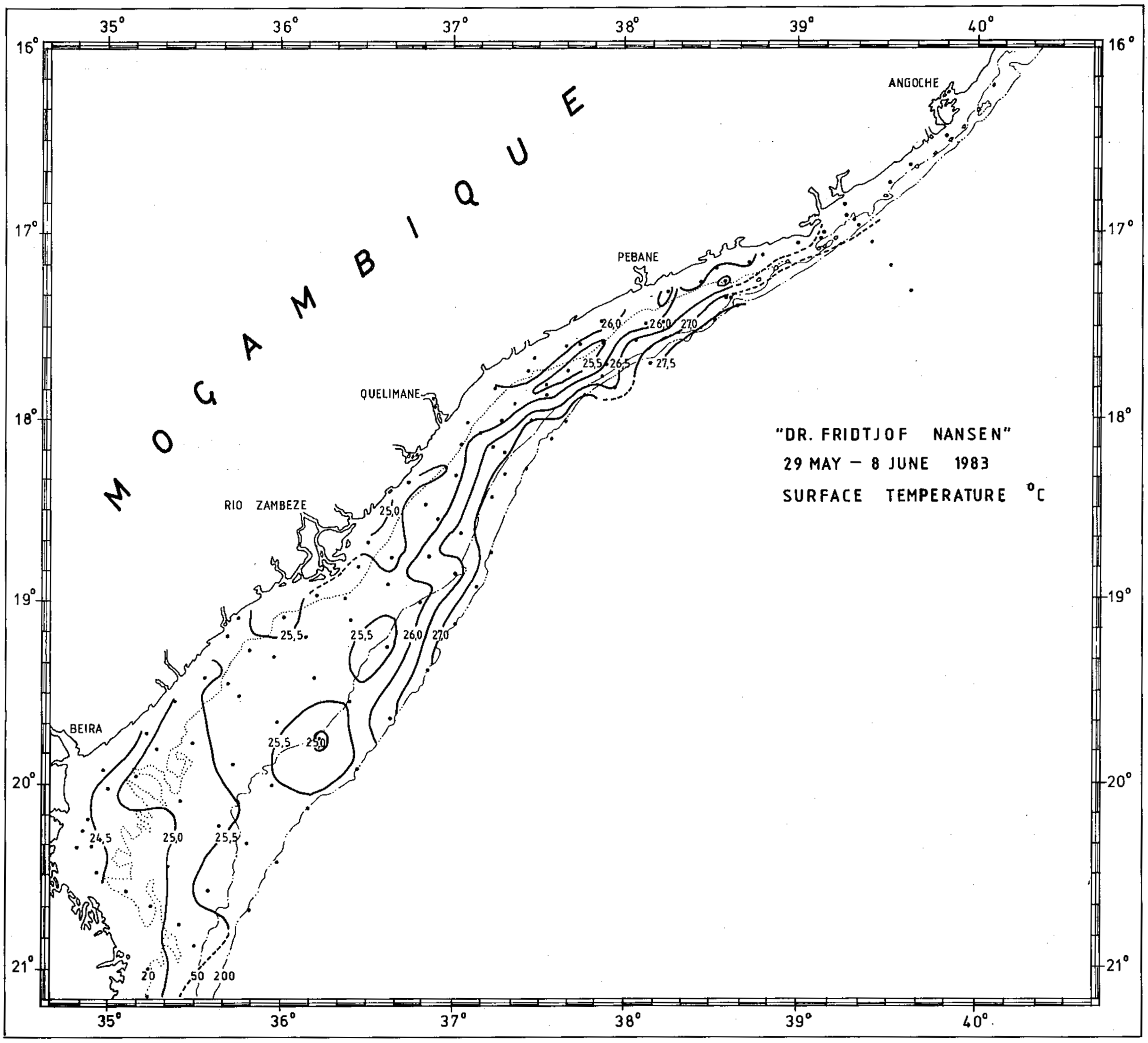

Fig. 2. Surface temperature distribution - 29 May–8 June 1983.

4. FISH DISTRIBUTION AND ABUNDANCE

Fig. 7 shows the distribution of echo abundance at Sofala Bank during the cruise. The recordings were nearly exclusively made up by pelagic species. North of 17°50'S the Sardinella spp. and Dussumieria acuta dominated the recordings. The isolated patches along the shore were mainly Pellona ditchela and Thryssa vitrirostris while Decapterus spp. and Rastrelliger sp. were observed near the shelf edge. The largest contribution to the echo abundance came from the Stolephorus spp. In the southernmost area it was not possible to carry out neither bottom nor pelagic trawling

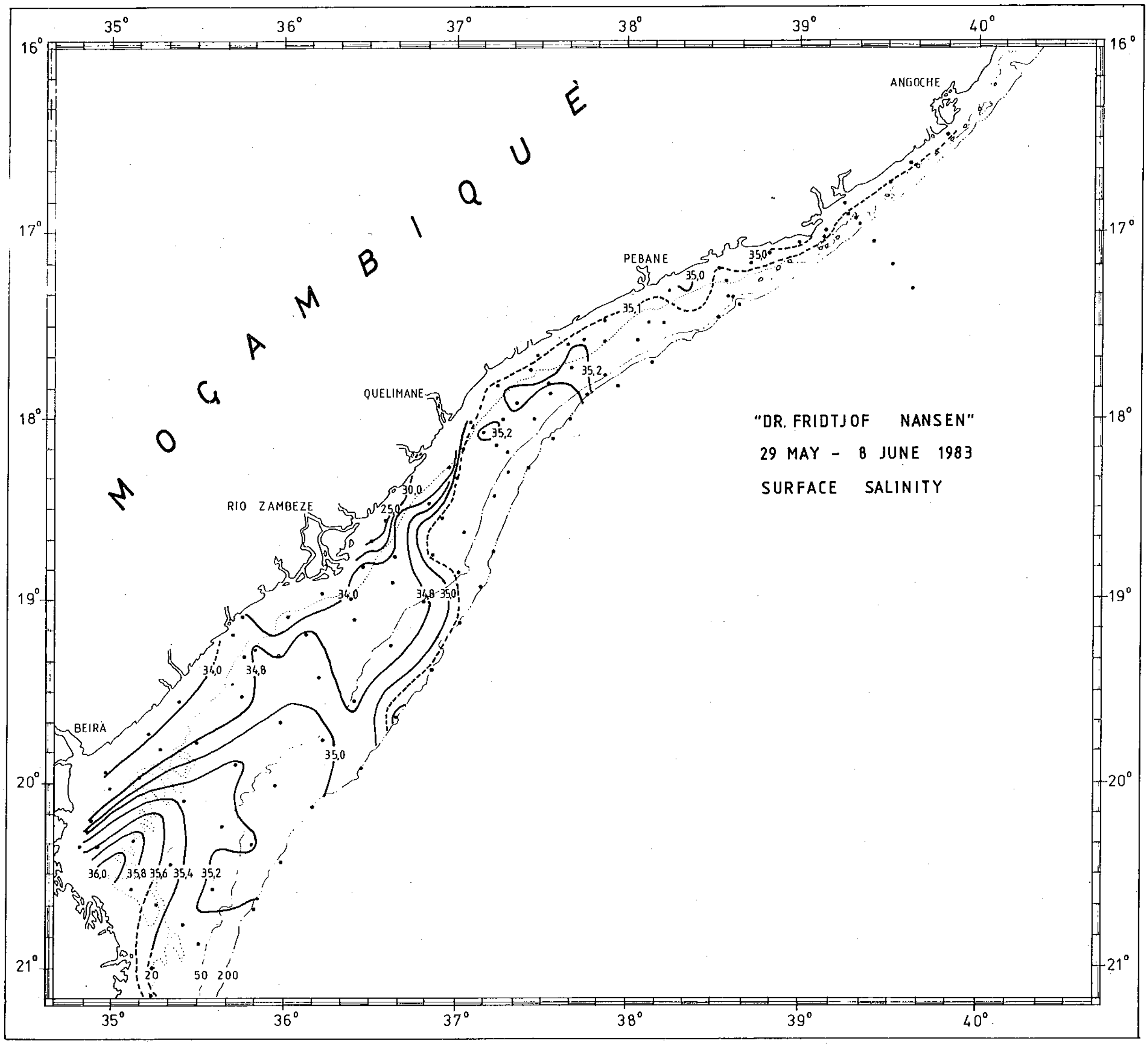

Fig. 3. Surface salinity distribution - 29 May–8 June 1983.

due to the bad bottom conditions. It is therefore not confirmed if these recordings really consisted of <u>Stolephorus</u> sp.

The acoustic abundance estimate was calculated by the equation

$$B = C \cdot \overline{M} \cdot A$$

where B is the fish biomass, $\overline{M}$ is the average integrator reading, A the corresponding area and C is a conversion coefficient. The numerical value for C applied in these calculations was

$$C = 0.8 \cdot L \ {}^{\text{tonnes}}/_{\text{mm}} \cdot (\text{n.mil})^2$$

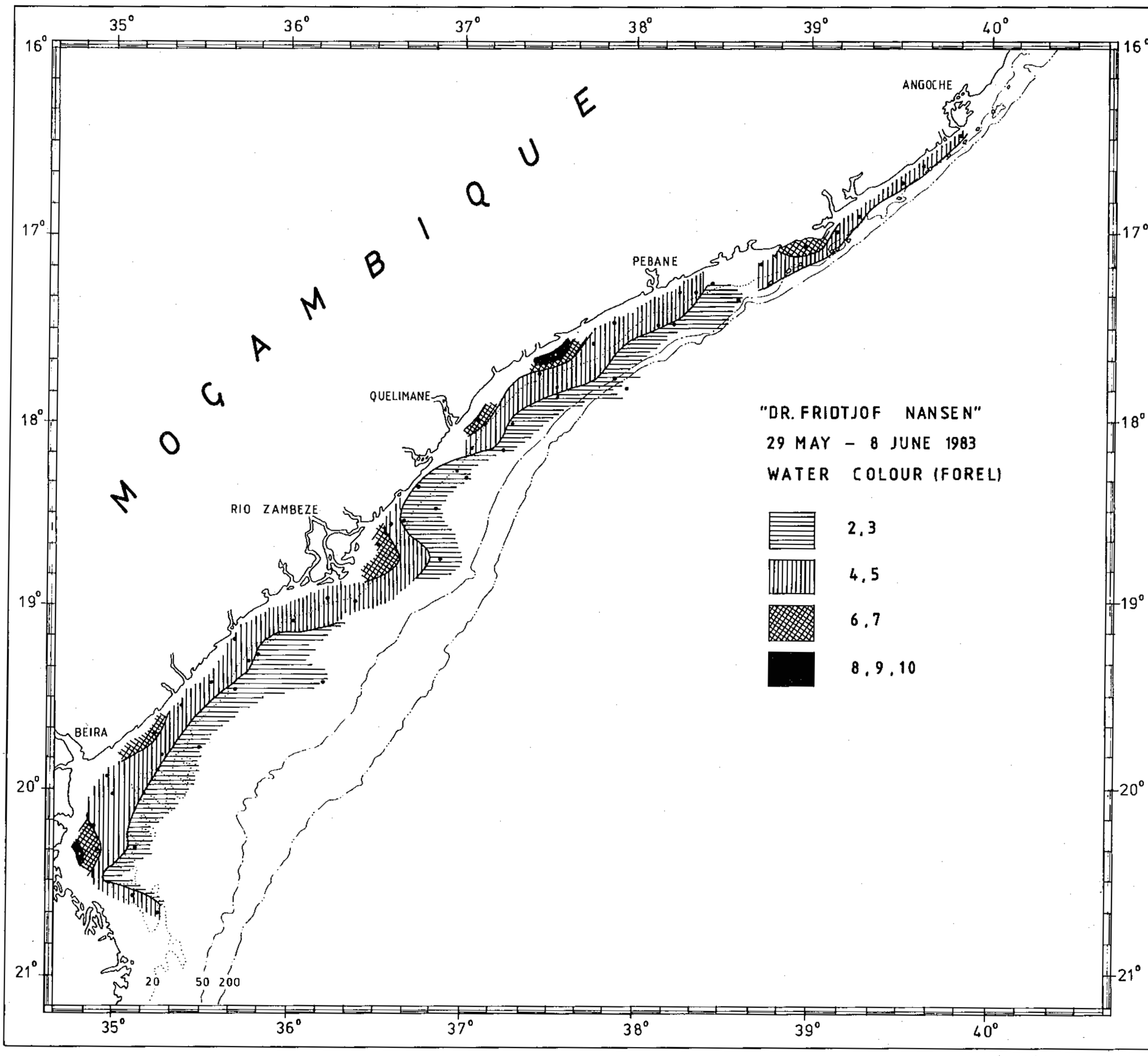

Fig. 4. Water colour according to the Forel scale - 29 May–8 June 1983.

when L is the average length in cm of the fish.

If all the recordings in the C areas of Fig. 7 consist of the small anchovy (Stolephorus sp.), this stock size will be about 170,000 tonnes while the sardines of area C amounts to about 20,000 tonnes. For the mackerel, area B, it is not possible to give any abundance estimate due to insufficient coverage of the area. In addition to the patches called areas D in Fig. 7, the Pellona sp. and Thryssa sp. are distributed scattered along the whole coast at depths shallower than 30 m. Calculations based on Fig. 7 will therefore give an underestimate for these species. Most likely, this stock will be of the order of 50,000 tonnes.

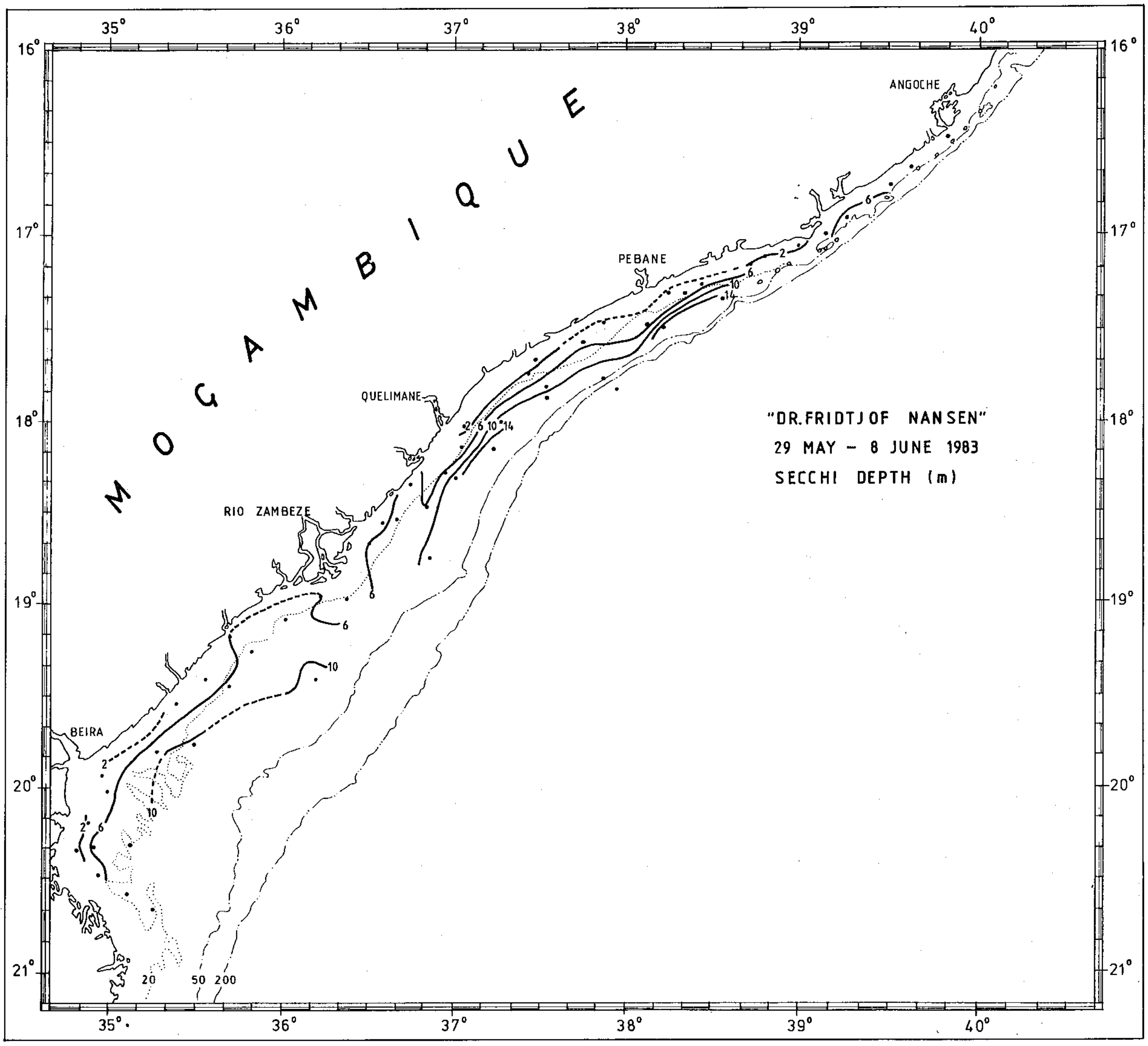

Fig. 5. Secchi depth distribution - 29 May–8 June 1983.

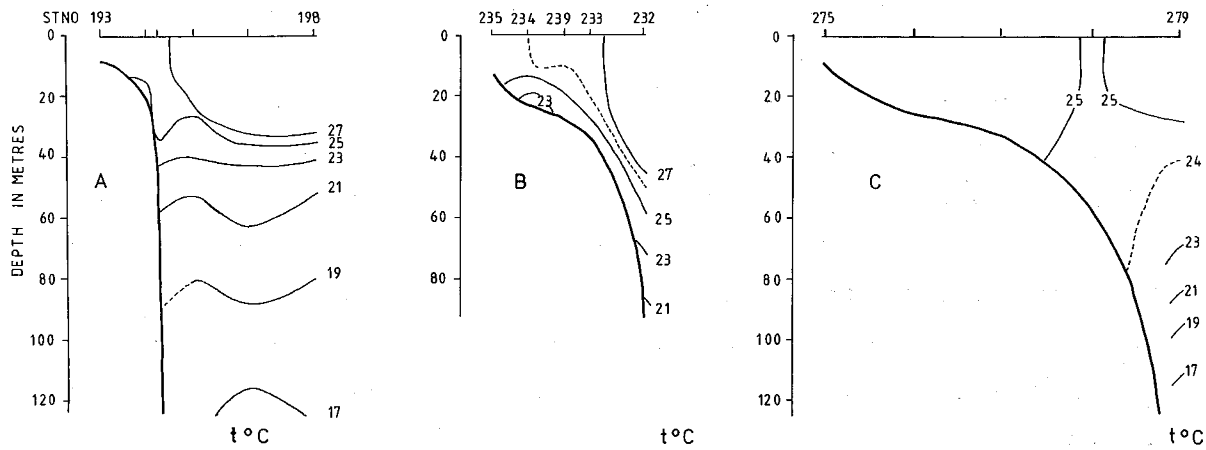

Fig. 6. Vertical temperature distribution in three sections indicated in Fig. 1.

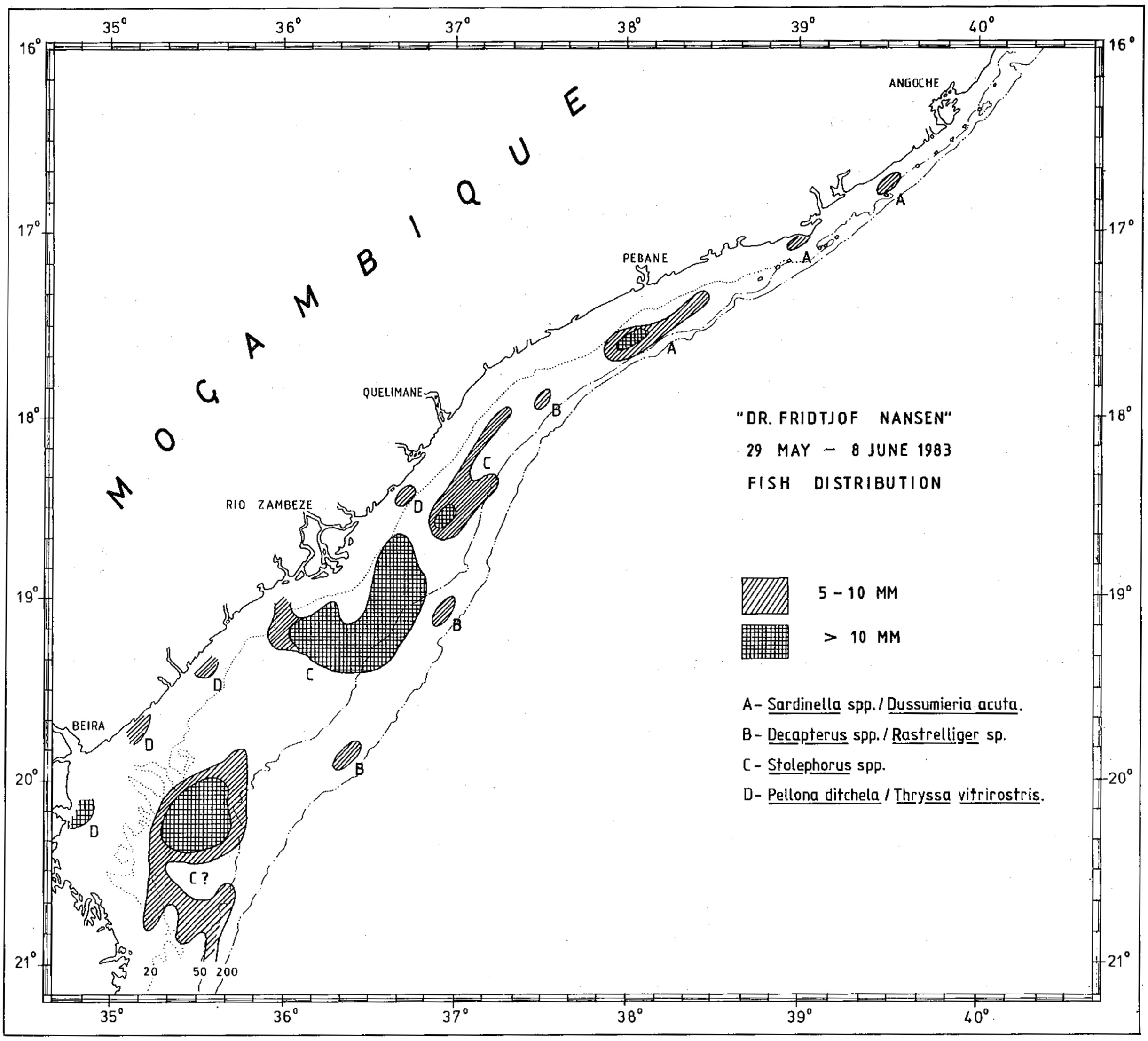

Fig. 7. Echo abundance distribution of pelagic fish - 29 May–8 June 1983.

5. THE SMALL ANCHOVY

Introduction

During the present survey anchovy was caught in pelagic trawls (during night time) and in some of the shrimp bottom trawls (during day time).

Using "FAO Species Identification Sheets, 1983" (W. Indian Ocean) the following species were identified:

Stolephorus punctifer
Stolephorus heterolobus
Stolephorus indicus

It was not possible to identify one of the species which occurred in some of the bottom trawls. This species will be referred to in the present report as Species A.

The difference between the two first species, was not detected during the survey. This difference was only detected later, in a sample analysed in the laboratory where the proportion between the S. punctifer and S. heterolobus was 1:2. As we do not have samples from other hauls and the majority of samples analysed could have been a mixture of these two species, this group is always referred to as S. punctifer/heterolobus.

S. punctifer, S. heterolobus and S. indicus occurred both in the pelagic and bottom trawls. Species A did not occur in the pelagic hauls.

Catch rates

8 pelagic trawl hauls (during night time) were made. The following table shows the results obtained.

Station number	Latitude	Longitude	Gear depth (m)	Bottom depth (m)	Catch rates kg/h
512	S 17°34'	E 38°03'	10	31-34	30.8
517	S 18°07'	E 37°14'	21-24	21-24	41.6
523	S 18°34'	E 36°55'	8-14	28-29	480.0
529	S 19°01'	E 36°48'	10-43	36-43	127.5
530	S 18°59'	E 36°42'	20-24	34-38	488.0
539	S 19°23'	E 36°52'	10	73	30.0
540	S 19°12'	E 36°07'	10	25	120.0
545	S 19°49'	E 36°17'	15	65-68	11.4

Anchovy was caught in seven Out of 44 shrimp bottom trawl hauls (during day time). The following table shows the catch rates obtained.

Station number	Latitude	Longitude	Gear depth (m)	Catch rates kg/h
499	S 17°01'	E 39°09'	13	0.5
501	S 17°06'	E 38°50'	9-10	2.2
504	S 17°16'	E 38°29'	15	0.2
525	S 18°17'	E 36°55'	18-19	31.2
536	S 19°05'	E 36°03'	19	2.4
541	S 19°16'	E 35°52'	20-21	3.0
550	S 20°11'	E 34°53'	5	5.2

Fig. 8 shows the distribution of the catch rates obtained with the two different types of gear.

