# FOOD AND FEEDING HABITS OF SILVER POMFRET *PAMPUS ARGENTEUS* (EUPHRASEN) FROM BAY OF BENGAL WITH A NOTE ON ITS SIGNIFICANCE IN FISHERY

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## ABSTRACT

A detailed study of the food and feeding habits of silver pomfret, *Pampus argenteus* (Euphrasen) was undertaken from Bay of Bengal along the Orissa coast. Copepod formed the main item in the diet followed by smaller jelly fishes and phytoplankters. A variety of smaller crustacea, polychaetes, fish eggs and fish-larvae occurred in minor quantities. The post-larvae feed on phytoplankton and a variety of zooplanktonic organisms are added to the diet during subsequent growth. The fish undertakes diurnal vertical migration in search of copepods, moving towards the surface after sunset and sinking to the bottom during the day time.

## INTRODUCTION

Preliminary investigations on food habits of pamfrets from the Arabian Sea were undertaken by Rege (1958) and Nath (1966). Kulkarni (1958) studied the alimentation and rate of digestion in the fish from Bombay waters. Kuthalingam (1967) made some observations on its food and feeding from Bay of Bengal. But no work has so far been done on the food and feeding of the fish in relation to its migration and fishery. The present paper deals with a detailed investigation of the food and feeding habits of *Pampus argenteus* from Bay of Bengal and its significance in the fishery.

## MATERIAL AND METHODS

Samples of *P. argenteus* were obtained at weekly interval from the gillnet catches in the night at Chandipur, an important fishing centre of Orissa, in the northwestern part of Bay of Bengal near Balasore. Fortnightly samples were collected from trawlers off Paradip and boatseines from Gopalpur, both fishing at day time. In all, 1805 stomachs were examined during 1972 and 1973.

The size, sex and stages of maturity of each fish were recorded prior to the removal of the stomach. The stomachs were preserved in 5% formalin. The volume of its contents were examined by displacement methods and analyses were carried out by the modified points method (Swynnerton and Worthington

1940, Frost 1943, Hynes 1950, Pillay 1953). Plankton samples used in the study were collected from the inshore areas off Chandipur with a simple half-meter net.

## Seasonal and annual variations in the food

The data on the analyses of the stomach contents of *P. argenteus* from Chandipur during 1972 and 1973 are presented in Table 1 and 2. The food was highly macerated and in an advance stage of digestion in most cases and hence the identification of contents to species level was difficult. A high proportion of semidigested pulpy mass was observed as in other stromateid fishes (Rege 1958, Basheeruddin and Nayar 1962, Sivaprakasam 1967).

Copepods formed an important item of food throughout the year. Their peak occurrence were observed during the early southwest-monsoon months of April-May and the post-monsoon period of August-November. Amphipods were recorded in January, February and April. Ostracods were encountered in the stomachs from February to May, in September and from November to December. Cladocerans were occasional in the diet and occurred in January, March and September. *Lucifer* sp. was present in the stomach contents in March and July, and *Acetes* sp. was found during March-May. Decapod remains formed a substantial part of the diet during January-July and September. Copepod eggs and nauplii were encountered in most of the months and contributed to a fair percentage of the diet. Decapod larvae were recorded in the gut contents only in August and October as a minor element. Marine insects were rare in the diet, occurring in June and July. Ctenophores and medusae, ranking second, were present in the diet throughout the year. Polychaete larvae and polychaete remains occurred significantly during most part of the year. Molluscan larvae appeared occasionally. *Sagitta* occurred in January and formed an insignificant part of the food. Fish eggs were found during May and October but fish larvae were recorded in March and April. Fish scales were found in most of the months. Diatoms occurred throughout the year and ranked third in the diet. Algal filaments were occasional in the food.

