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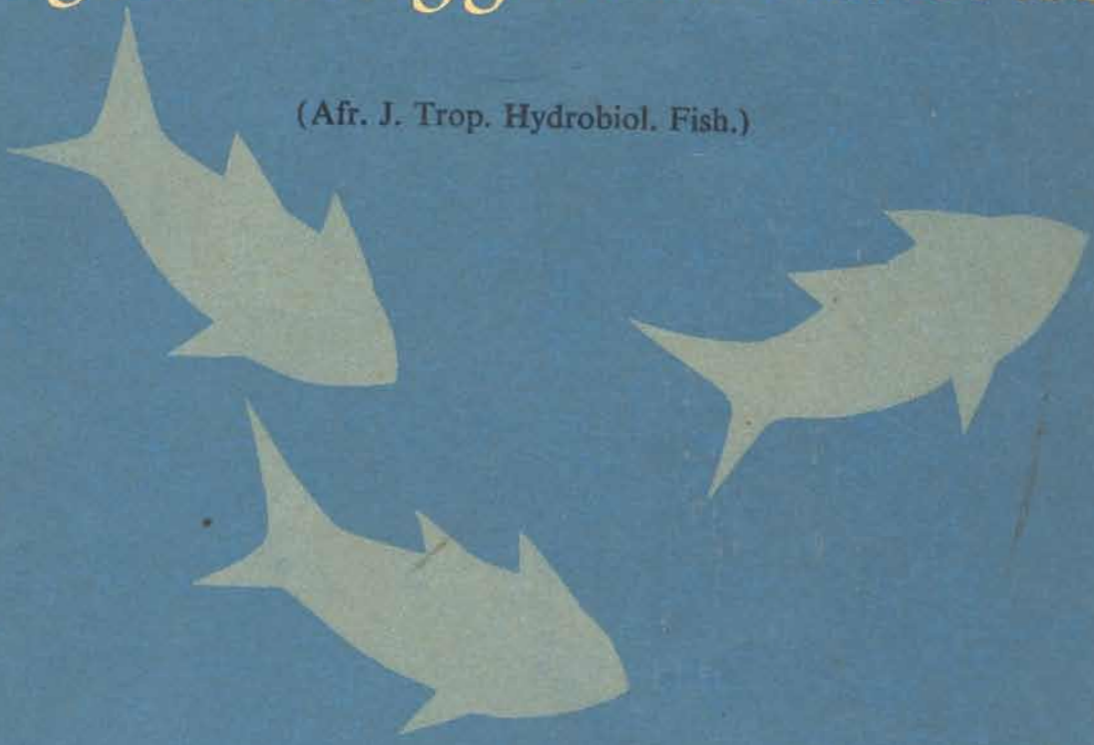

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RESOURCE STUDIES IN RELATION TO THE DEVELOPMENT OF AFRICAN INLAND FISHERIES

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INTRODUCTION

The inland fisheries of Africa are one of the major natural resources of the continent. It is to ensure that the best possible use is made of this resource that the Committee for Inland Fisheries of Africa was established. The present note discusses some of the ways in which biological information on the resource can be applied to obtain the optimum utilization of the resource. It is concerned less with technical problems of the biologist, or of the administrator or fisherman, than with the interdisciplinary problems, and of making, on the one hand the biologist aware of the questions that the administrator needs to have answered, and on the other, the administrator aware of the potential value of the biological studies, and in particular, the wrong decisions that can be taken if relevant biological information is not taken into account.

The outstanding and obvious (though often neglected) fact about natural fish population[1] is that they are finite. The annual catch that can be taken, while it may be large, is always limited. Beyond a certain level attempts to increase the catch by increasing the amount of fishing will be unsuccessful. At best the same catch will be taken with extra fishing and increased cost, more likely the catches will be decreased, possibly very greatly.

The first question that the administrator should ask of the fishery scientist, is therefore, how the present catches compare with the potential yield; are the stocks lightly exploited, with good possibilities of increased catches, or are they heavily exploited, and is the main problem of making the best use of these limited catches. Once this question is answered, a number of second-order questions arise, as discussed below. This discussion deals first with the types of question, and then, briefly, how these might be answered in the context of African inland waters.

PRACTICAL QUESTIONS ON RESOURCES

Under-exploited stocks

Once a stock is known to be under-exploited, biological questions about the resource become, until the fishery has developed, less important than technical and economic questions, such as the best methods to use for catching the fish, problems of marketing and distribution, and the availability of funds for investment in the necessary equipment and infrastructure. The biological information needed for development is, however, more than merely the provision of a green light.

[1] Possibilities of fish culture, which can often be important, are not discussed in this paper.

Every body of water in Africa contains a range of species (sometimes a very wide range), each of which will differ in the best times, places and methods of capture, and in their use—market demand, price, methods of presentation, etc. Fortunately, it is not essential for practical purposes to treat every species separately, and the fish in each body of water can usually be placed in perhaps half a dozen groups, according to their size, their distribution and behaviour (and hence optimum methods of capture) and market uses; further, though there are differences in precise species composition from area to area, the same groups occur in most African waters, with the balance between the groups varying according to the type of water body —deep lakes, shallow lakes, rivers, etc. This aids the extrapolation of experience from one body of water to another.

