

Some Biological Problems of the West Coast of India

By

S. N. Dwivedi

National Institute of Oceanography, Panaji-Goa.

The International Indian Ocean Expedition has presented a broad picture of the Arabian Sea and has helped in delineating the areas which can be better utilized. The expedition also outlined a few problems which require immediate attention. The results of the expedition have yielded considerable information, specially, about the open parts of the Arabian Sea but the coverage of the coastal areas has not been adequate. The coastal areas are extensively used and are vitally important for future development of marine resources and industrial uses. However, in this process the environment can be damaged. Therefore, monitoring the environment is essential for protection of the coastal zone.

Centuries old craft and gear are still in use along the west coast of India. There are about 40,000 active fishermen in India who live in 1,000 villages. They fish with indigenous methods in a narrow coastal belt, generally upto 10 m depths. In the recent past about 8,000 small and medium sized mechanized fishing boats have been added which generally fish upto 40 m depth zone. The shelf between 40 and 200 m depth is very poorly exploited by commercial boats and needs greater attention.

The coastal areas are equally useful for the industries like shipping, petro-

chemicals, oil refineries and serve as dumping ground for the industrial effluents and sewage causing pollution of the environment. Therefore, optimum use of coastal zone, for food, industry and recreation, needs careful planning of marine research and management.

Ecosystems

The oceanographic and marine biological studies conducted so far indicate the existence of five major coastal areas which have their own specific and distinct characteristics :

- (i) Coastal zone with and without upwelling
- (ii) Estuaries and backwaters
- (iii) Mangrove swamps
- (iv) Sandy beaches and
- (v) Islands.

(i) Coastal zone with and without upwelling

The coastal zone upto 40 m depth along the west coast has great socio-economic importance. The most dominant fisheries of this zone are oil sardine, mackerel, shrimps and prawns. The annual fluctuations in oil sardine fishery are well known and these result in a number of side effects which adversely affect the fishery industry. Even today, the ecology, breeding grounds,

Biological Problems of the West Coast of India

migrations and population structure of oil sardine are not fully understood (Nair, 1973). Considerable work has yet to be done to be able to formulate a plan for their optimum utilization.

Mackerel, *Rastrelliger kanagurta* which constitute about 10% of India's fish catch (CMFRI Annual Report 1959-60) poses identical problems. This single species is widely distributed; large quantities are landed all along Malabar and Konkan coast and in Maharashtra fishery is important upto Ratnagiri, but its breeding grounds, migrations and population structures are not yet understood.

Shrimps constitute a very valuable foreign exchange earner. India's marine food export principally depends on them. The ecology of prawn fishing grounds has yet to be studied to avoid our dependence on chance. The ecology and biology of the commercially important species have been under investigation for about last 25 years (CMFRI Annual Report 1972). It is now well known that these are not isolated or localised problems.

The ecological conditions of an ecosystem govern the nature and extent of its fishery resources. The present trend, therefore, is to study an ecosystem in respect of its physical, chemical and biological characteristics in an integrated manner.

The coastal zone can further be divided into two distinct areas (a) areas with upwelling—from Kerala coast to Ratnagiri in Maharashtra and (b) areas without or poor upwelling—from Ratnagiri to north of Bombay.

The upwelling areas are highly productive due to their richness in nutrients. The areas off Kerala, Mysore and southern Maharashtra are directly associated with the equally high occurrence of pelagic fisheries. It is perhaps due to this high productivity that the red tides have been reported mainly in these areas along Malabar coast (Bhimachar, 1950), dinoflagellates off Cochin (Prakash & Sarma, 1964), *Trichodesmium* near Laccadives (Qasim, 1970), off Goa water (Ramamurthy, et al. 1972). The occurrence of red tide is invariably accompanied by failure of pelagic fishery, particularly sardines and mackerels. The earlier information indicates that the red tide brings about depletion in oxygen (Bhimachar, 1950). Probably this with associated changes in other environmental parameters may be responsible for sudden setback in mackerel fishery. The causative factors including environmental conditions which lead to the occurrence of these blooms should be studied in nature and as well as in the laboratory.

The area without upwelling—from Ratnagiri to North Bombay is comparatively less productive. However, this area falls between two upwelling zones and its boundaries are influenced by the intensity and extent of upwelling in adjacent areas from year to year.

