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**The Economics of Fishery Regulation:
A Report from Ottawa**

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Abstract

The vigorous discussion of the economic effects of fishery regulation at the recent FAO conference in Ottawa is indicative of mounting scientific concern with this aspect of fisheries management. The theoretical papers and the case studies presented both emphasized the inevitable interaction of physical factors (including regulatory measures) affecting fishery yields and the economic reactions of the fleets involved.

Economists are increasingly concerned by evidence that conservation programs couched in terms of maximum physical yields cannot avoid economic side effects which dissipate many of the gains achieved. The common-property status of most sea fisheries, coupled with the vulnerability of some species to serious depletion, makes regulation essential in many heavily exploited fisheries. If, however, the prime objective is to realize the largest benefit to society, it is not enough to assure that the "right" catch is taken. It is no less important that that catch be taken at the lowest economic cost, and that improved technology be encouraged and rewarded.

Virtually all of our regulatory programs are deliberately intended to reduce efficiency or produce that effect as an unintended by-product. If the fishing industry is to realize adequate incomes at all levels, in the face of increasing competition at home and abroad, our control techniques must be designed with fishing and marketing efficiency in mind. This implies that control over the number of fishing units should be the principal (though not only) method of reducing fishing effort. Quite apart from its obvious effects on costs and incomes, restriction of entry to managed fisheries through license and tax measures would make possible simpler regulations and better compliance.

The proposal to limit the number of fishermen as a major conservation method is no radical departure. This is precisely the technique employed to assure efficient use of public forest and grazing land and of petroleum reserves. It will not resolve all economic problems of the world's fisheries, but it may well represent the most vital first step.

IT HAS BECOME EVIDENT in recent years that effective regulation of commercial fisheries calls for economic as well as biological analysis. Although the most striking effect of overfishing is physical depletion of the basic resource, the operating motive is economic, and only a thorough knowledge of price-cost relationships will permit evaluation of the fishing pressure to be expected. In

addition, the experience of successful management programs in the Pacific halibut and salmon fisheries demonstrates the complex effects of regulation on costs of production and the subsequent reaction of the regulated fleets to altered profit opportunities.

The FAO meeting in Ottawa was important and timely. The literature on fishery regulation has reached the point where neither economist nor biologist can reasonably plead ignorance of the analytical methods and objectives of the other. The conference brought together qualified people from all three areas affected: fisheries economists, fisheries biologists, and government administrators. Obviously, no final answers to all problems of fishery management were expected. However, it was hoped broad areas of agreement could be reached on the most pressing problems to be resolved and on the basic tools to be employed.

The agenda for the program was well planned to meet these objectives. Working papers by Professor A. D. Scott and Dr. Lloyd Dickie provided excellent summaries of the status of theoretical analysis of the economic and biological effects of regulation of exploited fisheries. General discussion of these papers was followed by presentation of case studies of regulation in fisheries with widely differing characteristics using a variety of control techniques. The North American lobster fishery, the Pacific Coast halibut and salmon fisheries, the South African West Coast fisheries, and the off shore trawl fishery of Japan were examined in considerable detail.

As an economist, I would not presume to evaluate the discussion of the current state of biological fishing theory as presented by Messrs. Dickie, Holt, Parrish, Beverton, VanCleve, and other distinguished scholars in the field. Perhaps it will suffice to say that all of the economists present were deeply impressed by the complexity of the structure of fishery populations, the theoretical and empirical accomplishments to date, and the magnitude of the research tasks that remain to be done in the dynamics of exploited fish populations. In the remainder of this paper I should like to stress the general areas of agreement on economic aspects of fishery regulation, and to point out their implications for practical policies.

