

PLANKTON STUDIES* IN THE FISHERIES BRANCH OF THE DEPARTMENT OF INDUSTRIES AND COMMERCE, MADRAS †

BY

D. W. DEVANESEN, M.A., Ph.D. (Lond.)

(Krusadai Biological Station, Gulf of Manaar)

THE outstanding results which the Marine Biological Station at West Hill (Malabar) has obtained from a knowledge of the coastal plankton of the Arabian Sea relate to

- (1) the food of the Oil-sardine (*Sardinella longiceps*) and
- (2) the food of the Mackerel (*Rastrelliger kanagurta*)

both of first-rate importance in the fisheries of Malabar.¹ Recent researches have revealed that both the Oil-sardine and the Mackerel regularly and normally feed on the fish-eggs occurring in the plankton. This is bound to have a far-reaching effect on the fluctuations of the fisheries of fishes on whose eggs the former may feed. This is receiving the attention of the West Hill Biological Station.

Recent studies have not only increased our knowledge of the food of the Oil-sardine and of the Mackerel but also have helped to ascertain the food of several other food-fishes feeding on planktonic organisms; e.g., the food of the White Sardine (*Kowala thoracata*), another sardine of economic importance, the food of the Hilsa (*Hilsa ilisha*) during its sojourn in the sea, etc. Of the food of the anodromous Hilsa in the sea nothing was known hitherto. The stomach-contents of 80 specimens of Hilsa examined from 17-6-1941 to 20-11-1941 revealed a planktonic diet pure and simple. For instance, the lot examined on 7-8-1941 had the following:

Copepods, larval bivalves, dinoflagellates (*Ceratium masiliense*, *Ceratium breve* and *Peridinium depressum*) and phytoplankton (*Coscinodiscus gigas*, *Cosci-*

nodiscus lineatus and *Chaetoceras coarctatum*).

This leads one to infer that the adult Hilsa cannot halt for a considerable period even in perennial rivers like the Ganges and the Indus which they seek for the purpose of spawning under sheltered conditions. Their pasture ground is the surface of the sea where planktonic organisms abound. When the spawning instinct seizes them, the Hilsa gather into shoals. To avoid the inevitable ravages of carnivorous fishes on such an occasion or wholly impelled by natural instinct, the Hilsa shoals escape into large rivers, there to spawn under sheltered conditions and return to the sea their natural feeding grounds and here to disintegrate and to deploy into smaller groups rendering the attack of their enemies less effective. This is an example where two factors are responsible for the migration of a fish-planktonic food at one end and spawning at the other extremity.

That Noctiluca, a phosphorescent planktonic organism competes with the Oil-sardine in feeding was observed in 1931. The former also feeds on such diatoms as *Coscinodiscus*, *Nitzschia* and *Fragillaria* which form the food of the Oil-sardine. Ribbons of the *Flagillaria* Colonies are wrapt equatorially round the body of Noctiluca and ingested—an effective method of having a sumptuous meal of a diatom. The abundance of the inedible Noctiluca may possibly have a bearing on a local scarcity of the Oil-sardine.

Noctiluca again is a round microscopical organism looking almost like a fish-egg. The plankton examined in September of last year at Quilandy, about 18 miles north of Calicut, at first appeared to contain nothing but Noctiluca. But a more careful examination showed that about 10 per cent. of the plankton was constituted by eggs of the Mackerel. The spawning Mackerels have probably exercised a choice in selecting an area where the inedible Noctiluca abounded for laying their eggs. Fishes feeding on fish-eggs would be loathe to enter an area

* These studies relate to surface-plankton only. Bathymetrical plankton studies have not yet been attempted.

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¹ *Vide* pp. 148-52 of Report 5 of 1923, *Madras Fisheries Bulletin*, 17. "A Contribution to the Life-History of the Indian Sardine with Notes on the Plankton of Malabar Coast," by Hornell and Ramasamy.

where the inedible *Noctiluca* abounded. Thanks to the instinct of the Mackerel spawners, their eggs thus derive protection and have a better chance of hatching and being liberated as larvæ which could grow into young fish and increase the livestock of the Mackerel.

