Plankton IN THE Arabian Sea

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The plankton in any area of the sea is taken as an index of fertility and can be used as material for the elucidation of the biological structure of the sea. So during the International Indian Ocean Expedition several thousands of zooplankton samples were collected, using the Indian Ocean Standard Net, which have given an unique opportunity for comparing the relative fertility of the various regions of the Indian Ocean. A better and clearer picture of this region is emerging as these samples and the vast amount of environmental data collected are being processed.

As a consequence of the rapid increase in the human population and their demands on the natural environment there is urgent need for investigating the potential yields or resources from the seas around us. The Arabian Sea, bounded by countries with large populations and protein in short supply, holds many riddles. The extent of protein wealth that could possibly be harvested from this Sea, where the concentrations of nutrient salts are believed to be twice as much as those in the North Atlantic, has not been fully realized. Because of the present inadequacy of our knowledge of marine ecology there are certain limitations in estimating the potential yields of biological resources within sufficiently realistic and dependable limits. Nevertheless, it is possible to get some idea of the magnitude of the productive potential of a region from a study of the plankton.

Fig. 1 shows the assemblage of some of the common organisms that constitute the zooplankton community.

Plankton production

One of the characteristic general features of plankton production in the Arabian Sea noticed during the recent Expedition is its patchiness. While there are patches of varying sizes where the plankton is so dense as to clog the nets, there will be adjacent areas which are almost barren. Though patchiness in the production and distribution of plankton is a well-known feature in all the seas such extremes occurring simultaneously in a region seem to be a peculiarity of the Arabian Sea.

Based on the two monsoons the year can be arbitrarily divided into two halves, one relating to the south-west monsoons and the months immediately preceding and succeeding it (April 16 – October 15) and the second a similar period covering the north-east monsoon (October 16 – April 15). The pattern of distribution of plankton is noticeably different during the two halves of the year. Thus, during the south-west monsoon period not only that the overall production, as indicated by the standing crop of plankton, is higher but there are restricted areas where the production is remarkably high. This is seen off the coast of Arabia, Somaliland, Iran, West Pakistan and south-west part of India. Along the Saurashtra and eastern part of the Coast of Pakistan, the production is, however, low. The central part Arabian Sea is comparatively poor in plankton with a core between 10° – 15°N and 65° – 70° E where

The term plankton is used to include all the living organisms, plants and animals, that swim weakly or drift in the water. The term zooplankton refers to the animal constituents of the plankton community.

Fig. 1. *Showing the Zooplankton Community*

the production is the lowest (Fig. 2). The region between longitude 40° – 65° E and lattitude 6° – 12° N is believed to be an area of divergence of currents and centre of a gyral. Such areas of divergence are known to be poor in zooplankton population and in this particular region the layer of minimum oxygen also is believed to be brought near the surface causing certain deleterious effects.

This picture changes during the other half (north-east monsoon) of the year. There is a general decrease in the order of magnitude of production in the entire sea, although the central part shows a slightly higher production. Comparatively rich areas are seen off the coasts of Arabia, Somaliland, Iran and West Pakistan and a small area off the south-west coast of India. Generally speaking the extent of production along the west coast of India is lower. The Saurashtra coast shows an improvement over the other half (Fig. 3).

In this connection it is of interest to focus the attention on a region along the Indian coast with which we are vitally concerned. Both during the south-west as well as the north-east monsoon periods there is a region of comparatively high standing crop of zooplankton between Cochin and Mangalore (10°–13°N). During the south-west monsoon, however, there is an increase in production in this particular area and further the area of comparatively higher production spreads towars north and south resulting in a wider area of highly productive zone extending from Cape Comorin in the south to a little beyond Karwar in the north.

Factors influencing the rich plankton production

It is a common experience that in almost all the oceans the magnitude of plankton production is greater near the shores while in the open ocean it is relatively poor. This is because enrichment of surface waters with nutrient salts is more effective in the comparatively shallow waters bordering land masses than in the open, deep, sea. In this enrichment process the profound influence of the monsoons by providing the energy required for these dynamic processes needs no emphasis. The impact particularly of the south-west monsoon on the Arabian Sea is more pronounced than that of the north-east. The strong and