Investigations have been undertaken at the NIO to delineate the extent of upwelling along the central west coast of India between Mangalore to Bombay. The results indicate existence of two peaks of phytoplankton (April and September) and zooplankton (April, May and September to November) production and peak period of produc-

tion has seasonal succession from south to north (Bhargava et al. in press; Dehadrail and Bhargava 1972). Probably this succession indicates that the effects of upwelling-off south-west coast of India extend upto Bombay region but the intensity decreases with progression from south towards north. It is, therefore, necessary to undertake long term studies to determine the upwelling itself and effects of upwelling on biological production at different trophic levels.

(ii) Estuaries and Backwaters

The backwaters and estuaries along the west coast are very extensive and play an important role for food production and disposal of effluents. These are widely scattered and have an area of 30.7 lakh acres (Mitra 1970). The statewide break up is given in Table I.

The estuaries and backwaters are very productive areas along the coast and are being used for various purposes. They are the breeding grounds of various species of marine and estuarine communities. The indiscriminate exploitation of the young ones is damaging the potential production from these waters.

This perhaps is the reason that these estuaries, in spite of being very rich at the primary and secondary levels, do not produce expected yield at the third trophic level. They are potential areas for future utilization. With proper management and suitable measures for protection of environment these areas can be profitably used for aquaculture, inland navigation, recreation and development of tourisms.

The major problem of the estuaries and backwaters is the increasing pollution due to disposal of sewage and industrial effluents. The bays around Bombay city are well known examples of pollution. The industrial effluents from Baroda city presents a threat to Mahisagar estuary. The Government of Gujarat is taking suitable measures for its protection and the National Institute of Oceanography in collaboration with the Central Public Health Engineering Research Institute, Nagpur is studying the problem to suggest protective measures. Similar problems are being faced in the backwaters of Kerala. The estuaries of Goa, have so far been clean, but the growing sewage discharge and

TABLE I

Brackish water swamps and estuaries

State	Brackish water	Estuaries	Total
Gujarat	9.2	10.0	19.2
Kerala	5.0	1.0	6.0
Maharashtra	2.0	1.0	3.0
Mysore	2.0	0.5	2.5
Goa	—	0.3	0.3

Biological Problems of the West Coast of India

disposal of the industrial effluents also poses new dangers.

Several estuaries along the west coast are used for navigation. Mandovi and Zuari estuaries in Goa are used for barge traffic and connect many iron and manganese mines situated in the hinterland with the harbour. The extensive barge traffic, land drainage, erosion, movement of coastal sediment due to tidal and wave action are causing sedimentation in some parts of these estuaries and the problem needs immediate attention.

The estuaries of Goa and backwaters of Kerala are the beautiful landscapes. They have scope for sport fishery and other aquatic sports. The development of these areas for long term use require ecological monitoring on a permanent basis.

(iii) Mangroves

Mangroves are common along the Indian coastline. They grow in backwaters and estuaries where the tidal action is low, due to their growth large areas remain practically unutilized. With the passage of time, cycle of succession of mangrove species is established (Fig. 1) They encroach upon adjoining land and make it unsuitable for agricultural and other more useful avocations. Large areas in the beds of the Galgibag estuary in Goa and Sharavati estuary near Mangalore are full of mangroves. However, mangroves are a source for tannin, which is used in leather industry and as a colouring agent and preservative for fishing nets. At present tannin is imported in India. Development of tannin production from these area can result in saving valuable foreign exchange. The

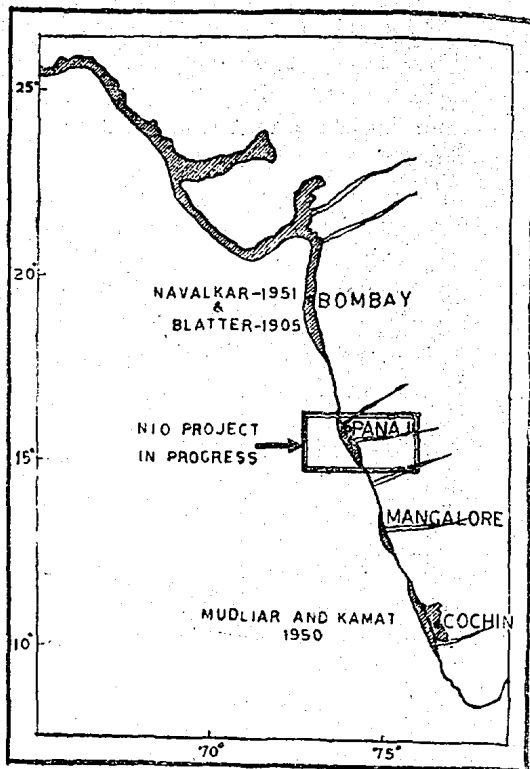


Fig. 1. Distribution of mangroves along West coast of India.

soil in mangrove swamps is rich in nutrients and in some parts of India, agriculturists use it as manure to improve quality of the soil of their fields.

