

**FOOD AND FEEDING HABITS OF FISHES FROM TRAWL CATCHES
IN THE BAY OF BENGAL WITH OBSERVATIONS ON DIURNAL
VARIATION IN THE NATURE OF THE FEED**

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INTRODUCTION

The magnitude of fish stocks in a region is a function of its food potentialities. Food is an important factor in the biology of fishes to the extent of governing their growth, fecundity and migratory movements. Variations in the seasonal and diurnal abundance of the favourite food organisms of different species of fish, in any region, may influence respectively the horizontal and vertical movements of the fish stocks. Hence, a correct knowledge of the relationship between the fishes and food organisms is essential for the prediction and exploitation of the fish stocks. An objective study of these relationships should be properly integrated in the orientation of a commercially exploited fishery, taking into account the diversity of the component species constituting the total fishery of the region.

From the published works, it is seen that the information on the food and feeding habits of fishes on the east coast of India is mostly based on material obtained from the fishermen's catches (indigenous gear used in inshore waters), in the regions of the Gulf of Mannar, Madras and Waltair. Barring the several studies of the food and feeding habits of isolated species or families, instances of a comprehensive study of the fish community in a locality are very few. Job (1940) working on the perches of Madras coast has given a fairly detailed account of their food and feeding habits with a historical resume of that type of study in the Indian waters. Chacko (1949) and Venkataraman (1960) who worked on the inshore fishes off the Gulf of Mannar and Calicut respectively, reviewed briefly the earlier works. Bapat and Bal (1950, 1952) and Basheruddin and Nayar (1961) made similar studies on the juvenile fishes obtained near Bombay and Madras respectively. The need for a comprehensive study on the food and feeding habits of the fish fauna off Waltair and its northern regions on the coast, has been greatly felt, since the available knowledge is limited to the works of Ganapati and Rao (1958, 1960) and Rao (1962) on *Sardinella gibbsa*, *Thrissocles mystax* and *Scomberomorus guttatus*, which are all pelagic in habit.

The present investigations were undertaken on the samples obtained from the catches of the Government of India trawlers M.T. Ashok and M. V. Seahorse, which started operating off Waltair (Waltair—False Point) within the depth range of 20-90 meters, with the inception of the Offshore Fishing Station at

Visakhapatnam towards the end of 1959. The fishing operations of M.T. Ashok were conducted round-the-clock.

Fishes obtained in the trawl catches have an added advantage over those in the fishermen's catches, in understanding the interrelationships of a community of fishes living in the same ecological environment and their dependence on the rest of the animate environment in an ecosystem, as the operation of the former gear is confined to the bottom. Large scale trawling operations in Indian waters being of recent origin, very little work was done on the food of fishes obtained in the trawls. Mohammed (1955) and Kagwade (1965) have studied the food and feeding habits of *Polyductylus indicus* and *Polynemus heptadactylus* respectively, off Bombay. A very general account of the food components met with in the fishes trawled from Wadge bank (situated off Ceylon and India) is found in the work of Malpas (1926).

Taking advantage of the operations of M.T. 'Ashok round-the-clock an attempt is made to understand the predator-prey relationship *vis-a-vis* their diurnal migration.

MATERIAL AND METHODS

Material for the present study was obtained during the period November 1959 to April 1960. The otter trawl was having 25 mm codend mesh and 60 mm at the square. Other operational details were given by Poliakov (1961). As soon as the trawl was hauled on board the vessel a representative sample was collected by a member of the research staff of the Central Marine Fisheries Research Unit, Waltair. The sample was preserved in 5% formaldehyde. Abdomens of the bigger fish were cut open to ensure thorough penetration of the preservative. Samples from the different hauls were kept separately. The operational and weather particulars regarding each haul were recorded on separate log sheets along with information about the composition of catches, nature of the bottom and benthos.

In the laboratory, each sample was sorted into the constituent species. The length* and weight of each specimen were noted and the stomachs were examined for food components. A total of 2,651 specimens belonging to 91 species, 68 genera and 43 families was examined. The analyses of all the stomachs were made by the author.

Qualitative and quantitative analyses of the stomach contents were made by following the points method described by Hynes (1950), introducing a slight modification in the assessment of degree of distention or amount of feeding, for which, the condition of the stomach wall was taken into consideration.

*Standard lengths only were taken into consideration unless otherwise mentioned.

Stomachs with thick walls (all the stomach folds apposed to one another) without any food material were considered as empty. A stomach containing food with all the stomach folds smoothed inside was considered as full, while the highly distended stomach with a very thin and transparent stomach wall was considered as gorged. An empty stomach was allotted 0.0 points, a full stomach 20.0 points and a gorged stomach 30.0 points. Intermediate values of 2, 5, 10, 15 etc. were allotted according to the different degrees of distention, based on the condition of the stomach wall. This method, though difficult to be followed in the initial stages, was found to be easy and reliable after experience, with the additional advantage of uniform applicability of the criteria to all types of fishes.

Job (1940) and Hynes (1950), who discussed in detail, the practical difficulties encountered with the various methods of analyses of the stomach contents, have not mentioned how to evaluate a fully distended stomach without food. Job (1940) gave a photographic illustration (plate V, Fig. 6) in which the features of the prey were clearly visible through the stretched stomach walls. Instances of evisceration of a freshly eaten prey were recorded, though rarely, when the stomachs were found fully stretched, with thin stomach walls, but without food. As the distention was in all probability due to feeding activity of the fish, the amount of feeding of such stomachs was assessed on the lines mentioned above, which if considered as empty might distort the picture of the feeding activity of the fish. Pillay (1952, p-189) realised the necessity for the evaluation of such a stomach but the method suggested was coupled with the quantity of food in the stomach.

The number of points gained by each stomach were sub-divided and distributed among the constituent food items according to their contribution towards the whole *e.g.*, a full stomach, having prawns contributing to 50% received 10.0 points crabs forming 25% received 5.0 points and so on. If only traces of an item were present, a nominal value of 0.1% was given, so as to facilitate calculation of average values. All the points gained by each category of good item in the different specimens examined were summed up and converted into percentages. Thus it was ensured that the presence of a single item of food in a scantily filled distended stomach was not given undue importance in the calculation of the averages.

The operations of M.T. Ashok and M.V. Seahorse were categorised under 6 periods of the day, as follows, to make possible a comparative study of the food composition of the different species at different times of the day:

Morning 05.00 to 08.00 hrs.

Forenoon 08.00 to 11.00 hrs.

Noon 11.00 to 14.00 hrs.

Afternoon 14.00 to 17.00 hrs.

Evening 17.00 to 20.00 hrs.

Night 20.00 to 05.00 hrs.

The different times were abbreviated as MO, FN, NO, AN, E, and NI in the following section, dealing with analyses of the stomach contents. If the duration of the haul was in two consecutive periods, the haul was categorised as belonging to the period under which the major part was covered.

The identification of fishes (and the order in which they are arranged), is mostly based on Munro's (1955) account of the fishes of Ceylon. The percentage composition of the food items is given separately for the different periods of the day. The period is indicated by the abbreviation mentioned above, followed by the number of fish examined; and the average amount of feeding during each period is indicated in parantheses. Finally, the average values of all the fish examined are given for each species.

In the remaining sections, only those organisms constituting above 10% of the stomach contents in a sample of fish larger than 10 individuals with an average amount of feeding exceeding 10.0 points are considered to be of some consequence, leaving very little scope for the consideration of organisms of chance occurrence.

ANALYSIS OF THE STOMACH CONTENTS

Elasmobranchs

Family : *Orectolobidae*

1. *Chiloscyllium indicum* (Gmelin)

(Size range : 25.7—54.5 cm. ; observed in February and March)

MO : 1 (30.0) ; Polychaetes 5.0%, Crustaceans 8.4%, *Octopus* 86.6%.

FN : 2 (17.5) ; Phyllodocid 40.0%, Gobeid fish 50.0%, Teleost remains 10.0%.

Average : 3 (21.7) ; Polychaetes 8.8%, Crustaceans 0.3%, *Octopus* 41.4%, Teleosts 49.5%.

Family : *Carcharinidae*

2. *Scoliodon sorrakowah* (Cuv.)

(Size range : 33.6—49.0 cm. ; observed in December, February and March)

MO : 5 (3.0) ; Teleost remains 100.0%.

FN : 1 (15.0) ; Crustacean remains 83.0%, Fish scales 17.0%.

NI : 1 (0.0) ;

Average : 7 (4.3) ; Crustaceans 13.9%, Teleost remains 86.1%.

Family : *Trygonidae*

3. *Gymnura macrura* (Bloch & Schn.)

(Size 124.0 cm. ; observed in December)

NI : 1 (0.1) ; Crustacean remains 100.0%

4. *Amphotistius zuguei* (Müller & Henle)

(Size 172.5 cm. ; observed in February)

FN : 1 (2.0) ; Alpheid 100.0%

5. *Himantura bleekeri* (Blyth)

(Size 180.0 cm. ; observed in December)

FN : 1 (20.0) ; Polychaete remains 10.0%, *Albunea* 20.0%, Cariid prawn 60.0%, Mysis 10.0%.

Family : *Myliobatidae*

6. *Aetomylaeus nichofii* (Bloch & Schn.)

(Size 59.0 cm. ; observed in February)

FN : 1 (25.0) ; *Stinum* 100.0%

Family : *Torpedinidae*

7. *Narcine timlei* (Bloch & Schn.)

(Size 34.5 cm. ; Observed in December)

NI : 1 (30.0) ; Polychaete remains 100.0%

Teleosts

Family : *Chupeidae*

8. *Sardinella fimbriata* (Val.)

(Size range : 6.3-12.5 cm. ; observed in November, February and March)

MO : 2 (13.5) ; *Coscinodiscus* 0.5%, *Corycaeus* 3.9%, Calanoids 78.4 %
Lucifer 15.7%, Crustacean remains 1.0%, Fish scales 0.5%

FN : 1 (30.0) ; Cariid prawns 93.4%, Decapod remains 6.6%

NO : 3 (20.0) ; *Corycaeus* 0.2%, Calanoids 0.7%, *Acetes* 66.1%, Teleost remains 33.0%.

Average : 6 (19.5) ; *Coscinodiscus* 0.2%, Copepods 23.2%, *Lucifer* 4.3 %
Cariid prawns 30.5%, *Acetes* 26.2%, Crustacean remains 2.4%, Teleost remains 13.3%.

9. *Pellona ditchela* Val.

(Size range 7.5—8.0 cm. ; observed in March)

FN : 10 (20.0) ; *Temora* 78.0%, *Eucalanus* 2.6%, *Megalopa* 5.2%, Porcellanid
goaea 2.6%, Decapod larva 2.6%, *Lucifer* 5.1%, Pagurid remains 2.6%, Cladocera
1.3%.

10. *Euplatygaster indica* (Swainson)

(Size range 14.5—24.5 cm. ; observed in February and March)

MO : 16 (15.8) ; Megalopa 9.5%, *Squilla* 27.2%, Prawns 1.7%, Crustacean remains 1.9%, *Rastrelliger* 22.4%, *Chirocentrus* 3.4%, Pleuronectid 2.6%, Teleost remains 31.3%.

FN : 1 (0.0).

AN : 4 (7.6) ; *Cypridina* 3.8%, Decapod remains 57.7%, Teleost remain 38.5%.

