

caroticus from the *Innominate* to the point of origin of the right *Common Carotid* (*ca*) forms really the basal part of the *Carotid* itself, i.e., the basal part of the *Carotid* has been bent backwards probably due to the backward pull by the contracting *ductus*. The remaining part alone (*ab*) which is rather short in the Presidency College specimen, connecting the *Carotid* with the *aortic arch* is the *Ductus caroticus*. This view brings these three abnormal specimens in the same category with varying degrees of contraction of the *Ductus caroticus* and explains the conditions in full accordance with embryological development. The Calcutta specimen would seem to represent the simplest condition with a typical *Ductus caroticus* (A, *a b*). The Trivandrum specimen would come next where the *Ductus caroticus* has contracted to a certain extent pulling the *Carotid* at its junction with the ductus slightly downwards (B, *a b*). In the Presidency College specimen which represents the extreme stage, (C, *a b*) the ductus has contracted considerably and the *Carotid* is pulled backwards from its very origin from the *Innominate* so as to bring the *ductus* and the base of the *Carotid* in a line. This apparent connection (C, *cab*) between the *Innominate* and the *aorta* is easily mistaken for the *Ductus caroticus* and the *Carotid* would then appear to arise from this connection! The backward displacement of the Vertebral and the oesophageal arteries on the right side is evidently the result of the pulling backward of the base of the *Carotid* due to the contraction of the *Ductus caroticus*.

This study also suggests that during the transition of the arteries from the embryonic to the adult condition one of the mechanical forces at work in bringing about atrophy of the unnecessary vessels is contraction, side by side with constriction. Under normal conditions where the connection becomes practically bloodless contraction would have only the effect of aggravating the constriction: but in these abnormal cases where the connection has full blood flow and grows side by side with the other parts of the circulatory system, contraction would pull the base of the *Carotid* backwards.

Zoology Laboratory,
University College,
Trivandrum,
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A. P. MATHEW.

1. *Curr. Sci.*, April, 1944. 2. *Anat. Anz. Bd.*, 1938, 80, No. 7/10, 178. 3. Lillie, F. R., "The Development of the chick" 1919, 361.

ON THE BIONOMICS OF THE *LEIOGNATHIDAE**

SPECIES of *Leiognathus* and *Gazza*, popularly known as the Silver-Bellies, contribute to one of the important fisheries in the shallow sea around Pamban and Rameswaram from September of one year to May of the next year.

One thousand and one hundred and seventy specimens ranging in size from 4 to 16 cm.

were examined in the laboratory of Krusadai Biological Station during the years 1941, 1942 and 1943. The following is the composition of the different species constituting the catches: *Leiognathus bindus* 40 per cent.; *L. equulus* 15 per cent.; *L. duara* 10 per cent.; *L. rucconius* 8 per cent.; *L. brevirostris* 4 per cent.; *L. insidiator* 3 per cent.; and *Gazza minuta* 20 per cent.

Food.—The diet consists entirely of plankton; but *Gazza minuta* occasionally feeds on fingerlings of the White-Bait (*Stolephorus* sp.). The following is the analysis of the planktonic food:—

Phytoplankton: (1) *Coscinodiscus*, (2) *Rhizosolenia*, (3) *Nitzschia*, (4) *Thalassiothrix*, (5) *Fragilaria*, (6) *Pleurosigma*, (7) *Biddulphia*, (8) *Detonula*, and (9) algal filaments.

Zooplankton: (1) Copepods, (2) *Rhopalophthalmus egregius*, (3) *Leucifer hanseni*, (4) Crustacean eggs, (5) *Megalopa* larvæ, (6) Ostracods, (7) Larval bivalves, (8) *Spiratella* spp., (9) Foraminifers, (10) *Ceratium* spp., and (11) Fish eggs of *Stolephorus* sp.

Spawning Season.—There are two spawning seasons, namely, November & December, and April & May.

Enemies.—Silver-Bellies form the natural food of the following carnivorous fishes: (1) the Black-finned Shark, *Carcharias melanopterus*, (2) the Seer, *Scomberomorus commersonii*, (3) the Jew-fishes, *Sciaenaglauca* and *Otolithus ruber*, (4) the Ribbon Fish, *Trichiurus savala*, (5) the Horse Mackerel, *Caranx sanson*, (6) the Big-jawed Jumper, *Lactarius lactarius*, and (7) the Barracuda, *Sphyræna obtusata*.

Food Value.—The Silver-Bellies contain fine bones, and the flesh is scanty. Yet they are esteemed both in the fresh and sun-dried condition, the latter being considered as more palatable. The dried Silver-Bellies are of medicinal value, it being given to convalescents in general and to patients suffering from Malaria in particular.

Fisheries Section,
Dept. of Industries &
Commerce, Madras,
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P. I. CHACKO.

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FOOD OF THE INDIAN MACKEREL (*RASTRELLIGER KANAGURTA* RUSSELL) OF THE WEST COAST OF MADRAS PRESIDENCY¹

"Upon the abundance of mackerel depends the welfare of many thousands of the citizens of Massachusetts and Maine." So observed Prof. Goode on the American mackerel fishery. So is the case with the mackerel of the West Coast of the Madras Presidency. The Indian mackerel (*Rastrelliger kanagurta* Russell) constitutes one of the important food fishes of the Malabar Coast.