Mangrove and mangrove swamps are distinct ecosystems. In India, mangrove flora was studied earlier by Prain (1903). On the west coast mangroves have been studied by Navalkar *et al.* (1940), Venkateswaralu (1944), Blatter (1945), Mudliar *et al.* (1952) and Navalkar (1952). However, information on ecology, production and energy pathways, which is essential for their utilization is very scanty.

Studies on the mangroves of Goa have been initiated by the NIO and the



Fig. 2. Oil Pollution at Sinquerim beach. Tar deposition seen at different tide levels.

preliminary results (Untawale et al. 1973) indicate that the mangroves do not grow in the lower reaches of estuaries where wave action is high, the bottom is rocky or sandy. In the middle reaches where wave and tide action becomes less pronounced, the mangroves start growing and establish their typical species associations. In these regions the bottom is swampy and fishing or other avocations become very difficult. The special root system loosens the soil which continuously add to silting and can adversely affect navigation. These areas with proper management practices can be profitably used for various purposes, including development of food resources.

(iv) Sandy beaches

The beaches have extensive human activities. Some of the beautiful beaches along the west coast of India,

particularly in Goa, are the places of entertainment, recreation, etc. They also play an important role in the productivity of the coastal waters. Their study is, therefore, necessary for the protection from erosion, to assess their importance in marine productivity and for effective utilization.

Beaches have very dynamic environment and the intertidal region undergoes changes every day. The animals and plants inhabiting this zone have a very large adaptability, and maintain a high degree of biological activity. However, human activity in different ways affect the beaches and sometimes result in pollution.

Recent study at the National Institute of Oceanography have shown that the beaches all along the Indian coastline

Biological Problems of the West Coast of India

are affected by oil pollution. During south-west monsoon period the deposition of coal tar is fairly extensive along the central west coast of India between Ratnagiri and Mangalore. Out of 22 beaches and rocky shores investigated during 1972, on 18 beaches tar deposition was found in varying degrees. Detailed investigations conducted along the beaches of Goa indicate that the deposition of tar starts with the advent of the monsoon (Fig. 2). However, the process lasts for a short period.

Variety of flora and fauna was associated with the oil deposition indicating that the material was washed ashore from some offshore areas. The problem needs extensive studies to answer several questions associated with the oil pollution.

Some of the beaches are also affected by human excreta, domestic and industrial waste. The influence of shipping and fishing can also be seen on beaches. These needs regular scientific investigations to understand the effect of such pollution. Bacteriological studies are very essential for monitoring pollution due to human excreta and sewage discharges, because on some beaches the count of Coliform bacteria is very high (Gore and Singbal, 1972). The microbiological studies will also help in understanding the degradation of oil.

(v) Islands

Arabian sea has a number of islands and the biological productivity along the islands is high. They are also important

for defence, for tourist industry and for oceanic food resources. Oceanographically, they are significant because of their pronounced influence on the surrounding seas, which results in creation of separate ecosystems around them. Along the west coast there are three distinctive groups of islands, called Saurashtra group, Konkan group and Laccadive group. Very little information is available about these islands. Recently some work has been initiated around these islands (Panikkar *et al.* 1971; Tranter and George, 1967; Qasim and Shankaranarayanan, 1970). Some of these studies indicate that the productivity around these islands is higher than the open sea. The Institute with production oriented objectives is making intensive oceanographic studies of these islands.

Summary

The Arabian Sea at present contributes about three fourths of fish landings in India which mainly come from coastal zone; the exploitation of fishery potential beyond 40 m depth zone requires greater inputs.

The Indian coast along the Arabian Sea is heavily populated and nearshore are subjected to great human interference, therefore, in order to protect the marine environment in the coastal zone there is an immediate necessity of planning at the national level. Amongst these sewage, industrial effluents and oil pollution pose immediate threat. The natural forces in the sea have self cleaning and regenerating capacity to keep the environment clean. In order to

obtain maximum benefit from these processes and to keep a clean, healthy and attractive sea side and harnessing the resources, the Arabian Sea requires greater attention for oceanography and better management of waste disposal.

