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# SYNCHRONIZATION IN THE OCCURRENCE OF *TRICHODESMIUM* BLOOM AND SWARMING OF *CRESEIS ACICULA* RANG (PTEROPODA) AND *PENILIA AVIROSTRIS* DANA (CLADOCERA) IN THE AREA OFF COCHIN

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## ABSTRACT

On 26th March 1973 the occurrence of *Trichodesmium* bloom was observed over a stretch of more than 40 miles in the area off Cochin. A dense swarm of *Creseis acicula* is reported for the first time in the inshore waters off Cochin along with a minor swarm of *Penilia avirostris*. The synchronization of these three swarms and their economic importance is briefly reviewed.

## INTRODUCTION

The occurrence of *Trichodesmium* bloom in the Indian coastal waters and Laccadive sea appears to be a regular phenomenon during March/April, when sunshine lasts for 10-12 hours a day (Qasim, 1970). Nagabhushanam (1967), and Qasim (1970, 1972), have reported the bloom in the area around Kavaratti and Minicoy Islands of the Laccadive sea, respectively.

*T. erythraeum* seems to play an important role in the economy of the sea. It appears to contribute to the nitrogen budget of the sea by its ability to fix atmospheric nitrogen. In the area where blooms occur, total depletion of nitrate-nitrogen has been reported (Qasim 1970, 1972) which probably upsets the normal N:P ratio and may further arrest the

growth of other phytoplankton species. Because of its high rate of multiplication, the dense bloom causes discolouration of water and the consequent decay of filaments very often results in mortality of organisms. The area where *Trichodesmium* bloom occurs is avoided by other living organisms.

Zooplankton biomass normally reaches peak abundance during October-April in the Indian coastal waters. A few species such as *Evadne tergestina* Claus (Della Croce and Venugopal, 1972; Menon *et al.* 1971), *Penilia avirostris* Dana (Della Croce and Venugopal, 1972), *Hyperia sibaginis* Stebbing (Nair, 1972), *Creseis acicula* Rang (Aiyer *et al.* 1936; Chacko, 1950; 1951; Pillai, 1968 and Prasad, 1954), *Cavolinia uncinata pulsata* Rang, Spoel (Sakthivel, 1972b) etc., have been reported to occur in

swarms in the Indian coastal waters. The present report deals with the swarming of two species in the area off Cochin. They are *Creseis acicula* and *Penilia avirostris*.

*Creseis acicula* Rang is a common neritic species occurring all over the Indian Ocean. It occurs more densely near the coasts. Of all the areas studied in the Indian Ocean, the region off Somalia, Saudi Arabia, West coast of India and off Java showed peak abundance (Saktivel, 1972a). The peak period of abundance along the west coast of India is observed during October-April. The average number of organisms per IOSN haul was 26 in 200 m<sup>3</sup> of water and the maximum number obtained in a single haul was 700/200 m<sup>3</sup> from a station (14°N-85°E) in the Bay of Bengal. The swarming of this species in the inshore waters off Bombay (Pillai, 1968), Trivandrum (Menon, 1945), Mandapam (Prasad, 1954), Krusadai Island (Chacko, 1950) and Madras (Aiyer *et. al.*, 1936 and Mukundan, 1951) has been noticed from time to time. As this species often drifts in swarms very close to the shore and even ascends into the estuaries and river mouths this causes "sea-stings" or dermatitis for sea-bathers. Such instances have been reported in bathing places of Florida, USA and in Japan (Nishimura, 1965). The "sea-stings" to larger fishes lower the market value of fishes.

*Penilia avirostris* is also a neritic species. It is distributed in the coastal waters of the Indian ocean with more common occurrence along the coasts of Indian peninsula (Della Croce and

Venugopal, 1972) during November-May. High population densities (500/haul) were observed in the Gulf of Cambay, off Goa and Cochin (Della Croce and Venugopal, 1972). Swarms were noticed at two stations during November, one in the area south off Quilon (24, 422 organisms/10 m<sup>3</sup>) and the other near Karachi (8056/27 m<sup>3</sup>). Bhimachar and George (1952) have observed that cladocerans form a substantial part of the diet of juvenile mackerel from August to December.

#### MATERIAL AND METHODS

In one of the fishing trips of "M. V. Master Fisherman" of the Central Institute of Fisheries Operatives on 26th March 1973, a series of plankton hauls were made from the inshore and offshore areas off Cochin at every 10 m depth intervals. The Indian Ocean Standard Net (IOSN) (Currie, 1963) was operated in horizontal hauls for 10 minutes keeping the vessel running at 2 knots. The volume of water filtered by the net was approximately 600 m<sup>3</sup>. The vessel went upto 30 fathoms and then returned to the shore.