A most important line of investigation being pursued at the West Hill Biological Station is the study of live fish-eggs. This is expected to throw light on the spawning season of commercial fishes.

The part played by the tiny prawn-like phosphorescent *Leucifer* as a link in the food-chain of the sea is remarkable. The following fishes feed on *Leucifer*:

- (1) The Oil-sardine (*Sardinella longiceps*).
- (2) The Mackerel (*Rastrelliger kanagurta*).
- (3) The Whitebait (*Stolephorus tri.*). One specimen, 60 mm. long, had in its stomach 257 specimens of *Leucifer* ranging in size from 7 to 12 mm. *Leucifer* is commonly found in another Whitebait as well, viz., *Stolephorus commersonii*.
- (4) In the Anchovies (*Engraulis spp.*) examined, *Leucifer* is occasionally found.
- (5) In the large-scaled Hilsa (*Hilsa kanagurta*) also, *Leucifer* is occasionally met with.

As the result of studies made at the Marine Biological Station, Krusadai Island, Gulf of Manaar, the food of the following fishes was found to be planktonic.

- (1) The Milk-fish (*Chanos chanos*).
- (2) Sardines (*Pellona brachysoma*, *Anodontosoma chacunda*, *Dussumieria haseeltii* and *Sardinella gibbosa*).
- (3) Silver-bellies (*Leiognathus brevirostris* and *Leiognathus insidiatrix*).

The alga *Trichodesmium* found in the plankton off Krusadai in great profusion during certain seasons forms a favourite item of diet of the Indian Sprat (*Sardinella gibbosa*), the Gizzard Shad (*Anodontosoma chacunda*), the Milk-fish (*Chanos chanos*)

and of a Mullet (*Mugil waigiensis*). The fishery of these fishes depends to a certain extent on the abundant occurrence of the alga *Trichodesmium*. Arrow-worms (*Sagitta*) found ordinarily in plankton constitute an item of food again of the Indian Sprat and the Rainbow Sardine. Paucity or profusion, therefore, of Arrow-worms in the plankton would have a direct bearing on the scarcity or abundance of these fishes in the fishing areas.

A remarkable feature of the Krusadai phyto-plankton is the occurrence in great profusion of the Blue Green Algæ (*Oscillatoria irrigua*) and of *Bacillaria paradoxa*² both known hitherto to occur in fresh-water. An equally remarkable feature of the West Hill phyto-plankton is the presence of a large percentage of dead diatoms. Apparently, dead diatoms do not sink at once.

A comparative study of the West-Hill phyto-plankton (Arabian Sea) and of the Krusadai phyto-plankton (Gulf of Manaar, Bay of Bengal) has brought to notice the great similarity between the two. Two species of *Biddulphia* (*B. mobiliensis* and *B. sinensis*), four species of *Chaetoceras* (*C. coarctatus*, *C. debilis*, *C. affinis* and *C. lævis*), four species again of *Rhizosolenia* (*R. alata*, *R. setigera*, *R. stollerforthii* and *R. styliiformis*) and a number of other genera such as *Asterionella*, *Bacteriastrum*, *Coscinodiscus*, *Nitzschia*, *Pleurosigma*, *Thalassiothrix*, *Fragillaria*, etc., are found to occur in both areas. Are the hydrographical and other conditions necessary and suitable for planktonic life almost the same in both seas?

Both the Fisheries Biological Stations have contributed data on the planktonic diet of several fishes of commercial importance treated in the Bulletin "On the Common Food Fishes of Madras", which is now under preparation. Additional information can be obtained from the Departmental Administration Reports where plankton studies of both the Stations are annually reviewed.

² This is also found in brackish water.