

## Observations on the distribution and biology of a few bathypelagic fishes from the South-West Coast of India

GRACE MATHEW<sup>1</sup>, P JAYASANKAR<sup>2</sup>, S SIVAKAMI<sup>2</sup> and J NARAYANASWAMY<sup>4</sup>

Central Marine Fisheries Research Institute, Cochin, Kerala 682031

### ABSTRACT

This paper deals with the biology, distribution and abundance of a few bathypelagic fishes, viz. *Psenopsis obscura* Headrich, *Trichiurus auriga* Klunzinger, *Chlorophthalmus agassizi* Bonaparte, *Neopinnula orientalis* Gilchrist and van Bonde and *Ariomma indica* (Day, based on the collection made by FORV Sagar Sampada. In the area between latitudes 8°30' N to 10°39' N and longitude 75°25' E to 76°37'E, off Ponnani to Trivandrum at depths beyond 300 m, these bathypelagic fishes constituted 98% of the total trawl catch of 36 t of the total fish catch: *Psenopsis obscura* 46.37%, *Trichiurus auriga* 15.46%, *Chlorophthalmus* spp. 18.2%, *N. orientalis* 1.8%, and *A. indica* 0.5%. The size of *C. agassizi* ranged from 150 to 230 mm, *C. bicornis* from 213 to 395 mm, *Psenopsis obscura* from 141 to 215 mm, *T. auriga* from 215 to 395 mm and *A. indica* from 105 to 171 mm. The length-weight relationship of these species was also worked out.

The coastal fish production is stagnating during the last few years (James *et al.* 1987). The only way to increase marine fish production is to exploit the untapped resources from the deeper parts of the EEZ. FORV Sagar Sampada carried out trawling surveys to locate and estimate the abundance of the deep sea resources, especially the crustaceans and fishes along the upper continental slope off Kerala coast during January-February 1988. The present paper deals with some of the important observations in this survey.

### MATERIALS AND METHODS

A series of bottom trawling operations were carried out using the High Speed Demersal Trawl (HSDT III), designed by the CIFT, with cod-end mesh size of 40 mm and trawling speed between 3.5 and 4.5 knots,

Present address : <sup>1</sup>Central Marine Fisheries Research Institute.

<sup>2</sup>Mandapam Regional Centre of CMFRI, Mandapam Camp.

during February 1988. The area covered was between 08°30'N and 10°39'N, and 75°25'E and 76°39'E, lying between Ponnani in the north to Trivandrum in the South. A total of 25 trawl hauls were taken at depth between 60 and 368 m, mostly in the Quilon Bank area. Haul-wise details of fishing operations and total catch are given in Table 1. Subsamples were drawn from each haul and analysed for species composition. The total length, weight, sex, food and feeding intensity, and maturity conditions of the different species were noted. Length-weight relationship for the different species was calculated using the formula :

$$\text{Log } W = a + b \text{ Log } L.$$

### OBSERVATIONS

#### *Species-wise abundance*

Out of a total catch of 36 tonnes, 35.07 t (98%) was constituted by fishes, comprising more than 20 species of deep sea fishes. Table 2 gives the catch of different species. Predominant species were *Psenopsis obscura*

Table 1. Station-wise trawling details and total fish catch

Station	Position		Depth at Station	Total fish catch (kg)
	Lat.	Long.		
1.	10°30'	75°40'	60	225
2.	10°37'	75°30'	80	200
3.	10°39'	75°25'	120	250
4.	9°17'	75°45'	350	500
5.	9°10'	75°47'	348	9
6.	9°05'	75°52'	325	1000
7.	8°58'	75°51'	335	2000
8.	9°01'	75°46'	340	250
9.	8°57'	35°37'	364	2000
10.	8°51'	75°40'	360	53
11.	8°40'	75°48'	340	4500
12.	8°54'	76°09'	64	40
13.	8°49'	76°22'	60	14
14.	8°37'	76°21'	84	53
15.	8°57'	75°42'	335	7000
16.	8°46'	75°43'	337	5000
17.	8°58'	75°34'	362	68
18.	8°57'	75°33'	364	200
19.	8°47'	75°34'	335	10
20.	8°49'	75°35'	330	27
21.	8°44'	75°32'	315	12000
22.	8°46'	75°37'	305	200
23.	9°15'	75°53'	230	5
24.	9°19'	75°56'	73	10
25.	9°22'	76°02'	60	1