Every serious student of fisheries has been disturbed by the persistent evidence of depressed earnings and technological backwardness in most fishing industries, large and small. Only in the first flush days of exploitation of a virgin fishery do we find periods when fishing enterprises are sufficiently profitable to provide consistently good incomes to fishermen and a stimulus to technical innovation and development. It is more disturbing, however, to find that even in cases where the basic stock has been protected by adequate regulation, or where successful management programs have rehabilitated depleted fisheries, the same depressing economic tendencies are evident. Each of the case studies presented at the Ottawa conference suggests that while "sound condition of the stocks" is a necessary condition for a healthy fishing industry, it is by no means a sufficient condition. Economists are not noted for their ability to agree, and it is of more than casual significance that the major base papers and subsequent discussion produced general agreement on three major points. First, the objective of sustained maximum physical yield, the accepted basis for most existing regulatory programs, does not provide an adequate guide for fully effective regulation. Secondly, it is essential to broaden the analysis of different types of regulation to indicate not only effects on landings but also their initial impact on costs and subsequent indirect effects on catch,

costs, and profits as the fleet reacts to the regulations. Finally, the introduction of economic criteria into the objectives of fishery management forces us to distinguish carefully among various methods of regulation, giving priority to those which achieve the desired level of fishing mortality with the least reduction in economic efficiency of the industry.

Despite its general acceptance, the objective of maximum sustained physical yield is ambiguous and inadequate as a guide to fishery regulatory policy. Unless the output of all fisheries available to a given fleet is maximized simultaneously, achievement of maximum sustained physical yield from any one population does not provide even maximum physical output. In the North Pacific, for example, it would be possible to expand the physical output of edible fish substantially by diverting capital and labor from salmon and halibut to various types of bottom fish. The reason this is not done is obviously economic, not physical. Moreover, the work of Holt and Beverton demonstrates conclusively that if fishing effort and gear selectivity can be varied simultaneously over a wide range, there need be no hump in the yield curve; maximum yield will be attained only at an infinitely large fishing effort if selectivity is appropriately adjusted for each level of fishing intensity.

A more compelling argument against maximum sustained yield as the sole objective of regulation is its inadequacy in economic terms. By definition, as we approach the level of maximum sustained physical yield the additional returns get smaller and smaller while the additional cost of obtaining it gets larger and larger. Unless labor and capital employed in the fishery are completely free there must come a point beyond which the additional catch which could be obtained is simply not worth the cost of obtaining it. In brief, the value of the last few units of fish will not compensate for the loss of other things which could have been produced with the same inputs. Fish are not the only resources that are to be conserved. As noted by Scott, Gordon, Holt, Beverton, and others in both biological and economic camps, maximum yield should not be treated as synonymous with optimum yield.

Since commercial fishing is an industry, it seems reasonable to ask that the objectives of fishery regulation be geared to the same standards of performance demanded of any industry in a private enterprise economy. This would suggest not only the importance of taking the right amount of fish, but also of insuring that any given level of catch will be taken at the lowest possible costs (including those incurred in marketing). In addition, where regulation is required to prevent overfishing, it is essential that the methods used should encourage rather than discourage research aimed at development of more efficient fishing and processing methods.

The reasons for the necessity of regulating commercial fisheries have been explored thoroughly in the literature and may be summarized only briefly here. For most natural resources, renewable and non-renewable, ownership is normally vested in one person or business enterprise. It is therefore impossible to reach a situation in which the application of larger amounts of capital and labor will actually cause a reduction in physical output if some person has the power to control the use of the basic resource. However, there is no practical (or acceptable) way to reduce sea fisheries to private ownership and therefore to assure proper management of the resource in a market economy. As long as the resource is freely available to all it will be utilized more and more intensively as prices rise until net economic yield is reduced to zero (i.e., until total costs, including a necessary minimum profit, are barely covered). If, as

in the case of salmon, halibut and lobster, demand for the end product rises continuously, it is not only possible but likely that it will be profitable for new firms to enter the fishery even after a period of declining physical yield has set in, simply because the higher price more than offsets the reduction in poundage of fish taken by each vessel. If the price-cost ratio is favorable enough, and if technological advances lower fishing costs still further, economic if not biological destruction of a major species can occur. The present desperate situation of the North Pacific salmon stocks, even under stringent regulation, suggests what might have happened had the fishery remained entirely free.

Three of the case studies presented at Ottawa indicated mounting concern over the evidence that even fisheries which have been managed with considerable success in a biological sense are not in satisfactory economic condition. Stocks of lobster, for example, are not regarded as in dangerous condition, and stocks of Pacific halibut and Fraser River salmon have been thoroughly rehabilitated under brilliant programs of scientific management. Yet there is abundant evidence of gross inefficiency in the overall use of resources in all three cases.

