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IMPORTANCE OF BIOLOGICAL STUDIES IN THE DEVELOPMENT OF FISHERIES

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INTRODUCTION

The application of scientific knowledge for the development of the fishing industry lies in an intimate knowledge of the biology of fishes. Without proper knowledge of the life, habits and behaviour of fishes, it would not be possible to plan, control and manage the fisheries resources in a satisfactory manner. The importance of some knowledge of the natural history and ecology of organisms affecting the particular fishery cannot be overestimated. Such knowledge is largely the basis for fishery regulation. It also helps in determining the need to improve a given environment and in the required direction. The fundamental principles of artificial propagation of fish rest upon a prior understanding of life of fishes in their natural surroundings. In this account, the importance of biological studies in the development of fisheries with special reference to inland and marine fisheries, fish processing and fishery regulation is outlined.

INLAND FISHERIES

Inland fisheries include the various activities connected with catching and culturing the fishes found in fresh water and their management. Though freshwater fishes are captured from rivers, lakes and reservoirs and such other bodies of water, they are very important from the culture point of view.

The most important qualities of a culturable fish are good taste, rapid growth and the faculty of breeding under controlled conditions. The very selection of such fishes therefore depends on the knowledge of their biology which has a bearing on its culture. Rapid growth may be linked with the type of food it eats, which means a knowledge of the natural food of the species is necessary. A biological study of the fish can provide this information, but it may so happen the particular body of water where it is proposed to be cultured may not have such food. This leads to the study of physico-chemical and biological qualities of water, necessity to add organic or chemical fertilizers, the acceptance of alternative types of food by the fish and the nutritional requirements of the species for proper growth. Fishes may or may not breed naturally in confined waters. If it is the latter, studies on inducing the fish to breed are necessary for which a knowledge of the size at maturity, breeding season and number of eggs produced is required. The success of breeding and rearing the fish very much depends on biological information concerning all the stages of the fish right from

the egg to the adult. Before attempts are made to culture the fish, a knowledge of the optimum conditions of water which vary widely from fish to fish and between different stages of the same fish is essential. These requirements are necessarily linked to the physiological reactions of the fish to such conditions. When a number of varieties of fishes are to be grown together for economic utilization of the food in a particular water area, the compatability of the species concerned and the food preferences of each species should be known.

Pollution of water due to discharge of various industrial wastes and sewage can cause great harm to fish. The suitability of such environment for fish depends on the extent of tolerance of the toxic substances by fish and its capacity to adjust to such conditions which are linked to its physiology. When intense fish culture is attempted on economic lines, often due to congestion or overcrowding, fish get susceptible to diseases and parasites which may take a heavy toll. In order to control such heavy mortalities, the life history of the fish together with the susceptibility and type of disease or parasite attacking each stage should be fully investigated.

MARINE FISHERIES

Marine fisheries comprise of the capture and management of fish and other commercially important organisms found in the sea. While this field is predominantly of the capture type, culture of certain marine organisms is also possible. In both cases, basic knowledge on the biology of fishes or other organisms of economic importance is necessary.

Since the effectiveness of the capture methods and the craft and gear are of prime importance in the development of marine fisheries, the distribution and behaviour of the fish which largely determine the suitability and efficiency of a particular method or type of gear must be known thoroughly. These factors are closely linked with various biological processes of the fish and hence assume high significance in this context. Therefore, in the exploitation of a living resource like fish, besides the physical efficiency of the methods of exploitation, the natural history and ecology of the resource itself is of paramount importance. Any improvement of the gear or methods without reference to the natural history of the resource is not likely to yield desired results. Marine fishery resources are unique in the sense that they are found in an ever changing dynamic environment, which, with each change in the physical and chemical characteristics of the medium, exercises a profound influence over the distribution and behaviour of the fish, the basic causes of which must be found in the biological cycle.

The aim is to obtain such information as would be helpful in increasing the yield without affecting the natural regenerating properties of the commercially important fish stocks. This information would be used in selecting the fishing grounds and to decide on suitable gear. Fishes are found in surface waters, at great depths, near the coast or far away from land in distant waters. Majority of the fishes spend their lives in one or more of these regions of the sea, the changes being influenced by biological necessities such as feeding or breeding. If plentiful food supply is available in surface waters, fish which lives at the bottom is likely to come up. This again is dependent on the biological needs of

such forage organisms which change their areas of abundance accordingly. They may come up at night and migrate to deeper waters during day for food, protection, etc. Correlated with this, the fish preying on such organisms may also do likewise. If this pattern is known, suitable gear to capture such fish at night in surface waters and a different type of gear to capture at bottom during day are necessary.

The migrations of oceanic fishes like tunas, the movement of hilsa fish from sea to rivers and back, the migration of the young stages of prawns from sea to backwaters and estuaries and their return to sea tend to follow a regular, seasonal pattern conforming to their spawning or feeding activities. Such well defined movements or migration of fishes and other animals are considered to be essential links in their biological cycles and hence a knowledge of their life is necessary to understand such movements which have a high practical value in their capture.