Headrich (46.37%), *Chlorophthalmus* spp (18.2%), *Trichiurus auriga* Klunzinger (15.46%), *Neopinnula orientalis* Gilchrist and van Bonde (1.8%) and *Ariomma indica* (Day) (0.5%). Other less abundant species contributing to the catch belonged to the families Myctophidae, Gonostomatidae, Sternoptychidae, Macrorhamphosidae and

Scorpionidae. Bathypelagic species were present in 16 hauls from depths beyond 225 m. From 7 stations of depth less than 100 m 543 kg of demersal fish was caught. Catch constituted *Nemipterus* spp, *Saurida* spp, Carangids, *Upeneus* spp, *Epinephelus* spp etc. The average catch rate for these resources was 71.2 kg. A catch rate of 1 tonne

Table 2. Station-wise (kg) catch of different bathypelagic species

Station	Duration of haul (in min.)	<i>Chlorophthalmus</i> spp	<i>T. auriga</i>	<i>P. obscura</i>	<i>N. orientalis</i>	<i>A. indica</i>
1.	30	-	-	-	-	-
2.	60	-	-	-	-	-
3.	15	-	-	-	-	-
4.	45	400	-	-	43	-
5.	60	5	-	-	-	-
6.	60	259	-	-	62	129
7.	60	864	-	-	400	-
8.	45	42	-	42	-	50
9.	60	350	-	1 100	-	-
10.	30	15	2	-	14	-
11.	60	1 200	1 800	1 000	-	-
12.	60	-	-	-	-	-
13.	45	-	-	-	-	-
14.	60	-	-	-	-	-
15.	45	700	280	6000	-	-
16.	30	500	250	4250	-	-
17.	45	25	-	-	5	-
18.	60	122	-	-	3	-
19.	5	-	-	-	-	-
20.	30	35	50	130	-	-
21.	60	1 800	3 000	3 600	-	-
22.	30	22	-	-	-	-
23.	60	0.5	-	-	2.5	-
24.	60	-	-	-	-	-
25.	60	-	-	-	-	-
		6 335.5	5 382	16 122	629.5	179

of *Nemipterus* spp. and *Decapterus* spp. was recorded at a depth of 120 m. *Psenopsis obscura* recorded the maximum catch of 16.1 t. The total catch of 0.6 t of *Neopinnula orientalis* was obtained with a catch rate of 0.143 t/hr.

#### BIOLOGY

This study was restricted to a brief pe-

riod. Hence only some aspects of biology like size range, maturity condition and length-weight relationship are dealt with here. The length-weight relationship was established for males and females separately. The significance of difference at 5%, of the sexes in each species, was tested by analysis of covariance (Snedecor and Cochran 1967) (Table 3).

Table 3. Comparison of regression of males and females of different species by ANOVA

Source of variation	df	Deviation from SS	Regression coefficient	MSS
<i>P. obscura</i>				
Male	71	1.358039	3.119235	1.912731 E-02
Female	71	1.630331	2.865906	2.296241 E-02
<i>C. agassizi</i>				
Female	308	6.343057	2.008585	2.059434E E-02
<i>T. auriga</i>				
Female	76	7.338584	2.712429	9.656031 E-02
Male	34	4.791139	3.294757	.1409159
<i>N. orientalis</i>				
Female	62	3.309763	3.374837	5.338327 E-02
Male	21	.284864	3.664738	1.356495 E-02