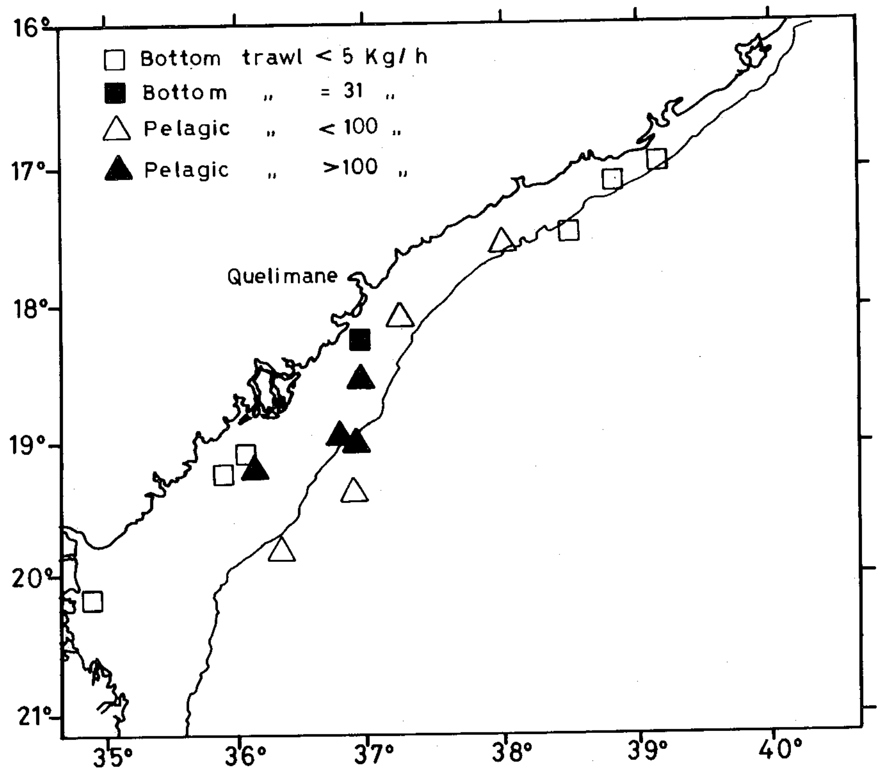

Fig. 8. Stations with catch of anchovy.

Biological analysis of the main species

At each station with a significant catch of anchovy, samples were analysed. For all species length was recorded by 0.5 cm groups. For S. punctifer/heterolobus maturity stages were also recorded using the maturity scale included in Annex 1, Table 2.

Length distribution was analysed by haul. Fig. 9 shows the mean length by haul obtained in pelagic trawls (A) and in bottom trawls (B).

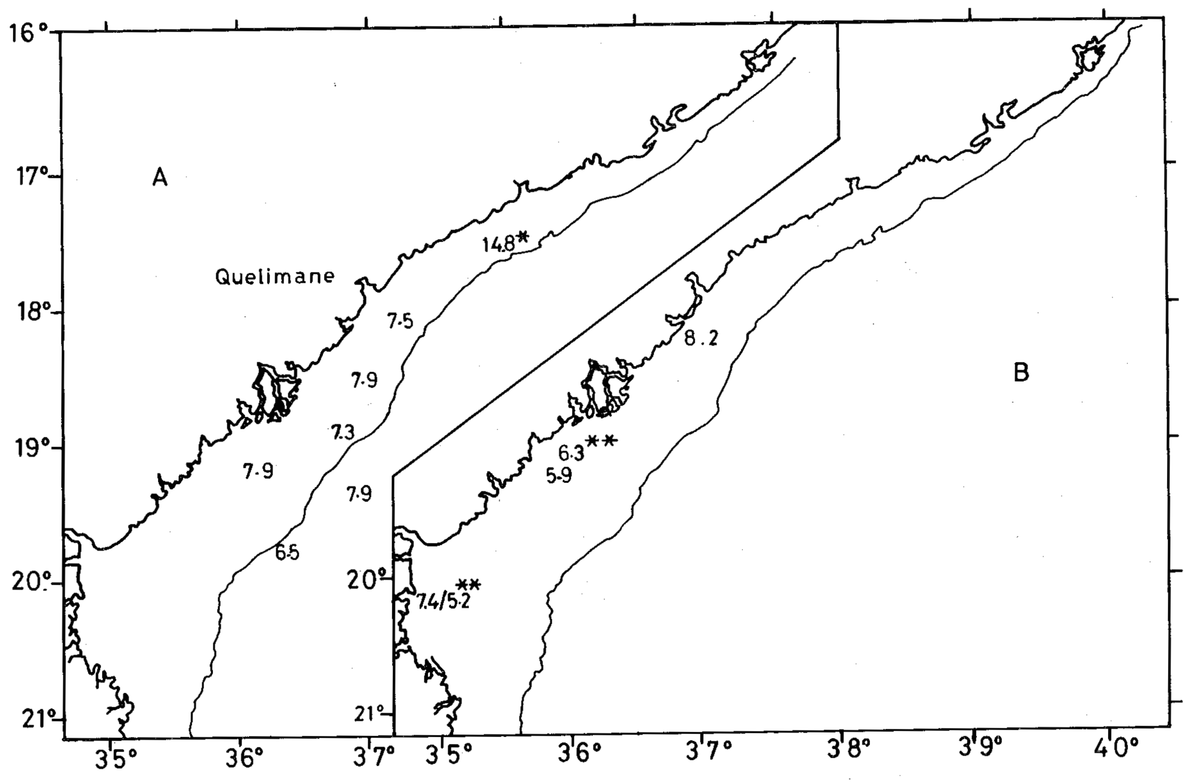

Fig. 9. Mean total length/haul of S. punctifer/heterolobus.
S. indicus (*) and Species A (**).
A) Pelagic trawl hauls. B) Shrimp bottom trawl hauls.

Comparing the distribution areas of the pelagic fish obtained during the present survey (Fig. 7), with the position of the control pelagic trawls (Fig. 1), the samples which seem to belong to the same distribution area were joined. The length distribution, modal size and mean estimates obtained (although not weighted by the stock size of each area) are approximations of the structure of the population of those areas.

Some samples were brought to the laboratory to calculate length-weight relationship. For each species this relationship was obtained by applying the functional linear regression to data, transformed in logarithms.

S. punctifer/heterolobus

This group dominated the catches. It was present from latitude S 17°34' to S 20°11'.

Total length of 572 individuals caught in 6 pelagic hauls, was measured (Annex 2, Table 1). The sizes ranged from 2.5 to 9.5 cm long, with the modes varying between the classes 3.5–4.0 and 8.0–8.5 cm.

From bottom trawls a total of 313 individuals were measured (Annex 2, Table 1). The size ranged from 4.0 to 9.0 cm long, with the modes varying between the classes 5.0–5.5 and 8.5–9.0 cm.

As already mentioned, the samples which seemed to belong to the same distribution area were joined and the results are shown in the following table:

Area	Length range Class Mark (cm)	Modal size Class Mark (cm)	Mean size (cm)
From Quelimane to Zambezi River	2.75 - 9.75	4.25 and 7.75	7.8
In front of Zambezi River	6.25 - 9.25	8.25	7.7

Gonads of 382 individuals were taken for analysis of sex and maturity stages. It was tried, for the first time to use a simplified maturity stage table for Stolephorus (TIEWS, RONQUILLO and SANTOS, 1968, Annex 2, Table 2). The results must be considered as preliminary.

The relative percentage of each maturity stage, males and females separated, are shown in the following table.

Another species, not identified and referred to as species A occurred only in three bottom trawl hauls at depths lower than 20 meters, and in negligible quantities.

The total length of 267 individuals was measured (Annex 1, Table 1). The range of sizes was from 4.5 to 7.0 cm long with the estimated mean of 5.8 cm.

Length–weight relationship was studied and graphically represented in Fig. 13. The results are as follows:

$\log W = 3.092 \log LT - 2.227$

$n = 293$

$r = 0.9752$

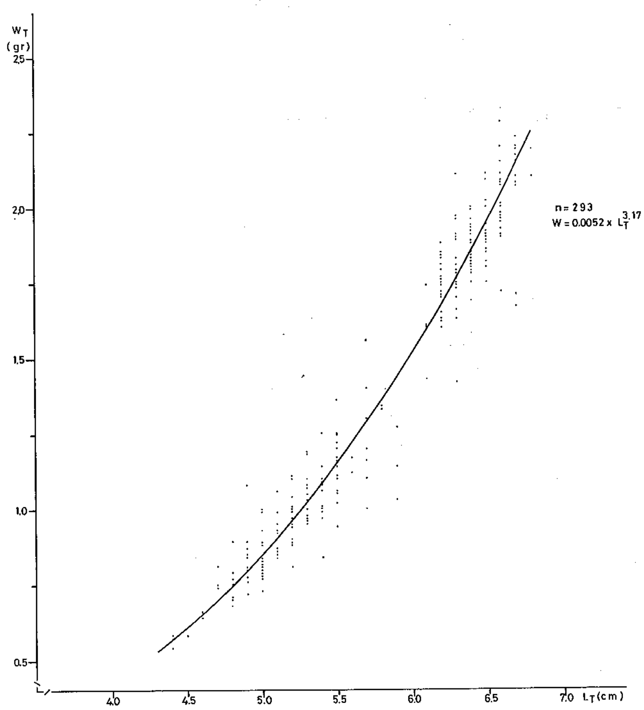

Fig. 13. Species A — Length–weight relationship.

6. OTHER SMALL PELAGIC FISH

Catch composition

Only catches from bottom hauls were considered in this analysis. As in the previous surveys conducted by "Pantikapey" and "S. Rybak" the area covered was divided into the following subareas: Machese, Beira, Quelimane I, Quelimane II and Angoche + Moebase.

Several families are included in the group (Table 1). Families Clupeidae, Engraulidae, Leiognathidae and Sphyraenidae were the most representative in the catches. They were mainly caught, at depths shallower than 25 meters where total catch amounted to about 6.5 tons. The best catch rates were obtained in the subareas Beira and Quelimane I at depths shallower and deeper than 25 meters, respectively, where the family Clupeidae dominated the catches. In subareas north of Zambezi river, Angoche + Moebase and Quelimane II, families Clupeidae and Carangidae were the most important in the catches.

Detailed information on sardines and ponyfishes is presented in the next chapters. The information concerning the other small pelagic fish is found in Annex 3.

Catch rates, distribution and biology of the main families

Sardines

In this group two families were included, Clupeidae and Engraulidae, excluding Stolephorus sp. which was considered in the group of anchovies as in the previous reports on surveys with the R/V Dr. Fr. Nansen.

A. Family Clupeidae

a) Catch rates and distribution

The most representative species of the family Clupeidae is Pellona ditchela. It was found in the whole surveyed area at depths from 6 to 36 meters. The highest catch rates were obtained at depths above 20 meters although in one single haul at 23–26 meters depth a catch of 516 kg was recorded (Fig. 14, Table 2).

Table 1. Composition of small pelagic fish catches (kg/h) by subarea and depth interval (meters).

	Angoche + Moebase	Quelimane II		Quelimane I		Machese		Beira	Total Area	
	< 25	< 25	> 25	< 25	> 25	< 25	> 25	< 25	< 25	> 25
Ariommidae	0.07	0.12	0.50	-	4.00	0.81	-	2.53	0.67	1.20
Carangidae	43.38	8.20	6.56	15.86	17.70	11.49	3.20	36.01	21.02	8.93
Clupeidae	7.17	67.10	10.54	44.11	344.53	86.30	40.92	274.92	98.58	46.82
Chirocentridae	1.54	0.39	-	0.11	-	2.26	-	0.81	1.08	-
Engraulidae	5.89	20.98	7.91	26.75	70.67	40.94	62.94	66.57	36.23	44.52
Formionidae	1.90	10.00	-	5.12	-	1.18	2.47	2.99	3.96	0.74
Gerreidae	2.95	-	-	-	-	0.31	-	0.76	0.64	-
Leiognathidae	28.86	9.37	0.21	1.75	33.60	11.46	-	61.27	19.72	10.08
Scombridae	5.17	0.92	0.11	0.84	3.47	0.70	0.48	9.56	2.84	1.24
Scomberomoridae	5.90	3.22	9.01	4.34	-	5.42	1.20	18.93	7.18	3.96
Sphyraenidae	6.38	0.08	1.17	0.76	13.50	0.25	2.45	201.59	35.86	5.49
Others	1.00	0.53	-	0.35	-	1.26	0.79	1.29	0.88	0.24
TOTAL	110.21	60.49	36.01	99.99	487.47	162.38	114.45	677.23	228.41	123.22
Sharks and Rays	0.47	1.79	2.04	3.76	-	0.84	-	-	1.59	0.82
TOTAL CATCH (Kg)	838.75	599.09	144.94	958.01	1122.36	1143.39	551.56	2900.71	6439.95	1818.86
Hours of hauling	3	3.25	2	5.5	1.5	5	1.5	3.5	20.25	5
Catch rate (kg/H)	279.58	184.34	72.47	174.18	748.24	228.68	367.71	828.77	318.02	363.77
Nr. of Hauls	6	7	4	11	3	10	3	7	34	17

Table 2. Catch rates of the main species of the family Clupeidae by depth and subarea.

	B. + Machese		Quel. I		Quel. II		Ang. + Moeb.		Total	
	< 20	21–45	< 20	21–45	< 20	21–45	< 20	21–45	< 20	21–45
P. ditchela	162.7	1.2	53.3	206.4	78.9	0.04	8.0	-	96.6	86.21
H. kelee	-	-	0.4	-	0.04	-	-	-	0.1	-
Sardinella spp.	33.0	-	12.2		0.4	10.5	0.4	-	17.0	3.5
Total (all species)	196.8	20.6	66.7	206.4	79.7	24.9	15.7	-	115.7	97.7
Hours of hauling	7.00	1.00	3.42	2.50	2.75	2.00	3.00	.50	16.17	6.00

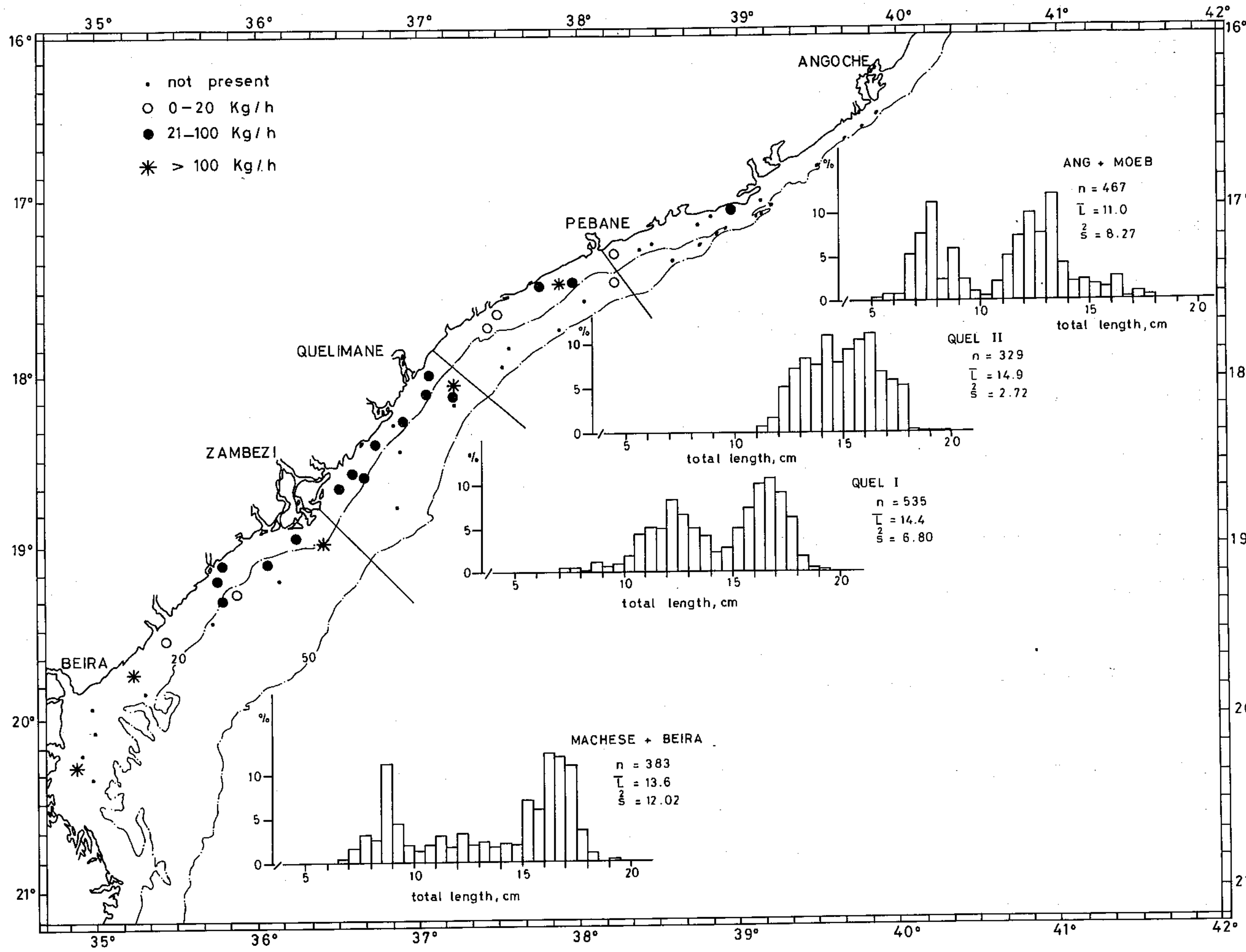

Fig. 14. Catch rates of P. ditchela and length composition by subarea.

The remaining species of this family, namely Hilsa kelee, Dussumieria acuta, Sardinella gibbosa, Sardinella sp., appeared in the catches in very low quantities. They were mainly found at depths above 20 meters.

This distribution is in good accordance with the results of the previous surveys.

b) Size composition of P. ditchela

The length distributions in each subarea were combined. For each haul the number of individuals measured was extended to the total catch in numbers per hour of trawling and the average catch in numbers per hour calculated for each length class. The percentage obtained in each class is represented in Fig. 14.

Small individuals were caught in the subarea Angoche + Moebase and Machese + Beira and the large ones between Quelimane II and Machese + Beira.

During the last "Fr. Nansen" survey, in September 1982 small fish were found in the subareas Quelimane I and II.

c) Growth curve of P. ditchela

A total of 55 otoliths were used for age readings by counting the number of daily growth rings.

The von Bertalanffy growth equation was fitted to the data and the following equation was obtained:

$$L_t = 24.0 \ (1 - e^{-0.88 \ (t - 0.23)})$$

where t is time in years and L_t the length in centimeters at time t.

Fig. 15 shows the growth curve of P. ditchela.

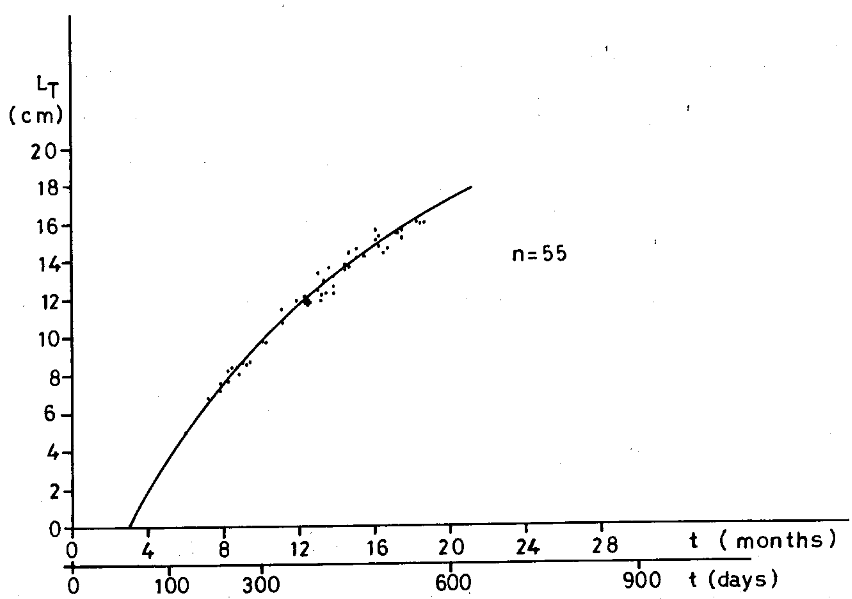

Fig. 15. Growth curve of P. ditchela.

d) Gonad development of P. ditchela

A total of 1027 gonads were examined and the maturity stages analysed (Table 3). Most of gonads were immature (stage II) or preparing for spawning (stages III and IV).

Fish smaller than 15 cm were mainly immature. Females in spawning were caught at nearly all stations where this species was present but the higher concentrations were found between Zambezi river and Quelimane (Fig. 16). Most of them were of sizes larger than 15 cm.

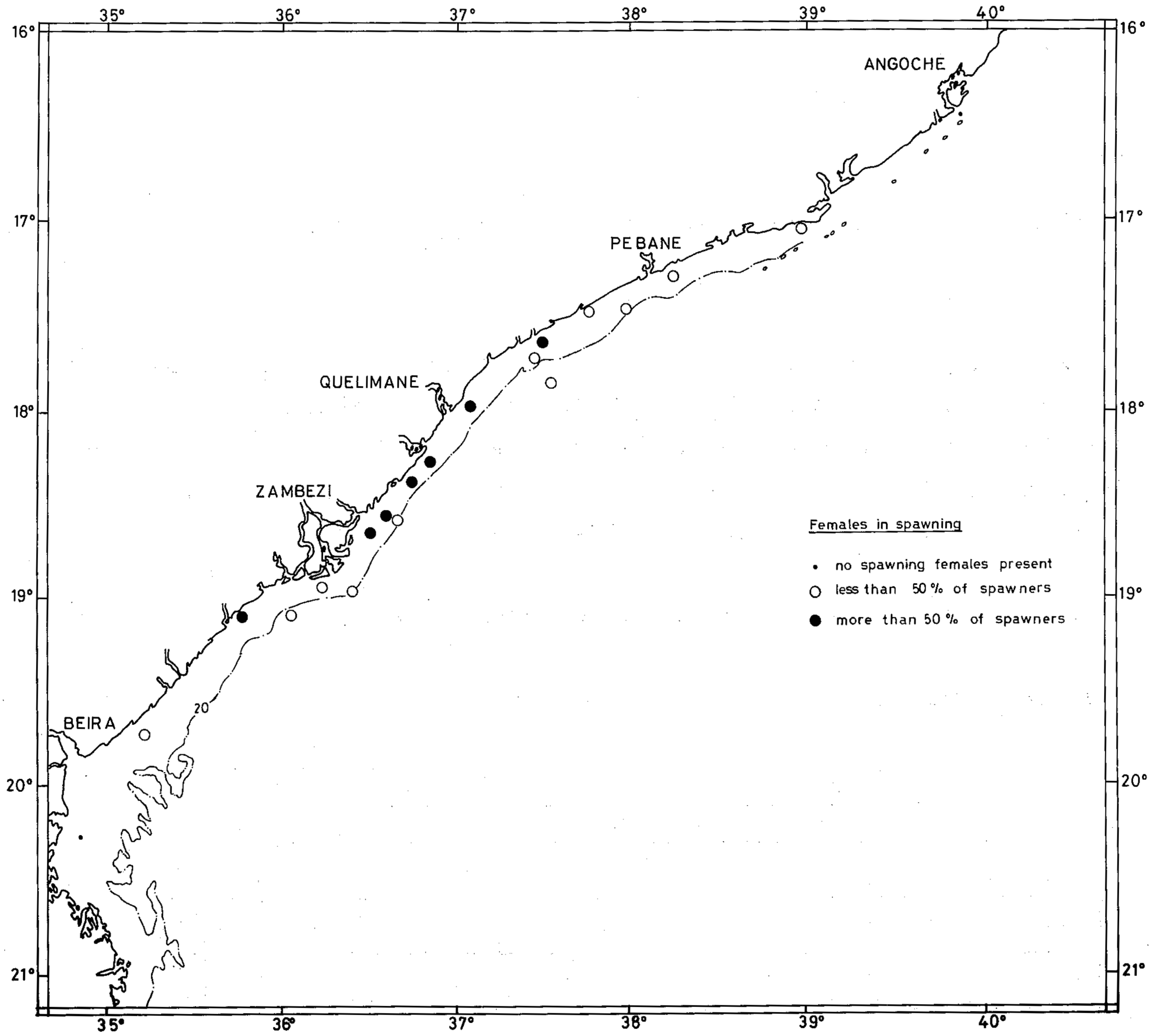

Fig. 16. Occurrence of females of P. ditchela in spawning.

Table 3. Relative percentage of maturity stages of P. ditchela by sex.

FEMALES						MALES					
I	II	III-IV	V	VI	n	I	II	III-IV	V	VI	n
-	31.9	30.4	30.4	7.3	533	-	15.8	17.6	59.5	7.1	494

Gonadasomatic index (gonad weight/total weight x 100) was estimated for each sex.

Females: $\overline{GSI} = 1.3$
$s = 1.36$
$n = 254$

Males: $\overline{GSI} = 1.4$
$s = 4.95$
$n = 234$

B. Family Engraulidae (excluding Stolephorus sp.)

a) Catch rates and distribution

This family was mainly represented by Thryssa vitrirostris which appeared together with P. ditchela. The best catch rates were obtained at depths above 20 meters, between Beira + Machese and Quelimane II (Table 4, Fig. 17). However, only in one haul at 23–26 meters depth a catch of 104 kg was obtained.

Other species of this family were caught, namely T. setirostris.

Table 4. Catch rates of T. vitrirostris by depth and subarea.

