FISHERIES HYDROGRAPHY *

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Although I have spent many years studying fish ecology, it was only about two years ago, soon after my arrival in Ernakulam that I became aware of this young and very active Society of Fisheries Technologists. It is therefore obvious that whatever little I know of this branch of science is through you and your journal namely "Fisheries Technology". Until a few days ago I could hardly imagine that I would be honoured by the request to give this talk and I wish to thank you all most sincerely for asking me.

But before I come to the topic of my lecture I would like to draw your attention that irrespective of the diversity in the lines of research which we all are pursuing i. e. whether we are engaged in the work connected with fishery biology, fishery technology or oceanography, we all have several things in common. Firstly, we all have to deal, in one way or the other, with the same environment. Secondly, as scientists, we share more or less similar disciplines, whether it is in the laboratory or on board the vessel; and thirdly we share fish as one of the main items of our food, either in a fresh condition or in a processed form. It is therefore evident that problems that largely determine the activities of fishery workers may ultimatly call for a great deal of inter-dependence of one another.

It is well known that fish stocks in which we are basically interested are parts of an ecological system in which physical, chemical and biological forces of great complexity operate and fluctuate year after year. To determine the extent with which these forces determine the reproduction, growth and survival of not only fish but also of other constituent organisms in the ecological system is a branch of science we call "Fisheries Hydrography".

The recent programme namely the International Indian Ocean Expedition with which we are all familiar has been primarily directed to provide answers to some of our problems connected with the resources of the Indian Ocean, both living and non-living. And from some of the data on physical and chemical oceanography which are available now it appears that the areas of greatest stock density are those which have high primary productivity. The survey conducted by the research vessel "Anton Bruun" has shown that productivity values are not uniformly distributed throghout the Indian Ocean. On the whole, the Arabian Sea is far more productive than the Bay of Bengal. Even in the Arabian Sea, the coastal areas, where most of our conventional fisheries lie are more productive than the central regions. One of the most important characteristics of the Indian Ocean is that it is greatly influenced by the monsoon cycle. During the south-west monsoon, a clockwise circulation of water is established in the Arabian Sea but during the north-east monsoon the circulation is reversed i. e. it becomes anti-

* Based on a talk given before a meeting of the Society of Fisheries Technologists (India).

clockwise. There is very little mixing of sub-surface and deeper waters as is found in other seas of the temperate regions. In the Indian Ocean one of the mechanisms with which the bottom water is brought to the surface is the upwelling. This water though extremely rich in nutrients is very deficient in oxygen and since it comes close to the shore it may have a great influence in the fluctuations of certain fish populations like the oil sardine and mackerel.

High surface nutrients and productivity levels and low concentrations of dissolved oxygen in the underlying waters are common aspects of fertile marine areas. Most frequently this combination occurs in the region where upwelling has been recorded. However, high primary productivity figures alone in certain areas do not necessarily indicate that such areas would be potentially rich in fisheries. If the primary production is in the form of food which the animals can utilize, enhanced productivity of higher forms of life would be favoured. If, on the other hand, animal populations are not present in adequate numbers or are otherwise unable to consume the primary production and if an appreciable fraction of it sinks below the euphotic zone, its subsequent oxidation could lead to deoxygenation of water which becomes a threat to animal life. Mass mortalities of animals including fish are likely to occur in such conditions and these accentuate the problem and tend to make it self perpetuating.

The annual fish production from the Indian Ocean as a whole, according to recent estimate, is of the order of 2.5 million tons and the annual marine fish production of India is approximately 9 lakh tons. It is expected to reach one million figure soon. The principal fishes constituting the fisheries of the Indian Ocean are pelagic species such as the clupeoid and scombroid fishes. Most of these fishes have a long breeding season and attain maturity very early in life, in the 1st or 2nd year. Their growth is largely confined to the first two years. Their catch composition clearly shows that practically the entire fish landing is taken up by the fish of 0-3 year class.

The other important fishery of India is the prawn fishery. It is comprised of prawn, shrimps, etc. This particular fishery is of far greater importance to fishery technologists than the other fisheries. In recent years considerable progress has been achieved in methods of exploitation and processing of prawns and shrimps. The last year's production of prawns from India is about one lakh tons and their export has been of the order of rupees eight crores.

In this country we are embarking on a large effort to increase production through increased mechanised fishing. Exploratory fishing has not shown very promising results in areas near the coasts and it appears that the main scope of trawl fishing may lie beyond the shelf region.

With regard to oceanic fisheries, we have only made a beginning and here we should expect a substantial increase in the catches of tunas and other larger scombroids.

With all this background in mind one can hardly doubt that researches on hydrography will provide many clues leading to fishery resources which could be ultimately turned to commercial advantage. It is well-known that photosynthetic process of the phytoplankton regularly consumes the available nutrients at suitable conditions of light and temperature. The world distribution of plankton and fisheries are closely connected and these two are necessarily governed by the availability of nutrients in the photosynthetic zone. The water which gets depleted of its nutrient is soon replaced by a process of either mixing or by upwelling or by other physical processes.

It is only recently that the relationship of nutrients through the plankton to the fisheries we have begun to understand.

There is, however, a great deal to be done in showing more precisely the nature of the relationship and of the factors which may tend to convert the raw material available in water into plankton and then in turn to corresponding quantities of fish. The relationships which exist between plants and nutrients and between herbivores and plants are called trophic chains and these extend in general, to all types of ecological systems. It is important to realise that these relationships seldom work in one direction. In many cases there are actions and reactions but these ultimately lead to the fact that all fish are dependent on plankton either directly or indirectly. The best example that I can give in this context is of the European Herring where feeding relationship at different stages of its life history has been worked out and the most important result emerging from a series of investigations is the association of herring with the copepod, *Calanus*. From such a relationship it is now possible, by taking samples of plankton in various places, to estimate the components of food available and consequently to forecast the regions in which the herrings are generally likely to be very abundant at any one time. This is undoubtedly a very direct instance where an attempt has been made to apply plankton indicators to fisheries and it may be of importance to note that similar relationships may prove applicable to many of the well-known fisheries of the world.

I have only given a general outline of how problems related to hydrography may provide some answer to fishery problems and I hope that you would not disagree with me that the main purpose of our work is to make use of the data on hydrography to the best advantage of fisheries. To sum up it seems that the basic aim of fishery hydrographers is to establish not only the factors governing the availability of the populations but also the factors controlling the fluctuation in abundance of fish year after year. The basic aim, on the other hand, with which you as fishery technologists are concerned is to find the best ways of exploitation; to turn fish into a commodity; to understand the qualities and charateristics of this commodity; to bring it into domestic and foreign trade; to evaluate principles of nutrition and public health and finally to produce such quality products which are within the easy reach of most persons.