Although the relative importance of particular items differed slightly between years, the gross picture remained the same. The mean percentage composition of the diet for the whole period of investigation was: copepod 10.07, amphipod 0.26, ostracod 0.45, cladoceran 0.20, *Acetes* 0.71, *Lucifer* 0.20, decapod remains 1.43, copepod eggs 0.22, copepod nauplii 0.36, decapod larva 0.26, marine insect 0.04, ctenophores and medusae 3.45, polychaete remains 0.35, polychaete larvae 0.65, bivalve larvae 0.15, gastropod larvae 0.02, Sagitta 0.10, fish eggs 0.07, fish larva 0.08, fish scale 0.52, diatoms 0.96, algal filaments 0.06 and semidigested pulpy mass 79.31.

## Variation in Food between Places

The stomach contents of *P. argenteus* collected from Paradip and Gopalpur were also analysed and the percentage composition of various items is given in Table 3.

TABLE 1. *Percentage of different food items in the gut contents of* P. argenteus *from gillnet catches during different months at Chandipur in* 1972.

| Food items | Jan. *(42) | Feb. (30) | Mar. (39) | Apr. (28) | May (37) | June (38) | July (24) | Aug. (44) | Sept. (37) | Oct. (60) | Nov. (71) | Dec. (48) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Copepod | 6.05 | 7.82 | 8.75 | 11.24 | 15.35 | 4.12 | 3.87 | 19.22 | 14.10 | 16.84 | 18.00 | 4.85 |
| Amphipod | 1.32 | —— | —— | —— | —— | —— | —— | —— | —— | —— | —— | —— |
| Ostracod | —— | —— | 0.82 | 0.62 | 1.82 | —— | —— | —— | —— | —— | 1.00 | 2.12 |
| Cladoceran | —— | 1.14 | —— | —— | —— | —— | —— | —— | —— | —— | —— | —— |
| *Lucifer* | —— | —— | 3.71 | —— | —— | —— | —— | —— | —— | —— | —— | —— |
| *Acetes* | —— | —— | 1.42 | 2.14 | —— | —— | —— | —— | —— | —— | —— | —— |
| Decapod remains | 1.22 | 1.42 | 4.12 | —— | 1.47 | —— | 2.46 | —— | 2.80 | —— | —— | —— |
| Copepod eggs and nauplii | 1.78 | —— | 3.86 | 0.44 | —— | —— | 1.25 | 0.53 | 1.12 | —— | 1.89 | —— |
| Decapod larvae | —— | —— | —— | —— | —— | —— | —— | 0.84 | —— | 0.72 | —— | —— |
| Marine insect | —— | —— | —— | —— | —— | —— | 0.66 | —— | —— | —— | —— | —— |
| Ctenophores and medusae | 8.60 | 8.12 | 2.70 | 3.20 | 3.14 | 3.75 | 1.44 | 0.66 | 2.05 | 3.15 | 4.53 | 8.43 |
| Polychaete remains | 1.62 | —— | 2.12 | —— | —— | —— | —— | —— | —— | —— | —— | 2.43 |
| Polychaete larvae | 0.81 | —— | 2.64 | 2.15 | —— | —— | 2.52 | 1.07 | 2.83 | —— | —— | 2.34 |
| Molluscan larvae | —— | —— | —— | —— | 1.02 | —— | —— | —— | —— | —— | 0.64 | —— |
| *Sagitta* | 1.54 | —— | —— | —— | —— | —— | —— | —— | —— | —— | —— | —— |
| Fish eggs and larvae | —— | —— | 1.25 | —— | 0.85 | —— | —— | —— | —— | 1.24 | —— | —— |
| Fish scale | 0.52 | 0.74 | 0.80 | 0.32 | —— | —— | 1.04 | —— | —— | —— | 0.52 | 0.63 |
| Diatom | 5.42 | —— | 0.41 | 1.29 | 0.62 | 1.68 | 0.22 | 0.68 | 1.50 | 2.33 | 1.22 | 0.44 |
| Algal filaments | 1.02 | 0.56 | —— | —— | —— | —— | —— | —— | —— | —— | 0.44 | —— |
| Semidigested matter | 70.10 | 80.20 | 67.40 | 78.60 | 75.73 | 90.45 | 86.45 | 77.00 | 75.60 | 75.72 | 71.76 | 78.76 |

* Number of fish examined during each month is shown in brackets.