	B. + Machese		Quel. I		Quel. II		Ang. + Moeb.		Total	
	< 20	21–45	< 20	21–45	< 20	21–45	< 20	21–45	< 20	21–45
T. vitrirostris	60.1	-	35.0	41.6	24.3	+	5.4	-	38.6	17.3
Total (all species)	62.9	61.5	41.6	42.1	24.8	7.9	7.0	-	41.6	30.4
Hours of hauling	7.00	1.00	3.42	2.50	2.75	2.00	3.00	.50	16.17	6.00

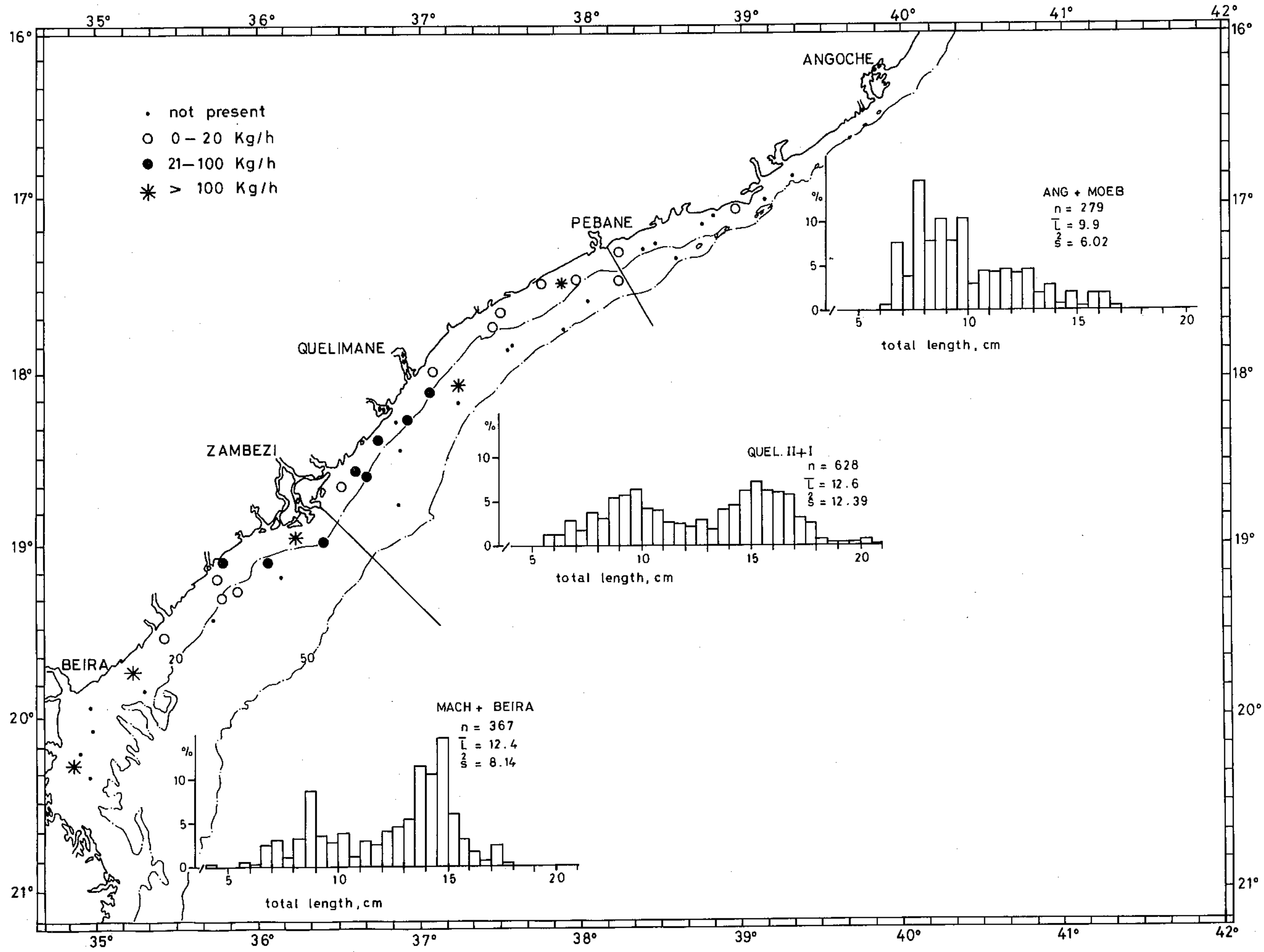

Fig. 17. Catch of T. vitrirostris and length composition by subarea.

b) Size composition of T. vitrirostris

Length samples were combined by three subareas and the percentage of catch in numbers per hour of trawling of each length class represented in Fig. 17. At least two modes are present in each distribution.

The juveniles seem to occur in the whole area surveyed. In the last survey by "Fr. Nansen" juveniles were mainly found in the subareas Quelimane I and Quelimane II.

c) Gonad development of T. vitrirostris

A total catch of 785 gonads were examined and the relative percentage of maturity stages by sex determined (Table 4). Most of the fish were immatures (stage II) or preparing for spawning (stages III and IV).

Table 5. Relative percentage of maturity stages by sex of T. vitrirostris.

FEMALES						MALES					
I	II	III-IV	V	VI	n	I	II	III-IV	V	VI	n
-	48.3	32.0	16.6	3.1	416	-	39.0	26.0	33.1	1.9	369

The gonadosomatic index was estimated for males and females separately. The results were:

Females: $n = 221$

$\overline{GSI} = 0.6$

$s = 0.59$

Males: $n = 195$

$\overline{GSI} = 0.6$

$s = 0.45$

Ponyfishes

a) Catch rates and distributions

Two species of the family Leiognathidae were abundant in the catches: Leiognathus equulus and Secutor insidiator. The best catches were obtained at depths above 20 meters in the subarea Beira + Machese. Catch rates of S. insidiator were also high in Quelimane II and Angoche + Moebase, as was found in the previous surveys (Figs 18, 19, Table 6).

Table 6. Catch rates of the species of family Leiognathidae by depth and subarea.

	B + Machese		Quel. I		Quel. II		Ang. + Moeb.		Total	
	< 20	21-45	< 20	21-45	< 20	21-45	< 20	21-45	< 20	21-45
L. equulus	11.5	-	0.5	6.5	-	-	4.2	-	5.9	2.7
S. insidiator	26.0	0.9	0.6	14.5	10.8	0.2	25.5	-	18.0	6.3
G. minuta	1.3	-	1.5	0.2	0.3	-	4.2	-	1.7	+
Total (all species)	38.8	0.9	2.6	21.1	11.1	0.2	33.9	-	25.5	9.0
Hours of hauling	7.00	1.00	3.42	2.50	2.75	2.00	3.00	.50	16.17	6.00

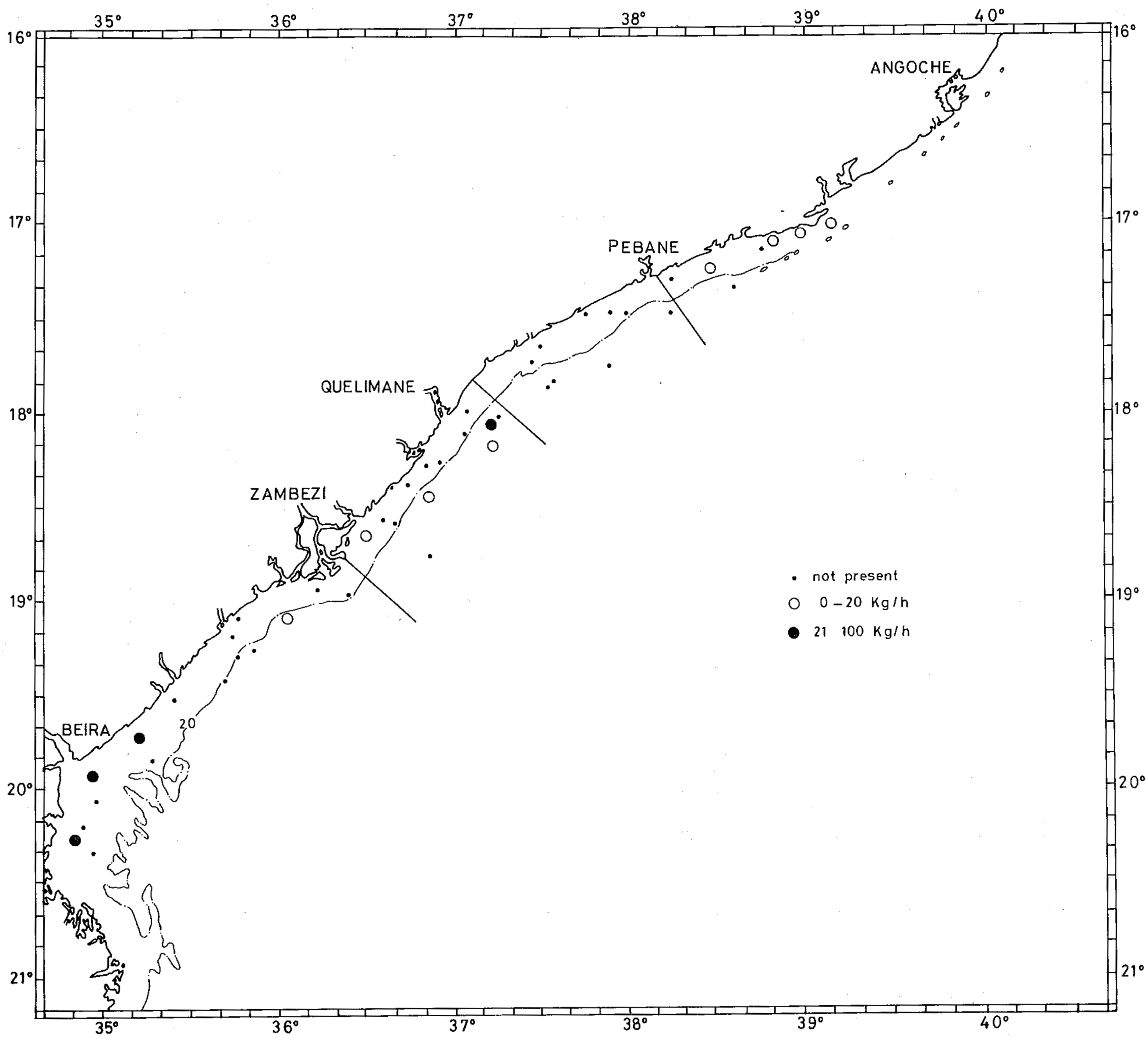

Fig. 18. Catch rates of L. equulus by subarea.

Another species of this family, Gazza minuta was also caught but in very low quantities.

b) Size composition of L. equulus and S. insidiator

A few samples of L. equulus were collected in the subareas Angoche + Moebase and Beira + Machese (Annex 3).

The length samples of S. insidiator were combined by subareas and the percentage of catch in numbers per hour of each length class represented in Fig. 19.

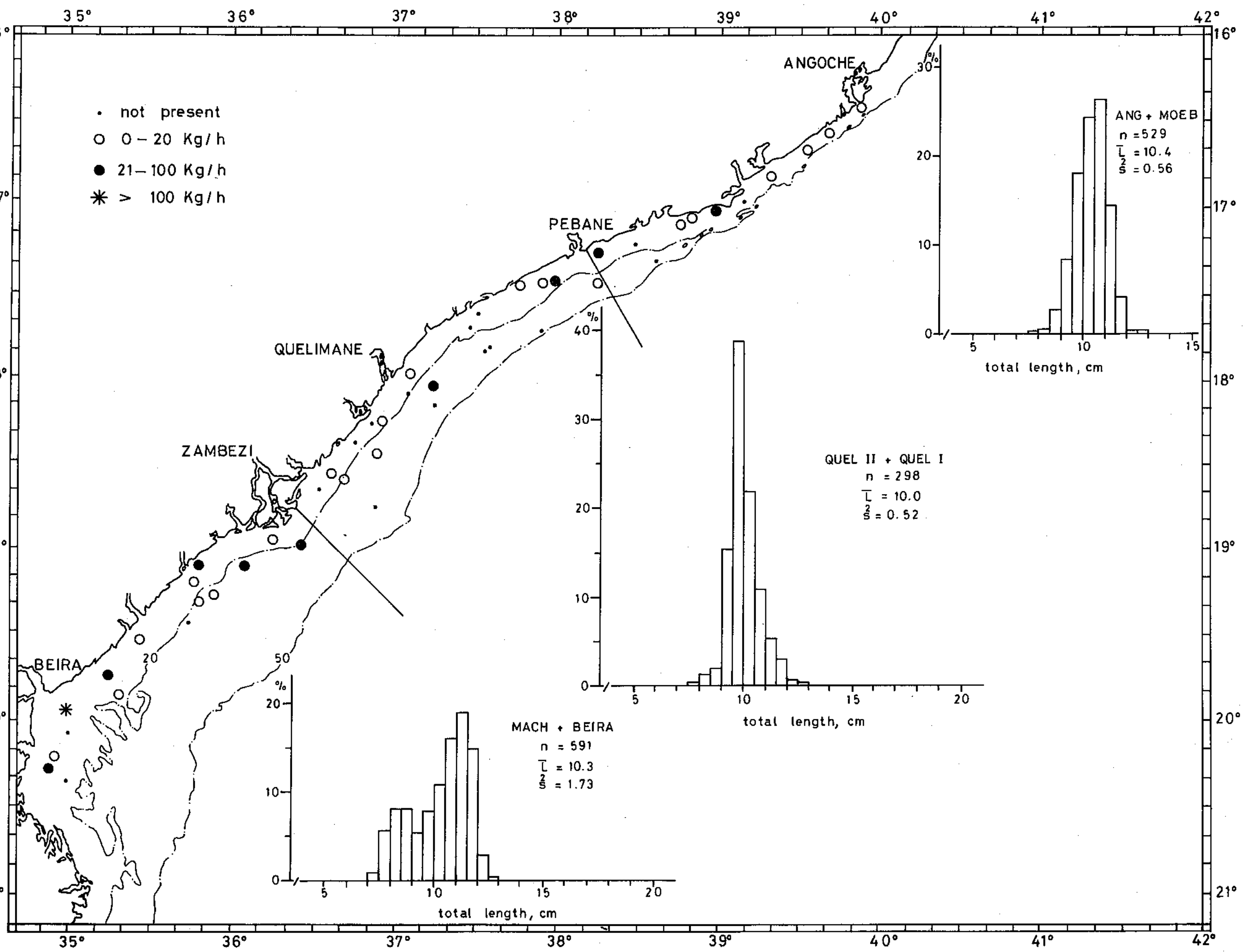

Fig. 19. Catch rates of S. insidiator and length composition by subarea.

c) Gonad development of L. equulus

A few gonads were examined and the relative percentage of maturity stages by sex determined (Table 7). Most of the fish was immature (stage II).

Table 7. Relative percentage of maturity stages of L. equulus by sex.

F E M A L E S						M A L E S					
I	II	III-IV	V	VI	n	I	II	III-IV	V	VI	n
-	73.6	19.1	7.3	-	110	-	72.0	22.0	6.1	-	82

Other small pelagic species

All collected data of other pelagic species are included in Annex 3.

7. DEMERSAL FISH

The analysis of demersal fish is based on catches from the shrimp trawl.

As in previous surveys, the Sofala Bank was divided in four subareas: Angoche-Moebase (16°20'-16°50'), Quelimane II (17°20'-17°50'): Quelimane I (17°50'-16°50') and Moebase-Beira (18°50'-21°00'). Angoche-Moebase and Machese-Beira were grouped and considered as two subareas due to the low number of trawl stations.

Catch composition and distribution

Fig. 20 shows that the demersal fish occurs all over the surveyed area with the best catches in Quelimane I and Beira.

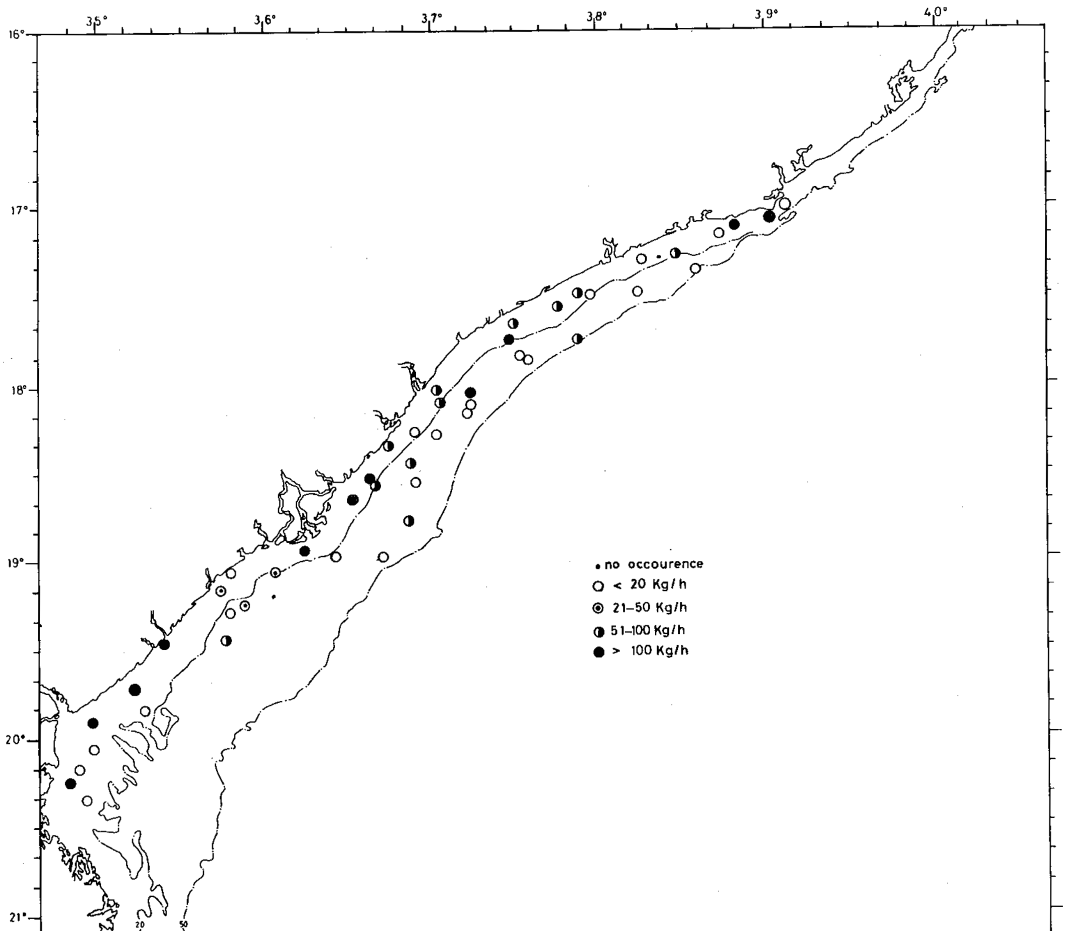

Fig. 20. Distribution of demersal fish.

Table 8 gives the composition of the catches, splitted by depth and by subarea. Pelagic fish usually dominated, the catches except for the catches in the Angoche and Moebase areas where demersal fish constitute approximately 65% of the catch. At depths shallower than 25 meters, the Sciaenidae is the dominant group in Quelimane II, Quelimane I and Beira. In Machese the family Trichiuridae dominates. Besides this family, Polynemidae made significant contribution in Quelimane II, Trichiuridae in Quelimane I and Pomadasyidae in Beira. Mullidae was the most important family in Angoche–Moebase together with Polynemidae.

Table 8. Catch composition (kg/h) by depth and subarea.

Catch composition	Ang + Moebase	Quelimane II		Quelimane I		Machese		Beira	Sofala Bank	
	< 25	< 25	> 25	< 25	> 25	< 25	> 25	< 25	< 25	> 25
Bothidae	-	-	0.12	-	-	0.06	+	-	0.03	0.07
Cynoglossidae	2.15	2.75	0.03	4.08	-	1.56	-	1.04	2.43	0.02
Drepanidae	0.34	1.38	-	0.06	-	0.45	-	-	0.48	-
Lutjanidae	-	-	-	-	-	-	-	-	-	-
Mullidae	139.34	1.81	0.35	12.65	14.60	10.37	0.24	5.69	28.93	0.96
Nemipteridae	-	-	0.27	0.08	0.13	-	-	-	0.11	0.04
Polynemidae	10.22	10.16	-	0.83	6.7	0.59	-	17.44	6.53	1.81
Pomadasyidae	8.77	5.21	-	2.21	-	2.48	-	33.68	9.17	-
Priacanthidae	-	-	-	-	-	-	-	-	-	-
Psettodidae	0.03	0.42	-	-	-	0.11	-	3.71	0.74	-
Sciaenidae	3.03	27.03	-	29.05	8.27	11.86	-	47.53	23.82	-
Serranidae	-	-	7.75	-	-	2.64	-	-	2.64	4.77
Sillaginidae	0.3	0.31	-	-	-	0.6	-	2.61	0.74	-
Sparidae	-	-	3.03	-	3.53	-	-	-	1.86	1.95
Synodontidae	1.23	0.90	0.19	1.72	0.32	2.8	-	0.95	1.64	0.17
Theraponidae	2.73	2.83	-	0.79	6.67	1.43	-	15.9	5.44	1.81
Trichiuridae	0.3	5.78	-	22.03	6.67	24.45	-	6.09	8.39	3.64
* Commercial	0.2	2.47	4.58	2.69	12.12	4.77	-	15.23	4.97	3.73
** Non commercial	1.17	0.53	0.02	0.65	-	0.48	-	1.00	0.72	0.04
Total demersal	170.31	60.96	16.25	67.32	94.14	64.65	0.24	150.87	99.98	25.32
Sharks and Rays	0.47	1.79	2.04	3.76	-	0.84	-	-	1.59	0.82
Total catch (Kg)	838.75	599.09	144.94	958.01	1122.36	1143.39	551.56	2900.71	6439.95	1818.86
Hours of trawling	3	3.25	2	5.5	1.5	5	1.5	3.5	20.25	5
Catch rate (Kg/h)	279.58	184.33	72.47	174.18	748.24	228.68	367.71	828.77	318.02	363.77
Nº of hauls	6	7	4	11	3	10	3	7	34	17

* In commercial fish are included the following families: Priacanthidae, Scorpaenidae, Apogonidae, Platycephalidae, Gobiidae, Luthianidae Ariidae and Lethrinidae.

** In non commercial fish are included the families: Menidae, Lagocephalidae, Fistulariidae, Balistidae and Lobotidae.

At depths of more than 25 meters, Mullidae dominated in Quelimane I and Machese while Serranidae was the most important family in Quelimane II. In general, the main families in shallow waters (above 25 m) are Sciaenidae, Mullidae and Trichiuridae and in deeper waters (below 25 m), Mullidae is the dominant family.

Sciaenidae

Among the demersal fish this family had the highest yields in waters shallower than 25 m and the best catches were obtained at Quelimane I and Beira (Fig. 21).

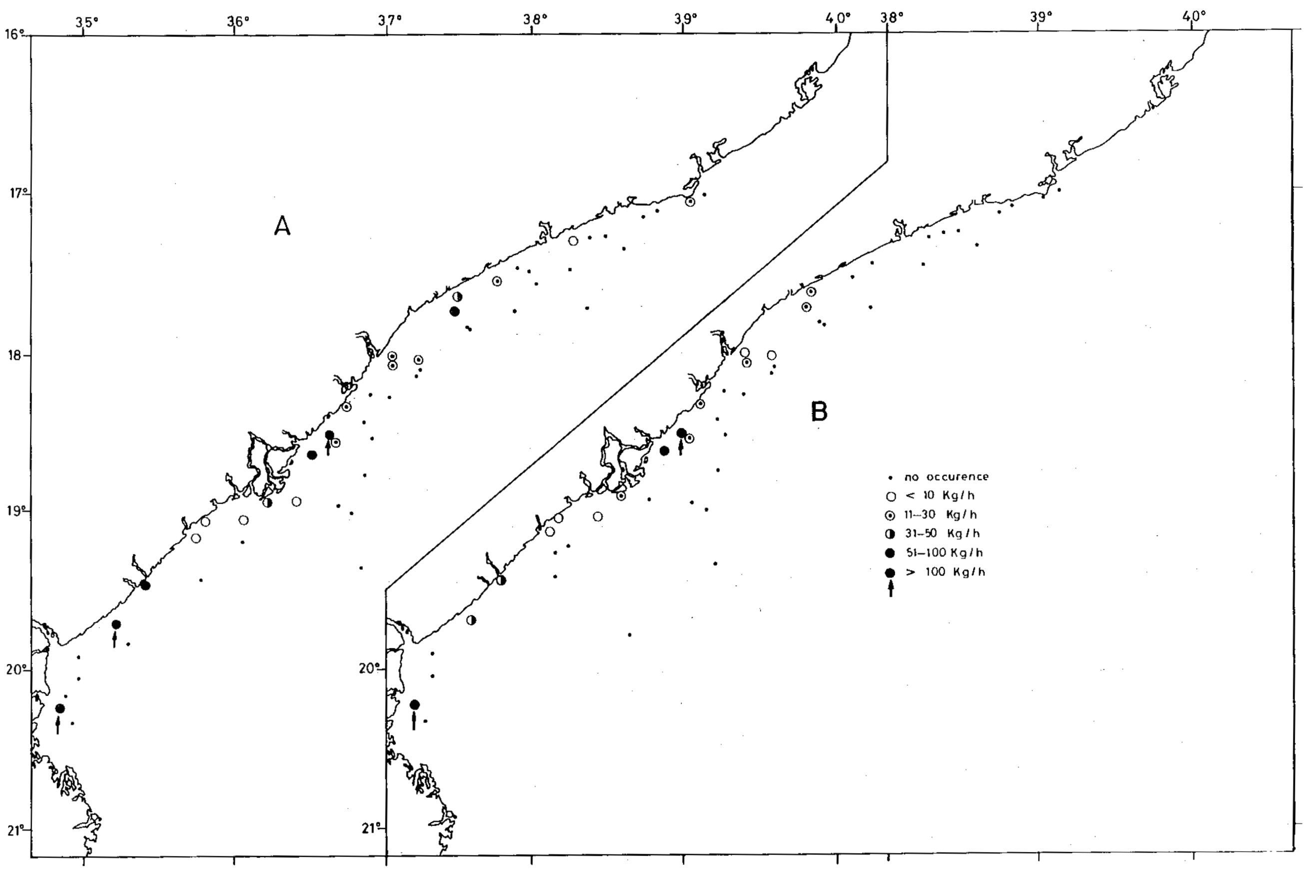

Fig. 21. A - Distribution of family Sciaenidae (catch per hour).
B - Distribution of Johnius belengerii (catch per hour).