For each group of fish an estimate is needed of the potential annual sustained harvest, with an indication of any seasonal pattern in supply, and likely landing places, the best gear to use, and an estimate of the likely catch rate of this gear in terms, say, of number caught per standard length of gillnet of a given mesh size. In theory, this last should decrease with increased fishing, as the stock is thinned out from its lightly exploited state, but in practice, so long as the stock is no more than moderately heavily fished, any decline in stocks is likely to be approximately balanced by increasing skill and experience of the fishermen.

The precision of these estimates need not be very high—within 50% would be useful, and a precision greater than $\pm$ 10% is almost certainly unnecessary. If the present fishery is only taking a few tens of tons of fish, the decision regarding investment, training of fishermen, etc., is the same if the potential catch is 2,000 tons as if it were 1,500 tons or 3,000 tons. On the other hand, it could be disastrous if this is the order of magnitude of the resource, to plan for catches of 10,000 tons, and invest in equipment accordingly.

Heavily exploited stocks

When the stocks of fish are heavily exploited, so that, at best, only moderate increases in catch are possible, the relative importance of biological advice, and the precision required of it, are greatly increased. Without good biological advice, the long-term effect of actions on catches is liable to be very different from what is expected. For example, a plank-built boat with an outboard engine is likely, because it can carry more nets, and get to and from the best fishing areas faster, to catch perhaps twice the amount caught by a dugout canoe. However, if 1,000 canoes are heavily exploiting a resource, and catching 5,000 tons of fish their replacement by 1,000 motorized boats would certainly not double the total catch. It is quite possible that the doubling of the amount of fishing will even decrease the yield.

The first task of the resource scientist is to assess the effect on the total yield of each group of fishes of any proposed action. Action being taken to include both increases in the amount of fishing through new investment, training of fishermen, etc., and controls on fishing aimed at management (e.g., limits on the type of nets that can be used, or on the total number of canoes). In the potential application of this information the scientist working in Africa is in a different, and in some ways rather better position than his opposite number in, say, North America. The African fishery administration, through its policies on such things as granting loans, licences for importation of equipment, training, and the provision of the necessary infrastructure—marketing, etc.—has a much greater opportunity for modifying the development of fisheries. Thus the biologist may, by giving the right advice at the right time, be able to ensure that development is

slowed down as the limit of the resource is approached and thus avoid the need to apply restrictive and often painful measures to manage a fishery in which the amount of fishing has risen to too high a level. On the other hand, if the latter situation does arise, effective management measures may be more difficult to introduce. The African fisherman is probably no worse than his European or American counterpart, at attempting to circumvent any rules or regulations, but there is often less effective machinery in existence to prevent him being successful. To some extent, though, direct enforcement against the individual fisherman can be reinforced by other controls, e.g., mesh size of nets might be controlled at the factory, or at the place of importation.

The advice from biologists to administrators may, therefore, be of one of two types—precautionary advice, not to engage in or encourage an increase of fishing, and advice to engage in a direct act of management, in applying definite restrictions or regulations. Even at present, when African fisheries are in general not very highly developed, there appears to be a number of fish stocks so heavily exploited that suitable management measures could significantly increase the yield. In Lake Victoria and elsewhere stocks of *Labeo* have been greatly reduced by heavy fishing at the time when the fish are very vulnerable as they leave the lake and move up the rivers to spawn. Measures which reduced this intense fishing, and allowed more spawning would soon result in greatly increased catches. Also in Lake Victoria the stocks of *Tilapia* in certain areas have long been known to be heavily fished. While the opportunities, through appropriate management action, to increase the total yield are not so large as in the case of *Labeo* some increase in yield should be possible, and there is certainly considerable opportunity to decrease the costs of fishing by reducing the excess input.

In relation to advising caution, as the limit of the resource is approached, but not exceeded, the implications of the biological assessments are often most clearly understandable in terms of the marginal yield that is the actual increase in total yield achieved by a given increase in the amount of fishing. The important point is that even when a stock of fish is not overfished, in the sense that the total yield is falling, the marginal yield can be very small. For example, it may be that 1,000 canoes are at present catching 6,000 tons of fish, but that the addition of 500 more canoes (with the same efficiency) would only increase the total yield to 6,500 tons. The marginal yield of the extra canoes is then only 500 tons, or one ton per canoe, i.e., one-fifth of the average production of the original fishery. The decision on whether or not to encourage the development (possibly through loans) clearly depends critically on the biological information—that increasing the amount of fishing by 50% will only increase the yield by 9%—without biological advice the decision would presumably be based on the existing catch per canoe of six tons. Very likely the wrong decision would be taken, possibly with disastrous results to both new and existing fishermen.