#### RESULTS

The bloom of *Trichodesmium erythraeum* was sighted at first along 20 m depth line in visible concentration; dense patches of bloom were then noticed further on at intervals in the form of sand coloured bands at the surface (Fig. 1). The concentration and occurrences of dense patches increased from inshore to offshore areas. The bloom was found to

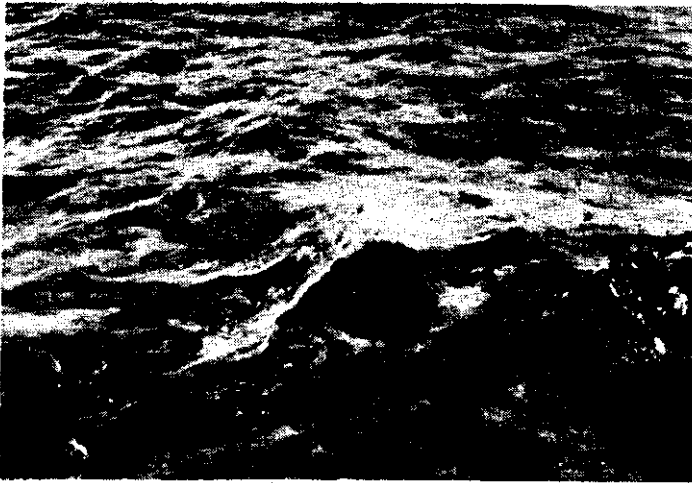


Fig. 1 *Trichodesmium* bloom

occur continuously along the to and fro track of the vessel. The number of filaments counted were 20,733/l in a water sample collected by a 20 litre-bucket at the surface. Many such patches of different concentrations were found. Qasim (1970) noticed the bloom in April 1968 over a stretch of more than 100 miles in the Laccadives Sea. In the area off Kavarathi Island, he observed fairly high concentration (500,000 clumps/m<sup>3</sup>) of *Trichodesmium* which often got washed ashore into dense pads of 4-6 cm thick.

No mortality of living organisms was found in the area of investigation. However, the populations of fish and other nekton were poor. In one of the bottom trawl operation for half an hour at 20 m, only about 20 kg of nekton were caught and the fishes *Nemipterus japonicus* and *Trichiurus* sp. contributed 3/4 of the catch. The other animals

present were *Sepia*, *Loligo*, carbs and *Squilla*.

The displacement volume of zooplankton was ranging from 0.15 ml to 0.3 ml/m<sup>3</sup>. Copepods and chaetognaths were the dominant groups in most of the collections. To our surprise, the haul made at 22 m depth was fully dominated by *Cresets acicula* and *Penilia avirostris*.

The entire net was clogged with needle like shells of *C. acicula*. As most of the specimens had very narrow shells with a diameter range of 0.2 to 0.4 mm a sizeable amount of population could have easily escaped through the mesh of the net which has a mesh width of 0.33 mm. It was difficult to remove all the organisms from the net as most of the shells of *C. acicula* were stuck in the meshes of the net. The organisms collected in the plankton bucket alone measured 102.5 ml in displacement volume. Of this, *C.*