Mainly three species were represented: J. belengerii, O. ruber and J. dussumierii.

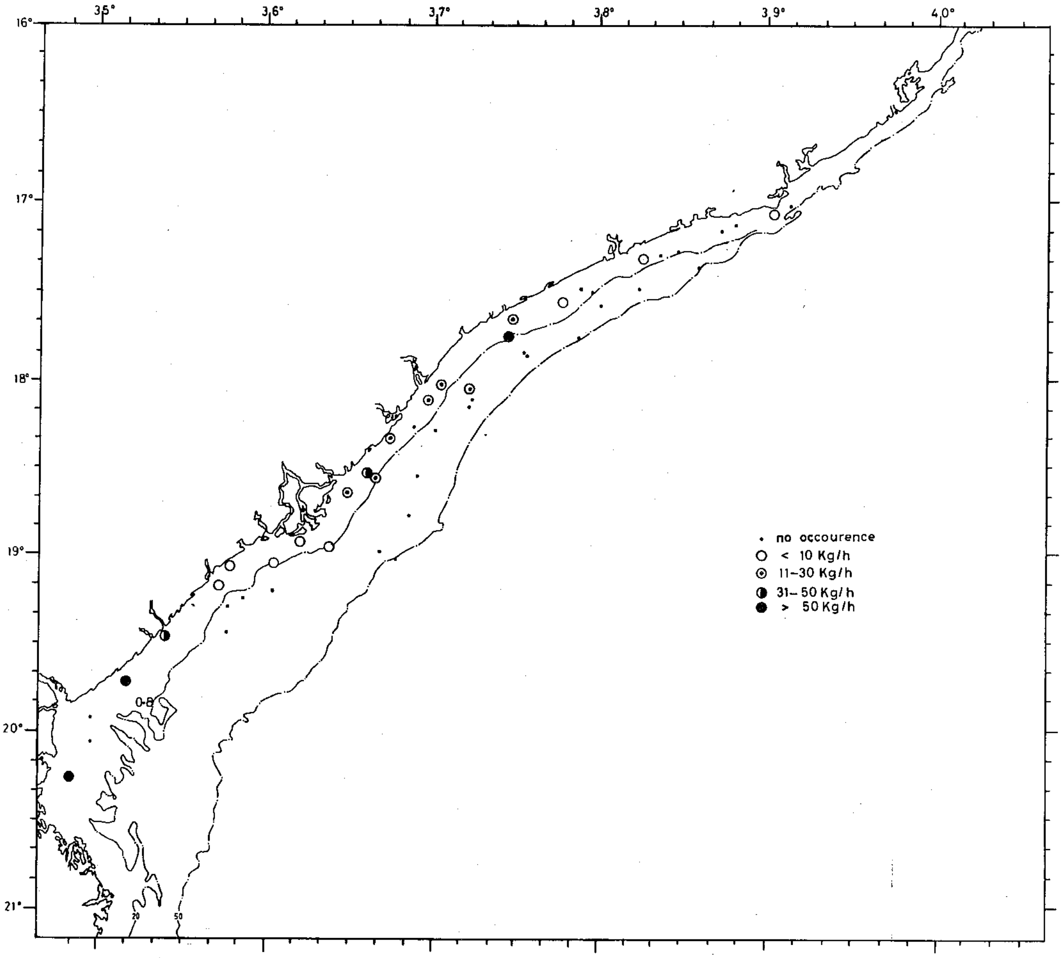

Fig. 22. Distribution of Otolithes ruber (catch per hour).

In table 9 it can be seen that J. belengerii occurs from Quelimane II to Beira subarea, with the best catches in Quelimane I. In Beira, one trawl station had a catch rate of more than 100 kg/h (Fig. 21B). O. ruber occurs from Moebase to Beira, with best yields in Quelimane I and Beira. In Quelimane II, one trawl station had a catch rate of more than 50 kg/h (Fig. 22).

Table 9. Species composition from family Sciaenidae splitted by species.

Species composition	Ang + Moebase	Quelimane II		Quelimane I		Machese		Beira	Sofala Bank	
	< 25	< 25	> 25	< 25	> 25	< 25	> 25	< 25	< 25	> 25
J. belengerii	-	6.69	-	19.20	0.27	6.41	-	20.84	11.47	-
O. ruber	1.77	15.23	-	12.11	8.0	5.32	-	20.83	10.91	-
J. dussumierii	1.26	5.11	-	-	-	0.13	-	5.86	2.05	-

Johnius dussumierii is present in Angoche–Moebase, Quelimane II, Machese and Beira. The first subarea was not included as the catches were small. Looking at table 9, it can be seen that the best catches were found in Quelimane II and Beira.

Pomadasyidae

This family occurs from Moebase to Beira with the best catch rates in Beira (328 kg was caught at one trawl station) (Fig. 23A). Three species of this family occurred in this survey: P. maculatus, P. hasta and R. stridens; of which the first is the most important. Table 10 gives the catch composition of the family Pomadasyidae. Pomadasys maculatus is present from Moebase to Beira with the best catches in Beira. Looking at table 10 Rhonciscus stridens occurred only in Angoche–Moebase with a catch rate of up to 352 kg/h.

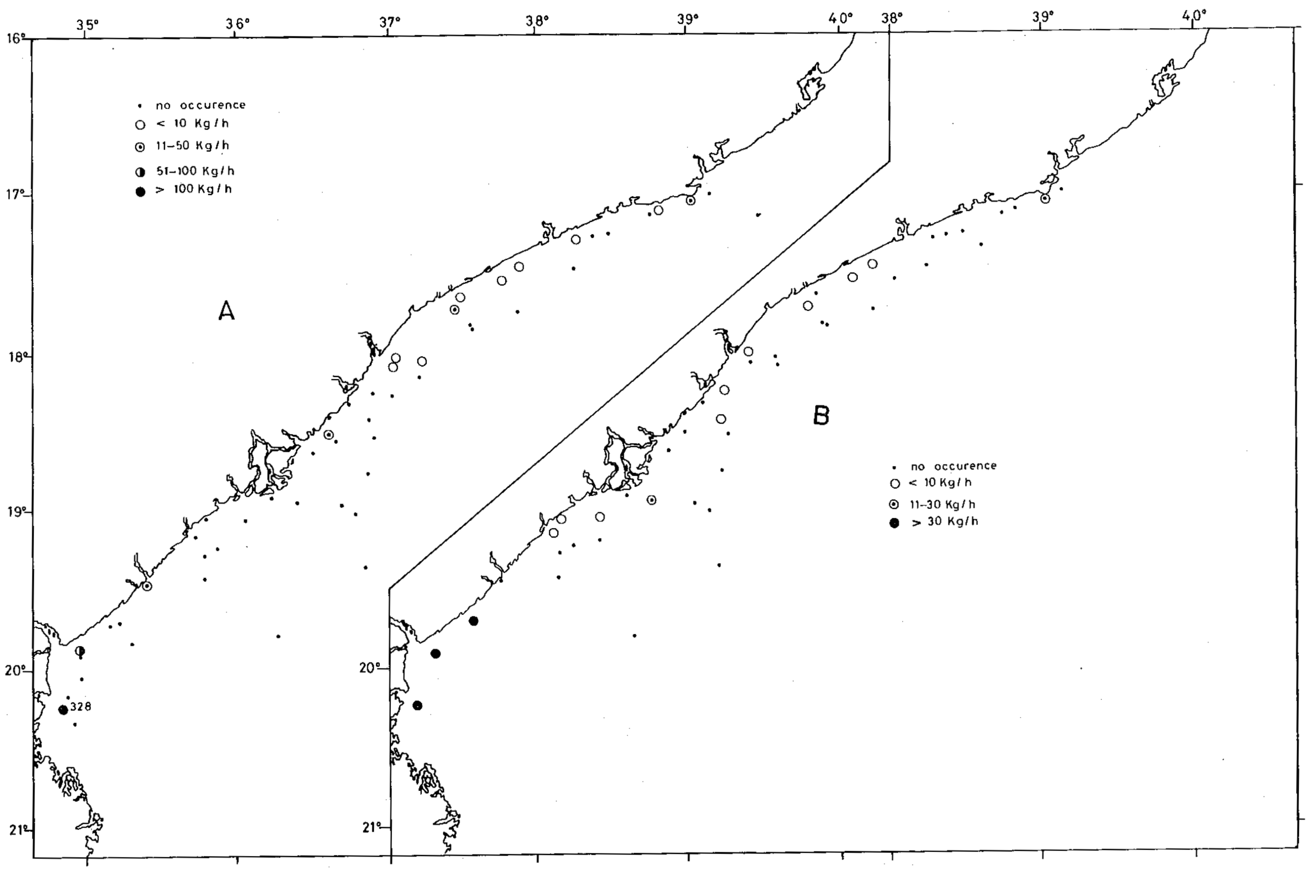

Fig. 23. A - Distribution of family Pomadasyidae (catch/hour).
B - Distribution of Pomadasys maculatus (catch/hour).

Table 10. Species composition from family Pomadasyidae splitted by species.

Species composition	Ang + Moebase	Quelimane II		Quelimane I		Machese		Beira	Sofala Bank	
	< 25	< 25	> 25	< 25	> 25	< 25	> 25	< 25	< 25	> 25
P. maculatus	4.95	1.57	-	0.14	-	2.24	-	33.44	7.36	-
P. hasta	0.30	3.64	-	2.07	-	0.24	-	0.24	1.29	-
R. stridens	3.52	-	-	-	-		-	-	0.52	-

Mullidae

This family is present from Moebase to Machese—Beira with the best catches in Moebase (Fig. 24A) at 9—16 meters.

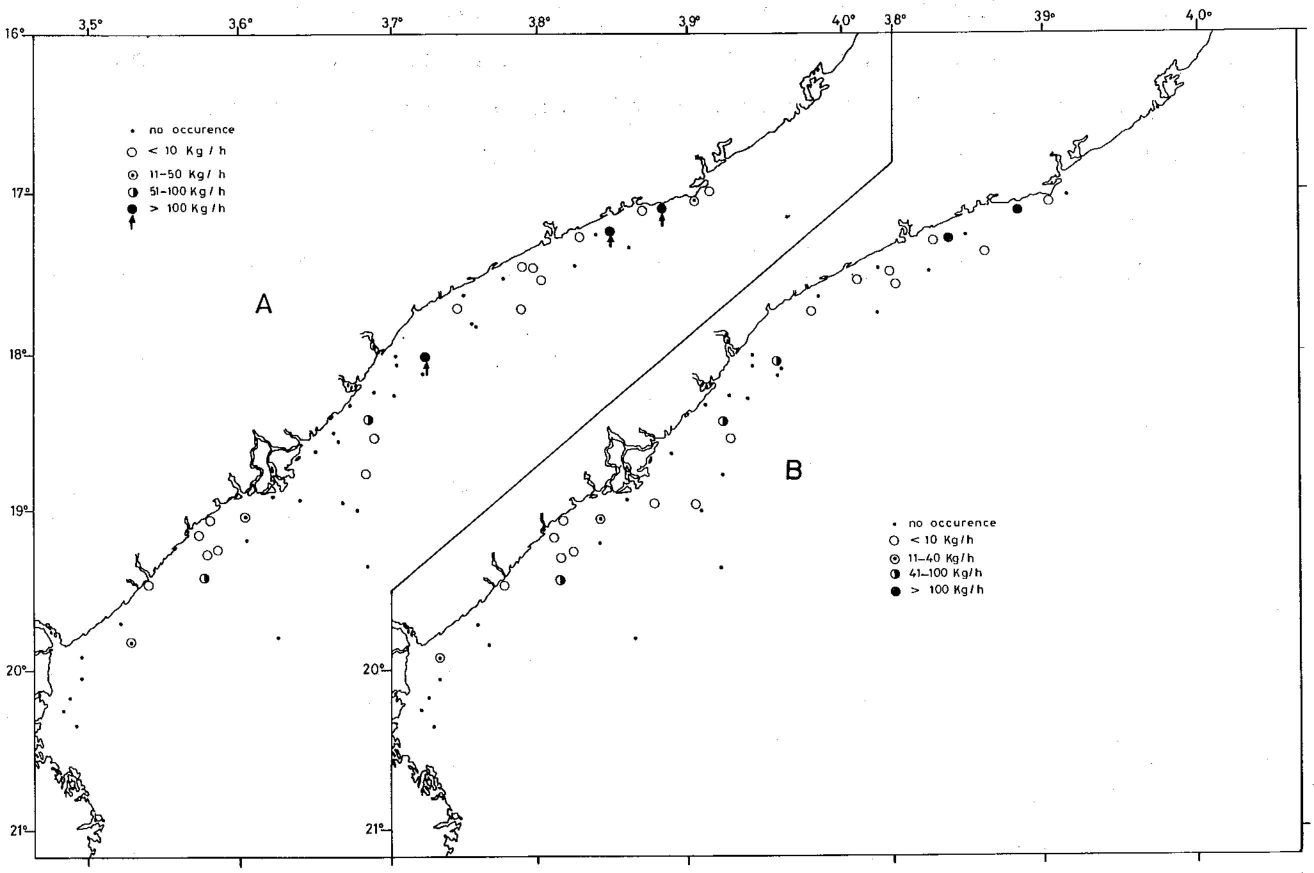

Fig. 24. A - Distribution of family Mullidae (catch/hour).
B - Distribution of Upeneus vittatus (catch/hour).

Three species of this family occurred: U. vittatus, U. bensasi and U. sulphureus. The first one was the most important. Table 11 gives catch composition of the family Mullidae. U. vittatus occurs from Moebase to Machese Beira with best catches in Moebase (137.37 kg) (Fig. 24B). U. bensasi occurs from Moebase

Table 11. Species composition from family Mullidae splitted by species.

Species composition	Ang + Moebase	Quelimane II		Quelimane I		Machese		Beira	Sofala Bank	
	< 25	< 25	> 25	< 25	> 25	< 25	> 25	< 25	< 25	> 25
U. vittatus	137.37	1.66	-	12.64	0.07	10.17	0.24	5.6	27.49	0.46
U. sulphureus	0.02	0.15	-	-	-	0.2	-	-	0.08	-
Others	2.45	-	0.35	0.01	14.53	-	-	0.09	1.36	0.5

to Quelimane I. The catch rates were insignificant.

Synodontidae

This family occurs from Moebase to Machese–Beira with catch rates up to 10 kg/h, excepting two trawl stations, in Quelimane II and Machese at depths of more than 25 meters (Fig. 25A). Three species occurred in this family: Saurida undosquamis, Saurida tumbil and Trachinocephalus myops. Looking at table 12, Saurida undosquamis occurred in all subareas with the best catches in Machese.

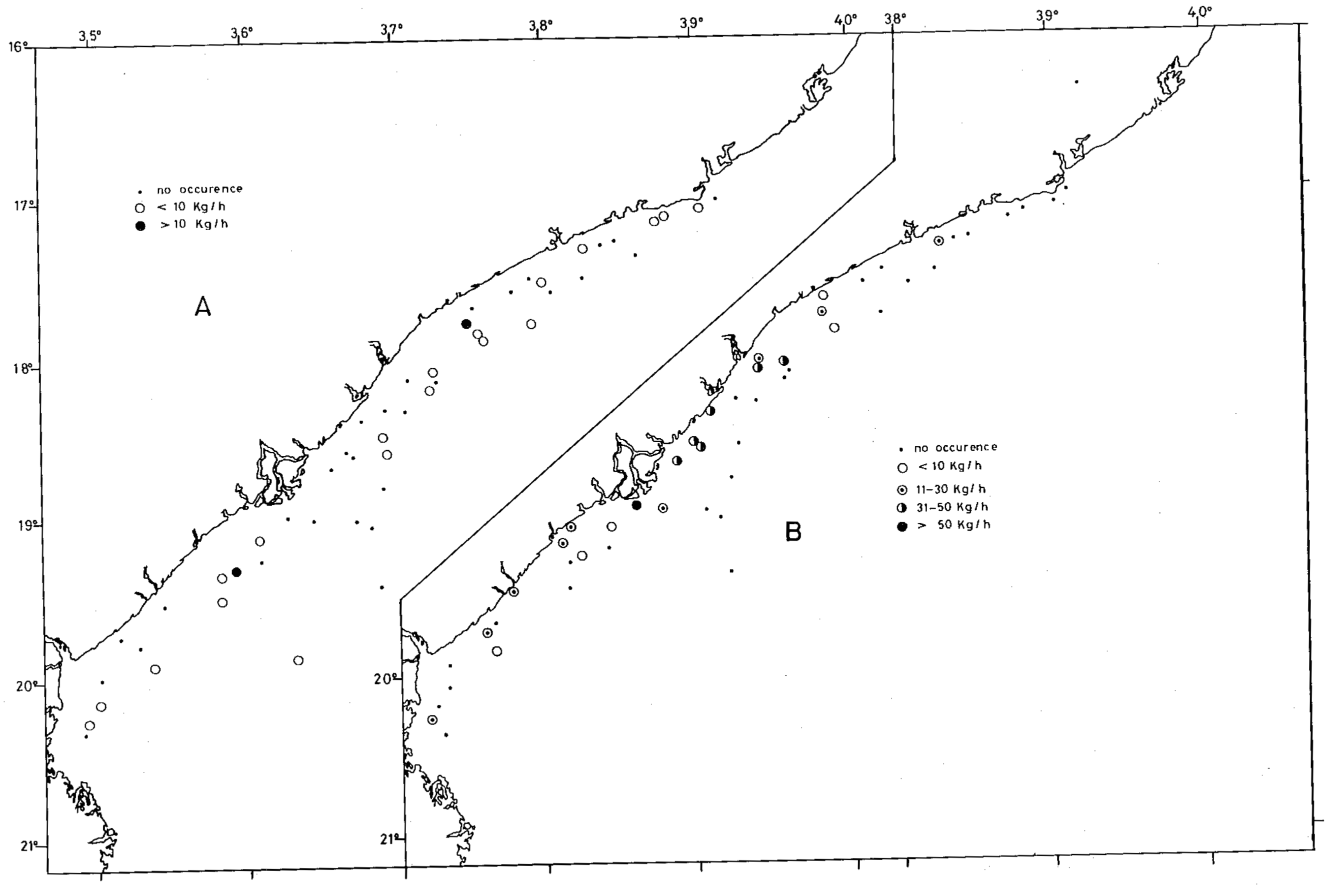

Fig. 25. A - Distribution of family Synodontidae (catch/hour).
B - Distribution of family Trichiuridae (catch/hour).

Table 12. Species composition from family Synodontidae splitted by species.

Species composition	Ang + Moebase	Quelimane II		Quelimane I		Machese		Beira	Sofala Bank	
	<25	<25	>25	<25	>25	<25	>25	<25	<25	>25
S. undosquamis	0.48	0.05	-	0.27	0.32	2.47	-	0.95	0.92	0.1
S. tumbil	0.73	0.85	0.14	1.45	-	0.33	-	-	0.72	0.05
T. myops	0.02	-	0.05	0.001	-	-	-	-	+	0.02

Trichiuridae

This family occurred from Quelimane II to Machese Beira with the best catch rates (11.4–46.0 kg/h) in Quelimane I at 25 meters depth (Fig. 25B).

Polynemidae

This family occurs from Moebase to Machese Beira. Generally the catch rates were less than 10 kg/h (Fig. 26).

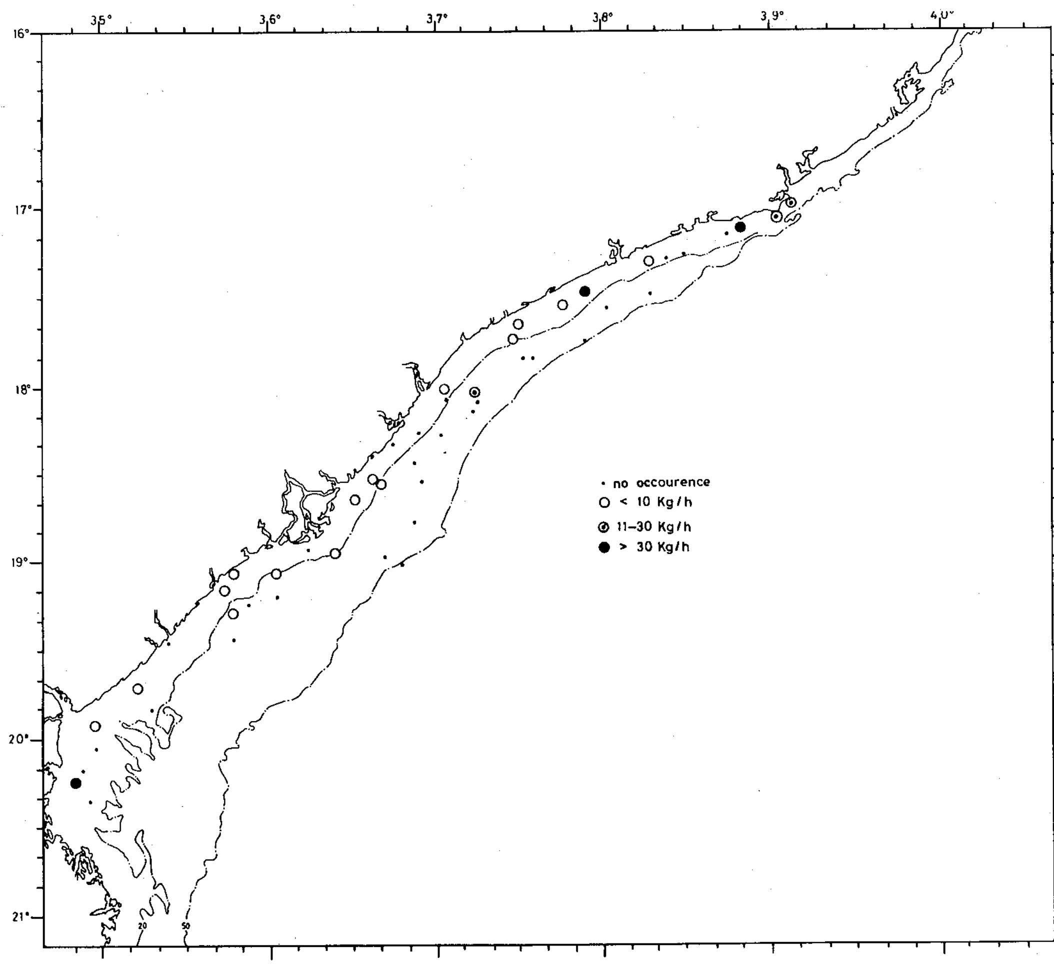

Fig. 26. Distribution of family Polynemidae (catch/hour).

Cynoglossidae

In table 8, it can be seen that best catch rates were found at Quelimane I, in waters shallower than 25 meters.

Theraponidae

Table 8 shows that the best catches per hour of this family were found at Beira at depths lower than 25 meters.

Abundance

A crude estimate for the demersal stock size can be obtained by the "swept area" method. The average catch rate for waters shallower than 25 m was found to be 99.98 kg/h.

The area of this zone is 14502 km^2. The average catch rate for waters deeper than 25 m was found to be 25.32 kg/h. The area of this zone is 3688 km^2. For the calculation of the swept area the following values were considered: horizontal opening of the net 18 meters and trawling speed 2.8 knots. The following table shows the biomass estimates obtained, considering three different values of the efficiency coefficient, q, of the trawl. For a covered area of 18170 km^2, a minimum biomass estimate of 16519 tonnes was obtained (with q = 1) and a maximum estimate of 55.064 tonnes was obtained (with q = 0.3).

Table 13. Calculation of mean biomass using different efficiency coefficient.

q	Mean biomass (tonnes)		
	25 m <	25 m >	Total
0.3	51750	3314	55064
0.5	31050	2000	33050
1	15525	994	16519

Biological characteristics of the main species

Johnius belengerii

Total length range from 4–20 cm ($\overline{LT}$ = 11.32) with most of the individuals (79.87%) being between 7–14 cm. Fig. 27 shows that the mean length varies in the three subareas, and the biggest specimens are found in Machese–Beira. The presence of the smallest individuals in Quelimane I, suggests that this is a recruitment area. The same result was observed in the SEBASTOPOLSKY RYBAK samples (TIMOCHIN, SOUSA et al., 1983).

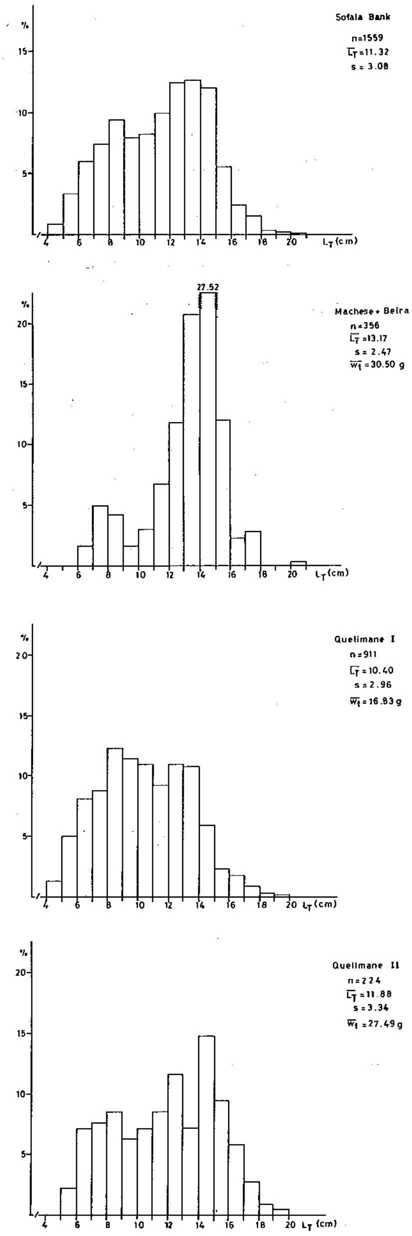

Fig. 27. Length frequency distribution of *J. belengerii*.