A remarkable uniformity has been observed in the food of different species of mackerels in the different seas regarding the selection of food organisms at certain seasons of the year. So much has been observed on the uniformity of diet that the English mackerel fishermen take the colour of the water as an indication of the fishery. The colouration of the water is due to the abundance of certain types of planktonic organisms, just like the 'red water' of the Malabar Coast caused by the abundance of *Noctiluca* and *Peridinium*, the green water by *Trichodesmium*, *Coscinodiscus*, etc. The formula of E. J. Allan regarding the relation between the good catch of mackerel and a rich development of plankton consequent upon the sunshine has got a similar bearing on the mackerel fishery of our coast.

The food of mackerel, as revealed by the examination of stomach contents are soft and semi-solid in consistency but in a few cases granular. It will be of interest to know about the colour of the stomach contents. In the absence of any colour standard it will be premature to draw any specific conclusions regarding the colour produced by the presence of certain organisms and yet the presence of the following organisms is attributed to the different shades of colour of the contents in mackerel in a general way.

Light green: Dinoflagellates; Copepods; Infusorians.

Dark green: Dinoflagellates; Infusorians.

Greenish yellow: Dinoflagellates; Copepods; Diatoms.

Dark yellowish brown: Dinoflagellates; Diatoms; Copepods (in smaller numbers); Infusorians (in smaller numbers).

Dark greenish brown: Diatom; Infusorians; Copepods.

From the analysis it seems that the Dinoflagellates give the green colour, Diatoms yellowish tinge, and Copepods brownish tinge and the combination of these three in various proportions result in the various shades of the food contents.

The following organisms constitute the regular diet of the Indian mackerel (*Rastrelliger kanagurta* Russell):—

Phyto-plankton—

- (1) *Coscinodiscus*: *C. jonesianus*; *C. oculusinidus*; *C. gigas*; *C. joneschii*.
- (2) *Peridiniums*: *P. depressum*; *P. ovatum*.
- (3) *Fragillaria*.
- (4) *Ceratium*: *C. tripos*; *C. massiliense*.
- (5) *Thalassiothrix nitzschoides*.
- (6) *Nitzschia* sp.
- (7) *Asterionella japonica*.
- (8) *Trichodesmium* sp.
- (9) *Rhizosolenia*.
- (10) *Pleurosigma*.
- (11) *Biddulphia*.
- (12) *Planktoniella*.
- (13) *Dinophysis homunculus*.
- (14) *Tintinnus*.
- (15) *Chaetoceras*.
- (16) *Ditylum*.
- (17) *Planktoniella*.

Zoo-plankton—

- (1) Copepods: *Paracalanus* sp.; *Euterpina* sp.; *Acartia* sp.; *Oithona* sp.; *Temora* sp.
- (2) *Evadne*.
- (3) *Leucifer*.
- (4) *Daphnids*.
- (5) Larval crustaceans.
- (6) Larval bivalves.
- (7) *Limacina* (a pelagic shell fish).
- (8) *Pteropods*.
- (9) Fish-eggs—(i) *Stolephorus* sp. (ii) Fish-scales. (iii) Bristle-worms.

Copepods.—The copepods along with larval crustaceans form the staple diet and constitute the bulk of its food. It is, therefore, supposed that mackerel closely follow the copepods, the abundance or paucity of which in the fishing zone may lead to a good or a poor fishery.

Fish-eggs.—Mackerel consumes regularly fish-eggs of the horse-mackerel, the Anchovy and the white bait. This feeding on fish-eggs may effect the fisheries of the fishes whose eggs the mackerel feed on.

Fish-scales.—Fish-scales have been found commonly included in the stomach contents of adult mackerel. Perhaps the fish supplements its planktonic diet by occasionally feeding on dead fish, as the adult has not been found to prey upon live-fish, unlike its European or American ally.

Stolephorus.—The inclusion of white-bait in stomach contents of young mackerel examined on a few occasions indicate the carnivorous habit of the young, while the adults are not.

Trichodesmium is said to fatten the mackerel and consequently it is believed that the taste of mackerel improves when this diatom occurs in large patches during March and April. This has been noticed in good quantities in the food of mackerel, during the month. The incidence of mortality of fishes by this algæ is more due to the asphyxiation caused by the dead decaying diatoms.²

The presence of these planktonic organisms in the sea in large numbers explains the abundance of the plankton-feeding fishes like mackerel and oil sardine. These animal organisms, copepods, depend upon the diatoms which in turn rely on the amount of "indispensable food substances" present in the sea and brought by the floods, rains and sunshine. Naturally it leads one to expect to forecast a good or bad fishery with the amount of rainfall, the quantity of nitrates, silicates and phosphates brought down into the sea and the amount of strong sunlight, besides various local ecological factors.

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K. CHIDHAMBARAM.

1. Part of the work of the Fisheries Biological Station, West Hill.

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2. A separate note on this is being written.