E : 35 (3.5) ; *Lytocarpus* 0.2%, Megalopa 2.6%, Crab remains 1.6%, *Squilla* 4.7%, Prawns 1.1%, Crustacean remains 10.5%, Gastropods 1.4%, *Rastrelliger* 33.5%, Teleost remains 43.0%, Fish scales 1.4%.

NI : 21 (15.6) ; Amphipods 1.7%, Isopods 13.3%, *Cypridina* 2.3%, Copepods 1.9%, Megalopa 7.3%, *Calappa* 8.5%, Euphausiids 1.1%, Alima 1.4%, *Squilla* 11.3%, Mysids 0.3%, Prawns 7.8%, Decapod remains 1.9%, Crustacean remains 2.7%, Bivalves 0.5%, Gastropods 0.4%, *Anchoviella* 6.8%, Teleost larvae 6.5%, Teleost remains 24.4%.

Average : 71 (8.8) ; Crustaceans 47.4%, Molluscs 0.8%, Teleost remains 51.8%.

11. *Ilisha elongata* (Bennett)

(Size range : 13.5-14.5 cm., observed in March)

FN : 2 (2.0) Crustacean remains 50.0%, Teleost remains 50.0%.

12. *Opisthopterus tardoore* (Cuv.)

(Size range 3.5—17.9 cm. ; observed in November and February)

MO : 18 (15.8) ; Polychaete setae 0.1%, *Eucalanus* 42.6%, *Euchaeta* 26.6%, *Cypridina* 10.7%, Megalopa 10.7%, *Aceres* 8.3%, Bivalve larvae 0.5%, *Lingula* 0.5%.

Family : *Dussumieridae*13. *Dussumieria hasselti* Blk.

(Size range: 4.8—12.5 cm. ; observed in November, December and March)

MO : 10 (19.2) ; *Eucalanus* 1.0%, *Lucifer* 5.2%, Prawn remains 5.2%, *Anchoviella* 83.4%, *Sphyraena* 5.2%.

FN : 26 (4.6) ; *Cypris* 14.9%, *Eucalanus* 2.4%, Megalopa 16.3%, *Lucifer* 6.6%, Alima 59.2%, other Decapods 0.6%.

NI : 3 (19.0) ; Zoaea 4.6, Amphipod 2.3%, *Lucifer* 2.3%, *Alima* 81.8%
Stomatopod 9.0%

Average : 39 (9.6) ; Crustaceans 43.3%, Teleosts 56.7%.

Family : *Engraulidae*

14. *Anchoviella heterolobus* (Rüpp.)

(Size range : 5.5—6.8 cm. ; observed in December and February)

FN : 12 (9.6) ; *Coscinodiscus* 2.4%, Polychaete larvae 0.6%, *Cypridina* 5.5%,
Entomostracans 70.3%, *Acrocalanus* 3.3%, *Eucalanus* 0.4%, *Corycaeus* 0.4%,
Decapod larvae 2.2%, Bivalve larvae 14.3%, Teleost remains 0.6%.

15. *Anchoviella insularis* (Harden)

(Size range : 4.0—7.5 cm. ; observed in November, December, February
and March)

MO : 41 (22.4) ; *Tulberjella cuspidata* 18.0%, *Cypridina* 27.0%, Calanoid
0.2%, *Paracalanus* 2.2%, *Acrocalanus* 0.4%, *Eucalanus* 0.4%, *Euchaeta* 0.2%,
Corycaeus 0.2%, Mysis 0.2%, Megalopa 1.0%, *Acetes* 45.4%, *Natica* 2.2%,
Heteropods 0.2%, Bivalve larvae 0.2%, Teleost remains 2.2%.

FN : 48 (16.6) ; *Cypridina* 39.0%, Copepods 0.6%, Calanoids 8.4%, *Acrocalanus*
19.7%, *Eucalanus* 3.4%, *Corycaeus* 1.4%, *Centropages* 1.4%, *Euterpina*
0.3%, Isopods 1.4%, Amphipods 1.4%, Hyperidae 1.5%, *Lucifer* 1.4%, Megalopa
0.3%, Decapod Larvae 0.6%, *Alima* 0.1%, *Acetes* 4.5%, *Natica* 0.3%, *Nerita*
0.3%, Bivalve larvae 14.0%.

No. 8 (30.0) ; *Cypridina* 2.2%, *Acrocalanus* 2.2%, *Eucalanus* 2.2%, Hyperidae
2.2%, *Alima* 2.2%, *Acetes* 89.0%.

Average : 97 (20.4) ; *Coscinodiscus* 0.1%, Entomostracans 43.7%, *Acetes*
34.5%, Other Crustaceans 13.3%, Molluscs 7.2%, Teleosts 1.3%.

16. *Setipinna taty* (Val.)

(Size range : 9.1—14.0 cm. ; observed in February)

MO : 7 (5.0) ; *Cypris* 8.0%, Copepod remains 1.0%, Decapod remain
90.0%, Stomatopod remains 1.0%.

17. *Thrissocles hamiltonii* (Gray)

(Size 16.5 cm. ; observed in March)

FN : 2 (30.0) ; Schizopods 1.3%, *Lucifer* 0.2%, Teleost remains 98.5%.

18. *Coilia dussumeri*

(Size range : 11.5—16.0 cm. ; observed in February)

MO : 11 (18.5) ; Copepods 2.0%, Crustacean remains 1.2%, Decapod larvae 57.2%, *Gammarus* 34.3%, Teleost larvae 5.3%.Family : *Synodontidae*19. *Trachinocephalus myops* (Bloch & Schn.)

(Size range 6.1—12.1 em. ; observed in February)

NO: 4 (6.5); Prawns 22.8%, *Squilla* 22.8%, Decapod remains 1.5%, Crustacean remains 7.5%, *Rastrelliger* 21.3%, Teleost remains 24.2%.20. *Synodus indicus* (Day)

(Size range 6.4—8.0 em. ; observed in February)

NO: 4 (15.0) ; *Rastrelliger* 41.6%, Teleost remains 58.4%.21. *Saurida undosquamis* (Rich)

(Size range 17.5—24.5 em. ; observed in December)

AN: 16 (17.5); *Caranx crumenophthalmus* 28.6%, *Secutor ruconius* 26.8%, Tetrodontidae 7.1%, *Lactarius* 0.1%, *Nemipterus* 8.9%, Teleost remains 28.5%.22. *Saurida tumbil* (Bloch)

(Size range 3.6—29.3 em. ; observed in December and February)

MO: 6 (20.0) ; *Loligo* 26.7%, *Rastrelliger* 30.0%, *Apogon* 23.3%, Teleost remains 20.0%.FN: 69 (13.8); Sergestids 0.8%, *Loligo* 27.5%, *Leiognathus* 4.1%, *Nemipterus japonicus* 13.2%, *Anchoviella heterolobus* 24.7%, *Bregmaceros* 0.1%, Teleost remains 29.6%.NO: 68 (9.0) ; Prawns 1.3%, Crustacean remains 3.2%, *Loligo* 3.0%, *Psettodes* 2.0%, *Anchoviella heterolobus* 36.0%, *Grammoplites scaber* 4.3%, Teleost remains 50.2%.AN : 7 (8.6) ; Crustacean remains 0.9%, *Nemipterus japonicus* 27.8%, *Anchoviella heterolobus* 18.6%, Teleost remains 53.7%.

E : 1 (0.0)

NI : 15 (4.5) ; Prawns 4.4%, *Rastrelliger* 39.8%, *Bregmaceros* 22.2%, Teleost remains 33.6%.Average : 166 (11.0) ; Crustaceans 2.5%, *Loligo* 13.7%, *Anchoviella heterolobus* 25.3%, Teleost remains 58.5%.

Family : *Tachysuridae*23. *Pseudarius jella* (Day)

(Size range 10.6—28.5 cm. ; observed in January and April)

MO : 25 (7.1) ; Foraminifera 0.7% , Gastropods 10.0% , Cephalopods 21.7% , *Lingula* 7.1% , Cypris stage 3.9% , Copepods 1.4% , Amphipods 7.4% , *Nemipterus* 3.5% , *Charybdis* 1.9% , Crab 17.4% , *Penaeus* 18.0% , *Squilla* 3.5% , Teleost remains 3.5% .

FN : 15 (10.4) ; Anemone 12.4% , Bivalve larvae 6.6% , *Natica* 1.5% , *Loligo* 7.3% , Cephalopods 4.4% , Isopods 1.4% , Megalopa 0.7% , *Diogenes* 11.0% , Crab 10.2% , Prawn 0.2% , *Squilla* 13.9% , Crustacean remains 5.3% , Teleost remains 24.7% , Fish scales 0.4% .

AN : 12 (9.1) ; Teleost remains 100.0% .

E : 19 (16.8) ; *Lophactaea* 0.9% , *Loligo* 8.4% , Cephalopods 0.5% , Cypris stage 0.5% , Isopods 6.0% , Amphipods 0.1% , *Neptunus* 17.8% , Portunids 4.3% , *Charybdis* 0.5% , *Grapsus* 1.9% , *Hippa* 6.4% , Crabs 15.7% , *Metapenaeus* 15.9% , Cariid prawns 0.4% , Prawn 1.3% , *Alima* 0.4% , *Squilla* 0.5% , *Syngnathus longimanus* 0.2% , Teleost remains 15.7% , Fish scales 2.6% .

NI : 12 (17.3) ; Anthozoans 6.4% , *Nereis* 0.2% , Polychaete remains 2.5% , Cypris stage 1.6% , *Gammarus* 0.7% , Amphipods 0.7% , Megalopa 0.1% , *Matuta victor* 1.2% , *Charybdis* 5.2% , *Ocypods* 0.2% , *Grapsus* 12.5% , Crabs 11.8% , *Penaeus* 0.7% , Prawn 4.4% , Decapod remains 0.7% , *Squilla* 3.6% , Crustacean remains 4.2% , *Saurida tumbil* 11.9% , *Apogon nigripinnis* 4.7% , *Syngnathus longimanus* 1.1% , *Cynoglossus* 3.6% , Teleost remains 0.1% , Fish scales 21.6% .

Average : 83 (11.7) ; Foraminifera 0.1% , Anemones 4.5% , Polychaetes 1.0% , *Lophactaea* 0.3% , Cephalopods 33.0% , other Molluscs 4.2% , *Lingula* 0.6% , Entomostracans 1.7% , Crabs 28.6% , hermit crabs 3.8% , prawns 9.1% , *Squilla* 4.5% , other crustaceans 6.9% , Teleosts 10.7% , Fish scales 8.5% .

Family : *Fistularidae*24. *Fistularia villosa* Klunzinger

(Size range 29—36.0 cm. ; observed in March)

E : 21 (4.0) ; Euphausiids 1.1% , Mysids 1.1% , prawns 2.8% , Decapod remains 2.3% , *Trichiurus* 8.6% , *Grammoplites* 9.8% , Clupeid larvae 1.1% , Teleost remains 73.2% .

Family : *Polynemidae*25. *Polynemus sextarius* (Bloch)

(Size range 2.5—15.2 cm. ; observed in November, January, February and March)

MO : 10 (22.0) ; *Eucalanus* 2.3%, Calanoids 34.1%, Amphipods 6.8%, Mysids 22.8%, *Charybdis* 15.9%, prawn 18.1%.

