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Remarks on the Place of Hydrography in Fisheries Research

by

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When I started preparing my remarks I realized that I do not have much to add to the many excellent comments on the same subject which were made by a number of my colleagues at our last meeting, but the problems can be viewed from so many angles that another approach may be worth while. I would like to start with a few trivial statements as to the very purpose of fisheries research. I believe we all agree that fisheries research is directed towards establishing a rational utilization of the natural resources of the sea. In its broadest sense fishery research is then concerned with a variety of problems such as the study of the fish in relation to its natural environment, the study of types of gear and types of ships, examination of methods of conservation of the fish products or preparation of new products, shipping and marketing and so on. We are, however, mainly concerned with the exploration of the sea. Although groups among us must be familiar with types of gear in order to evaluate the data that result from fishing efforts, the actual development of new gear lies beyond the scope of our activity.

The work at sea may indicate positive measures by which the yield of the fisheries may be increased, or negative measures for protection of a dwindling stock. It is our task to make the positive results known to the fishermen and to place the results that suggest the desirability of protective measures at the disposal of the proper authorities who may or may not take action. In both cases our work must lead to prediction of coming events.

Simplifying, it may be said that in fisheries research prediction fall in two categories: prediction of availability and prediction of the future size of the stock. We may therefore ask to what extent hydrography can contribute towards these predictions. Of these two types the former, the prediction of availability is the simpler.

As a classical example I may refer to the fact that as early as in 1879 it was demonstrated that in Lofoten the cod occurred in a transition layer in which the temperature was between 4° and 6°C, and that since the early 1880-s the thermometer has been used by the fishermen as a guide. This particular type of prediction is trivial and has in recent years been replaced by the observation of shoals of fish by means of echo-sounding gear.

The next step along this particular line is for the hydrographer to predict where in the sea conditions favourable to the occurrence of fish may be found, or, in the case of the Lofoten cod fisheries, where and at what depth the transition layer which the cod follows is to be found. In this case it is no longer a matter of a simple prediction that can be replaced by direct observation if suitable instruments are available, but it is a question of forecasting certain hydrographic events. Some advance has been made along this line as exemplified by some of Dr. Eggvin's recent work.

It seems that one here has to deal with a line of attack in which the hydrographer can collaborate fruitfully with the fisheries biologist. It must be the task of the biologist to demonstrate the reactions of the fish towards certain types of environment and the task of the hydrographer to learn the laws that govern changes in the environment. This is a too general statement to be of much use, but it shall serve to underline that in fisheries hydrography the processes by which the environment is constantly being altered must represent a fundamental topic.

The question as to these processes has, I believe, received too little attention by physical oceanographers in general. I may even venture to say that for a couple of decades methods of computing the ocean currents from the observed distribution of density have played a far too prominent part in our development of the knowledge of

the ocean, and even that the efforts made to apply these methods have distracted from the search for other means of increasing our understanding. We have focused our attention so much on the average, stationary, conditions that the study of the changes have been pushed into the background. Personally, I am convinced that in the future it will be necessary to devote much more effort towards the study of the effects of heating and cooling and the effects of winds. This applies not only to the deep water regions, where in the last instance the energy for maintaining the currents is derived from the wind, but it applies even more to the shallow water areas, where changes are rapid and greatly governed by winds. These views have already been advocated by Carruthers and Cooper.

These last remarks seem to carry me away from my topic, the place of hydrography in fisheries research, but they are pertinent because they point towards those developments to which the fisheries hydrographer must pay especial attention and to the types of problems which he may encourage his colleagues within other organisations to tackle.

