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A phytoplankton community

THE ROLE OF MARINE BIOLOGY IN FISHERIES RESEARCH

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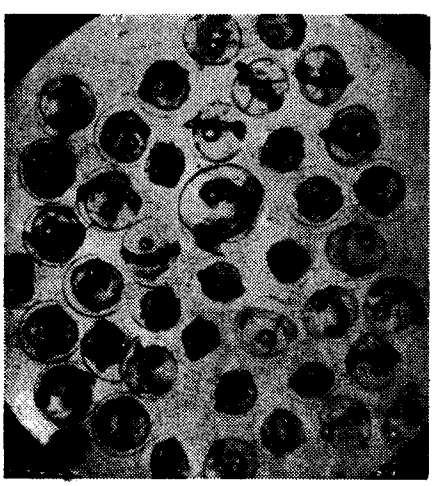
MARINE BIOLOGY COMPRISES the study of the life in the sea and the inter-relationships among the living organisms as well as the physico-chemical conditions under which they live. This is essential for a proper knowledge of the fishery resources and potentialities of any given area or mass of water.

In general terms we should have a thorough knowledge of the behaviour, growth and habits of fishes and other commercially important living resources, but this cannot be achieved without knowing something about the environment in which they live, their source of food, etc.

A zooplankton community



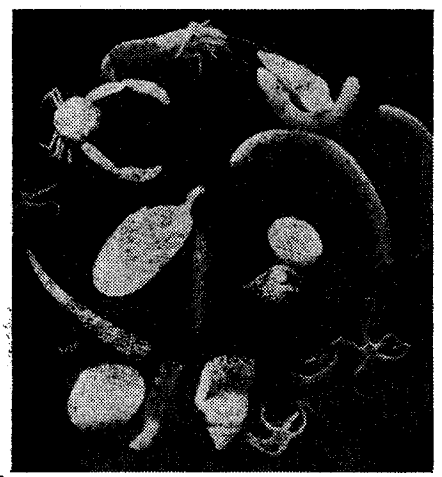
Pelagic fish eggs

In the development of marine fishery resources, fishery scientists have attached considerable importance to problems concerning the availability and natural fluctuations in the abundance of fish stocks, but the trouble is that the fish populations, besides reacting to the impact of fishing, react to other things in the variable environment. The factors and elements of the environment which affect fish and other marine resources can be placed in two groups. First, the *non-biological*, constituting the medium of existence of the organisms—the sea water, meteorological factors, being elements within the contiguous aerial medium and the sea bottom. Secondly, the *biological* which comprises the plankton, nekton and benthos. Here we are discussing only the biological factors but it should be emphasised that a thorough understanding of the non-biological factors is equally important. In recent times a separate branch of oceanography known as fisheries oceanography is rapidly developing.

FOOD FOR FISH

The fish that we catch and use as food must necessarily depend upon some source of food for themselves. Here we have the general principle applicable equally to land and sea animals, that is, the basis of sustenance of all animals is vegetable life which is represented in the sea chiefly by the diatoms (one-celled plants) which can synthesise their own food from simple inorganic substances by a process known as

photosynthesis. The quantitative measurement of this photosynthetic fixation is therefore of greatest importance to fisheries, but it is only comparatively recently that this has been fully appreciated. The net elaboration of the green plant substance is consumed by animals and these primary consumers are in turn consumed either before or after their death by other organisms. This is what is known as the food chain. The production of fish is thus based on the process of feeding and assimilation and the transformation of the assimilated food to new body substance. In harvesting the organic



Some of the animals which live at bottom of water masses

matter of the sea, man concerns himself primarily with the animals nearer the end of the food chain because it is convenient to him and easy to harvest; further, the widely dispersed organic matter in the lower part of the chain cannot easily be obtained in a concentrated form. In a fisheries research and development programme it thus becomes imperative that we should have a knowledge of the fertility and the basic productivity of the waters to be able to assess the potential economic productivity. Obviously, the magnitude of a fishery in any region and to a certain extent the natural fluctuations in the abundance and availability of fish are intimately connected with and in a way dependent upon the primary production, a proper understanding of which will enable the estimation of total organic matter that can be produced by the oceans and allow comparisons of ocean regions as possible sources of food. The factors determining this primary production and fish production are concerned with interactions of a large number of factors and it is necessary to understand and these interrelations.