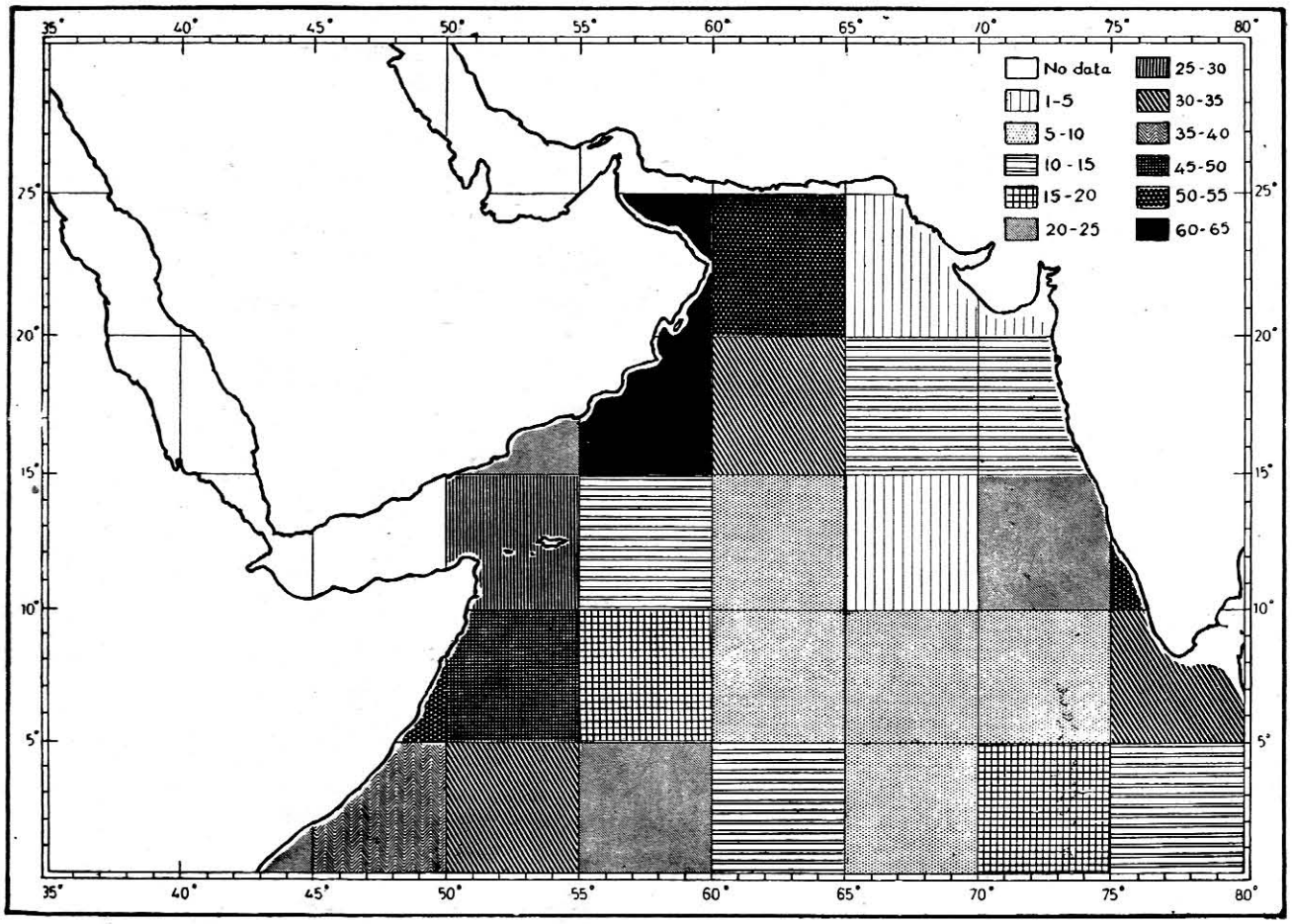

Fig. 2 – *showing the density of zooplankton during the South-West monsoon. In Figs. 2 and 3 the density is shown in millilitres of zooplankton under a square metre of sea surface.*

persistent winds that blow offshore during the south-west monsoon along the African and Arabian coasts result in vertical circulation of water. Although these winds are not favourable for causing upwelling along the Indian coast there are positive evidences of this phenomenon taking place along the south-west coast of India. It is believed that in this region it is not the typical wind - indueed upwelling but vertical circulation brought about by dynamical factors associated with the southerly currents at this time of the year.

The presence of high concentrations of nutrients fairly close to the surface of the Arabian Sea, the breakdown of the barrier of thermal stratification by vertical circulation and the ample supply of solar energy turn the potential productivity to a reality. Clear examples of such high production are seen along the coasts of Pakistan and south-west part of India.

Effects of high plankton production

This highly productive region on the southern half of the west coast of India coincides with the zone of active fishery for two of our most important pelagic fisheries — the oil sardine and the mackerel. The fishery for these starts by July–August and ends by March or April. Thus, the fishery commences during the south-west monsoon and ends towards the end of the north - east monsoon season. The rick plankton production triggered during the south-west monsoon makes the region an excellent pasturage for these plankton feeders. In addition, the northerly coastal drift current generated by the north-east monsoon winds is also believed to facilitate the northward migration of the fishes to this rich feeding ground.

The abundant plankton production in the Arabian Sea thus sustains rich pelagic fisheries. But this high production is not always utilised for building up protein in an easily harvestable

form (fish) and sometimes even causes untoward results, too. Several instances of mass mortality of fish in the northern half of the Arabian Sea have been reported. These occurred mostly in the months of June and January. Recent investigations tend to suggest that factors consequent on the high plankton production to be the most likely cause of this catastrophe. A situation that is potentially both highly productive and biologically unstable exists in the area. Such a condition leads to sudden and dense growth of planktonic organisms during times when the nutrient rich water from below is brought to the surface by the process of upwelling. During these occasions what seems to happen is the depletion of oxygen supply of the surface waters, which are normally low in oxygen, by the death and subsequent decomposition of this enormous quantity of organisms. When fish are exposed to such anoxic water they are asphyxiated resulting in their death. It becomes imperative then that in such a dynamic and unstable environment changes in the quantity of plankton will be sometimes abrupt and the resultant effects of these can be beneficial or detrimental to the rich fishery resources of the region. Fortunately prospects are not gloomy because instances of such deleterious effects so far recorded are few and far between although some of them have been presumably of considerable magnitude. The largest mass mortality of fish is reported to have occurred in June 1957 when the loss was estimated at 20 million tons of fish which is almost half of the world's total annual fish catch! While these mass mortalities of fish should be considered as major catastrophies, they prove beyond reasonable doubt the existence of large populations of fish in the Arabian Sea. This warrants an optimistic outlook for the future and the scope for increasing the rate of exploitation of the fishery resources. Such optimism is further justified by the high fertility of the region as indicated by the magnitude of plankton production.

Fig. 3. *Showing the density of Zooplankton during the North-East Monsoon*