The second category of predictions to which I referred had to deal with the prediction of the size of the stock of commercial fish. This problem is much more complicated and the possibilities for co-operation are less clearly defined. It is my impression that when dealing with variations in the size of the stock one does not know where biology stops and hydrography begins, and vice versa. There is probably always an interplay between a number of different developments, but in some instances the biological sequences may be deciding, and in other instances the hydrographic. To be more specific let me take an example. It is often stated that a year of successful spawning leads to a large year class. I wonder if anyone knows if "successful spawning" is biologically or hydrographically conditioned. It is conceivable that the success depends upon the presence of the right type of food for the fry, but the right type of food may develop or it may not under hydrographic conditions that are nearly similar. It is also possible that the success may depend upon the character of the currents which for instance may carry the young brood into coastal waters where it may find favourable conditions or out into the open deep ocean where it may perish. It is also possible that in one year certain features of the biological environment are deciding, whereas in another year certain features of the hydrographic environment are of the greater importance.

The very complexity of the problem makes necessary an intimate co-operation between the fisheries biologists and hydrographers. It implies that they should work together to obtain the best possible complete picture of the entire environment and that they should be able to discuss and evaluate the different findings.

It seems to me, however, that the problem of the size of the stock may not only be a question of success of spawning or of the conditions that lead to marked variations in the sizes of year classes. Fluctuations in the stock may also depend upon the amount of food that is available to the growing or grown fish. In the Norwegian Sea and the Barents Sea the total number of herring, cod and other fishes must be enormous. Correspondingly the total production of organic matter in these waters must be overwhelmingly large, but is it not possible that this production varies from one year to another? If so, does it vary by a factor of two or a factor of ten? If one should try to find an answer to this question the hydrographer must enter into the picture because the primary production in the sea is to a great extent governed by the physico-chemical condition. The point is that, viewed from whatever angle, the problem of fluctuations in the size of the stock is complex and requires complete co-operation between the biologists and the hydrographers.

In his remarks that were read at the last meeting in Copenhagen, Dr. Cooper suggested that the hydrographer should find a comfortable armchair in a good library and surround himself with literature from the last fifty years. I would add the suggestion that in each laboratory the men should meet regularly at tea, or coffee, for informal discussions of their problems. They should daily have an opportunity to listen to their colleagues or talk about their own favourite topics. This practice is, no doubt, followed at many laboratories and if it is not universal, it ought to become so. It is necessary that the hydrographers and biologists learn to understand each other's languages and learn to express themselves so that they are understood by the other party. For that purpose they may have to simplify their statements and cut out some of their technical vocabulary. They may have to omit the proper names of species or minute descriptions of bends of isotherms. These remarks are platitudes, but they appear to belong to a class that bears repetition.

Until now I have talked too much in generalities. When the generalities are presented, some specific questions are always raised, such as: How can fisheries biologists and hydrographers work together in the field? How is it possible to reconcile their often diverging demands as to when and where data shall be collected? How can these very practical problems be solved to the satisfaction of all concerned? The answer to the last question is simple: they cannot. All parties concerned have to show some resignation, but with increasing understanding of the character of the problem this resignation should become less difficult.

The lines of approach which I otherwise should like to suggest are as follows: (1) whenever possible hydrographic observations should be made concurrently with the collection of biological material in order that in each instance the knowledge of the immediate environment is as complete as possible; (2) The hydrographer should try to formulate specific problems which he can test, partly by means of supplementary observations of his own; (3) the Hydrographical Committee should undertake a careful analysis of the resources for work at sea of all the member nations of the International Council. The last would allow them to formulate a plan for such co-operative work at sea as needs to cover a larger area and to be repeated at regular intervals in order continually to follow changes in the hydrographic conditions which may be assumed to have bearing on fisheries problems.

The first two suggestions are not original. The first one is trivial and work along the indicated lines has long been in progress. The second implies a procedure which has been fruitful in many other instances and which for instance last year was urged by Dr. Cooper. The third deals only with such a review of possibilities and facilities as should be undertaken at intervals in order to continue the work of the International Council as effectively as is feasible.

In addition to the above the quick dissemination of information is also essential. In this respect the monthly charts of the surface temperatures and salinities of the North Sea, the waters around the British Isles and adjacent waters, now being issued from Lowestoft, represent an excellent undertaking, which soon will prove its value.

Concluding, I wish to say that I have had only a small contribution to make to the topic that is up for discussion, but I am confident that the following papers will give ample examples of result obtained by the co-operation between hydrographers and biologists.