LINKS OF FOOD CHAIN

This leads us to the study of plankton (mostly small plants and animals which float or drift almost passively). If we examine the stomach contents of fishes like the sardines, mackerel, etc., we find that they feed mainly on these planktonic organisms. While some of these depend directly on plankton for food throughout their lives others may not be direct plankton feeders at all stages in their life history but even these in their larval stages are pelagic and feed on plankton. A detailed qualitative and quantitative study of plankton in general, relation between the plant constituents (phytoplankton), and the animal constituents (zooplankton,) the path by which organic matter produced finally reaches the fish is essential when one comes to consider the fluctuations in the abundance of fish which are intimately tied up with the fluctuations in the abundance and availability of their food. The situation is more or less analogous to the condition of livestock raisers who should have a knowledge of pasture conditions. The quantitative study of plankton has thus become a useful guide in evaluating the productivity of water masses. Until recently it was believed that the plant concentration is smaller in the tropics than in the temperate and cold waters, but recent investigations have conclusively shown that the total crop beneath unit area may well be as great if not greater, especially in areas of upwelling. Planktonic organisms, on the other hand, have sometimes deleterious effects on marine fauna as a whole and fish in particular. For example, extensive diatom blooms have sometimes an adverse effect on, or are not associated with a high fish population and the occurrence of the wrong kind of plankton at the wrong time can be disastrous. On the basis of this it has been possible to establish certain correlations. The success or failure of particular fisheries may depend on the presence or absence of these organisms, known as indicator species, in the areas of active fishing.

Many marine fishes have free floating pelagic eggs and in all cases the larvae are pelagic. The study of these pelagic eggs and larvae is another aspect of planktological work which has a direct bearing on fisheries problems. From a qualitative and quantitative survey it has been found possible not only to establish the spawning season and locate spawning grounds but also to determine the intensity of spawning, dispersal pattern of the larvae and the survival of the larvae to the post-planktonic stage.

ROLE OF BACTERIA

The study of marine bacteria is assuming great importance because of the role of these organisms, among other things, in the disintegration of dead organic matter and consequent regeneration of the nutrient salts, the availability of which acts as a limiting factor in the growth of phytoplankton.

Another aspect of marine biology is the study of higher algae. The vegetation of the sea is more primitive in the evolutionary scale than that of the land and among marine algae, only red and brown have significant commercial value at present.

Then we come across the nekton comprising the actively swimming organisms including fish, various mammals, molluscs, etc. In other words, this group consist of the bulk of the commercially exploited animals. A detailed study of these organisms themselves is generally regarded as part of fishery biology.

Detailed investigations on the bottom fauna are equally important since many bottom dwelling animals form the food of demersal fishes.

In conclusion it may be said that most of the established fisheries are in coastal regions and are associated with the spawning period. The behaviour of the fish at this time of the fishery is often well-known but the rest of their life history is vague in most cases The studies on life histories must be supported by corresponding studies of the physico-chemical environment, enemies and predators, fertility and productivity of the environment, the availability of food supplies, etc., and must determine the fluctuations in each factor and allow their correlation to determine the degree to which each is limiting. It is possible to obtain a picture of the inter-woven communities in the sea from a study of the plants and animals living on the surface and at the bottom. These studies may be resolved into the various branches of marine biology and to go on with fishery research in a region without simultaneous effort to study the complicated and continually changing background of hydrography and biology means little progress.

Thus the true goal of marine biology is the acquisition of full and complete knowledge of every phenomenon touching the life of every animal and every plant in the sea. Adherence to this ideal, though unattainable in a literal sense, has sobering effect upon investigations and gives it a definiteness and co-ordination which it may otherwise lack. The particular problems in marine biology selected for investigation as part of a fishery research programme will then be determined entirely from the point of view of feasibility and immediate utility in taking proper steps for the development, management and conservation of the fishery resources.