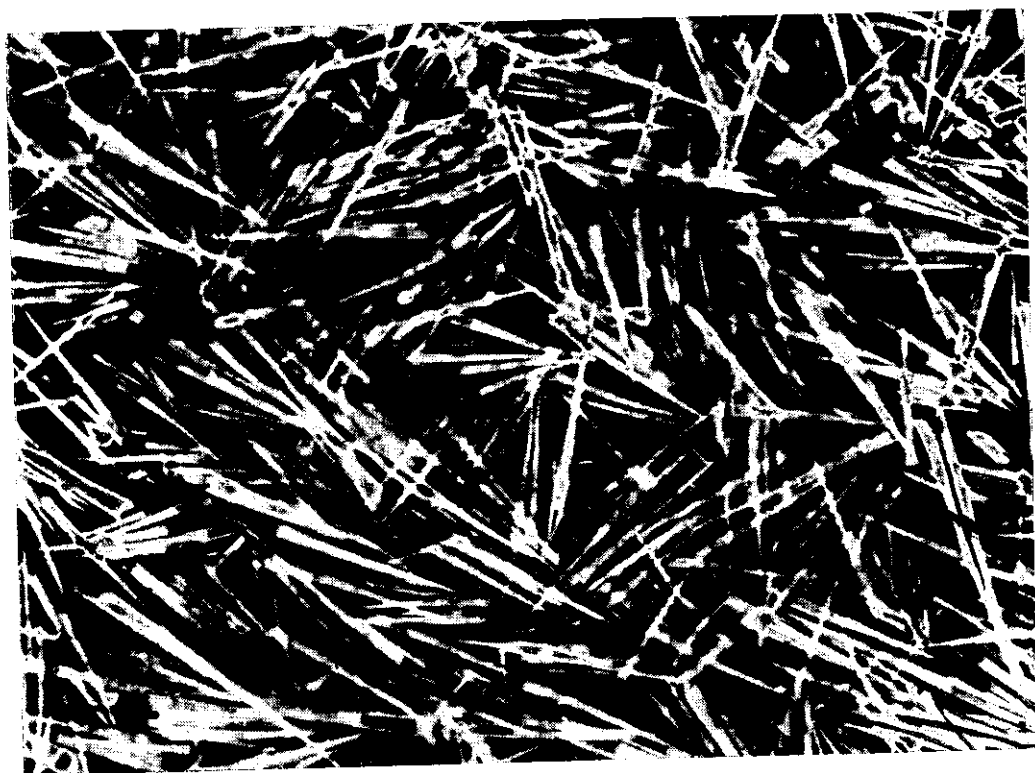


Fig. 2 A swarm of *Creseis acicula*

*acicula* alone contributed 80% (Fig. 2) and the rest was mainly *P. avirostris* (Fig. 3). The copepods became third in abundance. The number of organisms of different groups counted from a fraction of 2.5% and estimated to 100% are given below (approximately in 600 m<sup>3</sup>):

<i>Creseis acicula</i>	2,23,000
<i>Penilia avirostris</i>	98,580
<i>Evadne</i> spp.	7,740
Copepoda	25,490
Zoea larvae	3,460
Lucifers	3,450
Other decapod larvae	350

Lamellibranch veligers	400
Chaetognatha	880
Copelata	320
Fish larvae	580

Near the Fairway buoy off Cochin, a dense swarm of *Evadne tergestina* (20, 924/m<sup>3</sup>) has been reported by Menon *et. al.* (1971). Perhaps the swarm of *P. avirostris* appears to be the first record in the area off Cochin. Most of them were carrying developing embryos.

The swarm appears to have spread within the area of 5 miles, as the neighbouring stations on either side of the transect were devoid of *C. acicula*. The



Fig. 3 A swarm of *Penilia avirostris*

period of swarming coincides with the earlier findings of Prasad (1954) in the Mandapam area and of Chacko (1950) in the area around Krusadai Island. Off Trivandrum, Menon (1945) observed the swarm during November–April. Pillai (1968) has reported the peak abundance of *C. acicula* during October in the area off Bombay. However, there is no proper information on the size and density of *Creseis* swarms by the earlier authors as the earlier observations were made in a limited area following different field-techniques of sampling zooplankton.

In the present study, the shells of *Creseis acicula* were about half the size of adults as most of them were immature. Mainly two size groups were noticed—one with the length and breadth ratio of 2.5 : 0.2 mm and the other with the ratio of 6.0 : 0.4 mm. All the shells were with animals.

#### DISCUSSION

The most interesting feature is that the swarm of *C. acicula* synchronised

with the swarm of *Penilia avirostris* at the time of *Trichodesmium* bloom. Such a situation appears to be the first of its kind reported from the waters of the south west coast of India. The animals tend to avoid *Trichodesmium* blooms. So far there is no conclusive evidence to show that *Trichodesmium* causes toxic effect on animals. In the present observation although the population of nekton was scarce, zooplankton was moderately abundant. The biomass was two to three times richer than the average biomass of the Arabian sea. Therefore, the earlier idea that zooplankton tends to avoid *Trichodesmium* bloom is rather doubtful.

*P. avirostris* has been reported to be abundant (500/haul) in the Gulf of Cambay, off Goa and Cochin with occasional swarms in the areas off Quilon and off Karachi (Della Croce and Venugopal, 1973). Off Quilon, it records a maximum of 24, 422 specimens in 10 m<sup>3</sup> in a haul from 10 m depth. This swarm appears to be about

14 times denser than the present swarm. *P. avirostris* is reported to form the food of mackerel (Bhimachar and George, 1952). Selvakumar (1970) also reported on the cladoceran swarms in relation to mackerel fishery along the west coast of India and suggested, reviewing previous work, that cladoceran swarms herald the appearance of mackerel shoals. It is therefore worth investigating in detail the distribution and population density of this species as this may help to forecast the mackerel fishery in the Indian coastal waters. It seems desirable to conduct a detailed survey of the blooms of *Trichodesmium* in the

Arabian sea, taking into account its duration, size and density. It should not be difficult because it is a regular phenomenon, and occurs almost every year during March-May. As the swarms of certain species of zooplankton also seem to occur during the same period, it would be interesting to ascertain whether such a coincidence reported here is accidental or there is any direct relationship between the two.

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