FN : 35 (20.6) ; Mysids 7.5%, *Neptunui* 0.1%, crabs 0.1%, *Metapenaeus* 56.3%, *Penaeus* 1.8%, *Squilla woodmasoni* 26.3%, *Callionymus japonicus* 3.8%, Teleost remains 0.6%, Fish scales 0.1%, sand grains 0.1%, Decapod remains 3.3%.

NO : 28 (23.7) ; Calanoids 2.2%, Paguridae 0.9%, *Acetes* 44.4%, *Squilla woodmasoni* 35.2%, Stomatopod 17.3%.

AN : 2 (3.0) ; *Lingula* 10.0%, crabs 66.6%, *Acetes* 13.3%, Alima 6.7%, fish larvae 3.3%.

E : 1 (20.0) ; prawn 100.0%.

NI : 7 (17.3) ; Isopods 0.8%, *Charybdis* 23.0%, *Matuta* 43.0%, prawn 14.8%, *Acetes* 12.3%, *Gammarus* 0.5%, Teleosts 0.5%, Decapod larvae 5.1%.

Average : 83 (21.0) ; *Lingula* 0.1%, Crustaceans 98.1%, Teleosts 1.8%.

26. *Polynemus sexfilis* Val.

(Size range 7.8—11.0 cm. ; observed in February)

MO : 3 (18.0) ; Amphipods 22.3%, Decapod larvae 33.2%, Penaeid prawns 44.5%.

NO : 20 (20.0) ; Mysis 0.5%, *Lucifer* 0.5%, Amphipods 0.5%, Megalopa 0.5%, Penaeid prawns 75.0%, Stomatopods 2.5%, Gastropod eggs 5.5%, Teleost remains 10.0%, eel larva 5.0%.

Average : 23 (19.7) ; Crustaceans 82.3%, Gastropod eggs 4.9%, Teleosts 12.8%.

Family : *Ambassidae*

27. *Ambassis commersonii* Cuv

(Size 7.4 cm. ; observed in February)

FN : 1 (25.0) ; prawn 100.0%.

Family : *Theraponidae*

28. *Pelatus quadrilineatus* (Bloch)

(Size range 14.7—20.5 cm. ; observed in February and March)

FN : 1 (00.0)

AN : 3 (22.0) ; *Apogon* 72.3%, *Pristipoma* 27.7%.

Average : 4 (16.5) ; Teleosts 100.0%.

29. *Therapon jarbua* (Forsk.)

(Size range 8.3%—11.4 cm. ; observed in February)

FN : 6 (16.3) ; cypris stage 52.4%, Copepods 0.3%, Amphipods 0.2%, Megalopa 0.2%, Decapod larvae 1.2%, Crustacean remains 1.9%, Fish scales 43.8%.

NI : 1 (2.0) ; crab remains 100.0%.

Average : 7 (14.3) Crustaceans 56.3%, Fish scales 43.7%.

Family : *Priacanthidae*30. *Priacanthus tayeneus* (Rich)

(Size range 8.9—14.5 cm. ; observed in January, February and March)

FN : 3 (25.0) ; Metazoa 8.0, Megalopa 16.0%, Cariid prawns 20.0%, Stomatopod remains 8.0%, Teleost remains 48.0%.

AN : 2 (25.0) ; Amphipods 2.2%, Decapod remains 13.1%, Stomatopod remains 60.8%, Teleost remains 23.9%.

E : 1 (0.0)

Average : 6 (16.7) ; Crustaceans 55.0%, Teleosts 45.0%.

Family : *Apogonidae*31. *Apogon septemstriatus* Günther

(Size range 3.3—10.3 cm. ; observed from November to March)

FN : 16 (15.8) ; Copepods 0.1%, Amphipods 3.2%, Zoaea 1.0%, Megalopa 1.9%, *Acetes* 22.5%, prawns 20.9%, Stomatopods 16.2%, Teleosts 34.2%.

NO : 40 (8.0) ; Cypris 3.6%, prawns 27.0%, Stomatopods 8.9%, Crustacean eggs 42.2%, *Bregmaceros* 2.3%, Teleost remains 16.0%.

AN : 3 (6.7) ; *Neptunus gladiator* 36.4%, Crustacean remains 63.6%.

E : 1 (0.0)

Average : 60 (9.7) ; Crustacean eggs 17.0%, Crustaceans 53.3%, Teleost 29.7%.

32. *Apogon nigripinnis* (Cuv. & Val.)

(Size range 4.3—12.0 cm. ; observed in December and February)

MO : 2 (19.0) ; Crustacean eggs 15.8%, *Bregmaceros* 84.2%.

NO : 11 (15.0) ; *Cypridina* 3.4%, Calanoids 0.7%, Isopods 6.7%, Amphipods 0.7%, Megalopa 3.4%, prawn remains 1.7%, Teleost remains 83.4%.

AN : 2 (15.0) ; Teleost remains 100.0%.

Average : 15 (15.5) ; Crustacean eggs 3.7%, Crustaceans 12.0%, Teleosts 84.3%.

33. *Apogonichthys ellioti* (Day)

(Size range 10.0—10.8 cm. ; observed in December)

AN : 2 (7.5) ; Isopods 46.7%, Teleost remains 53.3%.

Family : *Lactariidae*

34. *Lactarius lactarius* (Schn)

(Size range 4.6—17.5 cm. ; observed in November, February and March)

FN : 79 (15.4) ; Cypris 1.4%, *Eucalanus* 0.7%, Isopods 0.2%, Amphipods 1.6%, *Lucifer* 3.2%, prawns 19.4%, Alima 32.4%, Cephalopods 0.5%, Teleost remains 40.6%.

No. : 52 (19.5) ; Polychaete remains 1.8%, *Lucifer* 0.4%, Shrimps 0.7%, Euphausiids 0.5%, *Acetes* 19.2%, Cariid prawns 1.1%, Alima 32.0%, *Trichiurus* 1.8%, Teleost remains 42.5%.

AN : 1 (0.0) ; Empty.

Average : 132 (16.9) ; Polychaetes 0.7 %, Crustaceans 56.7%, Teleosts 42.2%

Family : *Carangidae*

35. *Atropus atropus* (Bloch)

(Size range 3.2—15.5 cm; observed in November, March and April)

FN: 4 (16.3); *Acetes* 100.0%.

NO: 2 (25.0); *Acetes* 87.8%, Alima 1.7%, Stomatopods 10.5%.

E: 2 (2.5); Isopods 33.3%, other Crustaceans 66.7%.

Average: 8 (15.0); Crustaceans 100.0%.

36. *Carangoides chrysophrys* (Cuv)

(Size range 11.0—18.0 cm; observed in December, March and April)

MO: 1 (2.0); Teleost remains 100.0%.

FN: 4 (10.0); *Acetes* 5.0%, Alima 32.4% Gastropod larvae 0.3%, *Trichiurus* 29.8%, Teleost remains 32.5%.

AN: 5 (13.0); Mysids 5.9%, *Platycephalus* 5.9%, Teleosts 88.2%.

Average: 10 (10.7); Crustaceans 18.9%, Gastropod larvae 0.1%, Teleosts 81.0%.

37. *Carangoides malabaricus* (Bloch)

(Size range 11.0—20.5 cm; observed in November, March and April)

MO: 7 (5.1); Amphipods 1.0%, Euphausiids 4.9%, Portunid crab 14.7%,
Penaeus 1.0% Stomatopods 4.9%, *Rastrelliger* 68.6%, Teleosts 4.9%.

FN: 1 (20.0); Foraminifera 25.0%, Teleost remains 50.0%, Sand 25.0%.

NO: 1 (30.0); Amphipods 0.9%, Megalopa 2.3%, *Nemipterus* 13.6%, *Thalamira*
4.5%, *Acetes* 4.1%, Prawns 9.1%, Alima 31.8%, Percoids 9.1%, *Trichiurus*9.1%, *Opisthopterus* 4.1%, Fish post larvae 2.3%, Teleost remains 9.1%

AN: 1 (0.0)

NI: 18 (14.3); *Cypris* 1.5%, Megalopa 32.0%, Stomatopods 64.2%, Teleos
remains 2.3%.

Average: 28 (12.3); Foraminifera 0.3%, Crustaceans 60.0%, Teleosts 37.7%.

38. *Carangoides armatus* (Forsk)

(Size 13.7 cm; observed in March)

MO: 1 (25.0); Prawns 8.0%, *Rastrelliger* 92.0%.39. *Caranx sexfasciatus* (Quoy & Gaimard)

(Size 17.0 cm; observed in March)

FN: 1 (20.0); Foraminifera 1.3%, Crustacean remains 39.0%, Bivalves
1.3%, Cephalopods 6.4%, Teleost remains 52.0%.40. *Psenes indicus* (Day)

(Size range 11.2—15.6 cm; observed in February)

E: 41 (0.5); Calanoids 45.4%, Copepods 18.2%, Amphipods 9.1%, Decapod,
9.1%, Crustacean remains 9.1%, Fish scales 9.1%.41. *Chorinemus lysan* (Forsk)

(Size range 13.3—18.5 cm; observed in February and March)

MO: 1 (5.0); Teleost remains 100.0%.

FN: 8 (5.3); *Bregmaceros* 4.7%, *Anchoviella* 59.2%, Fish scales 36.1%,
Teleost remains 0.5%.AN: 1 (30.0); *Anchoviella* 100.0%.

Average: 10 (7.7); Teleosts 100.0%.

Family : *Zonychthidae*42. *Seriola* sp.

(Size 27.0 cm; observed in April)

FN: 1 (30.0); Cephalopods 100.0%.

Family : *Lutianidae*43. *Lutianus johnii* (Bloch)

(Size 15.4 cm; observed in February)

FN: 1 (30.0); *Pentaprim longimanus* 100.0 %.44. *Lutianus sanguineus* (Cuv)

(Size range 7.7—17.2 cm; observed in February and March)

MO: 2 (22.5); Prawns 89.0%, *Neptunus pelagicus* 11.0%.NI: 4 (25.0); *Cypris* 2.1%, Isopods 4.1%, prawns 39.8%, Crabs 1.0%.
Crustacean remains 40.8%, Cephalopods 8.2%, Fish scales 4.0%.

Average: 6 (24.2); Crustaceans 69.1%, Cephalopods 4.2%, Teleosts 26.7%

Family : *Nemipteridae*45. *Nemipterus japonicus* (Bloch)

(Size range 3.5—20.0 cm; observed from December to March)

FN: 52 (20.0); Foraminifera 0.2%, Anemones 12.0%, Polychaete remains 2.3%, *Cypris* 1.6%, copepods 0.7%, Isopods 0.1%, Amphipods 7.7%, Megalopa 0.2%, *Neptunus* 0.1%, *Charybdis* 1.1%, Grapsid 0.9%, *Doclea* 1.0%, *Ocypod* 1.1%, other crabs 13.6%, Cariid prawns 2.8%, Penaeid prawns 2.6%, *Acetes* 0.8%, prawn remains 18.4%, Euphausids 0.8%, Pagurid 4.6%, *Squilla* 2.9%, *Hippa* 0.9%, Crustacean remains 2.7%, *Lingula* sp. 0.2%, *Octopus* 6.4%, Cephalopod remains 5.2%, *Anchoviella* 4.6%, Fish larvae 0.2%, *Grammoplutes* 2.3%, Teleost remains 2.3%.NO: 52 (22.2); Foraminifera 0.1%, Nereid 5.5%, Polychaete remains 3.0%
Cypris stage 1.8%, *Cypridina* 3.7%, Copepod 0.1%, Isopods 14.8%, Amphipods 10.9%, Megalopa 5.9%, Grapsid 3.7%, Crab remains 3.7%, Cariid prawns 3.7%, Penaeid Prawns 5.5%, prawn remains 0.2%, *Raptantia* 0.5%, *Dorippe* 0.4%, *Philyra* 9.2%, Portunid 3.4%, *Squilla* 2.0%, other crustaceans 5.0%, *Lingula* 1.2%, Bivalve larvae 0.1%, Gobied 0.5%, Teleost remains 15.1%.AN: 12 (19.4); Anemone 10.1%, Nereid 5.0%, Amphipods 0.2%, Megalopa 1.0%, *Neptunus* 11.8%, crab remains 8.6%, *Acetes* 3.0%, prawns 2.0%, *Squilla* 3.7%, Crustacean remains 10.7%, *Loligo* 3.0%, Ophiuroids 7.7%

Pleuronectids 3.0%, Elver 12.8%, *Anchoviella* 10.1%, *Leiognathus* 1.5%, Teleost remains 5.8%.