TABLE 2. *Percentage of different food items in the gut contents of* P. argenteus *from gillnet catches during different months at Chandipur in* 1973.

| Food items | Jan. *(43) | Feb. (32) | Mar. (35) | Apr. (39) | May (26) | June (45) | July (42) | Aug. (34) | Sept. (58) | Oct. (39) | Nov. (65) | Dec. (42) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Copepod | 5.14 | 5.44 | 6.83 | 12.42 | 14.40 | 2.62 | 4.42 | 16.84 | 14.27 | 18.50 | 14.42 | 5.18 |
| Amphipod | — | 2.02 | — | 0.83 | — | — | — | — | — | — | — | — |
| Ostracod | — | 2.14 | 3.66 | — | — | — | — | — | 1.25 | — | — | — |
| Cladoceran | 2.13 | — | 1.34 | — | — | — | — | — | 1.18 | — | — | — |
| *Lucifer* | — | — | — | — | — | — | 1.55 | — | — | — | — | — |
| *Acetes* | — | — | 2.42 | — | 1.60 | — | — | — | — | — | — | — |
| Decapod remains | 1.63 | 1.82 | 1.22 | 1.42 | — | 1.53 | 1.23 | — | — | — | — | — |
| Copepod eggs and nauplii | 0.84 | — | 1.43 | 0.71 | — | — | — | 0.15 | — | 1.44 | 0.43 | 0.52 |
| Decapod larvae | — | — | — | — | — | — | — | 0.82 | — | — | — | — |
| Marine insect | — | — | — | — | — | 0.23 | — | — | — | — | — | — |
| Ctenophores and medusae | 4.22 | 6.55 | 3.23 | 3.71 | 2.70 | 2.22 | 1.27 | 3.50 | 1.20 | 1.18 | 3.72 | 8.34 |
| Polychaete remains | 1.73 | — | — | — | — | — | — | — | — | 3.00 | — | — |
| Polychaete larvae | 1.84 | — | 0.72 | 0.81 | — | — | 0.72 | 1.32 | — | 1.56 | — | 0.66 |
| Molluscan larvae | 1.00 | — | 1.24 | 1.12 | — | — | — | — | 0.49 | — | — | — |
| *Sagitta* | 1.45 | — | — | — | — | — | — | — | — | — | — | — |
| Fish eggs and larvae | — | — | — | 1.12 | 0.90 | — | — | — | — | — | — | — |
| Fish scale | 0.66 | — | — | 1.22 | — | 0.50 | 0.90 | — | — | 0.52 | — | — |
| Diatom | 1.50 | 0.83 | 0.66 | 0.84 | 0.40 | 0.50 | 1.41 | — | 1.21 | 1.72 | — | — |
| Algal filaments | — | — | 0.44 | — | — | — | — | — | 0.30 | — | — | — |
| Semidigested matter | 77.86 | 81.20 | 76.81 | 75.80 | 80.00 | 92.40 | 88.50 | 77.37 | 80.10 | 72.08 | 81.43 | 85.30 |

* Number of fish examined during each month is shown in brackets.

TABLE 3. *Percentage of different food items in the gut contents of* P. argenteus *from different localities along Orissa coast.*