Availability of food in an area greatly influences the abundance of fishes. For example, besides other factors, the success of oil sardine or mackerel fishery along the West coast of India in any year is influenced by the abundance of planktonic organisms which form their food in inshore waters. The same relationship holds good for other fishes also. Like the food habits, spawning habits also influence a fishery. The spawning grounds appear to be well defined for each species. Knowledge of the spawning grounds, the nurseries where young ones are found, and the feeding grounds where adults are found is important for capture of fishes. Over-abundance of certain organisms in sea and resultant change in the characteristics of water may cause mass mortalities or at least force the fish to leave such areas. Occurrence of jelly fishes in large numbers is known to have a negative influence on the fish. Such observations are possible only through biological studies. Several physical factors directly or indirectly influence the distribution of fishes in the sea. A phenomenon called upwelling, whereby bottom nutrient laden layers of water are thrown up and surface waters poor in nutrients sink down, is known to bring about far reaching changes in the richness of plankton (which forms food of fishes like oil sardine and mackerel) and fish abundance itself. A knowledge of such highly interconnected physical and biological phenomena are essential for proper management of such pelagic stocks of fishes.

The particular gear to be used depends on the knowledge of the behaviour of the fish. Fishes which are found in surface waters in dense shoals are captured by purse seines. Those that live mostly at the bottom are better captured by trawl nets. For fish that hunt their prey by sight such as tunas and seer fish, trolling or line fishing is suitable. Behaviour of an animal involves perception of the stimuli by its senses and the reactions resulting therefrom. Fish reacts to the nets based on their vision. Nets made of meterials which are invisible in clear waters are likely to be more effective than others. In line fishing, visual stimulus is an important factor. Movement of the bait in water provides the necessary stimulus. Attraction of fish by lights has been used in certain types of fishing. The reaction of fish to electric stimuli is used in electrical fishing

methods for pelagic shoals of fish. The reaction of fish to sound has been taken advantage of in some fishing methods. This involves techniques which create and simulate accoustically and visually conditions found in nature to which regions fish are attracted. In some fishing methods, fish are simultaneously influenced by a combination of different stimuli like lights to attract by vision and baits which are sensed by the olfactory organs. The above examples indicate that an understanding of the biological and behavioral characteristics of fish to different stimuli has helped in attracting, concentrating and capturing them efficiently. However, since fishes differ widely in their natural history, distribution and behaviour, comprehensive information on different species at different stages of their life is necessary for judicious development of the fisheries.

FISH PROCESSING

Biological knowledge is a basic requirement in fish processing industry also. Information on the resources of the raw material, their quality and quantity along with seasonal variations of abundance is helpful in the planning of processing industry. Assurance of the availability of raw material continuously and in the required quantities is essential for economic operation of processing factories. Such data can be provided only if the biological characteristics viz., reproductive potential, recruitment, mortality, growth rate, etc of the resource are known.

The case of the oil sardine and mackerel along the West coast of India is well known. Understanding of the fluctuations in their catches can contribute to the steady functioning of the factories using this material. Several other untapped raw materials like clams, mussels and oysters are available in certain areas but their resources need fuller biological study. The size and weight variations within a species and according to seasons, the fat or oil content which varies with changes in feeding intensity and breeding cycle, the texture and quality of the meat and variations in protein and vitamin content all of which are traceable to the biological changes often determine the type of fish suitable for the preparation of a particular product. The taste, quality, acceptability and the economics of processing greatly depend on the raw materials used and their biological condition.

While it may be economical to use certain species of fish for processing, it may not be so with others because of the differences in body proportions and relative yields of meat, bone, entrails, etc. These ratios of body proportions are but a reflection of the biology of the individual species concerned. The type of material and its condition at the time of processing has a direct bearing on the keeping qualities of the finished products. It is, therefore, clear that a prior knowledge of the biological characteristics of the species used in fish processing will greately help in a rational selecton of material and economic preparation of different processed products out of fish and other raw materials.

FISHERY REGULATION

The most important practical use of the outcome of biological studies on fishes and other similar living resources of the aquatic environment lies in its application to regulate fishing and related activities to obtain best possible returns without destroying the natural resource. Fishery resources are natural, self-renewing and dynamic. The abundance of fish populations is controlled by natural phenomena such as recruitment and growth which add to the population size and mortality whicb diminishes it. These are biological characteristics which affect the resource. Besides these intrinsic factors, extrinsic environmental changes also affect the living resource. Yet another outside agency interfering with the balance in a natural system is fishing by man. Due to fishing, a decrease in the population is expected. But this decrease provides for better growth, more food and less competition for the rest of the population, offsetting the initial decrease. But if the decreasing effect continues beyond the level at which the population can rebuild and grow, it will adversely affect the population and hence the future returns.

The maximum catch that could be obtained from a population without giving rise to these adverse consequences is known as the optimum sustainable yield or equilibrium yield. To determine this, we should know the age at which the fish is caught, the rate of growth, life span of the fish, natural mortality rate, fishing effort and fish catch. From these data, the level of fishing effort that will yield the optimum catch can be determined. The fishery can be regulated by altering either the fishing effort or the age at capture (by regulating the mesh size of the net) or both. In this way, the yields from natural, living resources can be controlled to give the best results and at the same time assuring the future prospects from such resources.