NI: 19 (3.1); *Charybdis* 49.4%, *Acetes* 49.4%, Fish scales 1.2%.

Average: 135 (18.4); Foraminifera 0.1%, Anemone 7.4%, Polychaetes 4.3%, Entomostracans 2.8%, Isopods 4.5%, Amphipods, 9.6% crabs 26.0%, *Acetes* 1.6%, Prawns 15.3%, other crustaceans 7.5%, Bivalve larvae 0.1%, Cephalopods 6.3%, Ophiuroids 0.9%, Teleosts 13.6%.

Family : *Gerridae*

46. *Pentaprion longimanus* (Cantor)

(Size range 4.9—10.0 cm; observed in February and March)

FN: 21 (13.0); *Cypris* 15.8%, Calanoids 30.8%, Crustacean remains 7.0% Gastropod larvae 30.6%, Bivalve larvae 15.8%.

NO: 20 (20.0); *Cypridina* 16.7%, *Eucalanus* 16.7%, Calanoids 16.7%, Amphipods 16.7%, Zoaea 16.7%, Decapod remains 16.7%.

Average: 41 (16.4); Entomostracans 58.4%, other crustaceans 13.9%, Gastro pod larvae 18.5%, Bivalve larvae 9.2%.

Family : *Leiognathidae*.

47. *Secutor ruconius* (Ham-Buch)

(Size range 1.9—8.2cm; observed in November, December February and March)

MO: 3 (16.7) *Coscinodiscus* 1.9%, *Neptochaetus* stage 2.9%, Polychaete remains 4.7%, *Cypridina* 4.7%, Calanoids 5.7%, *Centropages* 4.7%, *Acrocalanus* 28.5%, *Calanopia* 4.7%, *Eucalanus* 1.9%, Amphipods 9.5%, Alima 28.9%, Bivalve larvae 1.9%.

FN: 42 (10.1); Foraminifera 1.2%, Copepods 1.6%, Crustacean remains 1.7% Sand 95.5%.

NO: 114 (16.9); *Coscinodiscus* 0.6%, Foraminifera 0.6%, Polychaete remain, 2.3%, *Cypris* 2.3%, *Cypridina* 3.5%, Calanoids 57.8%, *Acrocalanus* 0.4%, *Eucalanus* 1.2%, *Paracalanus* 14.5%, *Euchaeta* 5.8%, Fish larvae 1.2%.

Average: 159 (15.1); *Coscinodiscus* 1.1%, Foraminifera 0.5%, Polychaetes 3.7%, Entomostracans 75.1%, Amphipods 3.7%, Alima 11.2%, Crustacean remains 0.7%, Bivalve larvae 0.7%, Fish larvae 0.7%, sand 4.2%.

48. *Leiognathus dussumeiri* (Val.)

(Size 7.2cm; observed in November)

NO: 1 (15.0) Foraminifera 25.0%, *Cypris* 25.0%, Copepods 25.0%, Decapod remains 25.0%.

49. *Leiognathus daura* (Cuv.)

(Size range 8.0—16.8cm; observed in November and February)

NO: 3 (16.7); Foraminifera 21.5%, Polychaete remains 21.5%, Amphipods 7.0%, Copepods 21.5%, crab 14.0%, Crustaceans 1.4%, *Architectonica* 14.0%.

50. *Leiognathus bindus* (Val.)

(Size range 2.3—11.0cm; observed from November to April)

MO: 21 (13.4); Cypris 3.8%, Calanoids 57.7%, Alima 28.8%, Teleost 9.6%.

FN: 80 (15.8); *Coscinodiscus* 0.9%, Polychaete remains 4.7%, *Cypris* 1.3%, *Cypridina* 1.0%, Amphipods 0.2%, *Eucalanus* 5.1%, Calanoids 4.5%, *Calanopia* 5.6%, *Oithona* 1.1%, *Oncaea* 0.3%, *Paracalanus* 27.2%, *Corycaeus* 4.1%, *Candacia* 2.3%, *Euchaeta* 11.7%, *Acrocalanus* 26.4%, Copepods 0.1%, *Lucifer* 0.2%, Decapod larvae 1.2%, Alima 1.1%, Teleost remains 0.1%, Isopods 1.0%.

NO: 22 (21.8); Polychaete remains 54.9%, *Cypris* 0.8%, Calanoid 0.8%, Copepods 0.2%, *Lucifer* 7.8%, Decapod larvae 3.9%, Alima 23.6%, fish eggs 7.8%, Sand 0.2%.

AN: 6 (10.8); *Cypridina* 31.0%, *Calanopia* 38.0%, *Acrocalanus* 31.0%.

Average: 129 (16.2); *Coscinodiscus* 0.8%, Polychaete remains 8.4%, Calanoids 26.0%, other entomostracans 13.4%, *Lucifer* 9.6%, Alima 32.8%, other Crustaceans 6.2%, Fish eggs 0.9%, Teleost remains 1.6%, Sand 0.2%.

51. *Gazza minuta* (Bloch)

(Size range 10.0—12.4cm; observed in December and February)

E: 2 (25.0); Maldiniids 50.0%, Eunicids 50.0%.

Family : *Pomadasyidae*52. *Pomadasys argyreus* (Val.)

(Size range 10.2—16.0cm; observed in March)

MO: 13 (11.9); Isopods 5.8%, Megalopa 2.0%, Portunid crabs 5.8%, Prawn remains 5.5%, *Squilla* 73.1%, Crustacean remains 3.8%, *Minolia* 2.0%, *Paphia* 2.0%.

FN: 15 (18.0); Polychaete remains 3.0%, Anemone 17.6%, *Lingula* 0.6%, Amphipods 0.6%, Copepods 0.6%, Portunid crabs 8.9%, Echinoids 3.0%, *Salpa* 0.6%, Platycephalids 53.4%, Teleost remains 11.7%.

AN: 4 (9.8); Amphipods 1.8%, Portunid crabs 11.5%, prawn remains 5.7%, *Squilla* 80.4%, Molluscan remains 0.6%.

Average: 32 (14.5); Polychaetes 2.2%, Anemone 10.1%, *Lingula* 0.4%
Portunid crabs 8.2%, *Squilla* 27.5%, other crustaceans 5.5%, Nolluscs
1.5%, Echinoids 2.2%, *Salpa* 0.4%, Platycephalids 34.6%, other Teleosts
7.6%.

53. *Pomadasys maculatus* (Bloch)

(Size range 5.0—27.0cm; observed in November and March)

FN: 17 (24.0); Polychaetes 8.0%, Stomatopods 47.0%, *Acetes* 39.0%, Teleost
remains 6.0%.

Family : *Sciaenidae*

54. *Sciaena dussumeiri* (Yal)

(Size 15.0cm; observed in February)

NI: 1 (20.0); Crustacean remains 100.0%.

55. *Sciaena macropterus* (Blkr)

(Size 6.4cm; observed in February)

NO: 1 (30.0); Amphipods 1.7%, crab 5.0%, *Acetes* 53.3%, Stomatopods
40.0%.

56. *Johnius dussumeiri* (Cuv)

(Size 15.0cm; observed in February)

MO: 1 (20.0); Polychaetes 40.0%, *Lingula* 40.0%, Crustaceans 20.0%.

57. *Johnius anaeus* Bloch

(Size range 18.2—24.0cm; observed from January to April)

MO: 1 (30.0); Prawns 0.7%, *Rastrelliger* 19.4%, Teleost remains 74.6%,
Megalopa 1.3%, Euphausids 4.0%.

FN: 16 (8.1); Isopods 7.1%, *Neptunus gladiator* 27.4%, Penaeid larvae 23.8%,
Cariid prawns 3.6%, Decapod remains 11.9%, Teleost remains 26.2%,
Fish scales 0.1%.

NO: 7 (27.1); Cypridina 50.0%, Isopods 50.0%.

AN: 13 (19.2); Decapod remains 0.2%, *Squilla* 2.1%, Teleosts 97.8%.

E: 11 (29.1); *Rastrelliger* 72.5%, Teleost remains 27.5%.

NI: 41 (16.7); *Cypridina* 3.5%, *Cypris* 0.1%, Calanoids 0.2%, *Euchaeta*
0.1%, Copepods 0.2%, *Megalopa* 0.6%, Isopods 0.3%, Amphipods 0.6%,
Crab remains 1.4%, *Acetes* 0.7%, prawns 0.9%, Decapod 7.7%, Mysids
0.1%, *Lucifer* 0.1%, *Alima* 1.4%, *Squilla* 0.1%, Crustacean remains

0.2%, *Loligo* 1.4%, Teleost larvae 3.5%, *Bregmaceros* 4.1%, *Anchoviella* 7.9%, *Rastrelliger* 29.9%, Teleost remains 31.3%, *Trichiurus* 3.6%, Fish scales 0.1%.

Average: 89 (18.0); Crustaceans 11.7%, *Loligo* 0.7%, *Rastrelliger* 34.7% other Teleosts 52.9%.

58. *Johnius coibar* (Ham-Buch)

(Size range 14.7—22.8cm; observed in February)

E: 13 (13.3); *Neptunus pelagicus* 25.9%, *Charybdis* 15.3%, Prawns 21.2%, *Sepia* 22.3%, *Polynemus* 3.7%, Percoids 0.6%, Teleost remains 11.0%.

59. *Johnius argentatus* (Houttuyn)

(Size range 8.1—9.0cm; observed in February)

MO: 7 (4.8); *Lingula* 27.8%, Copepods 55.5%, Crustaceans 16.7%.

60. *Johnius* sp.

(Size range 10.0—19.0cm; observed in February)

FN: 20 (10.3); crab remains 0.1%, *Ace.es* 3.1%, *penaeus* 9.9%, prawns 5.2%, Stomatopods 7.8%, Crustacean remains 3.1%, post larval Teleosts 3.1%, *Anchoviella insularis* 33.3% Gobeids 3.1%, Teleost remains 29.9%, Fishscales 1.5%.

E: 38 (0.5) Decapod remains 28.8%, Crustacean remains 5.8%, Teleost remains 52.5%, Fish scales 13.0%.

NI: 2 (27.5); Isopods 20.0%, *Matuta* 25.4%, *Penaens* 54.5%.

