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The Biologists' Needs for Fisheries Statistics

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THE BIOLOGISTS' NEEDS FOR FISHERIES STATISTICS

By A. W. H. Needler*

Most fish, especially sea fish, can seldom be seen and our observation of all species under natural conditions is far from easy or complete. We commonly depend for knowledge of their very existence on catching them, and when, in order to use our fish stocks to best advantage, we attempt to study their movements and changing numbers we must rely on the results of a great deal of effort to catch them. Government or private research organizations can do some exploration with their own boats and gear, but these efforts are small compared with commercial fishing. The fisheries are our principal source of information on the abundance and movements of fish and adequate statistics are the principal means of making the information available in usable form.

Our inability to observe fish directly and our reliance on indirect and limited evidence of their abundance and movements is apparently responsible for a great many misconceptions about fish stocks and about the best course to pursue in order to use them to the best advantage. In a few cases we may be regarding supplies as unlimited when they are already so affected by intensive fishing as to justify some degree of regulation. In other and, I believe, more numerous cases we may be underestimating or even unaware of the potential production. To meet the protein requirements of ever increasing populations we need to make full use of fisheries resources without jeopardizing their future and adequate statistics are one of the essential means to this end.

The biologists working in the fields contributing to the betterment of fisheries make relatively little use of fisheries statistics in developing the basic knowledge of the life-histories, ecology and behaviour of the valuable species. Nor is there much need for statistics in the application of this knowledge to the culture of fish or shellfish. On the other hand statistics play a very important part both in exploration and development of the fisheries resource and in management of intensive fisheries to maintain their yields at the optimum level. Even in these fields the biologists must, of course, get for themselves data of special sorts and this process occupies most of their energies, but adequate fisheries statistics are important in both fields.

What, then, must fisheries statistics provide to meet the biologists' needs? The needs vary with the particular purpose but we must nevertheless try to develop some generalizations which will help us use our not unlimited facilities to the best advantage.

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Statistics valuable in development of fisheries.

The development of the fisheries resource depends not only on the discovery of species entirely new to the commercial fisheries but, equally or more often, on learning how to make better use of species which are already being caught in small or large quantities. Information on the quantities of each species caught commercially in various areas and seasons using various kinds of gear may lead us to a much more productive fishery.

Sometimes information on where and when a species is caught incidentally in fisheries for other species indicates where we may seek larger quantities. For this purpose it is important that fisheries statistics should include separate records of the catches of all species even though the quantities are small. The value of the statistics will be increased by separating the catches by various types of gear because the relative effectiveness of various types of gear is closely related to the habits of the fish.

In the case of species which are already fished extensively, statistics tell us much about their seasonal movements and their changing abundance in various areas. When these changes are compared with the hydrographic conditions we may learn how those conditions influence both the numbers and the movements of the fish. Knowledge of fish movements in relation to hydrographic conditions may increase the efficiency of the fishery by helping the fishermen to find the fish and this may be specially important when unusual or changing conditions make the fish change their haunts. Knowledge of the effects of hydrography on production may enable us to predict changes in the yield of fisheries, especially if cyclical changes in conditions can be recognized.

The whole field of the relationship of fish movements and abundance to the hydrographic conditions is still in a very early stage of development. We may expect a great deal of progress in the next few decades as our knowledge of both the hydrography and the fish improves. To play their full part in this development statistics should give a long-term continuous record of the catches of the principal species by area, by season and by gear. Catch per effort data are valuable in this field, giving more reliable information on relative abundance than do catches alone. Great accuracy is not important, because only large changes are likely to be at all significant, but comparable records over long periods are very important and detail on the area of capture is valuable.

Statistics essential to the regulation of intensive fisheries.

Thorough and reliable fisheries statistics are essential both to the recognition of the need for regulation of intensive fisheries and to the discovery of promising remedial measures. Although many,

probably most, of the world's fisheries could yield more than they now do, some are so intensive as to make some measure of regulation desirable in order to maintain the yield at its optimum level.

In the early stages of any fishery the total catch is small and it represents only a small proportion of the stock; the age and, consequently, size composition of the stock is the result of natural mortality only. As the fishery develops fishing effort increases and results in a larger catch which may reach a large proportion of the stock; the age and size composition of the stock is the result of the natural mortality combined with a mortality resulting from fishing which may be much greater. The higher mortality means a smaller average age and size of the fish and a lower level of abundance; each successive addition to the fishing effort (more vessels, more gear, more men, or more activity) results, therefore, in a smaller and smaller increase in the catch. The growth of the fishery will eventually be arrested by producing a level of abundance so low that the profit is too low to encourage a greater fishing effort, and so an equilibrium is reached on an economic basis. The catch may or may not be at the best possible level because it is possible that the economic demand, which is determined by factors not necessarily associated to any significant degree with the conditions in the particular fishery under review, may be strong enough to encourage more fishing effort than will give the optimum yield. The extra mortality caused by the fishing may be so great that it would pay to restrict the fishing and let more fish grow larger. Restriction of fishing, whether in the form of restricting total fishing effort or whether applied specially to the smaller fish by such measures as establishing minimum sizes for fish landed or for the meshes of gear used, affects the stock by reducing the mortality caused by fishing. Whether such restrictions pay depends on the relation between growth, natural mortality and mortality caused by fishing; economic factors such as the relative value of fish of various sizes may also enter the picture. A very careful assessment of all these factors is necessary before we can form an opinion of the need for restrictive measures and of what they should be.