REFERENCES

- Annual Report (1960-1969). Central Marine Fisheries Research Institute Mandapam *CMFRI*.
- Blatter, E. 1905. The mangrove of the Bombay Residency and its biology. *J. Bombay nat. Hist. Soc.*, 16: 644-656.
- Bhargava, R. M. S., R. A. Selvakumar and S. Y. S. Singbal. Hydrobiology of surface waters along Panaji-Bombay Coast. *Indian J. mar. Sci.* (In Press).
- Bhimachar, B. S. and P. C. George. 1950. Abrupt setbacks in the fisheries on the Malabar and Kanara coasts and 'red water' phenomenon as their probable cause. *Proc. Indian Acad. Sci.*, (B) 31: 339-350.
- CMFRI 1972. Central Marine Fisheries Research Institute. Silver Jubilee Souvenir.
- Dehadrai, P. V. and R. M. S. Bhargava. 1972. Distribution of chlorophyll, carotenoid and phytoplankton in relation to certain environmental features along central west coast of India. *Mar. Biol.*, 17 (1): 30-37.
- Gore, P. S. and S. Y. S. Singbal. 1973. Ecology and production in two sandy beaches of Goa, Part (A) Distribution of bacteria in Colva & Siridao in relation to certain environmental parameters. *Fish. Technol.*, 10(1): 55-60.
- Mitra, G. N. 1970. Development of inland fisheries in India. *Resource of papers*. National Food Congress, Freedom from Hunger Campaign and Ministry of Food, Agriculture and C. D. and Co-op. Government of India. (20): 8.
- Mudliar C. Rajsekhar and H. Sunanda Kamath. 1958. Backwater flora of the west coast of South India. *J. Bombay nat. Hist. Soc.*, 16: 644-656.
- Nair, R. V. 1973. Indian Sardine. *Zool. monograph No. 2*. Publication and Information Directorate, CSIR, New Delhi.
- Nair, S. A., V. P. Devassy, S. N. Dwivedi and R. A. Selvakumar. 1972. Observations on tar-like material observed on some beaches. *Curr. Sci.*, 41(21): 766-767.
- Navalkar, B. S. and Bharucha, R. F. 1940. Study in the ecology of mangroves. *J. Univ. Bombay*, 58.
- Navalkar, B. S. 1956. Ecology of mangrove swamps of Bombay. *J. Univ. Bombay*, 335.
- Panikkar, N. K., A. H. Parulekar, and A. G. Untawale. 1971. Continental shelf islands of Konkan Coast, IGU Symposium held at Panjim.
- Prain, D. 1903. Flora of Gangetic Sunderbans. *Bot. Surv. India Memoir.*, 4(2).
- Prakash, A. and A. H. V. Sarma. 1964. On the occurrence of 'Red Water' phenomenon on the west coast of India. *Curr. Sci.*, 33(6): 168-170.
- Qasim, S. Z. 1970. Some characteristics of a *Trichodesmium* bloom in the Laccadive. *Deep-Sea Res.*, 17: 655-660.

Biological Problems of the West Coast of India

- Ramamurthy, V. D., R. A. Selvakumar and R. M. S. Bhargava. 1972. Studies on the Blooms of *Trichodesmium erythraeum* (Ehr) in the waters of the central west coast of India. *Curr. Sci.*, 41(22): 803-805.
- Shankaranarayanan, V. N. and S. Z. Qasim. 1972. The influence of some hydrographical factors on the fisheries of Cochin Area. *Bull. nat. Inst. India*, 38(II): 846-853.
- Shankaranaraynan, V. N. 1970. Production of particulate organic matter by the reef on Kavaratti Atoll (Laccadives). *Limnol. Oceanogr.*, 15(4): 574-578.
- Tranter, D. J. and J. George. 1969. Zooplankton abundance inside and outside the lagoon of Kavaratti atoll in Laccadive. *Acv. Astt. Contr. Aquat. Sci. Indta*, 3(1): 43. Abs. Pap *Corals and Coral reefs*, Mandapam camp.
- Tranter, D. J. and J. George. 1972. Zooplankton abundance at kavaratti and Kalpin Atolls in the Laccadive. *Proc. Symp. Corals and Coral Reefs 1969. Mar. Biol. Ass. India*, 239-256.
- Untawale, A. G., S. N. Dwivedi and S. Y. S. Singbal. 1973. Ecology of mangrove in Mandovi-Zuari estuaries and interconnecting Cumbarjua Canal of Goa, *Indian J. mar. Sci.*, 2: 47-53.
- Venkateswaralu, J. 1944. The estuarine flora of Godawari. *J. Bombay Nat. Hist. Soc.*, 44: 431-435.