| Food items | Chandipur (gillnet) | Paradip (trawl) | Gopalpur (boat-seine) |
|---|---|---|---|
| Copepod | 10.43 | 8.67 | 10.62 |
| Amphipod | 0.17 | 0.78 | 0.10 |
| Ostracod | 0.55 | 0.75 | 0.20 |
| Cladoceran | 0.24 | 0.34 | 0.11 |
| *Lucifer* sp. | 0.21 | 0.61 | 0.19 |
| *Acetes* sp. | 0.31 | 1.63 | 0.65 |
| Decapod remains | 0.99 | 3.97 | 0.60 |
| Copepod eggs and nauplii | 0.67 | 0.57 | 0.51 |
| Decapod larvae | 0.09 | 0.84 | 0.14 |
| Marine insect | 0.03 | 0.05 | 0.05 |
| Ctenophores and medusae | 3.81 | 3.66 | 2.99 |
| Polychaete remains | 0.45 | 0.10 | 0.38 |
| Polychaete larvae | 0.91 | 0.45 | 0.65 |
| Molluscan larvae | 0.22 | 0.35 | 0.04 |
| *Sagitta* sp. | 0.12 | 0.17 | 0.05 |
| Fish eggs and larvae | 0.21 | 0.22 | 0.08 |
| Fish scale | 0.34 | 0.47 | 0.71 |
| Diatoms | 1.03 | 0.90 | 0.91 |
| Algal filaments | 0.09 | 0.09 | 0.03 |
| Semidigested matters | 79.05 | 76.25 | 81.12 |

The stomachs contained largely, quantities of semidigested pulpy food and copepods dominated in the diet at all the localities under investigation. At Chandipur and Gopalpur ctenophores and medusae occupied the second place while diatoms ranked third. Decapod remains ranked fourth in order of importance followed by polychaete larvae in the fifth place at Chandipur, whereas, fish scales were fourth and *Acetes* and polychaete larvae the fifth important item at Gopalpur.

The stomach contents of *P. argenteus* from Paradip presented a slightly different picture. The copepods ranked first here also, but the second place went to decapod remains. The third position was occupied by ctenophores and medusae, and *Acetes* ranked fourth. The fifth rank was taken by diatoms. The trawling off Paradip is done in the vicinity of prawn beds and it is natural to have crustacean element as an important item from that locality.

It is evident that *P. argenteus* in all these far-off localities along Orissa coast take similar items of food. The gear and time of capture have negligible influence over the relative importance minor items, the overall picture remaining the same.

## Food in Relation to Age

Details of percentage occurrence of various food organisms in the stomach contents of *P. argenteus* in different size groups during January, 1972 to December, 1973 are presented in Table 4. The results reveal striking change in the diet of *P. argenteus* from post-larval stage to the adult. The post-larvae are dominantly phytoplankton feeders, feeding on diatoms like *Coscinodiscus centralis, Thallasiothrix frauenfeldii* and *Pleurosigma normanii*. With gradual growth the juveniles change over to copepods, copepod eggs and nauplii, and smaller crustaceans. The occurrence of polychaete remains in the size group 8-9 cm is of particular interest as the purely pelagic larvae become benthopelagic at this stage. This is associated with the elongation of the lower lobe of the isocercal caudal fin, converting it to a hypocercal tail suitable for column feeding and vertical migration. With further growth, increasing number of items are added to the diet. Copepod and diatom elements show proportional decrease with advanced age, but this is compensated by other crustacean elements, jelly fishes, polychaete larvae and chaetognaths.

## Selectivity in Feeding

In order to ascertain whether *P. argenteus* exhibits any selectivity in feeding, regular plankton collections were made from the fishing area during March 1972 onwards, from a station 10 kilometers northt-east of Chandipur. A comparative statement of monthwise occurrence of various phyto- and zooplankton for one year and simultaneously the elements present in the gut during those months are shown in Table 5.

The fish has a preference for copepod, the choicest of them being *Acrocalanus, Centropages, Euterpina, Nannocalanus, Oithona, Temora* and *Acartia*. Those preferred less are *Paracalanus, Eucalanus, Corycius* and *Pseudodiaptomus*. Although *Isias, Macrostella, Clytemnestra* and *Caligus* were present in the plankton, their non-inclusion in the gut indicated lack of choice for these copepods.

*P. argenteus* appears to prefer copepod eggs, copepod nauplii, smaller crustaceans but not the other crustacean larvae. A positive corelation was observed between polychaete larvae and its inclusion in the diet. Ctenophores and medusae were present in the plankton as well as gut during most months. The presence of fish egg and larvae was not significant.

