

PHYSICAL PROPERTIES AND FISHERIES

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Introduction

The study of physical processes and properties of the oceans in relation to fisheries forms a separate branch in oceanography and this branch is generally known as Fisheries Oceanography or Fishery Hydrography. It is known, for long, that the spawning, distribution, migration, concentration etc. of the fish are influenced by the oceanographic structure of the sea. Therefore, the analyses of the ocean information and the behaviour of the fish would help prediction of the occurrence and abundance of fish. This is generally termed as Fisheries Forecasting. In developed countries like, USA, Japan etc. there are fisheries forecasting services which make fishery forecasts for time scales of one day, one week, two weeks etc.

The physical aspects which influence the different stages of behaviour of the fish in the oceans can be divided into two categories: (i) the physical properties of the ocean like temperature, salinity, oxygen, high penetration etc: and (ii) the physical processes like upwelling, currents, oceanic fronts, wind, eddies etc. Some of the important physical properties/processes and their relation to fish abundance are described below.

Temperature:

Temperature as an environmental parameter affect the behaviour of fish in many ways. Apart from the influence of temperature on spawning, feeding, growth etc, it also affects the abundance, migration and shoaling of fish. That means, it serves as a useful indicator of fish in the ocean. The fish search for a certain optimum temperature and a knowledge of this temperature is necessary for the prediction of its environment. Thus, monitoring of the water temperature is an essential part of the prediction processes.

In fact, it is not the actual temperature alone that is important. The horizontal and vertical gradients like, the mixed layer, the thermocline, the horizontal discontinuity etc. are also are very important. Therefore a knowledge of the dimentions of the mixed layer, the long term variations of temperature etc. are essential for the prediction of fishery.

Oxygen:

Oxygen is important for the survival of the organisms in the ocean including the fish and the world oceans are characterised by an oxygen minimum layer below the surface. Therefore, a knowledge of this layer is important in prediction of the movement of the fish.

The distinct oxygen minimum layer is observed in the tropical and subtropical oceans. This layer is usually better developed in the eastern than in the western parts of the oceans. The most pronounced oxygen minimum layer is in the Arabian Sea between a depth of 100 - 150 m. Certain physical processes like upwelling, eddies etc can alter the depths of this layer and therefore tracing the oxygen minimum layer helps in the fisheries prediction.

Upwelling:

Upwelling is a process by which the sub-surface water comes to the surface due to divergence. This upwelled water brings-in lot of nutrients from sub-surface layers which promotes primary production and subsequent zooplankton/fish abundance.

It is estimated that about 90% of the world fish production is from the upwelling regims which is only 2-3% of the area of the world oceans. The major upwelling regions are: California Coast, Peru Coast, North-West Africa, Arabian Coast, West Coast of India etc.

Depending upon the area it occurs, we can divide the upwellings as coastal upwelling, offshore upwelling, equator upwelling and so on. As far as coastal fisheries is concerned, it is the coastal upwelling that becomes important. Coastal upwellings are generally caused by the

alongshore wind and the horizontal extend of this phenomena is 20. - 100 km from the shore.

Upwelling is generally detected by monitoring temperature, nutrients, oxygen, transparency etc.

Ocean Currents:

Ocean currents become important in the fishery as the distribution, concentration, depletion etc. of the fish eggs and larvae are mostly depend on them. The permanent currents like Gulf Stream, Kuroshio etc. carry the fish eggs and larvae of commercially important fishes from the spawning ground to areas suitable/unsuitable for feeding, growth and survival. Therefore, the variability of these currents affects the total production/catch of these fishes and it is possible, to some extend, to predict the fluctuation in the fishery by knowing the current pattern.

At the boundaries of ocean currents the water sinks and the bulk of organisms carried by the currents remain at the surface making that area feeding grounds for fishes and hence good fishing. In the cae of divergence, the resultant upwelling may facilitate primary production but these are then carried away from the divergent point and the zooplankton maximum may be observed away from this point.

Wind/Wind drift:

In shallow coastal waters, the immediate effect of wind is a wind drift in its direction. Coastal seas, especially estuaries are spawning grounds for fishes. Depending upon the wind direction, therefore, the fish eggs and larvae may be carried to places which may or may not be favourable for their survival. Thus a knowledge of the breeding season and place along with the seasonal winds enables us to predict the survival rate, transport etc.

Oceanic Fronts/Meso Scale eddies:

Fronts are areas of increased vertical advection and exchange of momentum, usually formed between adjacent water masses. These are also regions of high productivity and it is said that fish orient themselves towards fronts. These convergence zones accumulate phytoplankton and other forms of life in the food chain. The fronts are regions of discontinuity in temperature, salinity etc and therefore detected from the measurement of these parameters.

Similarly, cold core eddies/rings are areas of high productivity because of the upwelling taking place at the centre. Therefore, concentration of fish is also expected at this point.

Suggested Readings:

1. Ilmo, Hela and Taivo Laevastu, (1961). Fisheries Hydrography, pp. 137. Fishing News (Books) Ltd., London.
2. Ilmo, Hela and Taivo Laevastu, (1970). Fisheries Oceanography, pp. 237. Fishing News (Books) Ltd., London.