Average: 60 (4.7); Prawns 21.6%, Crustaceans 23.3%, *Anchoviella* 23.4%, Teleosts 31.7%.

61. *Johnius carutta* (Bloch)

(Size range 9.2—17.0cm; observed from February to April)

MO: 3 (10.0); Isopods 9.0%, copepods 10.0%.

FN: 10 (17.5); Glycerids 3.3%, *Megalopa* 1.6%, *Philyra* 9.9%, Paenaeids 6.6%, *Squilla woodmasoni* 65.6%, Elver 13.0%.

NI: 25 (14.4); Foraminifera 0.1%, Anemones 5.7%, *Eunice* 5.1%, *Nereis* 0.2%, Phyllodocids 0.1%, *Cypridina* 1.6%, Isopods 2.6%, Amphipods 0.9% crab remains 27.2% Hermit crabs 8.2%, *Elamene* 3.2%, *Corbis* 3.1%, prawns 3.7%, Decapod remains 0.1%, *Squilla* 4.9%, Crustacean remains 8.6%, Lamellibranchs 3.1%, *Dentalium* 1.3%, Molluscan remains 0.9%, Echinoids 0.5%, Ascidiars 3.1%, Blenneids 5.0%, Teleost remains 10.7%, fish scales 0.1%.

Average: 38 (14.9); Foraminifera 0.1%, Anemones 4.4%, Polychaetes 4.9%, crab 23.2%, Stomatopods 18.5%, other crustaceans 50.0%, Molluscs 4.1%, Echinoids 0.4%, Ascidiars 2.4%, Teleosts 15.0%.

62. *Otolithus maculatus* (Cuv.)

(Size range 10.5—20.8cm; observed in February and March)

FN: 3 (1.0); Megalopa 50.0%, Decapod remains 50.0%.

63. *Otolithus argenteus* Cuv.

(Size range 12.5—28.0cm; observed in March and April)

FN: 9 (20.0); *Scylla serrata* 2.8%, Cariid prawns 35.9%, *Squilla woodmasoni* 61.3%.

AN: 2 (7.5); *Metapenaeus monoceros* 100.0%.

E: 3 (2.8); crab remains 18.6%, prawns 6.8%, Teleosts 74.6%.

NI: 2 (10.0); *Neptunus* 97.3%, prawns 2.7%.

Average: 16 (14.0); crabs 11.0%, prawns 36.8%, *Squilla* 50.3%, Teleosts 1.9%.

64. *Otolithus ruber* (Schn.)

(Size range 6.5—8.5cm; observed in March)

FN: 3 (12.0); Amphipods 6.1%, Calanoids 2.4%, Alima 6.1%, Cephalopod remains 36.4%, Teleost remains 48.5%.

Family : *Mullidae*

65. *Upeneus sulphureus* (Cuv.)

(Size range 6.0—13.5cm; observed from November to February)

MO: 1 (30.0); *Acetes* 6.6%, Stomatopods 93.4%.

FN: 28 (5.7); Amphipods 0.7%, *Neptunus* 5.7%, *Matuta* 5.7%, Portunid crabs 0.2%, crabs 9.6%, *Acetes* 14.3%, penaeid prawns 6.4%, prawns 21.4%, *Squilla* 21.0%, crustacean eggs 0.3%, Heteropods 0.3%, *Sepia* 6.4%, Teleost remains 8.0%.

AN: 88 (7.1); Foraminifera 0.1%, Medusa 0.1%, Polychaete remains 0.1%, Cypris 0.6%, *Cypridina* 0.3%, Amphipods 4.5%, Copepods 0.1%, crab remains 4.5%, Penaeid prawns 7.9%, *Metapenaeus* 27.3%, prawns 20.9%, *Metapenaeus affinis* 1.1%, *M. brevicornis* 0.4%, Decapods 0.3%, *Squilla* 6.2%, Stomatopods 8.6%, crustacean remains 0.4%, Bivalve larvae 0.1%, Gastropod larvae 0.4%, *Nerita* 0.1%, *Natica* 0.1%, *Sinum* 0.4%, Ophiuroids 0.6%, *Leptocephalus* 0.6%, Gobeids 1.6%, *Grammoplites scaber* 6.2%.

Bregmaceros 1.0%, Teleost larvae 2.9%, Teleost remains 2.8%, fish scales 0.2%.

NI: 60 (2.4); *Cypridina* 2.0%, *Neptunus* 20.8%, prawns 12.5%, Bivalve larvae 2.1%, Teleost remains 62.5%.

Average: 177 (5.4); Foraminifera 0.1%, Medusa 0.7%, Polychaete remains 0.1%, prawns 47.8%, Stomatopods 17.0%, other Crustaceans 18.2%, Molluscs 2.3%, Ophiuroids 0.4%, Teleosts 13.4%.

Family : *Ephippidae*

66. *Ehipus orbis* (Bloch)

(Size range 6.1—12.7cm; observed in February and March)

NO: 2 (15.0); *Cypris* 33.3%, Crustacean remains 66.6%.

E: 3 (8.3); Teleost remains 100.0%.

Average: 5 (11.0); Crustaceans 60.0%, Teleosts 40.0%.

Family : *Drepanidae*

67. *Drepane punctata* (Linn.)

(Size range 6.0—29.0cm; observed in November, December, March and April)

MO: 4 (17.5); Polychaete remains 91.0%, crab remains 9.0%.

FN: 102 (24.1); Anemones 0.8%, *Nereis* 11.6%, sedentary polychaetes 2.9%, Eunicid 11.6%, polychaete remains 59.8%, *Bowerbankia caudata* 0.1%, *Lingula* 2.6%, *Cypris* 0.1%, Clanoids 0.1%, Copepods 0.1%, Amphipods 4.7%, *Lucifer* 0.1%, *Megalopa* 0.3%, Balanoids 0.7%, prawns 4.0%, Decapods 0.3%, Stomatopods 0.1%, Lamellibranchs 0.1%.

NO: 2 (25.0); Coelenterates 33.3%, Polychaete remains 53.3%, Amphipods 13.3%.

AN: 4 (10.5); *Nereis* 99.0%, Teleost remains 1.0%.

E: 6 (16.7); Foraminifera 1.4%, Maldiniids 2.9%, Polychaete remains 57.2%, Amphipods 10.0%, Decapod remains 28.5%.

Average: 118 (23.1); Foraminifera 0.1%, Coelenterates 0.6%, Anemones 0.7%, Polychaetes 86.0%, *Lingula* 3.1%, Crustaceans 9.3%, Miscellaneous 0.2%.

Family : *Uranoscopidae*

68. *Uranoscopus lebech* (Bloch)

(Size range 4.1—13.5cm; observed in November and April)

MO: 39 (13.4); *Lingula* 0.1%, Amphipods 4.2%, *Metapenaeus* 5.1%, *Therapon quadrilineatus* 2.6%, Penaeids 1.2%, *Grammoplites* 3.5%, Teleost remains 83.3%.

FN: 29 (15.2); *Cypris* 0.1%, crabs 0.6%, *Acetes* 1.4%, Cariid prawns 0.5%, Crustacean remains 2.1%, Elver 7.0%, Teleost remains 88.3%.

NO: 26 (17.0); *Lingula* 0.1%, young lobster 0.7%, Crustacean remains 15.0%, *Apogon* 9.2%, *Nemipterus* 9.8%, Teleost remains 65.2%.

AN: 31 (12.5); Isopods 1.0%, Mysids 0.4%, *Metapenaeus* 0.3%, prawn remains 5.6%, crustacean remains 2.4%, *Anchoviella* 4.7%, Elver 21.9%, *Apogon* 14.8%, *Bregmaceros* 8.9%, Teleost remains 39.8%, Sand 0.1%.

E: 3 (20.0); Teleost remains 100.0%.

NI: 15 (8.0); crabs 0.5%, *Acetes* 3.2%, *Metapenaeus* 3.2%, Cariid prawns 1.1%, Crustacean remains 3.5%, *Salpa* 1.1%, *Apogon* 12.8%, eel 12.8%, Teleost remains 61.8%.

Average: 143 (13.3); *Lingula* 0.1%, Crustaceans 9.8%, *Salpa* 0.1%, Teleost 90.0%.

Family : *Callionymidae*

69. *Callionymus sagitta* Pallas

(Size range 3.8—8.5cm; observed in February)

MO: 1 (20.0); Amphipods 100.0%.

NO: 20 (18.0); Amphipods 32.0%, crabs 21.3%, Decapod remains 10.7%, *Pecten* 32.0%, Bivalves 2.0%, Echinoid remains 2.0%.

Average: 21 (18.1); Amphipods 42.8%, crabs 17.9%, Decapod remains 8.9%, *Pecten* 26.8%, Bivalves 1.8%, Echinoid remains 1.8%.

Family : *Trichiuridae*

70. *Trichiurus haumela* (Forsk.)

(Size range 9.0—55.2cm; (Total length); observed in November, December and February to April)

MO: 2 (20.0); Stomatopods 1.3%, *Rastrelliger* 52.0%, Teleost remains 46.7%.

FN: 3 (16.7); Post larval Teleosts 33.3%, *Saurida* 66.6%.

NO: 10 (15.5); *Anchoviella* 100.0%.

AN: 3 (2.7); Teleost remains 100.0%.

E: 6 (5.0); Polychaete remains 0.1%, Teleosts 99.9%.

NI: 6 (12.2); *Bregmaceros* 34.2%, Teleost remains 65.8%.

Average: 30 (11.9); Polychaetes 0.1%, Stomatopods 0.1%, Teleosts 99.8%.

Family : *Scombridae*71. *Rastrelliger kanagurta* (Cuv.)

(Size range 3.1—20.0cm; observed in November and February to April)

MO: 3 (9.7); Cypris stage 4.4%, *Euterpina* 43.2%, Calanoids 4.4%, *Paracalanus* 21.8%, Decapod larvae 21.8%, Crustacean remains 4.4%.

FN: 1 (10.0); digested matter.

E: 16 (10.0); *Coscinodiscus* 31.8%, Foraminifera 0.5%, polychaete remains 0.2%, Cypris stage 11.4%, *Euterpina* 6.1%, Calanoids 23.9%, *Eucalanus* 0.8%, Copepods 0.8%, *Corypcaeus* 0.8%, Isopods 0.5%, Megalopod 1.1%, Stomatopods 5.6%, Bivalve larvae 1.3%, Fish scales 0.8%.

NI: 1 (20.0); Alima 100.0%

Average: 21 (10.4); *Coscinodiscus* 24.0%, Foraminifera 0.4%, polychaetes 0.2%, Copepods 36.0%, Stomatopods 20.1%, other Crustaceans 12.3%, Bivalve larvae 1.0%, Fish scales 6.0%.Family : *Stomateidae*72. *Parastromateus niger* (Bloch)

(Size range 14.0—23.0cm; observed in April)

Average: 25 (1.5); Cladocera 6.3%, Copepods 18.8%, Amphipods 6.3% Crustacean remains 37.6%, Fish scales 31.0%. (Samples from three hauls, got mixed up).

73. *Pampus argenteus* (Euphr.)

