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Monsoons and Marine Fisheries

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THE probable relation between the monsoons and the biology of marine populations was a matter of speculation in the past. As scientists could not locate the vulnerable points in the problem for attack, they steered clear of it. However during the last 25 years, our knowledge of both the monsoons and the marine fisheries of India has expanded considerably and the probable relation between the two is receiving increasing attention. Although it is true that scientists have not even sighted the outer defences of the problem, the onward push has been initiated and that itself is a gain for the scientific world.

Monsoons

Although strictly speaking the monsoons refer to the seasonal winds, in the Indian subcontinent these are also associated with the rains. In the sea there would, in addition, be changes in the current system and other oceanographic features. During the last 15 years considerable effort has gone into investigations of the oceanographic phenomena associated with the monsoons. A few findings stand out:

i) The wind force during the monsoon season may fluctuate from year to year (that is, within a season goes without saying),

ii) the thermocline and the oxygen minimum layer come nearer to the surface and closer to the coast along the west coast during the period of the south-west monsoon than during the other periods, iii) there is pronounced upwelling leading to the enrichment of the coastal waters, iv) there is turbulence and mixing in the nearshore waters, v) Primary production along the west coast reaches the peak during the period of the south-west monsoon and vi) highly productive mud banks are formed in certain regions.

Marine fisheries

The three major pelagic fisheries of India are confined to the west coast, those of the oil sardine and the mackerel along the southern part and that of the Bombay duck along the northern. We also know that the magnitude of the fish populations of both the Arabian Sea and the Bay of Bengal may fluctuate considerably from year to year. Quantitative studies of it has been made by Sekharan and Dhulkned (1963) and by Banerji (1973) in respect of the oil sardine and the mackerel. Their studies indicate that a rich year-class of oil sardine may be at least 10 times as abundant as a poor one and a rich year-class of mackerel

at least 20 times as abundant as a poor one. From the available evidence it would appear that in other fish stock also, the year-class variations (variations in the numerical strength of generations) may be of the same order. Thus if variation in year-class strength is a major factor affecting the catches, annual fluctuations in total landings would become inevitable.

Seasonal variations in the fish community inhabiting the exploited grounds is another notable feature. During the pre-monsoon, monsoon and post-monsoon periods different groups of fishes inhabit the coastal water coincident with the changes in the environment. This regularity in succession of fish fauna has of course been taken advantage of by the fishing industry.

Ecological questions

Ecologically two questions may be asked: i) Do the monsoons affect the biology of marine fish populations directly and/or indirectly, and, through it, the catches, and ii) If so, is it possible to predict it? The relation may be considered in two aspects: i) Physical, and ii) Biological.

One feature of the physical effect is well known in that the rough weather during the monsoon periods restricts fishing activity considerably. Here an important distinction between the Arabian Sea and the Bay of Bengal may be made. While in the Arabian Sea, stormy weather is restricted mainly to the June-September period, in the Bay of Bengal, it may occur at any time during the May-December period and so, comparatively more man-days may be lost for fishing in the Bay of Bengal than in the Arabian Sea, with the attendant loss in production.

Murty and Edelman (1970) have investigated another aspect of the possible correlation. Plotting the pressure difference (to express the intensity of the monsoon) between i) Cochin and Bombay and ii) Cochin and Madras during the individual monsoons against the corresponding annual catch of the oil sardine they found that i) below a critical level of monsoon intensity, the sardine catch decreases with increasing monsoon intensity and above the critical level the sardine catch increased with increasing intensity of the monsoon. In other words, up to a critical level of intensity the relation between the strength of the monsoon and the oil sardine catch is inverse and above that level the relation between the two is direct. Perhaps the process of enrichment of the sea gathers momentum and becomes very pronounced overcoming other inhibiting factors, when the intensity of the monsoon rises above the critical level. There are predictive possibilities here.

When the thermocline and the oxygen minimum layer move close to the surface layer and the coast, that would result in a contraction of the "living space" available to marine animals including fishes, in the belt adjoining the shore, with the result that they have either to remain in dense concentrations close to the coast or move away from the region. This is such a phenomenon takes place along the west coast is known now. Here only a limited time lag may be available for prediction.

But the more important question is whether the monsoons and the associated phenomena influence the breeding and recruitment of marine populations. Antony Raj (1972) has advanced the view that the amount of rainfall during the south-west monsoon

period may give a clue to the spawning success and recruitment of the oil sardine. According to him, during certain years when the south-west monsoon is weak and the rainfall erratic or feeble in the spawning fortnight (a week prior to and after the New Moon day) a phenomenon called atresia (breakdown of eggs in the ovary) takes place, greatly reducing the number of eggs likely to be spawned. He stated that taking into account the spawning fortnights a mean daily rainfall of 20-21 mm for June, 25-26 mm for June-July and 22-23 mm for June-August would appear to be the threshold value for getting favourable conditions for the normal ripening of gonads and successful spawning. But then it may be argued that rainfall data refer to the land, and not to the sea and that it is not proper to attempt to correlate a phenomenon taking place in the sea with what takes place on land. There is force in this argument, but then the amount of rainfall by itself need not be regarded as causing the changes in recruitment, but it need be regarded only as symptomatic of the general climatic/oceanographic conditions that would influence spawning success. Obviously research will have to be intensified on two aspects i) the extent of atresia in the ovaries and the conditions under which it takes place, and ii) how far rainfall and other connected phenomena are related to it.

Land drainage during the monsoon periods would also result in increased enrichment of the coastal waters. Quantitative studies on this would be of importance in fishery biology.

Conclusion

The researches that have taken place in India on the influence of the monsoons on the fisheries have to be considered in the

context of the worldwide interest in the study of the relation between climate and marine fisheries. Cushing (1974) has discussed the present trend of the work in this field, with special reference to recruitment. Predictive possibilities make such studies not only academically interesting but also practically rewarding.

A strong monsoon (with the accompanying rain) generally has a beneficial effect on crop and animal production on land. Probably a similar situation obtains in the sea also. A characteristic feature of the monsoon sea is the turbulence, by itself a grand spectacle. It is as if the process of churning is a necessary condition for a new production cycle. Scientists generally agree that for the eastern Arabian Sea the south-west monsoon period is the beginning of the biological year.

The invigorating influence of monsoon rain on life is very well illustrated by the trees. Temporary ponds and pools formed during the monsoon season are other pointers in this direction. It is often seen that even plots, used as sports fields during the hot months, become ponds in the rainy season, teeming with life. From such ponds the present author has recorded a variety of animals, including rotifers, copepods, other crustaceans, insects, tadpoles and frogs. Temporary ponds and the life in them have of course been investigated in detail before. It is also known that many aquatic animals produce drought-resistant eggs or aestivate in summer. But the question is whether the sudden "explosion of life" is merely a response to an abundant supply of water; does the rain water contain a "nectar of life" bringing these animals to activity? The effect of monsoon freshets on the spawn-

ing of fresh water fishes is also well documented. Looking at the problem from different points of view, it appears possible that the rain water may have a profound influence on the life of animals in the sea, in regard to their reproduction, growth and general well-being

Therefore, the investigation of the effect of monsoons on marine fishes and fisheries requires new approaches and concepts. No doubt the initial results may go under the label of "pure science" but the fall-out would sooner or later be measurable in economic terms.

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