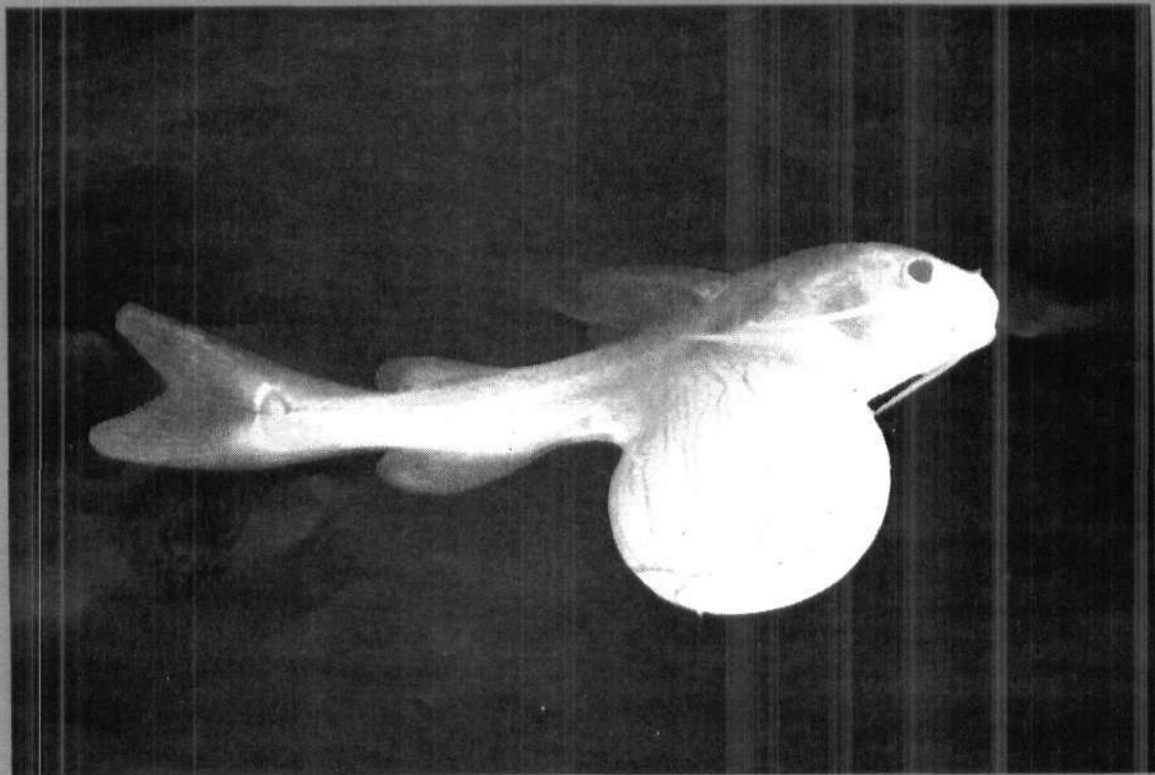




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PHYTOPLANKTON BLOOMS ALONG THE INDIAN COASTS—SOME HIGHLIGHTS*

Introduction

Blooms of plant origin are known to occur under various conditions in the inshore regions. These may take place, often with cyclical regularity in any particular area when some optimum conditions of temperature, salinity, sunlight, nutrients *etc.* prevail in the marine environment. The bloom usually takes place rather suddenly and may spread with amazing speed, sometimes changing the colour of the surface waters into red, green or hay colour. The blooms will be normally monotypic.

The most important factor for the phytoplankton blooms is the presence of high quantities of nutrients in the surface waters which may be due to the process of upwelling or run off from land. Thus it has been observed that the majority of blooms appear during monsoons or soon after.

The southwest coast of India is known for intense upwelling during the southwest monsoon period. During this period the nutrient rich subsurface water is brought to the surface, which provides congenial condition for high productivity at the primary level, sometimes leading to the flowering of certain species of phytoplankters.

Trichodesmium though totally non-toxic, can cause fish kills when it occurs in blooms by clogging the gills. Usually fish tend to avoid such thick blooms as these are not much favoured as food and ingested only accidentally. Destruction of corals can also take place due to the depletion of oxygen when thick dumps of *Trichodesmium* decompose.

The CMFRI has been continuously monitoring the pattern of productivity at the primary and secondary levels in the inshore fishing grounds at important fish landing centres along the coasts of India. During the course of these investigations phytoplankton blooms have been recorded regularly from the selected centres. The present article embodies a critical appraisal of the blooms observed at Karwar, Mangalore, Cochin, Vizhinjam, Tuticorin and Madras from 1982 to 1987.

Observations and results

Noctiluca miliaris, *Coscinodiscus* sp. and *Fragilaria oceanica* are the three common species which appear in blooms regularly. There are some other phytoplankters also which bloom occasionally at restricted areas. These include species of *Ceratium*, *Chaetoceros*, *Rhizosolenia*, *Biddulphia*, *Skeletonema*, *Thalassionema*, *Thalassiosira subtilis*, *Thalassiothrix* and *Trichodesmium*. The organisms which bloomed at various centres in different years under study are given in Table I.