Of the various phytoplankters, a positive corelation was observed in the case of *Coscinodiscus*. Other diatoms occasionally met with were *Thallasiothrix, Pleurosigma* and *Rhizosolenia*.

## Condition of Feeding

To determine the condition or degree of feeding, the stomachs examined were classified into gorged, full, $\frac{3}{4}$full, $\frac{1}{2}$ full, $\frac{1}{4}$ full, $\frac{1}{8}$ full or with traces and

TABLE 4. *Percentage occurrence of food items in the stomach contents of young* P. argenteus *in various size groups (January 72 to December 73).*

| Food items | Size groups in cm SL. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2.1-3.0 | 3.1-4.0 | 4.1-5.0 | 5.1-6.0 | 6.1-7.0 | 7.1-8.0 | 8.1-9.0 | 9.1-10.0 | 10.1-11.0 | 11.1-12.0 |
| | (2) | (6) | (10) | (28) | (24) | (34) | (28) | (41) | (44) | (136) |
| Diatoms | 100.00 | 100.0 | 100.0 | 43.50 | 19.30 | 17.20 | 6.80 | 8.60 | 5.10 | 4.44 |
| Copepod | — | — | — | 56.50 | 80.70 | 81.30 | 74.20 | 72.20 | 66.10 | 69.14 |
| Copod eggs | — | — | — | — | — | 1.50 | — | — | 0.50 | — |
| Copepod nauplii | — | — | — | — | — | — | — | 1.10 | — | — |
| *Lucifer* | — | — | — | — | — | — | — | — | — | 1.10 |
| *Acetes* | — | — | — | — | — | — | — | — | 9.20 | 3.12 |
| Decapod remains | — | — | — | — | — | — | — | 9.10 | 8.50 | 9.41 |
| Polychaete remains | — | — | — | — | — | — | 8.00 | 7.10 | 9.10 | 2.04 |
| Ctenophores and medusae | — | — | — | — | — | — | — | — | — | 8.24 |
| Fish scales | — | — | — | — | — | — | 1.00 | 1.90 | 1.50 | 2.51 |

* Number of fish examined each months is given in parentheses Other figures indicate percentage.

TABLE 6. *State of stomach in different degrees of fullness* P. *argenteus* (*1972 and 1973*)

| | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Ooct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1972 | | | | | | | |
| No. of specimens examined | 42 | 30 | 39 | 28 | 37 | 38 | 24 | 44 | 37 | 60 | 71 | 48 |
| Empty | —— | 9.99 | 7.69 | 25.00 | 18.92 | 28.95 | 25.00 | 4.54 | 2.70 | —— | —— | —— |
| $\frac{1}{8}$ full | —— | 43.42 | —— | 14.28 | 8.10 | 42.11 | 8.33 | 2.27 | 2.70 | 3.33 | 2.81 | 10.41 |
| $\frac{1}{4}$ full | 9.52 | 6.66 | 46.15 | 10.71 | 37.84 | 5.26 | 16.66 | 15.91 | 16.21 | 10.00 | 2.81 | 8.33 |
| $\frac{1}{2}$ full | 42.85 | 9.99 | 25.64 | 32.13 | 18.92 | 5.26 | 25.00 | 38.64 | 27.03 | 30.00 | 32.38 | 39.57 |
| $\frac{3}{4}$ full | 23.81 | 9.99 | 15.38 | 10.71 | 16.21 | 13.16 | 16.66 | 4.54 | 8.10 | 20.00 | 30.97 | 18.74 |
| full | 19.04 | 16.66 | 7.69 | 7.14 | —— | 5.26 | 8.33 | 31.82 | 40.54 | 23.33 | 28.16 | 16.66 |
| Gorged | 4.76 | 3.33 | —— | —— | 2.70 | —— | —— | 2.27 | 2.70 | 13.33 | 2.81 | 6.24 |
| | | | | | 1973 | | | | | | | |
| No. of specimens examined | 43 | 32 | 35 | 39 | 26 | 45 | 42 | 42 | 58 | 39 | 65 | 42 |
| Empty | 2.32 | —— | 5.17 | 15.38 | 11.53 | 24.44 | 23.81 | 9.52 | 3.44 | —— | —— | —— |
| $\frac{1}{8}$ full | 4.64 | 6.25 | 5.17 | 30.76 | 50.00 | 31.10 | 8.28 | 19.04 | 1.72 | 2.56 | 3.07 | 9.52 |
| $\frac{1}{4}$ full | 9.30 | 37.50 | 31.04 | 2.56 | 11.53 | 4.44 | 19.04 | 19.04 | 18.96 | 5.12 | 3.07 | 7.14 |
| $\frac{1}{2}$ full | 18.60 | 15.62 | 25.87 | 35.88 | 7.69 | 22.22 | 19.04 | 9.52 | 39.65 | 33.33 | 23.07 | 42.85 |
| $\frac{3}{4}$ full | 11.63 | 15.62 | 18.10 | 10.25 | 15.38 | 13.33 | 8.28 | 38.08 | 18.96 | 25.64 | 24.60 | 19.04 |
| Full | 41.86 | 18.75 | 5.17 | 5.12 | 3.84 | 4.44 | 9.52 | 9.52 | 13.79 | 25.64 | 27.68 | 8.28 |
| Gorged | 11.63 | 6.25 | —— | —— | —— | —— | —— | —— | 3.44 | —— | 3.07 | 7.14 |