The length–weight relationship was studied for females and males and the functional regression was applied (Fig. 28).

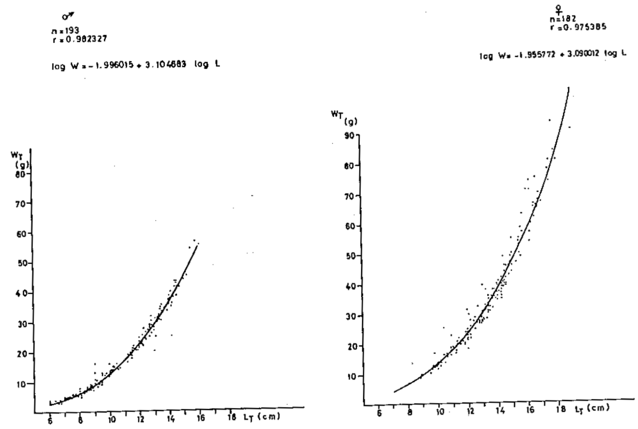

Fig. 28. Length–weight relationship of *J. belengerii*.

The results are as follows:

Females: n = 182

r = 0.975385

log W = −1.955772 + 3.090012 log L

Males: n = 193

r = 0.982327

log W = −1.996015 + 3.104683 log L

At the Sofala bank, females generally were at maturity stages 3 and 4; while males were at stages 2–3 and 4, excepting Quelimane II subarea, where 58.5% were at stage 2 (Table 14). Females were found at spawning in Quelimane I and Machese, and males only in the last subarea.

Table 14. Relative frequencies (%) of maturity stages of *J. belengerii* by subarea.

Subareas \ Maturity Stages	Females									Males						
	Juv	2	2–3	3	3–4	4	5	6–3	n	2	2–3	3	3–4	4	5	n
Quelimane II % (in nº)	8.3	32.8	5.7	20.0	22.9	18.6	–	–	70	58.5	17.1	24.4	–	–	–	41
Quelimane I % (in nº)	2.5	30.0	3.1	22.3	12.9	30.5	1.2	–	256	36.4	12.0	26.7	0.9	24.0	–	217
Machese % (in nº)	4.8	41.7	–	19.4	–	27.8	8.3	2.8	36	44.0	16.7	17.8	–	13.1	8.3	84
Beira % (in nº)	0.8	19.7	3.0	48.5	3.0	25.8	–	–	66	3.2	14.5	66.2	–	16.1	–	62
Total % (in nº)	3.5	29.9	3.3	25.7	11.9	27.6	1.4	0.2	428	35.1	13.9	30.7	0.5	18.1	1.7	404

Gonadosomatic index was estimated for both females and males and the results were:

Females: n = 64
$\overline{GSI}$ = 1.53

Males: n = 36
$\overline{GSI}$ = 0.29

For all subareas the stomach contents were predominantly shrimps, and the maximum frequency of occurrence was 27.3%.

Otolithes ruber

Total length varies from 5–38 cm ($\overline{LT}$ = 19.15) with most of the individuals (54.24%) being between 15–22 cm. The length varies in all subareas, and the biggest specimens were found in Machese–Beira (Fig. 29).

For the same reason as for Johnius belengerii, Quelimane I, seems to be a recruitment area. The same result was observed with S. RYBAK (TIMOCHIN and SOUSA et al., 1983).

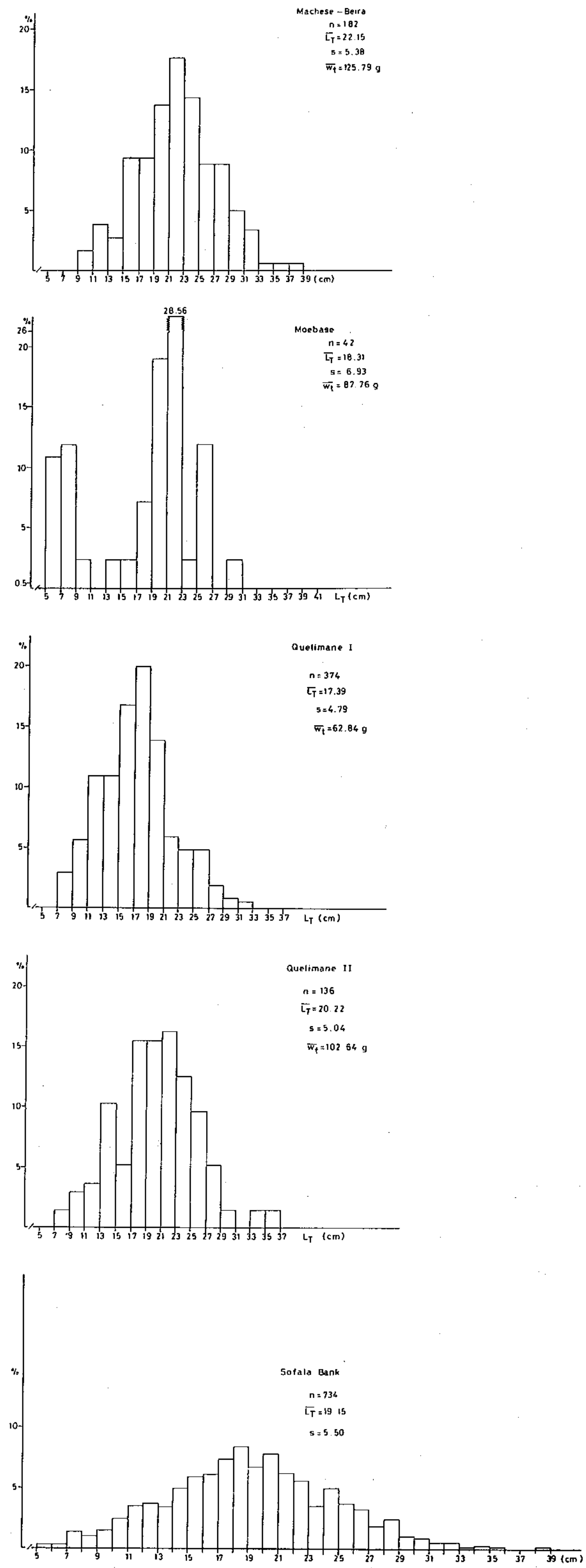

Fig. 29. Length frequency distribution of Otolithes ruber.

The length–weight relationship was studied for females and males (Fig. 30). The equations were:

Females: n = 115
r = 0.934980
log W = -1.971848 + 3.001492 log L

Males: n = 138
r = 0.954251
log W = -2.117650 + 3.101417 log L

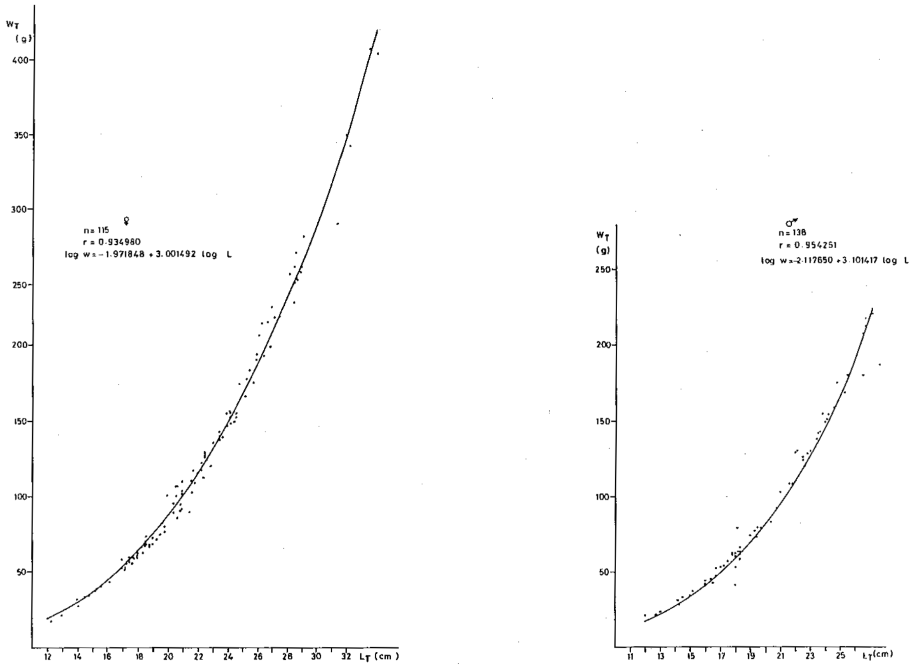

Fig. 30. Length–weight relationship of O. ruber.

Generally, females were at maturity stages 3 and 4, and males at stages 2–3 and 3, excepting Quelimane I and Machese sub-areas, where the major number of specimens (males and females) were at stage 2 (Table 15).

Gonadosomatic index was estimated for males and females.

Females: n = 107
$\overline{GSI}$ = 1.01

Males: n = 91
$\overline{GSI}$ = 0.34

Table 15. Relative frequencies (%) of maturity stages of O. ruber by subarea.

Subareas \ Maturity Stages	Females								Males								
	2	2-3	3	3-4	4	4-5	5	n	2	2-3	3	3-4	4	4-5	5	n	Juv
Moebase (% in n$^{\underline{o}}$)	29.2	12.5	33.3	20.8	4.2	-	-	24	7.2	21.4	35.7	35.7	-	-	-	14	9.5
Quelimane II (% in n$^{\underline{o}}$)	19.7	16.9	38.0	14.1	11.3	-		71	30.0	22.0	36.0	2.0	10.0	-	-	50	11.0
Quelimane I (% in n$^{\underline{o}}$)	59.3	3.6	21.0	3.6	12.0	-	0.6	167	50.9	6.8	17.4	0.6	21.1	-	3.1	161	5.7
Machese (% in n$^{\underline{o}}$)	53.6	-	14.3	-	30.3	-	1.8	56.	43.9	2.4	19.6	-	31.7	-	2.4	41	-
Beira (% in n$^{\underline{o}}$)	2.2	6.7	37.8	13.3	37.8	-	2.2	45	2.5	5.0	32.5	-	55.0	-	5.0	40	-
Total (% in n$^{\underline{o}}$)	41.6	6.6	26.2	7.4	17.4	-	0.8	363	38.2	9.2	23.5	2.3	24.2	-	2.6	306	5.8

Johnius dussumierii

Total length varies from 8–21 cm ($\overline{LT}$ = 14.16) with most of the individuals (73.04% being between 12–16 cm (Fig. 31). The comparison between subareas is not possible as samples are quite different.

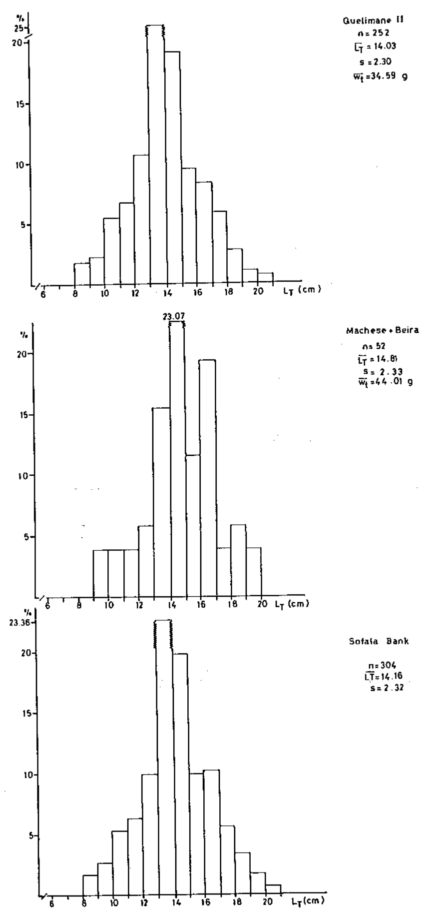

Fig. 31. Length frequency distribution of Johnius dussumierii.

In Quelimane II, both sexes were at maturity stages 2, 3 and 4 but the majority of females (38.4%) and males (53.7%) were at stage 3. In Machese-Beira, both sexes were at stages 2, 3 and 4, however, the majority of females (43.4%) were at stage 4, while males (48.3%) were at stage 3.

Gonadosomatic index was estimated for males and females.

Females: $n = 46$
$\overline{GSI} = 1.13$

Males: $n = 46$
$\overline{GSI} = 0.28$

For Quelimane II and Machese-Beira, the main component of stomach contents is shrimps which has a frequency of occurrence of 12.8 and 36.4% respectively.

<u>Pomadasys maculatus</u>

Total length range from 5-21 cm ($\overline{LT}$ = 12.35), with most of the individuals (79.11%) being between 9-15 cm. In Fig. 32 it can be seen that mean length is more or less similar in all subareas, except in Quelimane I, where the mean length is reduced. It seems that this is a recruitment area for this species. The same situation was found for other species.

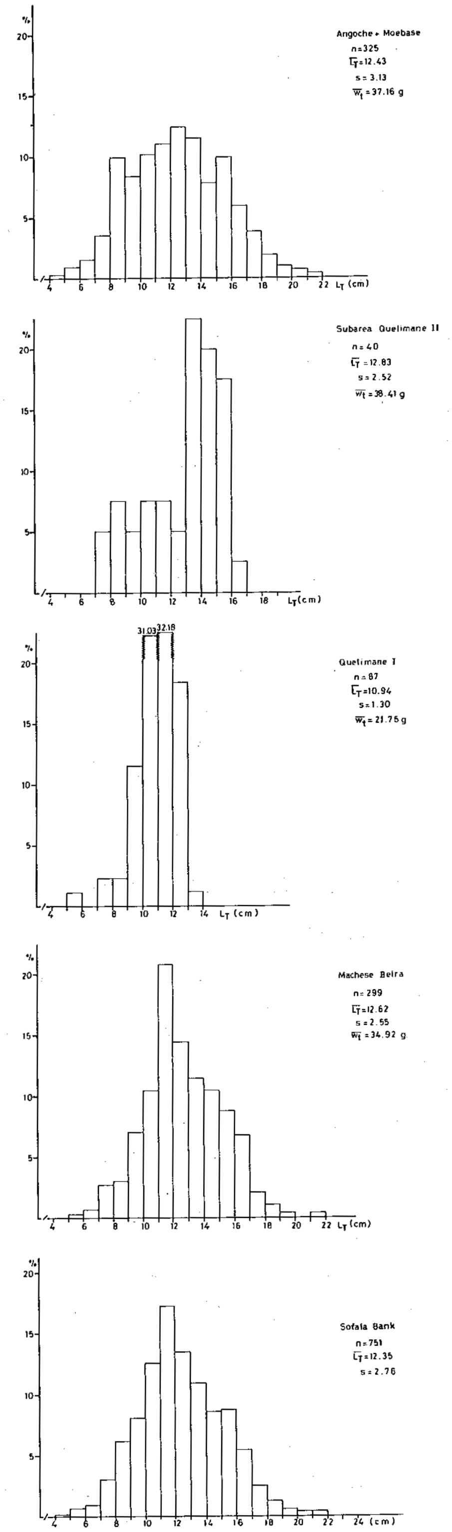

Fig. 32. Length frequency distribution of Pomadasys maculatus.

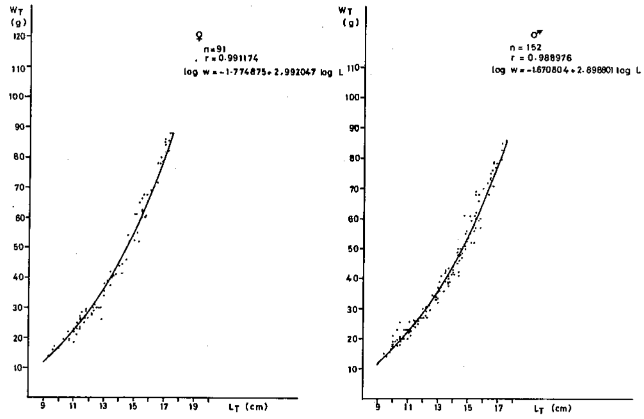

Fig. 33. Length–weight relationship of P. maculatus.

The length–weight relationship was studied for males and females (Fig. 33) the equation follows:

Females: $n = 91$

$r = 0.991174$

$\log W = -1.774875 + 2.992047 \log L$

Males: $n = 152$

$r = 0.988976$

$\log W = -1.670804 + 2.898801 \log L$

Generally for Sofala bank, females were at maturity stage 2. In Quelimane II, however, the majority of the females were at stages 2–3 and 3–4. In Angoche–Moebase and Quelimane I, males were at stage 2, while in Machese–Beira and Quelimane II they were at stages 3 and 4 (Table 16).

Table 16. Relative frequencies (%) of maturity stages of Pomadasys maculatus.

Subareas \ Maturity Stages	Females									Males							
	Juv	2	2–3	3	3–4	4	4–5	5	n	2	2–3	3	3–4	4	4–5	5	n
Angoche + Moebase %(in nº)	13.5	53.3	2.2	20.0	14.1	8.2	1.5	0.7	135	50.0	4.1	21.2	15.8	8.9	-	-	146
Quelimane II %(in nº)	5.0	36.3	18.2	18.2	27.3	–	–	–	11	25.9	11.1	59.3	-	3.7	-	-	27
Quelimane I % (in nº)	9.2	89.2	2.7	8.1	-	–	–	–	37	78.6	-	19.0	2.4	-	-	-	42
Machese+Beira %(in nº)	4.4	54.9	6.2	27.4	1.8	6.2	–	3.5	113	42.5	2.8	26.5	2.8	21.5	-	3.9	181
Total % (in nº)	8.5	57.7	4.4	21.3	8.1	6.1	0.7	1.7	296	48.0	3.5	26.0	7.1	13.6	-	1.8	396

In Machese–Beira, both sexes were at spawning. Gonadosomatic index was estimated for males and females. The results follows:

Females: n = 45
$\overline{GSI}$ = 0.84

Males: n = 59
$\overline{GSI}$ = 0.54

The stomach contents was composed of shrimps and fish with a maximum frequency of occurrence of 17.6 and 10.3% respectively.

Rhonciscus stridens

Total length ranged from 6–16 cm, and the mean length was 12.27 cm (Fig. 34).

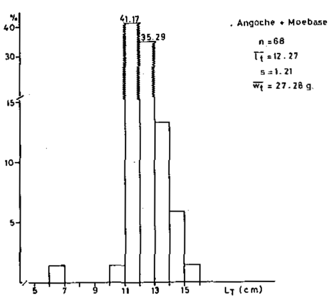

Fig. 34. Length frequency distribution of Rhonciscus stridens.

Females and males were at maturity stages 2, 3 and 4. However, the majority of females (71.8%) were at stage 3, while males (75.9%) were at stage 2 (Table 17).

Table 17. Relative frequencies (%) of maturity stages of Rhonciscus stridens by subarea.

Subareas \ Maturity Stages	Females						Males						
	2	2-3	3	3-4	4	n	2	2-3	3	3-4	4	n	Juv
Angoche +Moebase (% in nº)	28.2	25.6	46.2			39	75.9	6.9	10.4	3.4	3.4	29	1.4

Upeneus vittatus

Total length varies from 7.5–19.0 cm ($\overline{LT}$ = 12.66) with most individuals (70.76%) being between 11.5–13.0 cm. It seems that the mean length decreases from north to south.

The length-weight relationship was studied for males and females (Fig. 36). The equations follows:

Females: n = 192
r = 0.9446
$\log W = -1.888943 + 3.041261 \log L$

Males: n = 178
r = 0.9490
$\log W = -2.177613 + 3.299889 \log L$

In Angoche-Moebase, Quelimane II and Machese-Beira the majority of females were at maturity stages 3 and 4, while males were at stage 2 (Table 18).

In Quelimane I males and females were at spawning. Gonadosomatic index was estimated for females and males.

Females: n = 78
$\overline{GSI} = 0.49$

Males: n = 27
$\overline{GSI} = 0.20$

The main components of the stomach contents were shrimps and fish with the frequency of occurrence of 63.5% (Quelimane II) and 28.4% (Quelimane I) respectively. Other components which occurred were crabs, squids in reduced percentage.

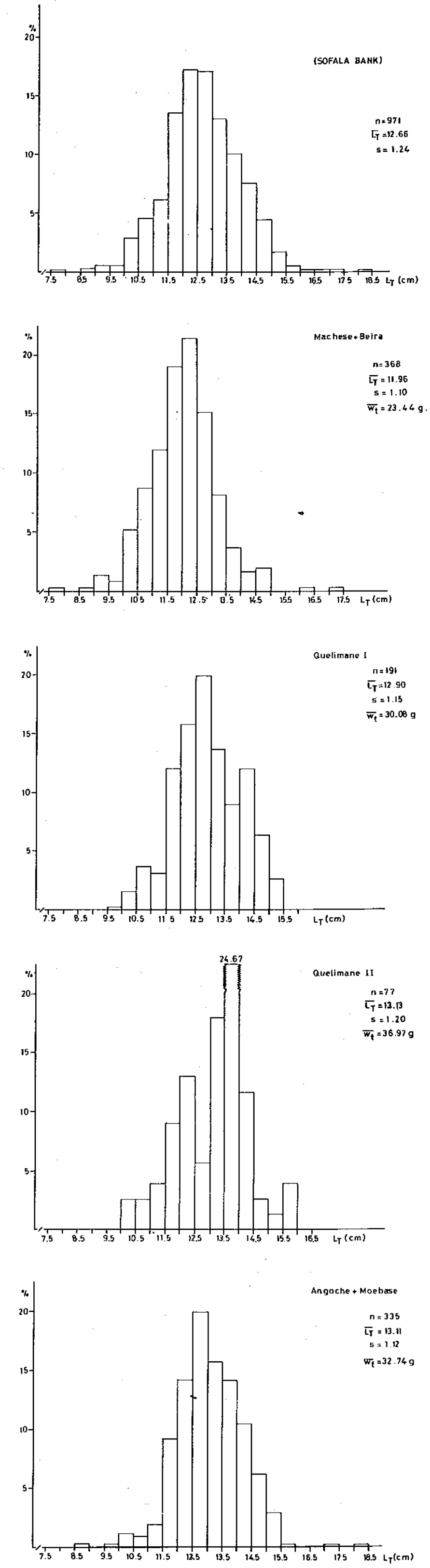

Fig. 35. Length frequency distribution of U. vittatus.

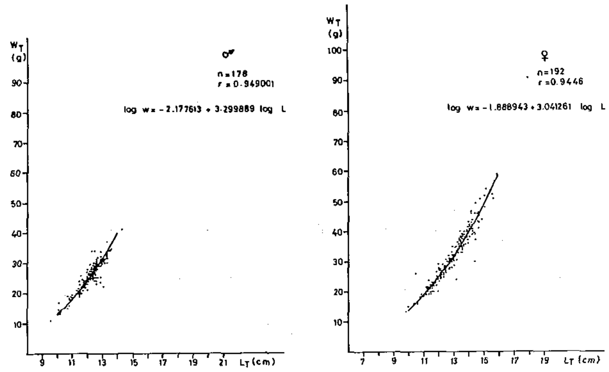

Fig. 36. Length-weight relationship of U. vittatus.

Table 18. Relative frequencies (%) of maturity stages of U. vittatus by subarea.

Subarea \ Maturity Stages	Females									Males							
	Juv	2	2-3	3	3-4	4	4-5	5	n	2	2-3	3	3-4	4	4-5	5	n
Angoche (% in n^o)		31.5	1.1	57.3	2.2	7.9			89	66.7	10.5	22.8					57
Moebase (% in n^o)	1.1	21.0	7.4	37.1	11.1	22.2		1.2	81	43.4	5.7	31.2	8.5	9.4	0.9	0.9	106
Quelimane II (% in n^o)		17.9	6.0	25.4	28.3	20.9	1.5	-	67	66.7	11.1	11.1	-	11.1	-	-	9
Quelimane I (% in n^o)		16.7	27.8	25.9	0.9	22.2		6.5	108	24.1	14.5	32.5	10.9	9.6	-	8.4	83
Machese + Beira (% in n^o)	0.3	39.1	12.0	41.2	-	7.7			233	54.2	8.5	21.1	0.7	14.8	-	0.7	142
Total	0.3	28.7	11.9	38.4	5.4	14.0	0.2	1.4	578	47.1	9.3	26.2	4.8	10.1	0.2	2.3	397

Total length varies from 9.0–16.5 cm and there is no significant variation in mean length for the various subareas (Fig. 37).

Saurida undosquamis

Total length range from 15–30 cm, the mean length being 22.29 cm, (Annex 4).

Polynemidae

Total length varies from 6–20 cm. The major specimens appeared in Quelimane I + Beira (Annex 4).

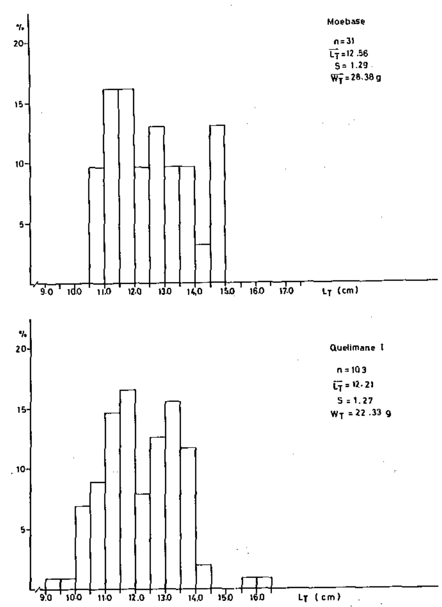

Fig. 37. Length frequency distribution of U. bensasi.