(Size range 12.5—21.0cm; observed from February to April)

FN: 49 (2.2); Polychaete remains 0.8%, Cypris 28.4%, *Evadne* 16.9%, *Candacia* 0.6%, *Corypcaeus* 2.0%, *Eucalanus* 6.5%, *Macrosetella* 0.8%, *Saphirina* 1.4%, *Oithona* 0.8%, Calanoids 0.8%, Copepods 16.9%, Amphipods 10.9%, Decapod larvae 3.9%, Crustacean remains 4.1%, Gastropod larvae 1.4%, Calcareous remains 1.4%, *Salpa* 0.8, fish eggs 0.8%, fish scales 0.8%.74. *Pampus chinensis* (Euphr.)

(Size range 12.6—18.7 cm; observed from January to April)

MO: 2 (0.5); crabs 100.0%.

FN: 5 (20.0); Crustacean remains 100.0%.

E: 4 (7.0); *Gammarus* 28.3%, crabs 14.2%, Crustacean remains 56.7%, fish eggs 0.9%.

NI: 1 (0.0); Empty.

Average: 12 (3.0); *Gammarus* 26.4%, crabs 16.5%, Crustacean remains 56.2%, fish eggs 0.9%.

Family : *Kurtidae*75. *Kurtus indicus* (Bloch)

(Size range 3.5—11.6cm; observed in February)

MO: 20 (12.0); *Eucalanus* 0.9%, *Euchaeta* 0.9%, Amphipods 4.4%, *Megalopa* 6.6%, Cariid prawns 39.2%, Teleost remains 48.0%.Family : *Synanceidae*76. *Minous monodactyles* (Bloch and Schn.)

(Size range 7.0—8.5cm; observed in March)

FN: 2 (28.0); Amphipods 9.1%, *Scylla serrata* 18.2%, *Metapenaeus* 32.8%, *Parapenaeopsis* 32.5%, Decapods 7.3%.E: 3 (16.0); Amphipods 6.8%, *Charybdis* 13.6%, *Metapenaeus* 13.6%, Carid prawns 22.7%, Decapods 6.8%, *Platycephalus* 36.5%.Average: 5 (20.0); Amphipods 8.1%, *Charybdis* 6.1%, *Scylla serrata* 10.1%, *Metapenaeus* 24.2%, *Parapenaeopsis* 18.1%, Carid prawns 10.0%, Decapods 7.1%, *Platycephalus* 16.3%.Family : *Platycephalidae*77. *Grammolites scaber* (Linn.)

(Size range 6.2—22.0cm; observed in December, February and March)

MO: 8 (17.9); *Lingula* 1.1%, Copepods 0.3%, Penaeids 9.1%, Decapod remains 11.3%, *Squilla woodmasonii* 56.6%, prawn remains 17.0%, Teleost larvae 4.6%.FN: 8 (0.7); *Megalopa* 9.1%, Portunids 36.4%, *Arcania* 54.5%.NO: 12 (12.0); Portunids 83.4%, Crustacean remains 8.3%, *Platycephalus* 8.3%.AN: 2 (22.5); *Metapenaeus dobsonii* 55.6%, Teleost remains 44.4%.NI: 8 (7.7); crab remains 27.0%, *Acetes* 11.1%, *Metapenaeus obsonii* 33.3%, Decapod remains 3.0%, Sciaenids 25.6%.Average: 38 (10.7); *Lingula* 0.4%, crabs 30.5%, prawns 24.5%, *Squilla* 17.4%, other crustaceans 10.2%, Teleosts 17.0%.Family : *Dactylopteridae*78. *Dactyloptena orientalis* (Cuv.)

(Size range 14.0—18.5 cm; observed in April)

FN: 3 (18.3); *Metapenaeus* 90.0%, prawn remains 10.0%.

Family : *Psettodidae*79. *Psettodes erumei* (Bloch)

(Size range 13.8—30.5cm; observed in December, February and March)

MO: 1 (0.0).

FN: 3 (8.3); *Leiognathus* 100.0%.

NO: 1 (0.0).

AN: 2 (0.0).

E: 1 (20.0); Teleost remains 100.0%.

Average 8 (5.6); *Leiognathus* 38.5%, Teleost remains 61.5%.Family : *Bothidae*80. *Pseudorhombus javanicus* (Blkr)

(Size range 4.8—24.5cm; (Total length); observed in December and February)

FN: 2 (5.0); digested matter.

NO: 41 (25.4); Polychaetes 3.2%, Amphipods 0.1%, Gammarids 2.5%
Hyperids 0.5%, Mysids 8.8%, Megalopa 0.3%, *Metograsmus* 4.0%, Grapsid
crabs 2.1%, *Charybdis* 2.0%, crabs 0.3%, *Diogenes* 8.0%, Porcellanid 1.7%
Cariid prawns 2.5%, prawns 1.6%, Gobeids 24.6%, Platycephalids 21.8%,
Teleost remains 16.0%.NI: 1 (20.0); *Acetes* 7.9%, Stomatopods 73.7%, Crustacean remains 2.6%,
Teleost remains 15.8%.Average: 44 (24.4); Polychaetes 3.2%, Amphipods 3.1%, Mysids 8.6%,
crabs 17.9%, other Crustaceans 5.9%, Teleost remains 61.5%.81. *Pseudorhombus arsius* (Ham-Buch)

(Size range 5.0—14.5cm (Total length); observed in January and February)

NO: 15 (26.0); Euphausiids 3.8%, *Gammarus* 1.9%, Hyperids 3.8%, Megalopa
3.8%, crab remains 7.7%, *Diogenes* 7.7%, *Lystosquilla* 13.5%, Teleost remains
46.3%, Fish larvae 11.5%.AN: 2 (20.0); *Gammarus* 7.5%, *Neptunus gladiator* 25.0%, *Arcania* 12.5%,
Charybdis 30.0%, other crabs 10.0%, prawn 5.0%, Fish larvae 10.0%.Average: 17 (24.0); crabs 21.2%, *Lystosquilla* 12.2%, other Crustaceans 13.4%
Fish larvae 11.4%, Teleost remains 41.8%.

82. *Pseudorhombus triocellatus* (Bloch)

(Size 9.5cm (total length); observed in November)

FN: 1 (25.0); Euphausiids 8.0%, Acetes 76.0%, *Opisthopterus* 16.0%.83. *Bothus polylepis* (Alcock)

(Size range 9.0 cm; (total length); observed in February)

FN: 1 (30.0); *Trachynocephalus myops* 100.0%.84. *Crossorhombus valde-rostratus* (Alcock)

(Size range 11.0—17.5 cm; (total length); observed in December and March)

FN: 3 (22.0); Percoid 4.8%, *Bregmaceros* 76.0%, Teleost remains 19.2%.

AN: 1 (20.0); Amphipods 0.5%, Portunids 59.5%, other crabs 40.0%.

E: 1 (20.0); *Cypris* 0.5%, Decapod remains 14.9%, Percoids 84.6%.Average: 5 (21.2); Crustaceans 23.4%, *Bregmaceros* 46.6%, Teleosts 31.0%.Family : *Soleidae*85. *Solea elongata* Day

(Size range 7.5—9.5 cm (total length); observed in March)

FN: 2 (15.0); Copepods 33.3%, Amphipods 33.3%, *Diognes* 22.2%, *Megalopa* 11.1%.Family : *Cynoglossidae*86. *Cynoglossus arel* (Bloch)

(Size range 14.2—20.0 cm; (total length); observed in November)

FN: 1 (1.0); Crustacean remains 50.0%, Sand 50.0%.

NO: 2 (5.0); Stomatopod remains 50.0%, Sand 50.0%.

Average: 3 (1.5); Stomatopods 33.3%, Crustacean remains 16.7%, Sand 50.0%.

87. *Cynoglossus macrolepidotus* (Blkr.)

(Size range 9.9—31.0 cm (Total length); observed in November, February and March)

MO: 35 (10.0); Polychaetes 25.4%, *Lingula* 2.0%, *Cypris* 2.0%, Amphipods 6.4%, Isopods 7.8%, Copepods 0.8%, *Philyra* 7.8%, Pagurids 2.3%, crab remains 11.6%, Decapods 19.2%, Brachyura 6.4%, Bivalves 1.9%, *Dentalium* 6.4%.

FN: 25 (4.8); Foraminifera 2.2%, *Lingula* 6.6%, Amphipods 14.5%, *Polonyx* 1.1%, Grapsids 26.5%, crab remains 2.2%, Decapods 2.2%, Stomatopods 2.2%, Teleost remains 42.5%.

NO: 23 (7.6); Foraminifera 7.9%, Stomatopods 73.7%, Teleosts 18.4%.

NI: 1 (2.0); Foraminifera 33.3%, Crustacean 33.3%, Echinoids 33.3%.

Average: 84 (7.7); Foraminifera 1.8%, Polychaetes 15.9%, *Lingula* 2.6%, Amphipods 7.0%, Isopods 4.9%, crabs 18.9%, Stomatopods 12.7%, other Crustaceans 18.6%, Molluscs 6.4%, Echinoids 0.4%, Teleosts 11.0%.

88. *Cynoglossus lida* (Blkr.)

(Size range 11.0—16.5 cm (total length); observed in November)

NO: 4 (2.3); Foraminifera 28.6% Crustacean remains 57.1% sand 14.3%.

Family : *Tetradontidae*

89. *Arothron immaculatus* (Bloch)

(Size 3.5 cm; observed in November)

MO: 1 (30.0); Crustacean remains 100.0%.

Family : *Logocephalidae*

90. *Gastrophysus lunaris* (Bloch)

(Size range 4.2—20.0 cm; observed in November, December and February)

MO: 2 (20.0); Ctenophores 5.0%, Megalopa 20%, Prawn remains 60.0%, Stomatopods 15.0%.

FN: 1 (28.0); *Acetes* 10.5%, Stomatopods 3.5%, Teleost remains 86.6%.

NO: 12 (7.4); *Cypridina* 1.5%, Crustaceans 18.5%, Teleosts 80.0%.

AN: 9 (4.4); Isopods 9.3%, Crustaceans 0.1%, Echinoderm shells 89.0, Teleost remains 1.3%.

Average: 24 (8.2); Ctenophora 1.1%, Crustaceans 38.5%, Echinoderms 18.4%, Teleosts 42.0%.

Family : *Gadidae*

91. *Bregmaceros atripinnis* (Tickell)

(Size range 5.5—9.0 cm; observed in January)

AN: 9 (10.00); Megalopa 1.2%, *Penaeus* 46.0%, Cariid prawns 51.6%, Stomatopods 1.2%.

NI: 6 (14.0); Amphipods 3.6%, crab remains 18.0%, *Metapenaeus monoceros* 78.4.

Average: 15 (11.6); *Penaeus* 26.8%, *Metapenaeus* 32.8%, Cariid prawns 30.2%, other crustaceans 10.2%.

FOOD AND FEEDING HABITS

It may be seen from the analysis of the stomach contents that there is a wide variation in the food and feeding habits between the different groups of fishes obtained at the bottom and also between different species within a group. There are marked diurnal differences in the composition of the food items.

The elasmobranches were observed to be feeding on bottom living organisms like *polychaetes*, alpheids, *Albunea*, *Sinum* and Gobeid fish with the exception of *Scoliodon sorrakowah*, which ingested fish and crustaceans that are in general found at all levels from the surface to the bottom of the sea.