TABLE 5. *Monthwise occurrence of organisms in plankton and gut of promfret* (++), *plankton only* (+−) *and gut only* (−+) *along Chandipur during* 72-73.

| Planktonic organisms | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Acrocalanus* spp. | ++ | +− | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | +− |
| *Acartia* spp. | ++ | ++ | ++ | ++ | ++ | +− | ++ | ++ | ++ | ++ | ++ | ++ |
| *Centropages* spp. | ++ | ++ | ++ | +− | ++ | +− | ++ | ++ | ++ | ++ | ++ | ++ |
| *Coryceus* spp. | ++ | +− | +- | +− | +− | | | | ++ | ++ | +− | ++ |
| *Corycella* spp. | ++ | ++ | ++ | ++ | | | ++ | ++ | ++ | ++ | +− | ++ |
| *Eucalanus* spp. | ++ | +− | +− | | +− | ++ | ++ | +− | | +− | +− | |
| *Euterpina* spp. | ++ | ++ | ++ | +− | ++ | ++ | ++ | +− | ++ | +− | ++ | ++ |
| *Macrostella* spp. | +− | +− | | +− | | | | +− | +− | | +− | |
| *Paracalanus* spp. | +− | +− | ++ | +− | | +− | | +− | ++ | | +− | |
| *Nannocalanus* spp. | ++ | ++ | ++ | ++ | +− | ++ | ++ | ++ | ++ | | +− | |
| *Temora* spp. | ++ | ++ | ++ | ++ | | ++ | ++ | | ++ | ++ | ++ | ++ |
| *Pseudodiaptomus* spp. | ++ | +− | | | | +− | ++ | +− | +− | | | |
| *Isias* spp. | | | | | | | | +− | +− | | | |
| *Oithona* spp. | ++ | ++ | ++ | +− | ++ | +− | | ++ | ++ | ++ | ++ | +− |
| *Clytemnestra* spp. | +− | +− | | | | +− | | | | | | +· |
| *Caligus* spp. | +- | | | +− | | | | | | | | +− |
| *Copepod* eggs | ++ | | | | ++ | +− | +− | +− | ++ | +− | ++ | |
| *Copepod* nauplii | ++ | ++ | | +− | +− | ++ | ++ | +− | ++ | | +− | +− |
| *Zoea* | | | | | +− | +− | +− | ++ | | | | |
| Megalopa | | | | | | ++ | +− | | | | | |
| Cladoceran | | +− | | | | | | | ++ | ++ | | |
| *Lucifer* spp. | ++ | +− | | ++ | | | | | ++ | ++ | | |
| *Acetes* spp. | ++ | ++ | | | | | | | | | | ++ |
| Medusae | ++ | ++ | +− | | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| Ctenophores | ++ | | ++ | ++ | | | | ++ | | ++ | ++ | |
| Polychate larvae | ++ | ++ | | | ++ | ++ | ++ | | +− | ++ | +− | |
| *Sagitta* spp. | +· | +− | +− | | | +− | | | +− | +− | +− | |
| Fish egg | | | ++ | | +− | +− | +− | ++ | | | | |
| Fish larvae | ++ | | | +− | +− | +− | +− | +− | +− | | | |
| *Cosinodiscus centralis* | ++ | ++ | ++ | +− | ++ | ++ | ++ | ++ | +− | ++ | +− | +− |
| *Coscinodiscus spp.* | ++ | ++ | ++ | ++ | ++ | +− | ++ | ++ | ++ | ++ | ++ | ++ |
| *Thallasiothrix* spp. | +− | +− | | +- | +− | | +− | +− | +− | +− | +− | +− |
| *Pleurosigma* spp. | | ++ | | | | | | | | | | |