8. SHALLOW-WATER SHRIMP

Objectives and methods

The objective of the present survey was to study the shrimp distribution and to estimate an index of abundance in order to compare with previous estimates.

The methodology applied was the same as during the last survey (BRINCA *et al.*, 1982).

Design of the survey

The design of the present survey was basically the same as the one in the above mentioned report. However, as it was recommended in that report, the main strata were subdivided into smaller strata, keeping the previous boundaries unchanged. Eighteen strata were defined (see Annex 5, table 18).

The stations were allocated using a proportional scheme. Optimum allocation was not used because there is still some doubts concerning the variance of the catches in each stratum. Figs. 38 and 39 shows the strata and the station pattern obtained.

The first four trawl hauls (three from stratum 1 and one from stratum 2) could not be considered because of technical problems with the net. These problems were not solved until station no. 499.

Due to the lack of time, strata 5.2.a, 5.2.b and 7 were not covered.

Indices of abundance

The tables from 19 to 23 and tables from 27 to 29, included in Annex 5, show the individual catch per tow in each stratum, the mean catch per tow, the biomass and the stock size estimates per stratum. The total catch of shrimp and the catch of the main

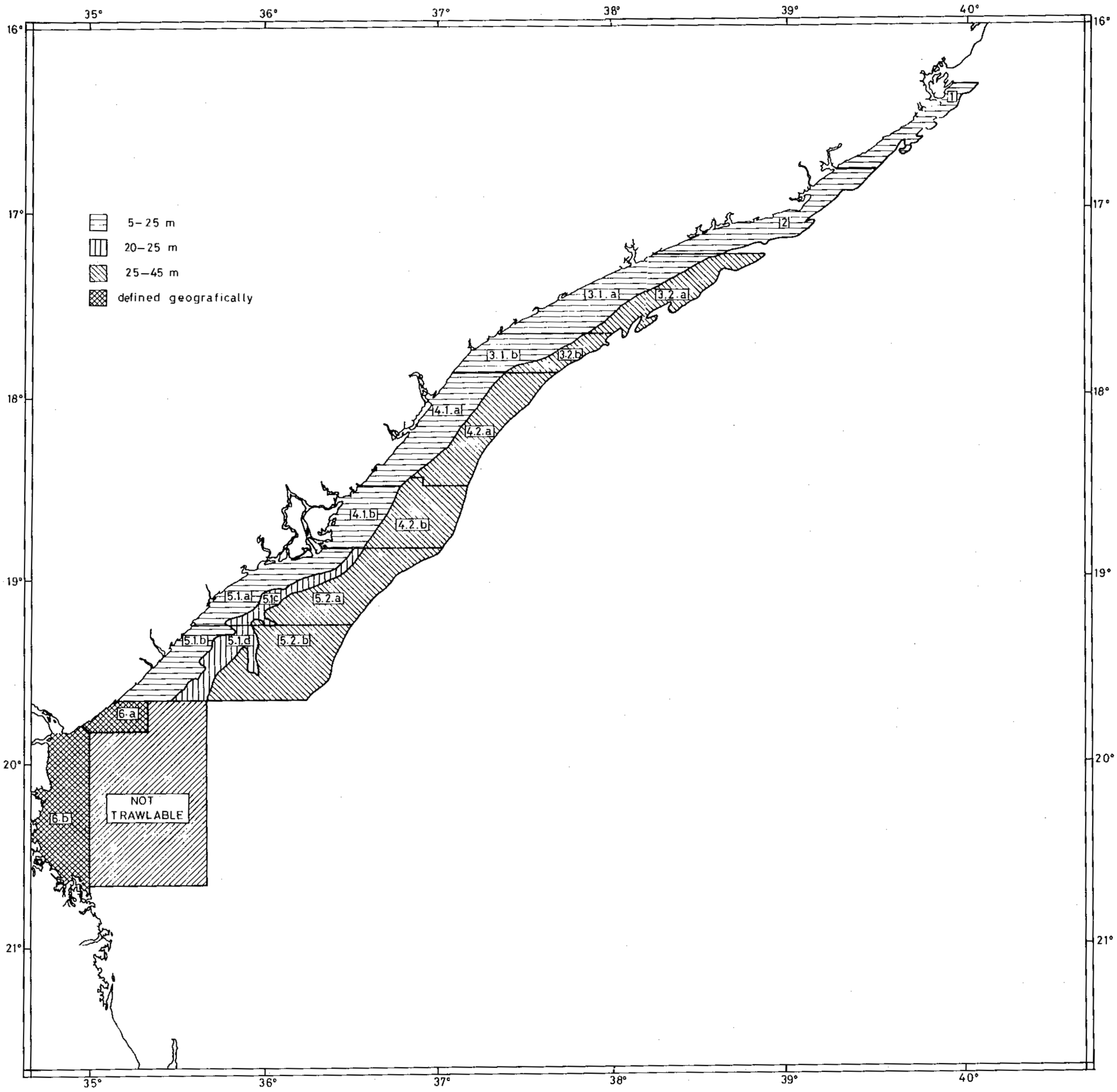

Fig. 38. The stratification scheme for shallow-water shrimp survey.

species, Penaeus indicus and Metapenaeus monoceros was considered.

The problem of constructing valid confidence limits of the mean catch per tow, was not clearly defined in the previous report (BRINCA et al., 1982). Due to this fact, variance per stratum was not calculated in the present report and the stock size was estimated using only the arithmetic mean.

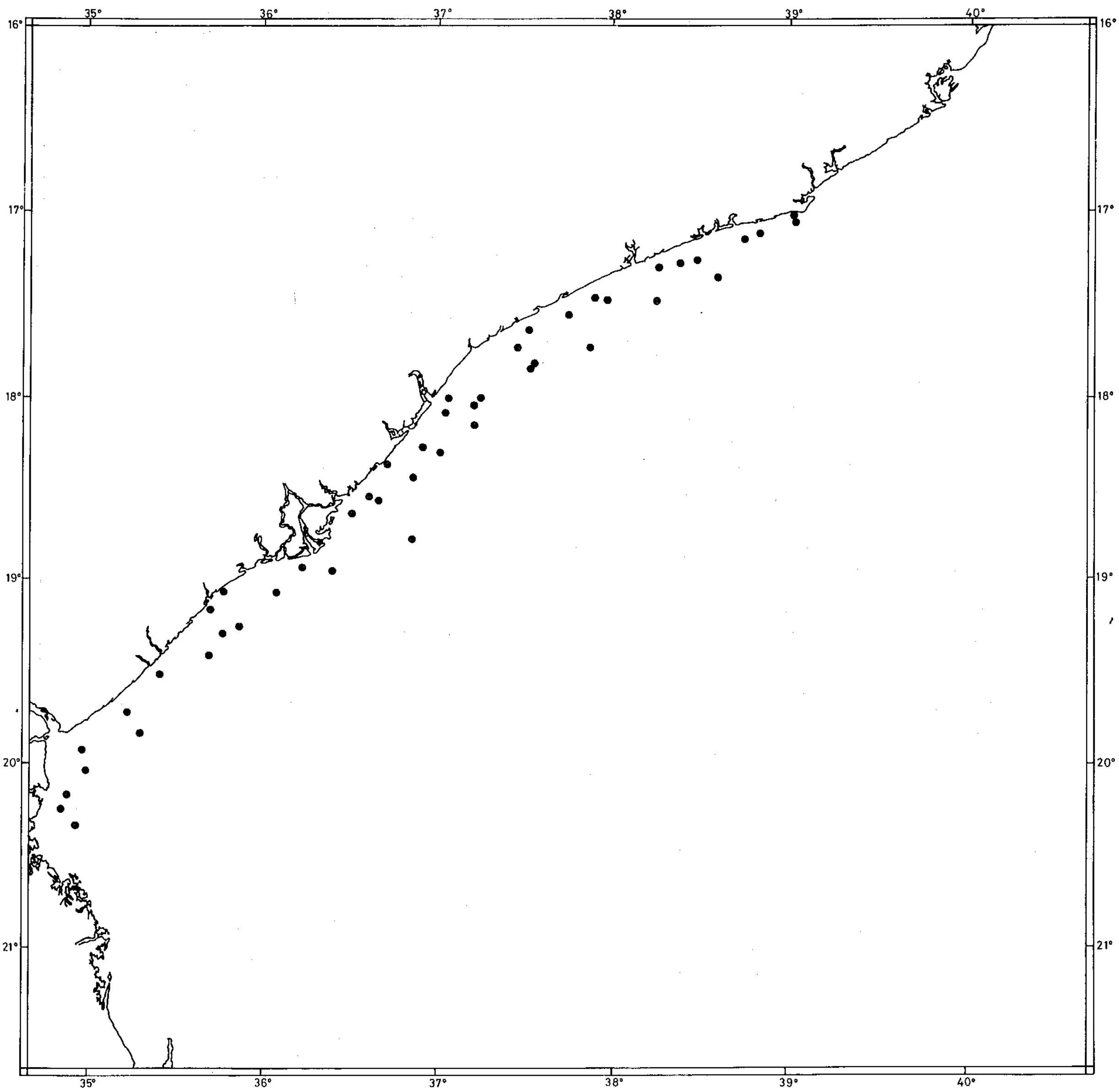

Fig. 39. Station pattern for the shallow-water shrimp survey.

For the computation of the swept area by tow the following values were used:

mean trawling speed - 2.8 knots
horisontal opening of the net - 18 meters

For total shrimp biomass a stratified mean per tow of 5.34 kg was estimated and a mean biomass of 2,077 tons. For the species P. indicus a stratified mean catch per tow of 1.398 gr and 37 individuals was obtained. The biomass was estimated to 544 tons and the stock size as $14x10^6$ individuals. For the species

M. monoceros a stratified mean catch per tow of 764 gr and 61 individuals was obtained. The biomass was estimated to 297 tons and the stock size as 23×10^6 individuals.

Biological characteristics of the main species

Measurements of carapace length were grouped in 2 mm classes. At each station the length composition obtained in the sample was weighted by the total catch of the species, expressed in numbers. Within each stratum the length composition was combined and weighted by the stock size of the stratum.

By combining the length composition of the different strata the overall length composition for the total area covered was obtained. The above mentioned methodology was applied considering the different stages of maturity of females. (The gonad maturity stage just after spawning is referred to as 1 d.)

The total length – total weight relationship was obtained for P. indicus and M. monoceros (females and males separately) applying the functional linear regression to data transformed in logarithms. Due to the scarcity of data these relationship were not calculated per stratum.

Penaeus indicus

a) Females

Carapace length varied between 16 and 52 mm, with most of the individuals (73%) being between 32 and 48 mm (Fig. 40).

Annex 5, table 24 shows that the smallest size occurred in strata 4.1.b and 5.1.a. Annex 5, table 25 shows the percentage of the gonad maturity stages per stratum. For the total area covered, late maturing and mature females constitute 37% of the female population. The highest percentage were found in strata 5.1.c and 6.a.

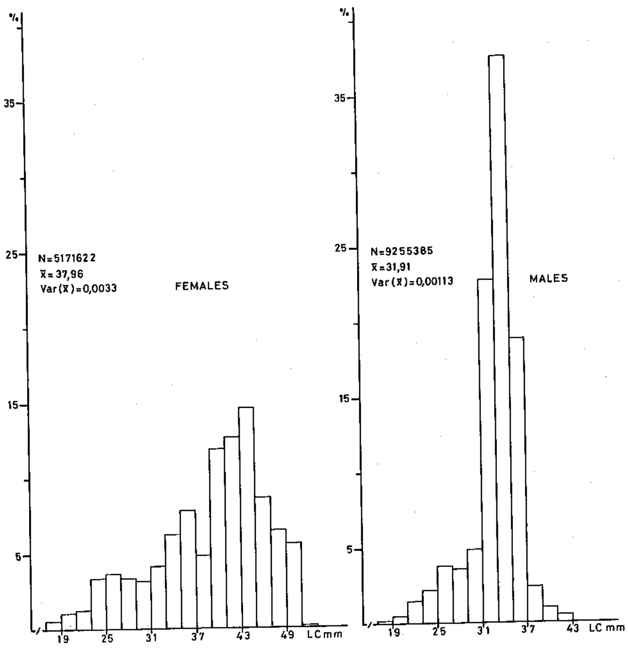

Fig. 40. Penaeus indicus - Carapace length distribution.

Fig. 41 shows the length-weight relationship, expressed by the following equation:

$$\log W = 3.5464 \log LT - 6.3237$$
$$n = 141$$
$$r = 0.9779$$

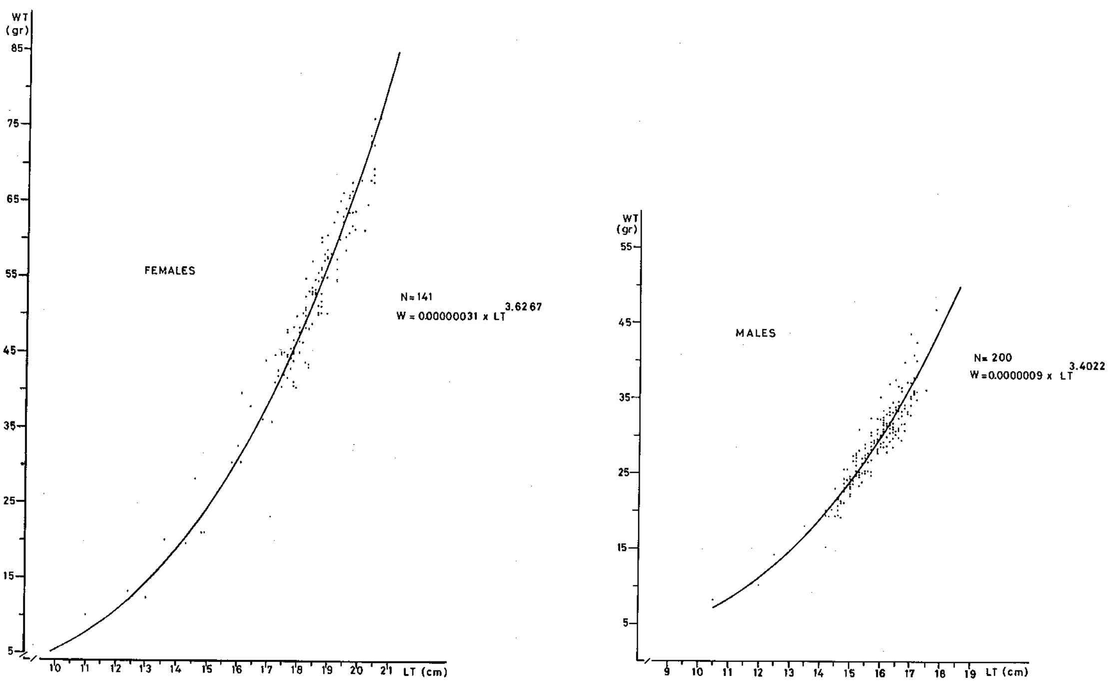

Fig. 41. Penaeus indicus - Length-weight relationship.

b) Males

Carapace length varied between 16 and 42 mm with most of the individuals (79%) being between 30 and 36 mm (Fig. 40). The smallest size occurred in strata 4.1.a, 4.1.b and 5.1.a (see Annex 5, table 26). Fig. 41 shows the length–weight relationship, expressed by the following equation:

$$\log W = 3.2181 \log LT - 5.6205$$
$$n = 200$$
$$r = 0.9459$$

c) Sex - ratio

Sex - ratio was computed and males were dominant (60 to 80%) except in strata 3.1.a and 6.a.

<u>Metapenaeus</u> <u>monoceros</u>

a) Females

Carapace length varied between 12 and 52 mm with most of the individuals (68%) being between 22 and 34 mm (Fig. 42). Annex 5, table 30 shows that the smallest individuals were found in strata 3.1.a, 4.1.a, 4.1.b and 5.1.a.

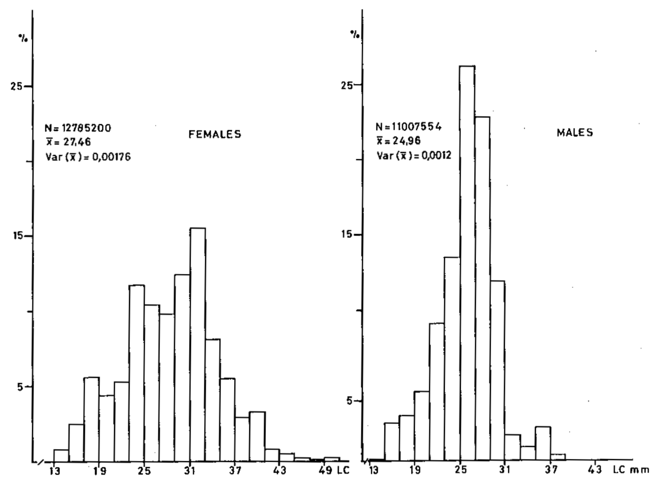

Fig. 42. <u>Metapenaeus</u> <u>monoceros</u>. Carapace length distribution.

Annex 5, table 31 shows the percentage of the different maturity stages per stratum. In general, females seem to be at the early maturity stages, except in the stratum 3.2.b, where the percentage of the late maturing and mature females was higher. For the total area covered, only 4.7% of the female population was formed by late maturing and mature females.

Fig. 43 shows the length–weight relationship, expressed by the following equation:

$$\log W = 3.1441 \log LT - 5.4521$$
$$n = 423$$
$$r = 0.9853$$

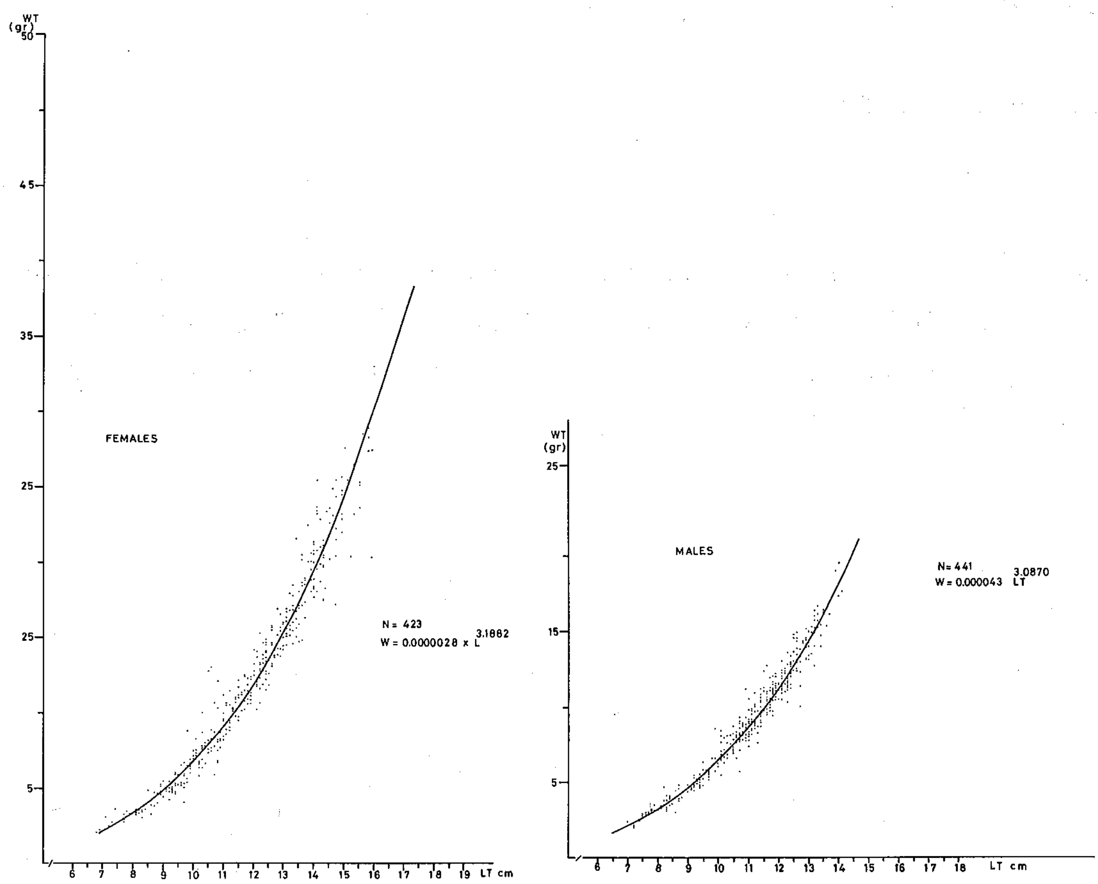

Fig. 43. <u>Metapenaeus monoceros</u>. Length–weight relationship.

b) Males

Carapace length varied between 12 and 44 mm, with most of the individuals (84%) being between 20 and 30 mm (Fig. 42). The smallest size occurred in strata 2, 3.1.a, 4.1.a and 5.1.a (see Annex 5, table 32).

Fig. 43 shows the length-weight relationship, expressed by the following equation:

$$\log W = 3.0285 \log LT = 5.2449$$
$$n = 441$$
$$r = 0.9810$$

c) Sex - ratio

Sex - ratio was calculated and the proportion between males and females was 1:1.

Conclusions and recommendations for future surveys related to the survey design.

1. The stratification scheme applied in this survey seems to be better than the one used during the previous survey (BRINCA et al., 1982). This is particularly evident in stratum 4.1, which was subdivided into two new strata and these showed a significant difference in catch per tow.

2. The subdivision of stratum 5 had also given better results. However, it seems that a new geographic subdivision of stratum 5.1.a into two new strata may improve the results.

Therefore, it is recommended that during future surveys, a new boundary at 19°05'S should be considered for stratum 5.1.a.

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ANNEX 1

RECORD OF FISHING OPERATION

ANNEX I

DATE	TIME START	STN No.	GEAR TYPE	DEPTH (M) BOTTOM	DEPTH (M) GEAR	POSITION NORTH	POSITION EAST	CATCH (KG) TOTAL	CATCH (KG) PR HR	DOMINANT SPECIES	WEIGTH (KG) PR HR	%
29.05	0835	495	BT	10	10	16 28'	039 52'	31,7	63,4	Dussumieria acuta	14,00	22,0
										Alepes djeddaba	10,80	17,0
										Rastrelliger kanagurta	6,30	9,9
										Secutor insidiator	5,60	8,8
29.05	1110	496	BT	11	11	16 37'	039 39'	32,3	64,6	Dussumieria acuta	20,50	31,7
										Rastrelliger kanagurta	5,92	9,1
										Upeneus vittatus	4,44	6,8
										Pomadasys maculatus	3,88	6,0
29.05	1245	497	BT	12	12	16 44'	039 33'	21,4	42,8	S H A R K S	6,20	14,4
										Polynemus sextarius	5,20	12,1
										Scomberomorus lineolatus	4,50	10,5
										Saurida undosquamis	2,60	6,0
29.05	1510	498	BT	16	16	16 52'	039 18'	110,4	220,8	Pomadasys maculatus	73,60	33,3
										Sphyraena obtusata	26,80	12,1
										Upeneus bensasi	19,20	8,6
										Secutor insidiator	18,00	8,1
29.05	1715	499	BT	13	13	17 01'	039 09'	16,8	33,6	Sphyraena obtusata	10,30	30,6
										Chirocentrus dorab	9,26	27,5
										Gerres filamentosus	3,00	8,9
										Rastrelliger kanagurta	2,70	8,0
30.05	0650	500	BT	10	10	17 03'	039 02'	181,8	363,6	Secutor insidiator	61,20	16,8
										Polynemus sextarius	59,40	16,3
										Pomadasys maculatus	28,80	7,9
										Pellona ditchela	24,00	6,6
30.05	0840	501	BT	10	10	17 07'	038 50'	161,3	322,6	Upeneus vittatus	255,00	79,0
										Gerres filamentosus	11,50	3,5
										Secutor insidiator	10,50	3,2
										Rhonciscus stridens	8,50	2,6
30.05	0955	502	BT	11	11	17 08'	038 45'	18,8	37,6	Scomberomorus lineolatus	10,20	27,1
										Scomberoides commersonianus	9,00	23,9
										Caranx armatus	4,70	12,5
										Scomberomorus commersoni	2,80	7,4
30.05	1230	503	BT	37	37	17 21'	039 36'	3,0	6,0	Chysoblephus lophus	2,10	35,0
										Loligo sp	1,00	16,6
										Nemipterus metopias	,66	11,0
										Caranx armatus	,40	6,6
30.05	1415	504	BT	15	15	17 16'	038 29'	402,0	804,0	Upeneus vittatus	565,40	70,3
										Carangoides malabaricus	151,80	18,8
										Alepes djeddaba	30,80	3,8
										Atule mate	24,20	3,0
03.05	1535	505	BT	15	15	17 17'	038 23'	,0	,0	N O C A T C H	,00	,0
31.05	0540	506	BT	11	11	17 18'	038 16'	68,4	136,8	Secutor insidiator	54,00	39,4
										Pellona ditchela	18,40	13,4
										Thryssa vitrirostris	14,20	10,3
										Scomberomorus commersoni	12,20	8,9
31.05	0735	507	BT	27	27	17 28'	038 15'	12,0	24,0	Scomberomorus commersoni	9,44	39,3
										SQUALIDAE	8,16	34,0
										Loligo sp	3,20	13,3
										Scomberoides tol	,90	3,7
31.05	0945	508	BT	13	13	17 29'	037 58'	102,5	205,0	Pellona ditchela	118,20	57,6
										Secutor insidiator	48,00	23,4
										Carangoides malabaricus	19,20	9,3
										Upeneus vittatus	9,00	4,3
31.05	1100	509	BT	8	8	17 28'	037 54'	230,4	921,6	Pellona ditchela	546,00	59,2
										Thryssa vitrirostris	238,00	25,8
										Polynemus sextarius	75,60	8,2
										Secutor insidiator	22,40	2,4
31.05	1315	510	BT	8	8	17 33'	037 46'	55,6	111,2	Pellona ditchela	26,80	24,1
										Johnius dussumieri	23,60	21,2
										Polynemus sextarius	20,80	18,7
										Cynoglossus lingua	6,80	6,1
31.05	1530	511	BT	37	37	17 45'	037 53'	56,7	113,4	Epinephelus sp	31,00	27,3
										Scomberomorus commersoni	26,60	23,4
										Lutjanus sebae	11,60	10,2
										Carangoides malabaricus	11,40	10,0
31.05	1945	512	PT	31	10	17 34'	038 03'	76,7	153,4	Dussumieria acuta	57,40	37,4
										Sardinella sp.	42,00	27,3
										Stolephorus punctifer	15,80	10,2
										Stolephorus indicus	15,00	9,7
01.06	0550	513	BT	10	10	17 39'	037 31'	72,5	145,0	CARIDEA	36,24	24,9
										Johnius belangerii	25,00	17,2
										Otolithes ruber	18,00	12,4
										SQUALIDAE	11,20	7,7
01.06	0720	514	BT	15	15	17 44'	037 27'	156,7	313,4	Otolithes ruber	79,20	25,2
										Formio niger	61,00	19,4
										Trichiurus lepturus	28,06	8,9
										Pomadasys hasta	23,26	7,4

ANNEX 1 (Cont.)