Noctiluca miliaris appeared in blooms in some place or other in all the years under consideration. The period of blooming of this species was found to be between August and April of every year except in Madras where it occurred in June, 1984 also. At Karwar during a two year period under observation, *N. miliaris* occurred in blooms in September, 1982. At Mangalore it occurred continuously for four months from November, 1986 to February, 1987. At Cochin though observations were on from 1984 onwards only, blooms of *N. miliaris* were seen in three months (February, March and June) in 1986 and April, 1987. At Vizhinjam, August to November was the period for the blooms of *Noctiluca*. Thus in 1982, the bloom occurred in October but in 1983, it was during August and September. Blooms were not observed during 1984 and 1985 but appeared again in November 1986. A striking peculiarity observed in the occurrence of blooms of *Noctiluca* was that while at Mangalore and Vizhinjam blooms appeared during November–December, in 1986 and November in 1987 respectively, at Cochin during some years the bloom took place in February, March and June. Thus it is seen that *Noctiluca*, as a rule, appears in blooms during the post monsoon and premonsoon seasons when the water temperature is comparatively high and required amounts of nutrients are present in the surface waters especially during the post monsoon period.

From Madras reports were received with regard to the blooms of *Ceratium* sp. in 1982 (May & June) and 1984 (April & May). However, from 1985 to 1987 flowering of this species had not been reported from Madras.

Blooms of *Coscinodiscus* sp. had been reported from the northern parts of the southwest coast of India namely Karwar and Mangalore and Madras on the

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Table 1. Details of occurrence of phytoplankton blooms at different centres during 1982 - '87

Species		1982	1983	1984	1985	1986	1987
1. <i>Noctiluca miliaris</i>	Karwar	Sep.	—	No	No	No	No
	Mangalore	—	—	—	—	Nov., Dec.	Jan., Feb.
	Cochin	No	No	—	—	Feb., Mar., Jun.	Apr.
	Vizhinjam	Oct.	Aug., Sep.	—	—	Nov.	—
	Madras	Aug., Sep.	No	Jun.	—	—	—
2. <i>Ceratium</i> sp.	Madras	May, Jun.	No	Apr., May	—	—	—
3. <i>Coscinodiscus</i> sp.	Karwar	Jan., Dec.	Jan., Feb.	No	No	No	No
	Mangalore	—	Mar.	—	Nov.	Feb., Mar.	—
	Madras	—	No	Apr., Sep., Dec.	Jan.	—	—
4. <i>Fragilaria oceanica</i>	Cochin	No	No	Jul.	Jul.	Jul.	Jun., Aug.
	Vizhinjam	Jul.	—	—	Jun.	—	—
5. <i>Chaetoceros</i> sp.	Karwar	Feb.	—	No	No	No	No
	Vizhinjam	Aug.	—	—	—	—	—
6. <i>Rhizosolenia</i> sp.	Mangalore	—	—	—	Nov.	—	—
	Vizhinjam	—	—	—	Jun.	—	—
	Madras	May, Jun.	No	—	—	—	—
7. <i>Biddulphia</i> sp.	Mangalore	—	—	—	Nov.	—	—
8. <i>Skeletonema</i> sp.	Mangalore	—	Feb.	—	—	—	—
	Madras	Jun.	No	—	—	—	—
9. <i>Thalassionema</i> sp.	Vizhinjam	—	—	—	Jun.	—	—
10. <i>Thalassiosira subtilis</i>	Vizhinjam	—	—	—	—	—	Jun.
11. <i>Thalassiothrix</i> sp.	Madras	Apr.	No	—	—	—	—
12. <i>Trichodesmium</i> sp.	Tuticorin	—	—	—	Aug., Oct.	Aug.	Apr., May
	Madras	Jun.	No	Apr.	—	—	—

No = No observation.

— = Not present.

east coast. At Karwar it occurred during both the years of observation. In general November–March was the period of bloom for this species. During January and December in 1982 it appeared in blooms at Karwar. From December, 1982 the bloom continued up to March, 1983 at this centre. At Mangalore out of six years under consideration, the *Coscinodiscus* sp. was in bloom during 1983 (March), 1985 (November) and 1986 (February & March). On the east coast, the bloom took place in April, September and December in 1984 and January in 1985 in Madras. From the data obtained it could be seen that the period of bloom for *Coscinodiscus* sp. was almost the same as that of *Noctiluca miliaris* though they were not seen in blooms simultaneously in any year.

Fragilaria oceanica is a typical phytoplankton which appears in blooms during the monsoon season especially in the southern parts of the southwest coast of India.

Ever since regular sampling started in Cochin, the species occurred in blooms in one of the months of June, July or August. While in 1984, '85 and '86 it occurred in dense blooms in July, in 1987 it was abundant during June and August. At Vizhinjam, however, *Fragilaria oceanica* was in bloom occasionally, in 1982 and 1985. But the phenomenon appeared in June in both the years.