What part do fisheries statistics play in our understanding of this picture? Most of the knowledge needed for the assessment of the probable value of restrictive measures comes from biological studies outside the scope of statistics of the commercial fisheries (sampling the stock for age and size composition and total mortality rates, determination of growth rates, study of movements, divisions of the stock and proportions caught by marking, etc.). Fisheries statistics, however, play an important part.

In the first place we are interested in the <u>total catch</u> taken from the stock of fish under study. Its changes indicate the growth of the fishery; its constancy indicates the attainment of equilibrium levels; its decline, with a maintained or growing fishing effort, indicates the possible need for restrictions. Thus total catch, con-

sidered in relation to fishing effort shows us the growth, the maturity and perhaps the over-development of the fishery. It not only poses the problems of whether or not restriction is desirable, but it also is the final criterion of whether regulatory measures are successful. The proof of the pudding is in the eating.

The catch per unit of effort is important to the biologist as an indication of changes in abundance, as it is to the economist because of its bearing on profit. In many fisheries catch per effort is our only measure of relative abundance. While there is evidence to indicate that in its usual form of catch per hour's dragging, catch per 100 hooks set, etc., catch per effort is not directly or strictly proportional to abundance, it at least shows the direction in which abundance changes and in what approximate proportion. The declining catch per effort is, as noted above, one of the criteria of the effect of a fishery on the stock. The decline in the catch per effort from individual broods or "year-classes" of fish may be a measure of total mortality rate, always an important factor.

Fishing effort is difficult to measure and the problems involved in getting reliable records vary greatly from one fishery to another. Changes in fishing gear change its efficiency. In the early stages of a fishery the efficiency of each unit may be increased by the greater ability of a larger fleet to find the fish. As fishing becomes intense units of gear may interfere with one another. When catches are good, and only then, the carrying capacity of vessels may limit the proportion of their time spent in actual fishing. These and many other factors make the collection of reliable catch per effort data very difficult. We may conclude: (1) that the particular problems of each fishery must be considered carefully and the statistical program modified to meet its special needs, (2) that catch per effort data may be more reliable and valuable if obtained on a good sample of the fishery rather than attempting to get it for the whole, and (3) that special care is needed to see that the data are comparable over a considerable period, which may necessitate getting detail on the operations of groups of vessels overlapping in time.

The total mortality rate, which is a decrease in numbers with age, increases as fishing intensity increases and, as noted above, is an essential value for assessing the need for restrictions. Mortality rates must ordinarily be estimated by determining the age composition of the stock through special sampling, but commercial statistics on the sizes of fish taken can sometimes give contributory information on changes in mortality rates. If a species is sold in commercial size-categories which are stable over a number of years, statistics on the quantities of each size caught may be well worth recording.

What statistics should be collected?

Conditions vary so greatly from place to place that it is, of course, impossible to list the statistics which should be collected

on all fisheries the world over. The listing which follows is, therefore, only a series of suggestions which may be of general value. It is, moreover, not suggested that all of these should be published, except locally, even if collected.

1. Total catch. Figures on the total catch are the basic requirement for all purposes. They should be obtained for all catches whether small or large, whether the principal item in a fishery or only incidental. Figures on total catch should be broken down according to:

(a) Species. Species should be correctly identified in recorded statistics by scientific as well as by common name. If possible the catch of every species should be recorded separately; a single figure for more than one species is of little value to the fisheries biologists and should be avoided just as far as practicable.

(b) Area. The more detailed the breakdown by area the better but, of course, the attempted detail should never out-run the practical possibility. Two points are specially important: (1) the areas used for statistical purposes should as far as possible coincide with the real natural divisions of the environment and of the stocks so that we can get figures for the yield of divisions of the fish population and (2) the areas should remain the same over as long periods as possible because both in elucidating the relation of fish movements and numbers to hydrographic conditions and in studying the growth and regulation of fisheries, statistics are valuable only if comparable over long periods.

(c) Time. Catches are almost universally recorded year by year; monthly or seasonal breakdown increases the value to the biologist.

(d) Gear. Recording the catches by various types of gear not only indicates much about the habits of fish and what directions might be explored to improve the fishery, but provides the basis for some catch per effort data when combined with economic statistics on personnel and equipment.

2. Fishing effort.

(a) General. Information on fishing effort is an important part of the history of a fishery and, even in crude form, has some value in recognizing the cases in which more detailed and reliable information is needed. The biologists should consult with the economists, whose interest in capital equipment and operating costs may be satisfied by much the same information.

(b) Detailed. Detailed and reliable information on catch per effort is difficult to get (see above) and is worth while only in intensive fisheries, and then need not cover the entire fishery. Each case needs special consideration and a special program.

3. Sizes of fish. Information on quantities of fish caught in commercial size-categories may be available in a few cases, and may be worth recording if the categories are sufficiently constant.

Some general points should be borne in mind in formulating and implementing statistical programs, among which we might mention the following:

(1) Resources of money and personnel for collection and compilation of fisheries statistics are usually limited and the biologists' needs overlap with those of the economists so much, that there should be close consultation between the two groups.

(2) It is impossible to over-emphasize the importance of continuity. To be valuable to the biologist statistics must be comparable over long periods. Often a small improvement which might result from a change in the collection or organization of the statistics is overshadowed by the loss of continuity.

(3) The desirable or practicable degree of detail will, of course, vary greatly but so much may be lost by publishing only summaries of data originally collected in detail, and the cost of a permanent record seems usually to be so small in comparison with the original cost of collection, that it is much wiser to err in the direction of publishing, at least locally, too much rather than too little detail.