DATE	TIME START	STN No.	GEAR TYPE	DEPTH (M) BOTTOM	DEPTH (M) GEAR	POSITION NORTH	POSITION EAST	CATCH (KG) TOTAL	CATCH (KG) PR HR	DOMINANT SPECIES	WEIGTH (KG) PR HR	%
04.06	1420	535	BT	10	10	18 57'	036 14'	314,0	628,0	Thryssa vitrirostris	216,00	34,3
										Trichiurus lepturus	100,80	16,0
										Pellona ditchela	93,60	14,9
										Sardinella sp.	43,20	6,8
05.06	0815	536	BT	19	19	19 05'	036 03'	120,9	241,8	Pellona ditchela	94,72	39,1
										Thryssa vitrirostris	44,02	18,2
										Secutor insidiator	25,34	10,4
										Upeneus vittatus	18,00	7,4
05.06	1035	537	BT	11	11	19 05'	035 47'	169,8	339,6	Pellona ditchela	192,00	56,5
										Thryssa vitrirostris	55,20	16,2
										Trichiurus lepturus	28,80	8,4
										Secutor insidiator	24,00	7,0
05.06	1210	538	BT	13	13	19 11'	035 43'	57,6	115,2	Pellona ditchela	60,00	52,0
										Trichiurus lepturus	16,00	13,8
										Secutor insidiator	9,00	7,8
										Thryssa vitrirostris	5,00	4,3
05.06	2340	539	PT	73	10	19 23'	036 52'	15,4	30,8	Stolephorus punctifer	30,00	97,4
										Loligo sp	,44	1,4
										Rastrelliger kanagurta	,32	1,0
06.06	0510	540	PT	25	10	19 12'	036 07'	61,7	185,1	Stolephorus punctifer	180,00	97,2
										Rastrelliger kanagurta	2,70	1,4
										Loligo sp	2,10	1,1
06.06	0735	541	BT	21	21	19 16'	035 52'	43,9	87,8	Carangoides malabaricus	17,10	19,4
										Dussumieria acuta	14,70	16,7
										Saurida undosquamis	13,20	15,0
										Therapon jarbua	12,00	13,6
										Upeneus vittatus	9,00	10,2
06.06	0855	542	BT	17	17	19 18'	035 47'	70,2	140,4	Pellona ditchela	99,74	71,0
										Scomberomorus commersoni	11,00	7,8
										Upeneus vittatus	5,86	4,1
										Saurida undosquamis	4,58	3,2
06.06	1050	543	BT	22	22	19 26'	035 42'	86,8	173,6	Upeneus vittatus	64,96	37,4
										Dussumieria acuta	24,00	13,8
										Scomberomorus commersoni	22,20	12,7
										CARIDEA	20,40	11,7
										Carangoides malabaricus	18,00	10,3
06.06	1340	544	BT	12	12	19 32'	035 24'	168,7	337,4	Trichiurus lepturus	74,40	22,0
										Arius dussumierii	39,60	11,7
										Otolithes ruber	32,40	9,6
										Johnius dussumieri	31,20	9,2
06.06	2135	545	PT	65	15	19 49'	036 17'	6,2	12,4	Stolephorus punctifer	11,40	91,9
										Decapterus russelli	,40	3,2
										Loligo sp	,36	2,9
										RASTRELLIGER SP.	,18	1,4
07.06	0820	546	BT	11	11	19 44'	035 14'	554,1	1108,2	Sardinella albella	239,40	21,6
										Pellona ditchela	235,60	21,2
										Thryssa vitrirostris	108,30	9,7
										Sardinella sp.	95,00	8,5
07.06	1010	547	BT	18	18	19 51'	035 18'	49,5	99,0	Atule mate	53,70	54,2
										Scomberomorus commersoni	19,40	19,5
										Carangoides malabaricus	9,00	9,0
										Scomberomorus lineolatus	7,40	7,4
07.06	1300	548	BT	11	11	19 56'	034 58'	205,8	411,6	Secutor insidiator	165,20	40,1
										Leiognathus equulus	57,40	13,9
										Pomadasys maculatus	54,88	13,3
										Upeneus vittatus	39,20	9,5
07.06	1510	549	BT	10	10	20 03'	034 59'	20,9	41,8	Atule mate	27,80	66,5
										Scomberomorus commersoni	11,50	27,5
										Loligo sp	,60	1,4
08.06	0835	550	BT	5	5	20 11'	034 53'	34,0	68,0	Scomberomorus lineolatus	44,00	64,7
										Carangoides sp	7,20	10,5
										Scomberomorus commersoni	4,80	7,0
										Scomberoides tol	2,70	3,9
08.06	0955	551	BT	6	6	20 16'	034 51'	2132,7	4265,4	Sphyraena obtusata	1394,00	32,6
										Pellona ditchela	1271,00	29,7
										Thryssa vitrirostris	352,00	8,2
										Pomadasys maculatus	164,00	3,8
08.06	1225	552	BT	16	16	20 21'	034 56'	8,5	17,0	Scomberomorus commersoni	7,60	44,7
										Scomberomorus lineolatus	5,00	29,4
										Carangoides malabaricus	3,40	20,0
										Atule mate	,50	2,9

ANNEX 1 (Cont.)

DATE	TIME START	STN No.	GEAR TYPE	DEPTH (M) BOTTOM	GEAR	POSITION NORTH	EAST	CATCH (KG) TOTAL	PR HR	DOMINANT SPECIES	WEIGTH (KG) PR HR	%
01.06	0930	515	BT	24	24	17 51'	037 32'	13,1	26,2	Scomberomorus commersoni	4,00	15,2
										Loligo sp	3,70	14,1
										Saurida tumbil	3,40	12,9
										Caranx sexfasciatus	3,10	11,8
01.06	1100	516	BT	20	20	17 50'	037 34'	10,4	20,8	Scomberomorus lineolatus	9,00	43,2
										Scomberomorus commersoni	6,30	30,2
										Loligo sp	3,70	17,7
										Decapterus macrosoma	1,10	5,2
02.06	0010	517	PT	24	24	18 07'	037 14'	41,8	83,6	Stolephorus punctifer	40,80	48,8
										Pellona ditchela	26,40	31,5
										Sphyraena obtusata	8,40	10,0
										Rastrelliger kanagurta	2,40	2,8
02.06	0605	518	BT	8	8	18 02'	037 04'	82,0	164,0	Pellona ditchela	33,00	20,1
										Trichiurus lepturus	21,90	13,3
										CARIDEA	21,30	12,9
										Thryssa vitrirostris	13,20	8,0
02.06	0740	519	BT	12	12	18 06'	037 03'	117,3	234,6	Pellona ditchela	48,00	20,4
										Thryssa vitrirostris	47,50	20,2
										Trichiurus lepturus	46,00	19,6
										Otolithes ruber	14,00	5,9
02.06	0955	520	BT	26	26	18 03'	037 13'	837,0	1674,0	Pellona ditchela	1032,00	61,6
										Thryssa vitrirostris	208,00	12,4
										Upeneus vittatus	84,00	5,0
										Secutor insidiator	68,00	4,0
02.06	1110	521	BT	30	30	18 01'	037 15'	,0	,0	N O C A T C H	,00	,0
02.06	1600	522	BT	25	25	18 10'	037 13'	4,5	9,0	Atule mate	3,40	37,7
										Carangoides malabaricus	1,80	20,0
										Carangoides fulivitatus	1,34	14,8
										Loligo sp	1,00	11,1
02.06	2320	523	PT	28	8	18 34'	036 55'	265,4	530,8	Stolephorus punctifer	480,00	90,4
										Decapterus russelli	30,40	5,7
03.06	0600	524	BT	8	8	18 23'	036 43'	189,0	378,0	Sardinella sp.	71,40	18,8
										Pellona ditchela	70,00	18,5
										Formio niger	46,00	12,1
										Megalaspis cordyla	45,50	12,0
03.06	0800	525	BT	19	19	18 17'	036 55'	79,0	158,0	Pellona ditchela	54,24	34,3
										Thryssa vitrirostris	46,32	29,3
										Stolephorus punctifer	31,20	19,7
										Trichiurus lepturus	11,40	7,2
03.06	0920	526	BT	24	24	18 18'	037 01'	29,0	58,0	Mobula diabolus	41,40	71,3
										Scomberomorus commersoni	10,00	17,2
										Alepes djeddaba	4,40	7,5
										Decapterus russelli	1,64	2,8
03.06	1115	527	BT	23	23	18 27'	037 32'	62,9	125,8	Upeneus vittatus	55,00	43,7
										Carangoides malabaricus	31,50	25,0
										Megalaspis cordyla	16,50	13,1
										Secutor insidiator	4,56	3,6
03.06	1405	528	BT	31	31	18 47'	036 52'	28,2	56,4	Lutjanus sanguineus	20,80	36,8
										Lethrinus miniatus	14,60	25,8
										Argyrops filamentosus	10,60	18,7
										Upeneus bensasi	3,60	6,3
03.06	2005	529	PT	36	10	19 01'	036 48'	275,1	550,2	Pellona ditchela	395,76	71,9
										Stolephorus punctifer	127,52	23,1
										Sardinella sirm	9,24	1,6
										Formio niger	7,40	1,3
03.06	2135	530	PT	34	20	18 59'	036 42'	262,3	524,6	Stolephorus punctifer	488,00	93,0
										Thryssa vitrirostris	11,20	2,1
										Atule mate	8,00	1,5
										Sphyraena obtusata	5,60	1,0
04.06	0555	531	BT	17	17	18 35'	036 40'	137,7	275,4	Thryssa vitrirostris	71,60	25,9
										Pellona ditchela	65,50	23,7
										Trichiurus lepturus	46,00	16,7
										CARIDEA	16,56	6,0
04.06	0720	532	BT	12	12	18 34'	036 38'	224,5	449,0	Johnius belangerii	108,80	24,2
										CARIDEA	83,20	18,5
										Pellona ditchela	57,60	12,8
										Otolithes ruber	48,00	10,6
04.06	0910	533	BT	7	7	18 39'	036 31'	148,4	296,8	Johnius belangerii	57,40	19,3
										Trichiurus lepturus	40,40	13,6
										CARIDEA	56,00	18,8
										Pellona ditchela	36,40	12,2
04.06	1220	534	BT	19	19	18 58'	036 24'	176,4	352,8	Pellona ditchela	221,20	62,6
										Thryssa vitrirostris	53,20	15,0
										Secutor insidiator	33,60	9,5
										Trichiurus lepturus	14,00	3,9

ANNEX 2

ANCHOVY - Stolephorus spp.

- Total Length frequency distributions

  and maturity stages

Table 1. ANCHOVY - Total lenght frequency distributions by stations

Species	Gear	Station nº \ Class Mark	2.75	3.25	3.75	4.25	4.75	5.25	5.75	6.25	6.75	7.25	7.75	8.25	8.75	9.25	9.75	Total number
Stolephorus punctifer/ heterolobus	Pelagic Trawl	517	1	3	3	5	1			1	4	10	26	26	25	1		103
		523								2	4	19	26	18	26	5		100
		529							1	11	23	15	36	6	7		1	100
		539										4	37	56	11	2		110
		540							1		3	5	17	55	18			99
		545							3	17	28	12						60
	Bottom Trawl	525											23	28	37	11		99
		541					1	8	47	40	9	2	1					108
		550							2	2	1	28	45	23	5			106
Species A	Bottom Trawl	536								57	81							138
		550				1	13	49	57	8	1							129

Species	Gear	Station nº \ Class Mark	13.75	14.25	14.75	15.25	15.75	16.25	Total number
S. indicus	Pelagic Trawl	512	1	10	51	64	13	1	140

Table 2. ANCHOVY - Maturity Stages

Stages	State	Description
Juvenile	Immature	Testes: Small transparent, colourless to grey Ovaries: Glassy transparent, compact wall and small volume. Eggs not visible with the naked eye, but under the microscope they are glassy transparent, polygonal, curved to one another.
2	Mature virgin	Testes: Small, transparent reddish grey colour. Ovaries: Translucent, of reddish to reddish grey colour, walls compact, volume solid and readily recognized. Under microscope the eggs are polygonal.
3	Developing stage	Testes: Longer opaque, non-transparent, white in colour, wall compact, if pressed white milt runs out slowly. Ovaries: Opaque orange to reddish white, wall richly vascularized. Contents very compact, but loose spherical translucent eggs present.
4	Mature	Testes: Translucent creamy white. Milts runs out with slight pressure. Walls loose and soft. Ovaries: Translucent, reddish, some orange in colour. Ovaries filled with loose eggs which run out with slight pressure. All eggs are glassy transparent.
5	Spent	Testes: Much shorter in length, dark grey to reddish grey with loose walls, and rich in blood vessels. No milts runs out when pressed. Ovaries: Transparent, dark red, walls very loose with numerous folds, very much shorter and bloody. Lots of solid materials, but only with few eggs, sometimes already quite similar to stage 2.

ANNEX 3

SMALL PELAGIC FISH

Size distribution of fish examined and Maturity stages of *D. russellii* and *R. kanagurta*

Size distribution of small pelagic fish examined

		Length Classes, cm																																																
	St. Nr.	4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		19		20		21		22		23		24		25		26		27		28		n
			5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5	
CARANGIDAE																																																				
Decapterus	504																										4	5	7	-	-	-	1																			17
russellii	521																								1	2	4	3																								10
	523														1	-	-	-	-	4	8	11	3	2	7	20	12	8	14	4	5	1																				100
	526																								1	1	2	2	3	5	1	2	1																			18
	547															1	-	-	2	1	1	2	4	1	5	3	3	2	1	-	-	-	-	1																		27
Carangoides	495																					1	-	2	8	6	2	2																								21
malabaricus	496															1	-	-	-	-	1	-	-	4	1	14	3	5	3																							32
	497																				1	-	-	-	2	4	3	2	2	-	1																					15
	501																								1	1	-	3	4	1																						10
	502																								2	1	1	1	1	-	-	-	1																			7
	504																						2	6	10	18	9	8	3	6	5	9	6	4	4	2	-	-	1	-	-	1										94
	508														1	-	-	-	-	-	-	-	6	6	10	8	6	4	7	7	3	1																				59
	511																											1	1	1	3	8	8	8	8	4																42
	527																	2	1	-	2	10	24	22	22	5	3	4																								95
	543																1	1	-	-	-	1	1	5	5	1	1	5	2	1	2	2	2	1																		31
	547															1	-	2	4	6	8	6	3	4	3	2	3	-	-	1	4	5	4	4	2	1	1															64
	548														1	-	7	10	6	-	1	1	-	2	4	2	-	1	1	2	1	-	1																			40
Selar crumenophthalmus	528														1	-	4	4	5	-	2	-	2	1	1	2																										22

Length Classes, cm

	St. Nr.	4		5		6		7		8		9		10		11		12		13	
			5		5		5		5		5		5		5		5		5		5
CLUPEIDAE																					
Pellona	495			6	2	2	3	20	18	4	2	4	-	-	4	2	5	15	4	7	7
ditchela	496			1	2	5	22	27	21	5	4	3	3	1	1	1	3	1	2	1	2
	498			1	4	-	1	-	3	2	3	1	1								
	500				1	1	9	11	18	4	11	4	2	-	6	5	8	12	10	14	2
	506							2	3	-	1	1	-	2	1	10	12	13	10	19	11
	508															2	3	8	12	15	15
	509																1	4	5	5	5
	510															1	2	5	5	8	5
	513																				
	517											5	7	8	12	10	10	13	9	6	6
	519																			1	-
	524																				
	525							2	2	1	3	-	-	2	8	11	8	19	15	8	7
	531										1	-	-	1	1	1	6	2	3	8	5
	532																				1
	534									2	2	3	2	4	3	6	3	8	4	8	5
	536						2	7	14	9	43	15	2	2	3	1	-	1			
	535														2	1	1	-	-	-	3
	538											1	7	5	4	8	6	5	4	5	3
	546							1	-	-	1	1	1	-	2	1	-	-	-	-	-
Dussumieria	496																				2
acuta	512																				
	541																1	10	23	29	20

St. Nr.	14		15		16		17		18		19		20		21		22		23		24		25		26		27		28		n
		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5	
495	2	1																													108
496																															105
498																															16
500	-	2	1	2	5	-	2	1																							131
506	8	5	5	2	1	1																									107
508	12	9	4	4	5	5	3	3																							100
509	12	8	14	16	16	8	7	7																							108
510	6	7	7	8	14	13	12	5	2																						100
513						1	7	4	4	3	1	1																			21
517	7	4	1	3	2																										103
519	-	4	4	17	23	25	9	10	3																						96
524			1	1	4	13	16	8	2	1																					46
525	1	1	1	1	2																										92
531	5	4	13	13	15	7	6	5	1																						97
532	-	5	10	13	18	20	16	12	4	1	1																				101
534	4	3	10	7	10	7	2	1																							94
536																															99
535	3	2	3	7	10	7	3																								42
538	6	11	12	13	8	1	1																								100
546	-	1	4	1	5	14	9	5	1	-	1																				48
496	8	15	25	26	21	7	1																								105
512	2	21	38	35	14	5	3																								118
541	13	1	3	1																											101

	St. Nr.	Length Classes, cm																																																		n
		4	5	5	5	6	5	7	5	8	5	9	5	10	5	11	5	12	5	13	5	14	5	15	5	16	5	17	5	18	5	19	5	20	5	21	5	22	5	23	5	24	5	25	5	26	5	27	5	28	5	
ENGRAULIDAE																																																				
<u>Thryssa</u>	496					1	9	13	15	9	6	8	4	4	2	-	-	-	2	1	-	2	-	-	3	2	-	-	-	1																						84
<u>vitrirostris</u>	500						3	2	20	9	18	12	14	5	6	6	5	-	5	3	1	-	3	1	4	-	1																									118
	506					1	10	4	9	6	4	4	7	1	3	3	4	7	4	1	4	1	1	-	-	3																										77
	509											1	3	-	-	-	-	-	-	-	3	8	11	18	15	18	12	9	2	1	1																					102
	510						4	9	17	17	12	8	4	2	6	4	3	4	-	1	2	1	2	2	-	-	-	1	3	1																						103
	519					1	6	3	5	6	5	4	4	-	2	1	-	2	3	5	4	6	11	7	7	5	8	3	1	2	1	-	1	1	2																	106
	525									5	10	17	14	14	10	8	7	6	5	3	3	3	2	1																												108
	531					1	2	3	6	1	7	1	6	2	6	2	3	2	7	3	9	6	6	6	7	5	5	4	8	1																						109
	532				9	7	12	5	12	6	5	3	2	2	-	1	1	-	-	-	3	1	5	5	3	2	7	-	2	-	-	2	2	3																		100
	534							2	1	-	-	2	-	6	-	7	3	13	14	14	12	10	7	5	1	4	1																									102
	536	1	-	-	2	1	9	9	3	11	16	5	6	5	4	4	3	2	3	-	9	2	5	2	4	2	1	-	1																							110
	538					2	-	3	4	11	10	4	4	5	2	-	4	4	6	6	11	8	6	2	5	2	3	1	1																							104
	546										5	2	-	1	-	-	1	-	-	2	7	9	14	5	2	-	-	3																								51
LEIOGNATHIDAE																																																				
<u>Leiognathus</u>	500								5	1	2	5	14	9	12	8	8	2	2	-	-	-	-	-	1	-	-	-	-	-	1	-	-	1																		71
<u>equulus</u>	501											1	1	3	9	5	7	1	2	1	2																															32
	546														1	-	-	4	4	6	4	4	7	7	5	2	2	1	4	1	-	2																				54
	548																2	6	9	15	21	16	11	5	4	6	3	1	2	1	-	1	-	1																		104
	551															2	4	4	3	3	1	-	1	-	1																											19

		Length Classes, cm																																																	
	St. Nr.	4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		19		20		21		22		23		24		25		26		27		28		n
			5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5		5	
Secutor	495							1	1	-	4	18	42	22	10	8																																				106
insidiator	496							2	4	10	10	34	24	16	8	6	2																																			116
	498								1	-	1	10	25	28	25	10	3																																			103
	500											3	6	28	35	23	8	1																																		104
	506									1	6	12	27	21	22	9	1	-	1																																	100
	508								1	1	4	21	34	21	10	1	2	1	1																																	97
	509									1	4	15	20	7	10	2	1																																			60
	520									1	-	7	29	16	7	5	2																																			67
	527					1	-	-	1	-	-	3	10	13	8	17	14	7																																		74
	534								15	36	29	10	4	5																																						99
	536							8	25	11	16	5	19	1	5	5	4																																			99
	537								2	3	7	13	29	18	12	12	5																																			101
	538									3	7	15	31	20	11	9	3	1																																		100
	546										1	2	1	9	12	14	20	7	4	1																																71
	548										1	3	8	19	27	26	12	5																																		101
	551											1	-	-	3	7	9																																			20
SCOMBRIDAE																																																						
Rastrelliger	501																												1	-	-	1	-	1	-	-	1															4
kanagurta	504																													1	-	-	4	7	12	5	6	4	3	1	1											44
	509																										1	-	-	1	1	6																				9
	521													2	2	6	4	4	-	-	-	-	-	1	3	2	2	-	-	-	-	1																				27
	523													2	-	4	10	14	5	2	1	-	2	-	1	2	4	3																								50
	524																								1	1	-	-	-	1	1	-	-	1	3	1	2	5	1	-	2											19
	531																									1	-	1	-	-	-	1	1	-	-	1																5
	535																														1	3	-	1	1																	6
	536																																			1	1															2

TABLE 2 . Maturity stages of D. russellii and R. kanagurta

SPECIES	St. Nr.	FEMALES							MALES						
		I	II	III	IV	V	VI	n	I	II	III	IV	V	VI	n
Decapterus russellii	504		1	4		3		8			5	3	1		9
	521		2			2		4		2	3	1			6
	523		1	11	15	7		44			4	10	2		16
	526			1		4	2	7				2	9		11
	547		7	10	2	3	1	23		2	1				3
Rastrelliger kanagurta	501		3				1	4							
	504		3			15		18		3			17	4	24
	509		3				2	5		2	1		1		4
	521		6					6		3					3
	523	10	4					14	28	8					36
	524		2	2	2	7	1	14				1	4		5
	531		2	1				3					2		2
	535			1				1		3	1		1		5
	536			2				2							

ANNEX 4

DEMERSAL FISH

- Length frequency distribution and scale of maturity stages

Table 1. - DEMERSAL FISH - Length frequency distributions of <u>Saurida undosquamis</u> and <u>Polynemus sextarius</u>

DEMERSAL FISHES

		6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	N	$\bar{L}$	s^2
Saurida undosquamis	Sub. Total										1	2	1	4	5	17	18	26	12	14	2	5	1	1	1		110	22.3	5.62
Polynemus sextarius	Angoche + Moebase	3	23	10	31	32	28	8	2	2	12	11	2	2	1												167	10.9	10.19
	Quelimane I + Beira			9	11	12	16	4	1	3	4	7	3														70	11.8	7.41
	Quelimane II	1	15	22	56	22	34	3	1																		154	9.8	1.81

Table 2. . DEMERSAL FISH . Scale of maturity stages

Stages	State	Description
Juvenile	Immature	The gonads are slender, transparent. The colour is yellow to rose. Generally, it is difficult to determine the sex of the specimen at naked eye.
2	Mature virgin	Ovaries transparent. Blood vessels can be seen in the ovary wall. Ova small and not visible to naked eye. Testis are translucent, slender and round. The colour is rose pale or grey.
3	Ripening	Development of ovaries. Ovocytes translucent,the colour of ovaries range from yellow to orange. Ovary wale with several blood vessels. Ovocytes visibles to naked eye and yellow to orange. Testis are rose-grey and developped occupying about $\frac{1}{2}$ of ventral cavity. No milt produced under pressure, excepting in last phase of this stage where it is possible to see some spermatozoons.
4	Ripe	Ovaries round. Occupying $\frac{1}{3}$ of ventral cavity. The colour varies from species to species. In majority of cases are orange-red. Ovocytes translucent, which can be separate easily, and the size varies. Females in stage 4 to 5, presents the gonads with minimum weight and ovocytes transparent. End of spermatogenesis. Spermatic channels with mature spermatozoons, which are released with a notch.
5	Spent	Ovocytes transparent which are released by pressure of the abdomen. The rupture is synchronous. By pressing the abdomen,sperm is released. Testis are whitish and flabby. The size decrease, because of sperm release.
6	Recovering spent	Ovaries bloodshot, flabby and light. The cavity of ovary is big and contain remnants of disintegrating opaque and ripe ova, darkened or translucent which are adherent to the ovary walls. External sexual opening is big. Testis are slender and flabby. The colour is rise pale to bloodshot.