empty, depending upon their degree of fullness. The percentage occurrence of stomach under each category was calculated for each month (Table 6). The stomachs classified as gorged, full ¾ full were considered as actively fed, and those with ½ full, ¼ full and ⅛ full or with traces as poorly fed. Feeding was active in January 1972, but the percentage or empty stomach was high during April-July. Active feeding occurred again during September-February followed by empty stomachs in June and July 1973. The feeding became active once more in October and November.

All fish measuring 140 mm SL and above were grouped as mature and those below as immature and the average volume of the stomach content in each month for the two groups are given in Fig. 1. In 1972, the feeding was comparatively high in the immatures from September to December. For mature fish it was higher in January and then from August to December. In 1973, the average volume for immatures was greater than the annual average in the months of January, February, and from August to December. For matures higher values were recorded from August to December.

The high feeding intensity from August to November coincides with the abundance of copepod. But from December to February copepods being less abundant, the fish ate more jellyfish and other items. During March-July, which coincides with the spawning season of silver pomfrets from the Orissa Coast (Pati 1978), the slackening in the feeding intensity of matures may be attributed to spawning activity. But a decline in the feeding of immatures during

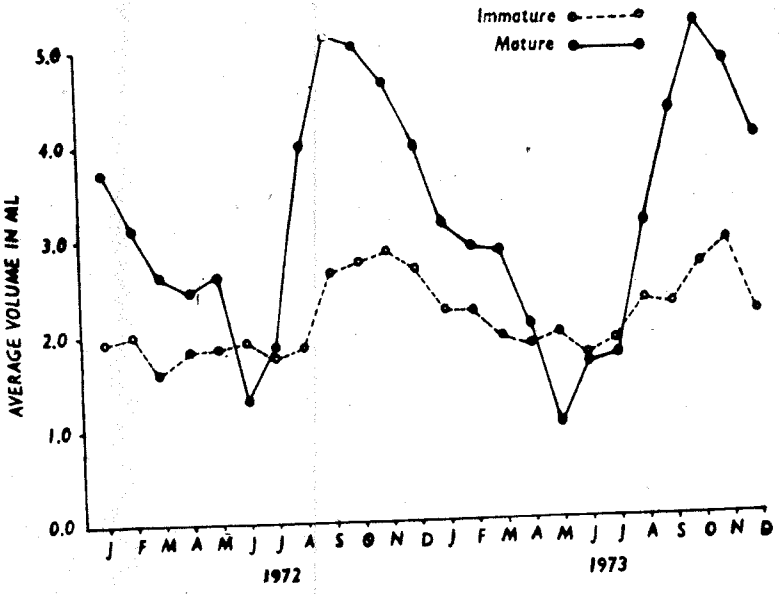


FIG. 1. Average volume of stomach contents of *P. argenteus*

those months cannot be due to scarcity of the zooplankton, since copepods are plenty in the premonsoon period (Pati 1977). The fall in the feeding activity may be attributed to rise of surface temperature.