The Clupeids contained copepods as the major food items in their stomachs. The predominantly copepod feeders (*Sardinella fimbriata*, *Opisthopterus tardoore*, *Dussumieria hasselti*, *Anchoviella heterolobus*) were caught in the trawls mostly during the morning hauls and to some extent in the forenoon hauls also. *A. insularis* was observed to differ from *A. heterolobus*, in containing a very high percentage (34.5%) of *Acetes*, though both the fishes were found primarily to be copepod feeders. *D. hasselti* was found to prefer *Anchoviella* and *Alima* larva, which were observed in abundance in the stomach contents during the morning and forenoon periods. *Euplatygaster indica* was caught mostly during the evening and night hauls (to some extent in the morning hauls also) and was observed to be feeding largely on crustaceans, of which *Squilla* was very common. The presence of typically benthic organisms like *Lytocarpus*, amphipods, *Calappa*, bivalves, gastropods and pleuronectids in the stomachs of *E. indica* shows that the fish frequents the bottom.

Of the Synodontids, *Saurida tumbil*, which was commonly available in the trawl catches, was found to subsist mostly on a variety of small fish—pelagic as well as benthic. *Loligo*, which formed a considerable percentage of the stomach contents, as reported by Malpas (1926) also, appears to be a favourite food item of the fish. The occurrence of pelagic fish and *Loligo* in greater abundance in the stomachs of these fish obtained during the morning and forenoon hauls, coincided with their height of feeding.

The catfishes were mainly represented by *Pseudarius jella*, which appears to be an omnivorous and voracious feeder, particularly during the night time. Typical benthic forms like anemones, polychaetes, crabs, amphipods, anomurans, stomatopods, bivalves and gastropods, were observed frequently, indicating the pronounced bottom feeding nature of the fish. Crabs, prawns and cephalopods constituted the bulk of their food during the night. The presence of the typically bottom living *Cynoglossus* also, during the night only, in their stomachs shows that the fishes in general fell an easy prey to the tactile propensities of catfishes, under cover of darkness resulting in an increase of the feeding activity of the catfish during the period.

Fistularia villosa which was often encountered in the trawl catches, appear to be predominantly piscivorous.

Polynemids were of frequent occurrence in the trawl catches, of which *Polynemus sextarius* and *p. sexfilis* were fairly common. The feeding activity of these fishes was very high at all times of the day. Stomatopods and crabs were the important food items. *P. sexfilis* was however observed to have ingested teleosts in considerable quantities unlike *P. sextarius*. It is interesting to note that *Acetes*, stomatopods and small prawns were observed in the stomach contents of these fish in greater abundance during midday which shows the abundance of the food items at the bottom during the period. Similarly, copepods were observed in the stomachs of a few *P. sextarius* obtained during the morning period only.

The family Apogonidae was represented by *A. septemstriatus* and *A. nigripinnis* in the trawl catches, of which the former was more common than the latter. Exceptionally large numbers of *A. septemstriatus* were observed in the noon hauls in the months of February. The food of these fish was mainly composed of crustaceans. An interesting feature was the occurrence of crustacean eggs in their stomachs in considerable quantities. *Bregmaceros* was the important teleostean item. *A. septemstriatus* appears to be a very active feeder during the forenoon period ingesting *Acetes*, young prawns and *Squilla*.

Lactarius lactarius constituted a good fishery of the trawl catches. Alima larva, prawns and *Acetes* were the favourite food items of the fish, which was found to be an active feeder around midday. Polychaete remains were observed in the fish obtained during noon along with *Acetes*, while copepods were met with during the forenoon period only.

Carangids were fairly common of which, *Carangoides chrysophrys*, *C. malabaricus* and *Psenes indicus* were feeding mainly on crustaceans. Alima larva and *Acetes* were met with more frequently in *Atropus atropus*, *C. chrysophrys*, and *C. malabaricus* while copepods were of frequent occurrence in the stomachs of *P. indicus*.

Nemipterus japonicus constituted a fishery of some importance in the trawl catches from December to May. From the variety of bottom fauna observed among the food items, the fish may be described as a typical bottom feeder. The important food organisms were found to be anemones, polychaetes, isopods, amphipods, crabs, prawns, cephalopods and teleosts, besides which benthic organisms like foraminifera, *Hippa*, ophiuroids, pleuronectids, gobiids and *Grammolites* sp. were present in small quantities. The feeding activity of the fish was high during forenoon and noon periods and low during the night. The fish appears to be a sight-feeder preferring a variety of benthic fauna including crustaceans.

Pentaptrion longimanus was observed to be feeding mainly on copepods, *Cypridina* and molluscan larvae.

Leiognathus bindus and *Secutor ruconius*—the common leiognathids off Waltair, were caught in large numbers during the noon and forenoon hauls, when foraminifera and polychaetes were often encountered in their stomachs along with Calanoid copepods and Alima, which appear to be their favourite food items.

The food of *Pomadasys* spp. was mainly benthic in nature consisting of *Squilla*, polychaetes, molluscs, echinoids, anemones and *Platycephalus* sp., besides which other crustaceans were also observed.

Teleosts constituted a considerable percentage of the food composition of Sciaenids, which were mainly, represented by *Johnius anaeus* and *J. carutta*. The food of the latter was mostly composed of benthic fauna. Other Sciaenids of lesser importance were observed feeding on crabs, *Acetes* and stomatopods also. The feeding intensity of *J. anaeus* was very high from evening to morning with a secondary peak during noon. The fish was feeding heavily on *Rastrelliger* and *Bregmaceros* during the night. Caridid prawns and *Squilla* were observed in greater volume and frequency in the stomach contents of *J. carutta* and *Otolithus argenteus* obtained during the forenoon hauls.

Upeneus sulphureus was another important fish caught in large quantities in the trawls. *Acetes*, prawns and *Squilla* were the chief food items of the fish obtained in the forenoon and afternoon hauls, while teleosts were predominant in their stomachs during the night. The bottom living fishes like Gobeids, *Grammoplites* and *Bregmaceros* were observed in fish obtained during the evening hauls. The average feeding intensity of the fish was poor without any marked increase during any period of the day.

Drepane punctata was observed to be predominantly vermivorous with a pronounced bottom feeding habit.

Uranoscopus lebeck was also frequently observed in considerable numbers in the trawl catches. The fish was found to be a voracious feeder, subsisting mainly on a variety of teleosts, with particular preference for *Apogon*. The feeding activity of the fish was very high during noon. The food items were mostly in an advanced state of digestion.

The depressed head of *Callionymus sagitta*, a characteristic feature of the bottom feeders, and the food eaten, show that it is a strictly bottom feeder.

Trichiurus haumela was found to be predominantly piscivorous. There is a general decrease in its feeding activity from morning to afternoon, with a rising trend during the subsequent period of the day.

The food of *Rastrelliger kanagurta* was mostly made up of copepods and *Coscinodiscus*, but the fish obtained in the evening hauls contained foraminifera, polychaete remains and stomatopods in its stomachs, signifying that these fish visit the bottom before or during evening.

The stomachs of pomfrets were always found with very little food, composed of copepods and amphipods along with whitish pulpy digested matter.

Grammoplites scaber is structurally very well adapted for bottom feeding. Crabs appear to be the favourite food items of the fish. The food items were strictly benthic, excepting *Acetes* and portunid crabs.

The flat fishes were mainly represented in the trawl catches by *Pseudorhombus javonicus* and *Cynoglossus macrolepidotus*. The food of these fishes was typically benthic as in all soles. These were caught mostly during the forenoon and noon hauls with a high intensity of feeding during the period. Teleosts formed a high percentage of their food composition, besides which, crabs, stomatopods, prawns, amphipods and polychaetes were also observed frequently. Bothidae were predominantly piscivorous while cynoglossidae were predominantly carnivorous. Polychaetes were eaten more by *C. macrolepidotus* than by any other flat fish. Polychaetes, amphipods and stomatopods were observed in greater percentages in the stomachs of *C. macrolepidotus* obtained respectively during morning, forenoon and noon periods. The intensity of feeding was highest in *C. macrolepidotus* during morning and in *P. javonicus* and *P. arsius* around noon. It was observed that these fishes were caught in larger numbers during the periods of their most active feeding.

Crustaceans constituted the food of *Bregmaceros atripinnis*, of which prawns were very important.

DISCUSSION

For a correct understanding of the scope and significance of the present study it is necessary to keep in view that the fishes examined were available either at or near the bottom at the time of capture. The presence of surface living fishes also in the trawl catches at certain times of the day may be of some interest. All the fishes obtained in the trawl catches cannot, however, be reckoned as bottom feeders, since some of them were found to feed predominantly on plankton. It is not merely a question of finding out the favourite food organisms of individual species of fish but also to find out whether there is any marked relationship between the food organisms and fishes caught in the trawls. To appreciate fully the wide spectrum of predator-prey relationships it is necessary to review briefly the possible factors influencing the movements of food organisms, which in their turn affect the availability of fishes in the trawl catches.

According to the classical experiments of Russell (1925-34) on the diurnal rhythms in the vertical movements of macroplankton, including the hydrobiological factors, light appears to be the most important factor influencing their movements. Clarke (1934), who correlated the vertical movements of *Calanus* and *Metridia* with measurements of varying light intensity also found a closer correlation between the vertical movements and changes in the submarine irradiation than changes in the hydrographic conditions (salinity, temperature etc.) or the phytoplankton. The changes in submarine irradiation seem to affect the trawl catches, obviously through the macroplankton, which is the connecting link. Jayaraman *et al.* (1959), while discussing the influence of light on the trawl catches said, "The day and night changes in the catch rates have also perhaps something to do with feeding habits of individual categories of fishes and the diurnal vertical movements of these food organisms themselves". It is easy to surmise that the availability of a food organism depends on its habits and that the predation of the organism is again conditioned by the habits, activity and preferences of the preying fish. Under such varying circumstances, it is difficult to draw valid generalisations about the relationships between food organisms and their predators. However, considering that the fishes examined during the present study were all obtained near the bottom, any marked fluctuations in the abundance of food organisms of common preference in the stomach contents of a group of fishes show the varying availability of the food organisms near the bottom during the course of the day. If a particular food item was consistently found to be comparatively more abundant in the stomachs of a variety of fishes during certain periods of the diurnal cycle, it may be assumed to signify migration of the food organisms to the bottom, which is governed by phototropisms.

In this connection, it is necessary to point out certain limitations of the present study. There may be a time lapse between the predation of the food organisms and capture of the predators. Blegvad (1916) who examined hundreds of stomachs of many kinds of bottom living fishes, showed that they took, on an average, 6 hours to empty their stomachs and 4 to 5 hours to fill them again. The duration may be much less in the tropical waters where the digestion is more rapid due to higher rates of metabolism. Since the food organisms considered for the following discussion were mostly in an identifiable state, it is reasonable to assume a negligible time lapse. The freshness of the food organisms obviates another drawback which lies in the possibility of predation taking place at a level far from that of capture.

Before proceeding with the analytical study of variations in the availability of food organisms at the bottom and its effect on the trawl fisheries at different times of the day, it is required to find out the favourite food organisms preyed upon by the different fishes obtained in the trawl catches. In the table below

a list of the important fishes obtained in the trawl catches and their favourite food organisms (based on their quantitative abundance in the stomachs) is given.