Remark: In case of doubt or if the specimen is in a intermediate stage, the stages 2-3, 3-4 or 4-5 are used.

ANNEX 5

SHALLOW WATER SHRIMP

Design of the survey and worksheet for the computation

Table 1. - Design of the survey

Strata definition

Based on strata definition of the last survey and on their recommendations (Brinca et all 1982) the 6 sub-areas had been subdivided in eighteen new strata.

Sub-area	Stratum	Geographic Limits	Depth boundaries
1	1	16°20' - 16°47'5	5 - 20 m
2	2	16°47'5 - 17°15'	5 - 20 m
3	3.1.a 3.2.a	17°15' - 17°40'	5 - 25 m
	3.1.b 3.2.b	17°40' - 17°52'5	25 - 45 m
4	4.1.a 4.2.a	17°52'5 - 18°30'	5 - 25 m
	4.1.b 4.2.b	18°30' - 18°50'	25 - 45 m
5	5.1.a 5.1.c 5.2.a	18°50' - 19°15'	5 - 20 m 20 - 25 m 25 - 45 m
	5.1.b 5.1.d 5.2.b	19°15' - 19°40'	5 - 20 m 20 - 25 m 25 - 45 m
6	6.a 6.b	19°40' - 19°50' 19°50' - 21°00'	West of 35°40'

Table 2. - Worksheet for the computation of the mean catch per tow for the total catch of shrimp

	STRATUM ESTIMATES														
	2	3				4				5				6	
		3.1.a	3.1.b	3.2.a	3.2.b	4.1.a	4.1.b	4.2.a	4.2.b	5.1.a	5.1.b	5.2.a	5.2.b	6.a	6.b
Individual catches/tow (Kg)	0 5,215 0.130 0,020	2,075 0 0.370 0.125 0.740 3.145 25.50	5.570 0	0 0,050	0.050 0.775	14.860 13,240 7.510 0,425 0,030	15.555 47.830 39.440	1.990 0	0 0	20,630 5.180 2,040	0,120 10,200	1.250 0,420	0.300 10,940	35.995 0,170	0 0 0 0
Nº Hauls	4	7	2	2	2	5	3	2	2	3	2	2	2	2	4
$\bar{y}_h$ (kg)	1,341	4.565	2,785	0,025	0,4125	7,213	34.308	0.995	0	9.283	5.160	0.835	5.620	18,083	0

$\bar{y}_{st} = 5,34$

Table 3. - Worksheet for the computation of total shrimp biomass (in weight)
Swept area by tow = 1.4 x 1.852 x 0.018 Km^2

	STRATUM ESTIMATES															
	2	3				4				5				6		Total
		3.1.a	3.1.b	3.2.a	3.2.b	4.1.a	4.1.b	4.2.a	4.2.b	5.1.a	5.1.b	5.1.c	5.1.d	6.a	6.b	
$\bar{y}_h$ (Kg)	1,341	4,565	2,785	0,025	0.4125	7,213	34,308	0.995	0	9,283	5.16	0.835	5.62	18.083	0	5.34
A_h (Km^2)	1454	1753	1049	1063	458	1612	1070	2576	1091	1180	1173	789	1060	518	1324	18170
$\bar{B}_h$ (Ton)	41.8	171.4	62.6	0,57	4,0	249.0	786.1	54,9	0	234,5	129.6	14.1	127.6	200.6	0	2077

Table 4. - Worksheet for the computation of *P. indicus* biomass (in weight)

a) Basic data

	STRATA														
	2	3				4				5				6	
		3.1.a	3.1.b	3.2.a	3.2.b	4.1.a	4.1.b	4.2.a	4.2.b	5.1.a	5.1.b	5.1.c	5.1.d	6.a	6.b
Individual Catches/tow (Kg)	0	0	0.950	0	0	2.550	1.950	1.315	0	9.920	0	1.170	0	35.500	0
	0.015	0	0	0	0	0.990	2.770	0	0	4.580	0	0.270	0.650	0	0
	0	0				3.700	7.000			1.220					0
	0	0				0.100									0
		0				0									
		0.950													
		0.530													

b) Results

	Stratum Estimates															
	2	3				4				5				6		Total
		3.1.a	3.1.b	3.2.a	3.2.b	4.1.a	4.1.b	4.2.a	4.2.b	5.1.a	5.1.b	5.1.c	5.1.d	6.a	6.b	
$\bar{y}_h$ (Kg)	0.003	0.211	0.475	0	0	1.468	3.906	0.657	0	5.240	0	0.720	0.325	17.750	0	1.398
A_h (Km^2)	1454	1753	1049	1063	458	1612	1070	2576	1091	1180	1173	789	1060	518	1324	18170
$\bar{B}_h$ (ton)	0.09	7.9	10.7	0	0	50.7	89.5	36.2	0	132.4	0	12.2	7.4	196.9	0	544

Table 5. - Worksheet for the computation of <u>P. indicus</u> stock size ♀ + ♂

a) Basic data

	Strata														
	2	3				4				5				6	
		3.1.a	3.1.b	3.2.a	3.2.b	4.1.a	4.1.b	4.2.a	4.2.b	5.1.a	5.1.b	5.1.c	5.1.d	6.a	6.b
Individual Catches/tow (nº)	0	0	31	0	0	99	84	0	0	186	0	35	0	784	0
	0	0	0	0	0	45	105	0	0	186	0	7	17	0	0
	2	0				129	258			40					0
	0	0				5									0
		0				0									
		50													
		21													

b) Results

	Stratum estimates															Total
	2	3				4				5				6		
		3.1.a	3.1.b	3.2.a	3.2.b	4.1.a	4.1.b	4.2.a	4.2.b	5.1.a	5.1.b	5.1.c	5.1.d	6.a	6.b	
$\bar{y}_h$ (nº)	0,5	10,1	15.5	0	0	55.6	149.0	0	0	137.3	0	21.0	8.5	392	0	37.1
A_h (Km^2)	1454	1753	1049	1063	458	1612	1070	2576	1091	1180	1173	789	1060	518	1324	18170
S x 10^3 (nº)	15,6	380,6	348,2	0	0	1919.2	3413.9	0	0	3469.3	0	354.8	192.9	4348,1	0	14 442.6

Table 6. - Worksheet for the computation of P. indicus ♀ stock size

a) Basic data

	Strata														
	2	3				4				5				6	
		3.1.a	3.1.b	3.2.a	3.2.b	4.1.a	4.1.b	4.2.a	4.2.b	5.1.a	5.1.b	5.1.c	5.1.d	6.a	6.b
Individual Catches/tow (n° ♀)	0	0	10	0	0	14	19	0	0	47	0	11	0	472	0
	0	0	0	0	0	15	14	0	0	60	0	3	7	0	0
	2	0				18	39			24					0
	0	0				2									0
		0				0									
		36													
		11													

b) Results

	Stratum estimates															
	2	3				4				5				6		Total
		3.1.a	3.1.b	3.2.a	3.2.b	4.1.a	4.1.b	4.2.a	4.2.b	5.1.a	5.1.b	5.1.c	5.1.d	6.a	6.b	
$\bar{y}_h$ (n° ♀)	0.5	6.7	5	0	0	9,8	24,0	0	0	43.7	0	7	3.5	236	0	13.3
A_h (Km^2)	1454	1753	1049	1063	458	1612	1070	2576	1091	1180	1173	789	1060	518	1324	18170
$S \times 10^3$ (n° ♀)	15,6	251.5	112.3	0	0	338.3	549.9	0	0	1104.2	0	118.2	79.4	2617.7	0	5187.2

Table 7. - <u>P. indicus</u> ♀ - Estimates of stock size (in number) splitted by length group and by stratum

a) Length frequency distribution by stratum

Strata	Class mark																		Total number	$\bar{x}$	$s_{\bar{x}}$
	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51			
3.1.a					1	2	3	2	6	7	7	13	2	4					47	36.0	0.65
3.1.b								1	2	2	3	1		1					10	36.0	1.09
4.1.a				3	3	2	5	2	6	7	9	4	5	1	1			1	49	34.3	0.87
4.1.b	3	5	1	8	5	10	6	3	9	15		2		2	3				72	29.6	0.82
5.1.a	1	2	7	11	15	8	8	18	14	11	11	13	2	1	3	2	4		131	31.7	0.63
5.1.c						1		1		1	2	4	2	3					14	38.1	1.24
5.1.d											1	1	1	2	1	1			7	42.7	1.30
6.a									8	15		61	102	116	69	55	46		472	43.0	0.16

b) Data weighted by total n° of each stratum

Strata	Class mark																		Total number
	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	
3.1.a					5.3	10.8	16.1	10.8	32.2	37.2	37.2	69.7	10.8	21.4					251.5
3.1.b								11.2	22.5	22.5	33.7	11.2		11.2					112.3
4.1.a				20.6	20.6	13.9	34.5	13.9	41.3	48.4	62.2	28.1	34.5	6.8	6.8			6.8	338.3
4.1.b	23.1	37.9	7.7	61.0	37.9	76.4	45.6	23.1	68.7	114.4		15.4		15.4	23.1				549.9
5.1.a	8.8	16.6	57.4	92.8	128.1	67.4	67.4	151.3	118.1	92.8	92.8	109.3	16.6	8.8	25.4	16.6	34.2		1104.2
5.1.c						8.4		8.4		8.4	16.9	33.8	16.9	25.4					118.3
5.1.d											11.4	11.4	11.4	22.6	11.4	11.4			79.4
6.a									44.5	83.8		337.7	565.4	641.3	382.2	306.3	256.5		2617.7
Total number	31.9	54.5	65.1	174.4	191.9	176.9	163.6	218.7	327.3	407.4	254.2	616.6	655.6	753.0	448.8	334.2	290.8	6.8	5171.6
%	0.6	1.1	1.3	3.4	3.7	3.4	3.2	4.2	6.3	7.9	4.9	11.9	12.7	14.6	8.7	6.5	5.6	0.1	

Total number in the bottom line and in the last column do not coincide with the sums of the values for the original values were divided by 10^3 in order to allow a better reading of the table.

Table 8. - P. indicus ♀ - Estimates of stock size (in number) splitted by maturity stages and by stratum

a) Percentages of maturity stages by stratum (calculated by weigthing each sample by the total number of each station and combining the results by stratum)

Maturity Stages \ Strata	3.1.a	3.1.b	4.1.a	4.1.b	5.1.a	5.1.c	5.1.d	6.a
1	26.1	60.0	54.2	78.9	63.3	7.1	14.3	22.9
2	10.9	20.0	18.8	9.9	8.4	-		15.0
3	26.1		6.2	-	8.4	28.6	14.3	42.2
4	21.6		2.1	4.2	4.6	21.4		16.5
5	10.9		6.2	-	4.6	28.6	28.5	1.7
1d	4.4	20.0	12.5	7.0	10.7	14.3	42.9	1.7
Total number sampled	46	10	48	71	131	14	7	472

b) Data weigthed by total number of each stratum

Maturity Stages \ Strata	3.1.a	3.1.b	4.1.a	4.1.b	5.1.a	5.1.c	5.1.d	6.a	Total number
1	65.6	67.4	183.3	433.9	699.0	8.4	11.4	599.5	2062.4
2	27.4	22.5	63.6	54.4	92.8			392.7	653.3
3	65.6		21.0		92.8	33.8	11.4	1104.7	1329.2
4	54.3		7.1	23.1	50.8	25.3		431.9	592.6
5	27.4		21.0		50.8	33.8	22.6	44.5	200.1
1 d	11.1	22.5	42.3	38.5	118.1	16.9	34.1	44.5	327.9
S x 10^3	251,5	112.3	338.3	549.9	1104.2	118.3	79.4	2617.7	5171.6

Total number in the bottom line and in the last column do not coincide with the sums of the values for the original values were divided by 10^3 in order to allow a better reading of the table.

Table 9. - P. indicus ♂ - Estimates of stock size (in number) splitted by length groups and by stratum

a) Length frequency distribution by stratum

Strata	Class mark														Total number	$\bar{x}$	$s_{\bar{x}}$
	17	19	21	23	25	27	29	31	33	35	37	39	41	43			
3.1.a					1	1	3	11	8						24	30.9	0.42
3.1.b							1	8	10	1			1		21	30.6	0.52
4.1.a		1	5	4	3	7	13	67	96	26	5	2			229	31.8	0.20
4.1.b		1	9	5	10	12	19	110	143	56	2	8			375	31.8	0.17
5.1.a	2	4	4	16	29	22	21	54	71	42	14	2			281	30.3	0.26
5.1.c				1	1	1	1	3	12	8	1				28	32.4	0.60
5.1.d								1	5	3	1				10	33.8	0.53
6.a								30	145	123	7		7		312	33.9	0.10

b) Data weighted by total number of each stratum

Strata	Class mark													Total number
	17	19	21	23	25	27	29	31	33	35	37	39	41	
3.1.a					5.4	5.4	16.1	59.1	43.0					129.1
3.1.b							11.3	89.9	112.0	11.3			11.3	235.9
4.1.a		6.3	34.8	20.6	20.6	42.7	91.7	469.5	671.9	173.9	34.8	14.2		1580.9
4.1.b		8.6	68.7	37.2	77.3	91.6	146.1	839.2	1091.2	426.7	14.3	63.0		2864.0
5.1.a	16.6	33.1	33.1	134.8	243.6	184.5	177.4	454.1	598.4	354.8	118.3	16.6		2365.1
5.1.c				8.5	8.5	8.5	8.5	24.8	101.5	67.6	8.5			236.5
5.1.d								11.3	56.7	34.0	11.3			113.5
6.a								166.1	806.4	681.8	38.1	-	38.1	1730.4
Total number	16.6	48.0	136.6	201.1	355.4	332.7	451.1	2114.1	3481.1	1750.2	225.3	93.8	49.4	9255.4
%	0.2	0.5	1.5	2.2	3.8	3.6	4.9	22.8	37.6	18.9	2.4	1.0	0.5	

Total number in the bottom line and in the last column do not coincide with sums of the values for the original values were divided by 10^3 in order to allow a better reading of the table.

Table 10. - Worksheet for the computation of M. monoceros biomass (in weight)

a) Basic data

	STRATA														
	2	3				4				5				6	
		3.1.a	3.1.b	3.2.a	3.2.b	4.1.a	4.1.b	4.2.a	4.2.b	5.1.a	5.1.b	5.1.c	5.1.d	6.a	6.b
Individual Catches/tow (Kg)	0	2,060	0,470	0	0	0,190	5.900	0,630	0	6,900	0	0	0	0.480	0
	2.950	0	0	0,020	0.650	5.750	3.250	0	0	0.410	0	0.130	0,090	0	0
	0.120	0,320				0,820	2,500			0,730					0
	0	0,125				0,275									0
		0,740				0									
		1,670													
		2,000													

b) Results

	Stratum Estimates															
	2	3				4				5				6		Total
		3.1.a	3.1.b	3.2.a	3.2.b	4.1.a	4.1.b	4.2.a	4.2.b	5.1.a	5.1.b	5.1.c	5.1.d	6.a	6.b	
$\bar{y}_h$ (Kg)	0.77	0,987	0,235	0,010	0,325	1,407	3,883	0.32	0	2,580	0	0.065	0.045	0.240	0	0.764
A_h (Km^2)	1454	1753	1049	1063	458	1612	1070	2576	1091	1180	1173	789	1060	518	1324	18170
$\bar{B}_h$ (ton)	24.0	37.1	5.3	0.2	3.2	48.6	89.0	17.7	0	67.7	0	1.1	1.0	2.7	0	297.4

Table 11. - Worksheet for the computation of M. monoceros stock size ♀ + ♂

a) Basic data

	Strata														
	2	3				4				5				6	
		3.1.a	3.1.b	3.2.a	3.2.b	4.1.a	4.1.b	4.2.a	4.2.b	5.1.a	5.1.b	5.1.c	5.1.d	6.a	6.b
Individual Catches/tow (n^{o})		193	28	0	0	18	648	0	0	276	0	0	0	25	0
	0	0	0	1	32	503	446	0	0	41	0	7	6	0	0
	389	30				53	172			32					0
	9	14				30									0
	0	56				0									
		107													
		193													

b) Results

	Stratum estimates															
	2	3				4				5				6		Total
		3.1.a	3.1.b	3.2.a	3.2.b	4.1.a	4.1.b	4.2.a	4.2.b	5.1.a	5.1.b	5.1.c	5.1.d	6.a	6.b	
$\bar{y}_h$ (n^{o})	99.5	84.7	14	0	16	120.8	422	0	0	116.3	0	3.5	3	12.5	0	61.2
A_h (Km^2)	1454	1753	1049	1063	458	1612	1070	2576	1090	1180	1173	789	1060	518	1324	18170
$S \times 10^3$ (n^{o})	3097.9	3179.4	314.5	0	156.9	4169.8	9669.0	0	0	2939.4	0	59.1	68.1	138.7	0	23792.7

Table 12 - Worksheet for the computation of <u>M. monoceros</u> ♀ stock size

a) Basic data

	Strata														
	2	3				4				5				6	
		3.1.a	3.1.b	3.2.a	3.2.b	4.1.a	4.1.b	4.2.a	4.2.b	5.1.a	5.1.b	5.1.c	5.1.d	6.a	6.b
Individual Catches/tow (nº)	0	115	20	0	0	10	336	0	0	121	0	0	0	9	0
	187	0	0	0	19	324	232	0	0	21	0	2	1	0	0
	8	10				32	105			18					
	0	8				14									
		28				0									
		55													
		112													

b) Results

	Stratum estimates															
	2	3				4				5				6		Total
		3.1.a	3.1.b	3.2.a	3.2.b	4.1.a	4.1.b	4.2.a	4.2.b	5.1.a	5.1.b	5.1.c	5.1.d	6.a	6.b	
$\bar{y}_h$ (nº)	48.8	46.9	10.0	0	9.5	76.0	224.3	0	0	53.3	0	1.0	0.5	4.5	0	32.86
A_h (Km^2)	1454	1753	1049	1063	458	1612	1070	2576	1091	1180	1173	789	1060	518	1324	18170
S x 10^3	1519.3	1760.5	224.6	0	93.2	2623.4	5139.2	0	0	1346.8	0	16.9	11.3	49.9	0	12785.2

Table 13 - M. monoceros ♀ - Estimates of stock size (in number) splitted by lenght groups and by stratum

a) Lenght frequency distribution by stratum

Strata	Class mark																				Total number	$\bar{x}$	$s_{\bar{x}}$
	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51			
2		4	22	16	13	19	4	16	34	32	18	5	4	8							195	26.6	0.45
3.1.a	3	23	34	23	19	34	43	26	32	30	29	8	9	7	3	4	1				328	25.6	0.38
3.1.b					1	1	2	4	2	4		3	2		1						20	30.2	1.16
3.2.b						2		1	2	3	2	1	4	2	2						19	33.3	1.26
4.1.a	2	1	8	5	22	45	69	56	51	25	20	24	13	28	5	5	1				380	28.4	0.31
4.1.b	9	10	28	35	29	90	62	42	95	137	54	45	19	10	2			2		4	673	27.6	0.24
5.1.a		10	10	1	11	17	11	27	4	33	21	9	1	3	1						159	26.9	0.48
5.1.c								1								1					2	35.0	8.00
5.1.d													1								1	-	-
6.a							1		2	1				2	1		2				9	35.9	2.50

b) Data weighted by total number of each stratum

Strata	Class mark																			Total number
	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	
2		30.4	171.7	124.6	101.8	147.4	31.9	124.6	264.4	249.2	139.8	39.5	31.9	62.3						1519.3
3.1.a	15.9	123.2	183.1	123.2	102.1	183.1	230.6	139.1	172.5	163.7	154.9	42.3	47.5	37.0	15.8	21.1	5.3			1760.5
3.1.b					11.2	11.2	22.5	44.9	22.5	44.9		33.7	22.5		11.2					224.6
3.2.b						9.8		4.9	9.8	14.7	9.8	4.9	19.7	9.8	9.8					93.2
4.1.a	13.1	7.9	55.1	34.1	152.2	309.6	477.5	385.6	351.5	173.1	139.0	165.3	89.2	194.1	34.1	34.1	7.9			2623.4
4.1.b	66.8	77.1	215.9	267.2	221.0	688.7	472.8	318.6	724.6	1048.4	411.1	344.3	143.9	77.1	15.4			15.4	30.8	5139.2
5.1.a	8.1	84.8	84.8	9.4	91.6	142.8	91.6	227.6	33.7	277.4	176.4	75.4	9.4	25.6	8.1					1346.8
5.1.c								8.4								8.4				16.9
5.1.d													11.3							11.3
6.a							5.6		11.1	5.5				11.1	5.5		11.1			49.9
Total number x 10^3	103.9	323.5	710.6	558.6	679.9	1492.5	1332.4	1253.9	1590.1	1977.1	1031.1	705.4	375.4	416.9	100.0	63.7	24.2	15.4	30.8	12785.2
%	0.8	2.5	5.6	4.4	5.3	11.7	10.4	9.8	12.4	15.5	8.1	5.5	2.9	3.3	0.8	0.5	0.2	0.1	0.2	

Total number in the bottom line and in the last column do not coincide with the sums of the values for the original values were divided by 10^3 in order to allow a better reading of the table.

Table 14. M. monoceros ♀ - Estimates of stock size (in number) splitted by maturity stages and by stratum

a) Percentages of maturity stages by stratum (calculated by weigthing each sample by the total number of each station and combining the results by stratum

Maturity Stages \ Strata	2	3.1.a	3.1.b	3.2.b	4.1.a	4.1.b	5.1.a	5.1.c	5.1.d	6.a
1	60.5	78.6	80.0	15.8	85.8	93.2	79.4			44.4
2	21.5	10.7	5.0	-	2.8	2.4	7.5			22.2
3	13.5	5.2	5.0	10.5	0.3	0.9	1.8	100.0		22.2
4	4.5	0.6	-	15.8	0.3	0.6	0.6		100.0	-
5	-	1.5	-	36.8	4.0	0.6	6.3			11.2
1d		3.4	10.0	21.1	6.8	2.3	4.4			-
Total number sampled	195	328	20	19	380	673	159	2	1	9

b) Data weigthed by total number of each stratum

Maturity Stages \ Strata	2	3.1.a	3.1.b	3.2.b	4.1.a	4.1.b	5.1.a	5.1.c	5.1.d	6.a	Total number
1	919.2	1383.8	179.7	14.7	2250.9	4789.7	1069.3			22.2	10629.5
2	326.7	188.4	11.2		73.5	123.3	101.0			11.1	835.2
3	205.1	91.5	11.2	9.8	7.9	46.3	24.2	16.9		11.1	424.0
4	68.4	10.6		14.7	7.9	30.8	8.1		11.3		151.8
5		26.4		34.3	104.9	30.8	84.8			5.6	286.9
1 d		59.9	22.5	19.7	178.4	118.2	59.3				457.8
$S \times 10^3$	1519.3	1760.5	224.6	93.2	2623.4	5139.2	1346.8	16.9	11.3	49.9	12785.2

Total number in the bottom line and in the last column do not coincide with the sums of the values for the original values were divided by 10^3 in order to allow a better reading of the table.

Table 15. - <u>M. monoceros</u> ♂ - Estimates of stock size (in number) splitted by lenght groups and by stratum

a) Lenght frequency distribution by stratum

Strata	Class mark																	Total number	$\bar{x}$	$s_{\bar{x}}$
	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45			
2		16	4	8	35	30	75	35										203	23.2	0.24
3.1.a		26	27	21	28	38	55	35	20	7	5	2						264	23.0	0.29
3.1.b							2	4	2									8	27.0	0.54
3.2.b						1	3	5	3	1								13	27.0	0.60
4.1.a		1	3	21	21	49	43	60	17	7	1		1					224	24.6	0.22
4.1.b			10	31	45	65	152	146	91	10	9	26	4			4		593	26.0	0.17
5.1.a	1		6	7	8	20	53	45	32			3						175	25.4	0.25
5.1.c								3	1	1								5	28.2	0.80
5.1.d					1	1	1		2									5	25.4	1.60
6.a					1	1	2	3	6	2	1							16	27.8	0.77

b) Data weighted by total number of each stratum

Strata	Class mark																Total number
	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	
2		124.7	31.6	61.6	271.5	233.6	582.5	273.1									1578.5
3.1.a		140.5	144.7	113.5	149.0	204.3	295.1	188.7	106.4	38.3	27.0	11.4					1418.9
3.1.b							22.5	44.9	22.5								89.9
3.2.b						4.9	14.7	24.5	14.7	4.9							63.7
4.1.a		7.7	20.1	145.4	145.4	338.7	295.4	414.4	117.5	46.4	7.7		7.7				1546.4
4.1.b			77.0	235.5	344.3	498.3	1159.6	1114.3	697.6	77.0	63.4	199.3	31.7			31.7	4529.7
5.1.a	9.6		54.1	63.7	73.3	181.6	482.6	409.3	291.4			27.1					1592.6
5.1.c								25.3	8.4	8.4							42.2
5.1.d					11.3	11.3	11.3		22.7								56.7
6.a					5.6	5.6	11.0	16.6	33.3	11.1	5.6						88.7
Total number	9.6	272.9	327.6	619.7	1000.3	1478.3	2874.7	2511.2	1314.6	186.2	103.7	237.7	39.4			31.7	11007.6
%	0.1	2.5	3.0	5.6	9.1	13.4	26.1	22.8	11.9	1.7	0.9	2.2	0.4			0.3	

Total number in the bottom line and in the last column do not coincide with the sums of the values for the original values were divided by 10^3 in order to allow a better reading of the table.

From GEOLOGICAL-GEOPHYSICAL ATLAS OF THE INDIAN OCEAN, Moscow 1975.

A.S JOHN GRIEG