*Psenopsis obscura*: Its total length ranged from 148 to 215 mm with mode at 160 mm. Females predominated the catch, and 70% of fishes were pre-adults in maturity stages I and II. None of the specimens were mature or in spawning or spent condition. In almost all the specimens the stomach was empty. The length-weight regression equation of 71 males and 71 females are as follows :

Male :  $\text{Log } W = 1.389842 \text{ E} - 06 + 3.119233 \text{ Log } L$

Female :  $\text{Log } W = 1.829285 \text{ E} - 05 + 2.865906 \text{ Log } L$

*Chlorophthalmus agassizi*: This species (family Chlorophthalmidae) occurred in all stations beyond 220 m, where trawling was carried out. The total length ranged from 139 to 240 mm with prominent modes at 175 and 210 mm. A remarkable observation was that 90% of specimens examined during the present study were females. Whether this could be due to the phenomenon of reversal of sex during this period or whether this is an environment-induced factor has to be studied further. Maturity stage IV was predominating. Though majority of the speci-

mens were with their stomach empty, a few had semidigested portions of fish, squids, euphausiids and other crustaceans.

Length-weight relationship was studied based on 308 females, in the length range (TL) of 140 mm to 290 mm. The relationship was worked out only for females, as males were very few in the catch.

$\text{Log } W = 1.452837 \text{ E} - 03 + 2.008585 \text{ Log } L$

*Trichiurus auriga*: The total length of *T. auriga* varied from 208 to 395 mm. The modes were at 285 and 335 mm. Males and females occurred in the early stages of maturity. Nearly 70% of stomachs examined were empty, 5% half full, 8% 3/4 full and 12% full. Food was mainly constituted by *Euphasia* spp.

In this study 76 females in the length range 217 to 370 mm and 34 males in length range 176 to 344 mm were used.

Male :  $\text{Log } W = 1.279634 \text{ E} - 07 + 3.294757 \text{ Log } L$

Female :  $\text{Log } W = 4.0451095 \text{ E} - 06 + 2.712429 \text{ Log } L$

*Neopinnula orientalis*: A total of 248 specimens of this species belonging to family Gempylidae ranging in total length from

165 to 275 mm, were analysed. Two modes were discernible at 175 and 220 mm. In most cases stomachs were empty. In others they had only traces of organic matter. Females predominated in all the stations. Both males and females were either immature or in maturing stages. Specimens with ripe gonads were not obtained during this study.

The regression equations of 62 females and 21 males in the length range 165 mm to 250 mm are as follows :

Female :  $\text{Log } W = 9.545623 \text{ E} - 07 + 3.374837 \text{ Log } L$

Male :  $\text{Log } W = 1.86197 \text{ E} - 07 + 3.664738 \text{ Log } L$

**Bathymetric abundance :** During the present trawl survey the stations covered were at depths ranging from 60 to 368 m. From stations up to a depth of 100 m, the catch was mainly constituted by fishes like *Nemipterus* spp., *Decapterus* sp, *Upeneus* sp, *Epinephelus* spp., squids etc. The total catch from this depth range was 543 kg, with a production rate of 86.88 kg/hr. In the depth range 100-200 m the yield was 250 kg/hr and was constituted mainly of *Nemipterus mesoprion* and *Decapterus* spp. Only very few stations were sampled in the depth zone of 200-300 m. The catch rate here was only 5 kg/hr. A distinct demarkation in species composition or a change in distribution pattern of species was noticed at this depth zone, i.e. shifting from coastal species to bathyal ones. *Neoepinnula orientalis* and *Chlorophthalmus* spp were the dominant species, though a few specimens of *Saurida undosquamis* also occurred.