Chaetoceros sp. was found in blooms at both Karwar and Vizhinjam in 1982. However, the period of occurrence was totally different, being in February at the former centre and August at the latter. Similarly, *Rhizosolenia* sp. was another species which was in bloom in different periods at two different centres. At Mangalore while the bloom was in November in 1985, at Vizhinjam it was in June of the same year. Blooms of *Skeletonema* sp. was observed once only at Mangalore in February, 1983 and at Madras in June, 1982.

Five other species of phytoplankton which appeared in blooms at the various centres under observation were restricted to any one of the centres during a particular year or years. Thus *Biddulphia* sp. was in blooms at Mangalore in November, 1985, *Thalassionema* sp. and *Thalassiosira subtilis* at Vizhinjam in June, 1985 and 1987 respectively. *Thalassiothrix* sp. was the fourth species in this category which appeared in blooms in Madras in June, 1982.

Trichodesmium sp., the fifth species was reported only from the lower east coast. The period of bloom varied from year to year. Thus in Tuticorin it appeared during August and October in 1985, while in 1986 in August only. In 1987 the bloom occurred in the premonsoon months of April and May. In Madras the two occasions on which *Trichodesmium* were in bloom were June, 1982 and April, 1984.

An evaluation of the environmental features during the period of blooms at the respective centres revealed the following. At Karwar, the *Noctiluca* blooms appeared when there was a drastic reduction in salinity values (19.34‰). *Coscinodiscus* sp. and *Chaetoceros* sp. were in blooms in salinities ranging from 32.40 to 34.43‰. When the blooms occurred the surface temperature was relatively low and between 25.6 and 27.5°C. The dissolved oxygen content was well above optimum level and ranged between 3.79 and 4.25 ml/l.

When the blooms occurred at Mangalore, the temperature was rather high and ranged between 27.5 and 33.5°C. The salinity was also relatively high and varied from 33.97 to 35.3 ‰. The dissolved oxygen values were considerably low in November, 1985 (2.80 ml/l), when *Coscinodiscus* sp., *Rhizosolenia* and *Biddulphia* were in blooms and February (2.53 ml/l) and March, 1986 (2.76 ml/l) when *Coscinodiscus* sp. was in blooms.

At Cochin when *Noctiluca* bloom occurred, the surface temperature varied between 27.0 and 31.5°C. The salinity was also relatively high with a minimum of 32.25 and a maximum of 35.75‰. However, *Fragilaria oceanica* appeared in blooms in low temperature and salinity. The lowest temperature was 22.2°C while the maximum registered was 31.5°C. Most of the temperature values were below 30°C. The salinity values showed a wide range, the lowest being 10.55 and the highest 35.75‰.

Vizhinjam was the centre where single species and mixed species blooms occurred in the different years.

When *Noctiluca* blooms occurred at this centre there was no unusual environmental conditions present in the sea. The temperature ranged between 27.80 and 30.00°C, while the salinity varied from 30.6 to 35.68‰. When the mixed bloom of *Fragilaria oceanica*, *Rhizosolenia* sp. and *Thalassionema* sp. occurred in June, 1985, the temperature was as low as 26°C. However, during another mixed bloom with *Thalassiosira subtilis* as the dominant form in June, 1987 the surface temperature was 24.0°C. During any of the above blooms the salinity registered values between 33.5 and 35.68‰. The dissolved oxygen values always remained well above the optimum level and ranged between 4.50 and 4.85 ml/l.

When the blooms of *Trichodesmium* sp. were noticed from 1985 to 1987, in the Tuticorin waters the surface temperature fluctuated between 28.5 and 31.0°C and salinity between 32.8 and 34.84‰. The oxygen values were fairly high and ranged from 4.62 to 5.15 ml/l. The temperature and salinity values recorded during both the years when this species was in bloom in Madras were almost the same around 28.5°C and 31.0‰ respectively.

An examination of the environmental parameters in relation to blooms for Madras revealed the following. In general, the salinity values were considerably less when blooms occurred. The surface temperature was low (24.38°C) when the bloom of *Noctiluca milliaris* appeared in 1982. However, in 1984 the surface temperature was relatively high (28.4°C) and salinity low (33.6‰). When *Coscinodiscus* sp. was in blooms the surface temperature and salinity showed lower than normal values. *Rhizosolenia* sp., *Skeletonema* sp., and *Thalassiothrix* sp. were also in blooms in low saline cool water.

A close consideration of the foregoing facts indicates that the occurrence of phytoplankton blooms is a regular phenomenon in the coastal waters, than incidental. While it is possible that the interaction of environmental parameters act as triggers for the sudden outbursts of blooms, it is difficult to pin point any one parameter as responsible for this. May be a combination of various parameters is necessary to create an optimum condition for the flowering of any one species. Perhaps it might be a sudden increase or decrease in the values of certain environmental features that act as triggers for an organism to multiply at an explosive rate. Further works, particularly on the effects of blooms on fisheries are under progress.