## Feeding Habits

From the nature of the stomach contents of the fish caught from drift gillnets in the night and trawlers during the day time, it was inferred that copepods formed main item for fish caught from the surface as well as deeper waters. In general, vast number of copepods and other zooplanktonic organisms are found to swim towards the surface ofter sunset and move towards the deeper region during the day. The magnitude of migration is indicated by the fact that the copepod population may often move more than 100 meters in vertical direction (Clarke 1954). It can therefore be concluded that the silver pomfrets are column feeders, feeding on copepods near the surface in the night and in deeper parts during the daytime. At the sametime the fish undertakes diurnal vertical migration in quest of its main food namely copepods.

## Discussion

Suyehiro (1942) in his brief remarks on the food of silver pomfret from Japan, stated that the stomach of the fish contained some gelatinous substances and medusae Rege (1958) noticed salps, hydromedusae amphipods, copepods, shrimps and small fish besides gelatinous material in the stomach contents of *P. argenteus* from Bombay waters. Kulkarni (1958) noted a high percentage of tunicates, copepods, isopods, medusae and fishes. Nath (1966) in his studies on the fishes from Kerala coast considers silver pomfret to be a macroplankton feeder whose diet depends upon the seasonal abundance of crustaceans and polychaetes. Kuthalingam (1967) in his general observation on the food and feeding habits of silver pomfret from north-western part of Bay of Bengal considered copepods and other crustaceans as the main item of food. Apart from this, he recorded ostracods, amphipods, larval crustacea, polychaetes, *Sagitta,* larval bivalves, fish scales, vertebrae, flat fish, foraminifera, algal filaments and diatoms mixed with a copius quanity of mucous and the elements were in semi-digested condition.

Rao (1967) in his brief observation on the food of *P. argenteus* from Andhra-Orissa Coast recorded a high percentage of copepods along with amphipods, ostracods, cladoceran, decopod larvae, crustacean remains, gastropod larvae, fish eggs and fish scales.

The present investigation is in close agreement with the observations of Kuthalingam (1967) and Rao (1967). Items noticed by previous workers but unrepresented in the present study are isopods, larvae of squilla, salpa, flat fish, and foraminifera. The new item recorded in the present investigation is marine insect, which are however occasional in the diet.

The role of ctenophores, medusae and tunicates have been emphasised by the workers from Bombay coast and Chopra (1960) has gone to the extent of grading ctenophores and medusae as indicator species for silver pomfret. But jelly fishes are moderately represented in the diet of silver pomfret. The stromateid fishes possess a toothed pharyngeal sac which acts as grinding mill and converts the food into a pulpy mass resembling shredded jelly fishes (Haedrich 1967, 1969). Therefore the indentification of ctenophores and medusae in the food of pomfrets needs much caution. Reintjes and King (1953) in their investigation on yellowfin tuna concluded that 'those food items that rank large in volume, large in number and high in frequency are important as food at the time and in the area sampled.' In the present investigation copepods fulfill the above essential requirements in being considered as important food element of silver pomfrets and may prove to be an indicator organism.

Silver pomfrets are migratory fishes (Jenkins 1911, Gopalan 1969) whose shoals occur both at the bottom and near the surface (Moses 1947). The usual vertical migration of copepods (Clarke 1954), their dominance in the stomach contents of night samples collected from drift gillnets and day samples from trawl catch lends to the indirect evidence of a diurnal vertical migration amongst silver pomfrets, coinciding with the movement of copepods which form their main food. Many marine fishes perform regular vertical movements which are related to the search for food (Nikolsky 1963). This feeding behaviour can be commercially utilized in pomfret fishery by shooting drift gillnets during night and carrying out trawling operations in the day time. For obvious reasons bottom-set gillnets are employed by the fishermen along Gujarat coast in the daytime (Moses 1947, Lal 1969), whereas drift gillnets are shot in the night along Balasore coast (Roy and Roy 1974) for pomfret fishing.

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