About 80% of the stations covered in the present study were in the depth zone 300-400 m. Very high concentrations of deep sea fishes and crustaceans were observed from this bathyal zone. A total catch of 34.813 tonnes of bathypelagic fish were obtained with a catch rate of 3.067 t/hr. Maximum catch was observed in *Psenopsis obscura*; 16.1 t of this resource was obtained with an

average catch of 2 935.45 kg/hr. Very high catch rate of 7.2 to 8.5 t/hr was obtained from a few stations at 335-337 m depth. But from depths beyond 340 m, the average catch rate for this species was only 400-600 kg/hr. A total of 6.26 t of *Chlorophthalmus* spp with an average catch rate of 521.7 kg/hr was obtained from the depth range 300-400 m. Catch rate as high as 1 800 kg/hr. was noticed for this species at 305-315 m. Beyond this depth up to 350 m, the catch rate was 700 kg/hr. The average catch rate for this species beyond 350 m depth was only 173 kg. A total catch of 5.5 t of *Trichiurus auriga* with an average catch of 458.33 kg/hr was obtained from the depth range 300-400 m. The highest catch rate of 3 t/hr of this species was obtained at a depth of 300-320 m. Up to a depth of 340 m, the average catch rate was 1 200 kg/hr. Beyond 340 m the catch of *T. auriga* was very little. From 300-400 m depth zone 629 kg of *Neoepinnula orientalis* with average catch rate of 66.7 kg/hr was obtained. The highest catch rate of 400 kg/hr was recorded at 335 m. As the depth increased, beyond 340 m the catch rate became lesser. Lantern fishes and myctophids were also abundantly distributed in the depth zone 300-400 m.

#### DISCUSSION

*Psenopsis obscura* belonging to the family Centrolophidae was the most abundant species occurring in the trawl catches during the present survey. The catch rate varied from 3.5 to 6.5 t/hr at 8°44', 75°47' and 8°57', 75°43' at depths 315 and 335 m. Sudarsan *et al.* (1989), based on the data collected in exploratory cruises of FSI vessels, worked out the standing stock for this resource, using the 'Swept Area Method' as 8 589 t. *Chlorophthalmus* spp or the green eyes forms another resource with high potentialities of exploitation. During the present

survey on Quilon Bank, it formed 18% of the total fish catch. From depths beyond 305 m, the catch rate varied from 250 to 12 000 kg. Sudarsan *et al* (1989) estimated the standing stock for this resource from the same area to be 6 131 t, establishing this as a potential resource for exploitation. Other unconventional resources with promising prospects are *Neopinnula orientalis* and *Trichiurus auriga*.

Because of the unfamiliarity of these deep sea bathyal resources, there is little demand in local markets. CIFT (1990) gave an account of the chemical and nutritive values of these deep sea resources. Different value-added products are also made out of these mesopelagic non-conventional resources by CIFT and IFP to promote consumer acceptability. Philip *et al.* (1984) stated that these bathyal species are protein rich with values ranging between 14.4 and 17.54%.

#### ACKNOWLEDGEMENT

We thank Dr P S B R James, Director, and Dr P Bensam, Head, Demersal Fisheries Division, for their interest and encouragement.

#### REFERENCES

- CIFT. 1990. Studies on processing of deep sea fish caught on board FORV Sagar Sampada. Proceedings of the First Workshop on Scientific Results of FORV Sagar Sampada, 5-7 June 1989; pp. 457-65 (1990).
- Philip K P, Premchand B, Avhad G K and Joseph P J. 1984. A note on the deep sea demersal resources of Karnataka-North Kerala Coast. *Bulletin Fisheries Survey of India* 18 : 23-30.
- Snedecor G W and Cochran W G. 1967. *Statistical Methods*. 6th edn, 593 pp. Oxford and IBH Publishing Co., New Delhi.
- Sudarsan D, John M E and Antony Joseph. 1989. An assessment of demersal stocks in the south-west coast of India with particular reference to the exploitable resources in the outer continental shelf and slope. *Bulletin Central Marine Fisheries Research Institute* 44 (1) 266- 72.