Table showing the favourite food organisms of some important fishes

Name of the fish	Favourite food organisms
1. <i>Pellona ditchela</i>	<i>Temora</i>
2. <i>Euplatygaster indica</i>	<i>Squilla</i>
3. <i>Opisthopterus tardoore</i>	<i>Eucalanus, Euchaeta, Cypridina</i> and <i>Megalopa</i> .
4. <i>Dussumieria hasselti</i>	<i>Anchoviella, Alima</i>
5. <i>Anchoviella heterolobus</i>	Entomostracans, bivalve larvae
6. <i>Anchoviella insularis</i>	<i>Acetes, Cypridina</i>
7. <i>Coilia dussumieri</i>	<i>Gammarus</i>
8. <i>Saurida undosquamis</i>	<i>Caranx, Secutor ruconius</i>
9. <i>Saurida tumbil</i>	<i>Anchoviella heterolobus, Loligo</i>
10. <i>Pseudarius jella</i>	Cephalopods, crabs
11. <i>Polynemus sextarius</i>	<i>Metapenaeus, Acetes, Squilla</i>
12. <i>Polynemus sexfilis</i>	penaeid prawns
13. <i>Apogon septemstriatus</i>	prawns, stomatopods, <i>Acetes</i>
14. <i>Apogon nigripinnis</i>	<i>Bregmaceros</i>
15. <i>Lactarius lactarius</i>	<i>Alima</i> , prawns
16. <i>Carangoides malabaricus</i>	<i>Alima</i>
17. <i>Psenes indicus</i>	calanoids
18. <i>Nemipterus japonicus</i>	crabs, prawns
19. <i>Pentaprion longimanus</i>	calanoids, gastropod larvae
20. <i>Secutor ruconius</i>	calanoids, <i>Alima</i>
21. <i>Leiognathus bindus</i>	calanoids, <i>Alima</i>
22. <i>Pomadasys maculata</i>	stomatopods, <i>Acetes</i>
23. <i>Pomadasys argyreus</i>	<i>Squilla, Platycephalus, Anemones</i>
24. <i>Johnius anaeus</i>	<i>Rastrelliger</i>
25. <i>Johnius coibar</i>	Portunid crabs, <i>Sepia</i> , prawn
26. <i>Johnius spp.</i>	<i>Penaeus, Anchoviella</i>

Name of the fish	Favourite food organisms
27. <i>Johnius carutta</i>	<i>Squilla</i> , crabs
28. <i>Otolithus argenteus</i>	<i>Squilla</i> , cariid prawns
29. <i>Upeneus sulphures</i>	penaeid prawns, <i>Squilla</i>
30. <i>Drepaene punctata</i>	polychaetes
31. <i>Callionymus sagitta</i>	amphipods, <i>Pecten</i> .
32. <i>Trichiurus haumela</i>	<i>Anchoviella</i>
33. <i>Rastrëlliger kanagurta</i>	<i>Coscinodiscus</i> , calanoids, <i>Alima</i>
34. <i>Kurtus indicus</i>	cariid prawns
35. <i>Grammoplites scaber</i>	portunid crabs, <i>Squilla</i> , penaeid prawns
36. <i>Pseudorhombus javonicus</i>	Gobeid, Platycephalid
37. <i>Pseudorhombus arsius</i>	<i>Lyslosquilla</i>
38. <i>Cynoglossus macrolepidotus</i>	Polychaetes, Stomatopods
39. <i>Bregmaceros atripinnis</i>	penaeid prawns, cariid prawns

From the table, crustaceans, represented by copepods, *Alima*, *Actes*, young prawns, *Squilla* and crabs, appear to be the favourite food organisms of almost all fishes.

The fishes listed in the table have a variety of structural adaptations for feeding at different levels and at the bottom. Even those fishes which are well adapted for bottom living, with depressed heads (10, 31 and 35), inferior mouths (10, 11, 18, 22, 23, 25, 29, 31, 35 and 39) and tactile organs (10, 11, 25, 29 and 39) contained considerable quantities of crustaceans, which are capable of free movement. Some of the other fishes listed in the table (1, 3, 5, 16, 17, 19, 20, 21 and 23) were predominantly plankton feeders. The occurrence of free moving crustaceans in the stomachs of fishes which are well adapted for bottom feeding and the presence of plankton feeders in the trawl catches need a closer study. The question arises whether these events follow a certain periodicity and vary in magnitude, during the course of a day.

From the analysis of the stomach contents it is noticed that the following food organisms were present in the fishes mentioned against them in greater abundance during the forenoon and noon periods, than at other times of the day.

Actes sp.: *Sardinella fimbriata*, *Anchoviella insularis*, *Polynemus sextarius*, *Apogon septemstriatus*, *Lactarius lactarius*, *Atropus atropus*, *Pomadasy maculata*, and *Upeneus sulphureus*.

Prawns: *S. fimbriata*, *Priacanthus tyeneus*, *Otolithus argenteus*, *Bregmaceros atripinnis*, *Kurtus indicus*, *Trachynocephalus myops*, *A. septemstriatus*, *L. lactarius*, *Nemipterus japonicus*, *U. sulphureus*, and *P. sextarius*.

Squilla: *Trachynocephalus mayops*, *Pseudarius jella*, *Johnius carutta*, *O. argenteus*, *U. sulphureus*, *Pseudorhombus arsius*, and *Cynoglossus macrolepidotus*.

Alima: *Dussumieria hasseltii*, *L. lactarius*, *Carangoides Chrysophrys* and *Leiognathus bindus*.

Crabs were fed upon more during the night time than during day time by *P. jella*, *P. sextarius*, *N. japonicus* and *U. sulphureus*.

Copepods were encountered in the stomachs of *Pellona ditchela*, *Opisthopterus tardoore*, *Anchoviella heterolobus*, *N. japonicus*, *Secutor ruconius*, *Leiognathus bindus*, *Pentaprion longimanus*, and *Rastrelliger canagurta*, obtained during the morning and forenoon periods. Even *P. sextarius*, which is a habitual bottom feeder, was found to feed on copepods during the morning period only.

As has been observed earlier, light intensity appears to play an important role in the periodicity of abundance of the different food organisms at the bottom, within a diurnal cycle. Some experiments on the diurnal variations in the hydrographic conditions off Waltair were conducted by Rao and Rao (1962) who stated that the intensity of solar radiation showed a single oscillation, with a rise in the intensity from 09.00 hrs. to 13.00 hrs., after which it declined. This period corresponds to the periods categorised as forenoon and noon during the present study. *Acetes*, prawns, *Squilla* and *Alima* which were observed in the stomach contents in greater abundance during the forenoon and noon periods, appear to reach the near bottom region at the height of submarine irradiation. The copepods, which are comparatively lower in the food chain, were observed to precede the macroplanktonic and nektonic organisms in their downward descent. This downward descent of copepods is best illustrated on the one hand by the association of calanoid copepods which are planktonic, with sand, foraminifera and polychaetes, in the stomachs of *Secutor ruconius* and *Leiognathus bindus*, obtained during the forenoon period and on the other, traces of cypris and calanoid copepods were observed in the stomachs of *Drepane punctata*, which feeds almost completely on polychaetes at the bottom during the forenoon period only. Copepods as food organisms and copepod predators in the trawl catches, were scarcely present after the forenoon period. It shows that unlike *Acetes*, prawns, *Squilla* and *Alima*, which were found to be abundant at the bottom, around noon, the copepods do not remain actually hugged to the bottom during the peak period of submarine irradiation. The optimum level of the copepods during the period may be situated beyond the reach of trawling operations. The migra-

tory movements of copepods explain the absence of copepod predators in the trawl catches, subsequent to the forenoon and their presence before that period.

Though the abundance of the crustaceans appears to follow a certain diurnal variation, there were instances when the organisms were found in greater abundance in the stomachs of some fish, during periods other than their general abundance. Thus, *Secutor ruconius* which was observed to have the maximum feeding intensity during noon, and *Rastrelliger kanagurta* which was actively feeding during the evening and night periods also contained copepods which are their favourite food items in abundance during the periods of their highest feeding activity. *Euplatygaster indica* and *Grammoplites scaber*, with a high level of feeding intensity during the morning (the former during night also) were found to contain their favourite food item, *Squilla*, during the period in considerable quantities. These observations seem to show the selective feeding of the predators which complicates to some extent an understanding of the predator-prey relationships.

During certain parts of the day some food organisms were observed to be more vulnerable for predation at the bottom and similarly some preying fishes for capture in the trawls. This appears to depend upon the predator-prey relationships. Thus *Rastrelliger kanagurta* was found in the stomachs of *Euplatygaster indica*; *Saurida tumbil*, *Johnius anaeus* and *Trichiurus haumela*, obtained during the evening, night and morning hauls respectively. *Anchoviella* sp. (*S. tumbil*, *Nemipterus japonicus* and *T. haumela*) and *Secutor ruconius* (*S. undosquamis*), were observed more in the stomach contents of those fishes obtained around midday. *S. tumbil* and *T. haumela* contained *Bregmaceros* sp. during the night time, which coincided with the highest feeding activity of the prey. *N. japonicus* which was found to feed heavily on prawns, crabs, amphipods and isopods, besides anemones and polychaetes around midday was caught in the trawl nets in large quantities during the period. *Secutor ruconius* and *Leiognathus bindus*, became most vulnerable for capture in the trawl nets during the period of their maximum feeding activity, namely midday. The highest feeding intensity of *Upeneus sulphureus* was found to be during forenoon and afternoon periods, which coincided with the maximum abundance of their favourite items (prawns), along with stomatopods and other typical benthic fauna; and its maximum capture in the trawl nets. These were some of the commercially important fishes in the trawl catches which became most vulnerable for capture during midday coinciding with their highest feeding intensity, which again coincides with the period of maximum abundance of their favourite food organisms at the bottom. As a contrast, *Pseudarius jella* (another fish of commercial importance) the feeding of which reached a peak during the night, probably as a result of its tactile feeding, was found in the trawl nets in equal numbers during day and night, as a result of their voraciousness and predominantly bottom feeding habit.

The above account shows that the daily variation of food components equals in importance and magnitude, the hitherto recognised seasonal variation, influencing the availability of fishes for capture, in the trawl nets. Since the operation of the trawl nets is confined to the bottom, a precise knowledge of the favourite food items of the different species or groups of fishes, the varying habits of the food items and their distribution in space and time (diurnal and seasonal), will prove to be of immense help in predicting and locating the fishing grounds. Detailed investigations on the above lines are to be made to unravel the intricate and complicated predator-prey relationships. Such studies will help to improve not only the otter trawling currently in practice, but also initiation of any mid-water trawling in the near future for commercial exploitation of the fishing grounds.

SUMMARY

The food and feeding habits of fishes caught in the trawls have been studied, based on qualitative and quantitative analysis of the stomach contents of a total of 2,651 specimens of fishes belonging to 91 species and 68 genera and 43 families, obtained from the continental shelf extending from Waltair to False Point in the Bay of Bengal, along the east coast. The possible relationship between the diurnal migration of food organisms and the feeding habits of fishes, as evidenced by the variation in the quantitative abundance of food organisms in the stomach contents of the preying fish obtained at different times of the day, is discussed. Crustaceans like copepods, Alima, *Acetes*, young prawns, *Squilla* and crabs, were found to be the most commonly eaten food organisms, showing periodicity of abundance in the stomach contents of the different species of fishes caught at different times of the day. Copepods were observed in the plankton feeders and bottom feeders obtained during the morning only. The other crustaceans were recorded in greater abundance around midday, with the exception of crabs, which were frequent in the stomachs of the predators during night.

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