Besides assessment of the effect of changes in the total amount of fishing on one stock (or one group of fish), biologists can advise on the results of other action. A well-known example is the effect of changes in the mesh size used. Often in a heavily fished stock the catch can be increased by using a larger mesh size, thus allowing the fish to grow to a better size before being caught. More complex interactions are possible, and some assessment of their effect made when there are several fisheries in the same areas, either directed primarily for different species or using different gear. Thus it may be that the stock of say *Alestes*, best fished with a small mesh gillnet, is under-exploited, but that of *Tilapia*, using a larger mesh, fully

exploited. Development of a larger *Alestes* fishery could involve the incidental capture of small *Tilapia,* and thus a reduction in the total *Tilapia* catches. Assessments can fairly readily be made of the extent of this reduction which can be compared with the increase in *Alestes* catch, and hence the desirability, taking the fisheries as a whole, of the development.

METHODS OF RESOURCE STUDY

Under-exploited stocks

In these stocks the main source of study for precise assessment-analysis of data from the commercial fisheries—is, almost by definition, scarce or absent. However, studies in Africa and in North America have shown that, at least to the degree of precision required at this stage in fisheries development and planning, the potential yield from lakes and reservoirs is related to some easily measured characteristics—e.g., area, mean depth, and dissolved solids. A plot of the current yield per unit area against some index of expected productivity (e.g., based on depth and dissolved solids) will show to a useful first approximation the current state of exploitation. If the point corresponding to a given lake is significantly below the general trend line it is probably underexploited, and the approximate increase in catch that could be achieved can be estimated. Conversely, if the point is on or above the line, the stocks are probably moderately or heavily exploited, and little expansion can be expected. Some additional information on the ecological conditions can enable reasonable estimates of the composition of the catch between different groups of species to be made. While no explicit analysis for canoes has so far been attempted, similar conclusions could well be expected.

In this way, useful advice—can catches be increased substantially, and if so, roughly by how much—can be provided without very lengthy investigations (naturally it may be expected that the estimates will be subject to some variations, and a few wrong decisions may be taken, but these will be much less than the number of wrong decisions made if no biological information was considered). It is likely that one of the most useful things CIFA can do, in its first years, is to extend the systematic tabulation of data on lakes and rivers already drafted (CIFA/72/9), adding as much further information as possible, particularly on current catches, by groups of species.

While this broad information is probably sufficient for preliminary advice, it is also desirable that collection of other data is started as early as possible. Analysis of a heavily fished stock is made much easier, and much more accurate and precise if certain information, particularly on the sizes/ages of fish caught, and indices of the relative abundance of each group of fish, are available from a period of light fishing. Collection of these data, probably using as indices of abundance either the catch per unit effort of the fishermen, or regular surveys with research gear, should therefore start as early as possible. Other detailed biological studies, e.g., on feeding habits, can be made as and when the need becomes apparent, but once intense fishing starts, the opportunity to observe, say, the average size of individual fish in an unexploited stock, has gone forever.

Heavily exploited stocks

The most useful source of data for making assessments of an intense fishery is the fishery itself. Other sources of data, e.g., regular research surveys to provide indices of relative abundance unbiased by changes in commercial fishing practice, are useful but most detailed assessments of the state of fish stocks and of the effects of different actions, are derived from analyses of statistics of commercial catch and fishing effort, and of

changes in size/age composition. In particular, the analysis depends on observing the changes in some of these as the fishery develops. Despite the importance of these data to African inland fisheries, for far too many bodies of water, reliable estimates, even of total catch, to an acceptable level of accuracy (e.g., ± 10%) are lacking. Improvement in the supply of these data should receive high priority from CIFA.

SUMMARY

The paper discusses relevance of studies on the resources to the decisions that have taken for the development of management of African inland fisheries. Particular emphasis is given to outlining the types of advice that can be provided by the biologist, without which the decisions taken can easily be wrong. The primary information concerns the magnitude of the potential yield from the resource, and how it compares with present catches. From this the possibilities for development can be assessed, or the need for management be determined.

Methods of determining the potential, and the data used in their application are briefly reviewed. Because scientific advice on the resource is desirable as early as possible in the development of a fishery, simple but rather rough methods may be equally, if not more, valuable than more precise but more difficult methods.

RESUME

Le document traite du rapport des études sur les ressources avec les décisions qui ont été prises pour le développement et l'aménagement des pêches continentales d'Afrique. Il définit les types de conseils qui peuvent être donnés par les biologues, à défaut desquels les décisions prises peuvent aisément être erronées. L'information principale concerne l'ampleur du potential des récoltes des ressources, et la façon dont il peut être comparé aux prises actuelles. Ces données permettront d'estimer les possibilitiés de développement ou de déterminer le besoin d'aménagement.

Il passe brièvement en revue les méthodes servant à déterminer le potential, ainsi que les données employées pour leur application. Du fait que les conseils scientifiques concernant les resources en vue du développement d'un pêcherie s'avèrent nécessaires des les premiers stades, de méthodes simples et approximatives peuvent être tout aussi valables, si non plus, que des méthodes plus exactes mais plus difficiles à employer.