This inefficiency may be broken down into two distinct categories. On the one hand, the individual units may be using gear, vessels and techniques which are inefficient in the light of present technical knowledge; this situation is probably typical of most North American fisheries. In part it may reflect the "high cost of being poor." Incomes in many fisheries are so low as a result of excessive entry of boats and men that it is impossible to finance the level of research, development, and new investment needed to keep the industry up to date. Much has been accomplished by government and university research, but such aid is pathetically small in comparison to that offered to agriculture. Inefficiency of the individual fishing unit may also be a product, intended or unintended, of conservation regulations.

Even if the individual fishing vessels are thoroughly modern and ideally adapted to their task, it is possible to have inefficiency in a broader sense if the same catch could be taken by a smaller number of units. In perhaps the most glaring example, the number of men and vessels fishing for Alaska salmon has more than doubled in the postwar years, yet the total catch has declined sharply. There is surely something drastically wrong when a fishery ties up an increasing number of boats and men who are literally taking fish out of one another's pockets.

It is hard to avoid the conclusion that most current methods of fishery regulation either contribute directly to inefficiency in the first sense or condone it in the second. Fishing mortality can be curbed by regulation only through one or more of four basic variables: the number of units; the area distribution of fishing effort; the total amount of fishing time; and the catching power of the individual unit. In addition, regulation may take the form of altering the age and size at which fish are first exposed to contact with commercial fishing gear. Such regulations include the closure of nursery areas and the establishment of gear limitations which have the effect of changing selectivity. Any particular regulatory program may, of course, include more than one of these techniques.

If the objective is solely to obtain maximum sustained physical yield, it makes little or no difference which of these techniques is employed. The choice becomes largely a matter of administrative feasibility and adaptation to the techniques of the fishery involved. Once maximum economic efficiency is accepted as one legitimate objective of regulation, however, it makes a very

great deal of difference, since the effects of the various regulatory methods on costs of production are widely different. Space limitations preclude an exhaustive examination of the economic effects of all possible types of regulation, but the following major features should be noted. From the standpoint of both businessman and economist it is startling to find wholesale acceptance of gear and vessel limitations designed specifically to reduce efficiency. Yet this is perhaps the most general of all types of fishery regulation in use at the present time. Efficiency effects are likely to be compounded if restrictions on various types of fishing gear become entangled in the political quarrels among their users. The fishing industry is not the only case in which legislation designed to prevent or slow down the introduction of cost-saving equipment is to be found. But it is certainly one of the few in which such barriers to progress are supported not only by pleaders for special interests but by scientists and technologists as well.

Closed seasons and closed areas, to the extent that they are effective in reducing fishing mortality, are also likely to reduce overall efficiency, except in the unlikely event that such closures can be dovetailed perfectly to keep men and gear steadily employed. To the extent that area and seasonal closures are designed to protect immature fish or fish that are not in proper condition for processing and marketing, the regulation becomes, in effect, a selectivity device which may be justified both in biological and economic terms.

Perhaps the most effective regulatory device employed thus far is the establishment of catch quotas. It is essentially a simple and direct form of regulation and—if based on a solid groundwork of analytical and statistical information—is both flexible and enforceable. It does not depend for its effectiveness on reducing the catching efficiency of the individual unit, and it minimizes the more annoying kinds of petty restrictions. However, it was pointed out in one of the papers at the Ottawa meeting that in the case of the Pacific halibut, the only major instance in North American experience where this technique has been used, distinctly undesirable indirect effects have developed. As the fishery was rebuilt, the increasing attractiveness of the halibut operation drew a host of new entrants, and the quota was taken in successively shorter and shorter fishing periods. This effect was accentuated by the obvious incentive for each individual fishing vessel to take the largest possible share of the fixed quota. Since this frequently meant staying on the grounds until a full load was taken and bringing the largest possible load to port even at the expense of inadequate icing, quality of the final product has suffered to some extent. More serious is the fact that with the total catch taken in less than three months, it has become necessary to freeze a much larger part of the total catch and to store and market it in frozen form over a period of nine to twelve months. It has been estimated that the additional marketing costs imposed by shortening of the season may be of the order of 5 per cent or more of the landed value. In short, the brilliant success of the Halibut Commission in restoring the badly depleted stock of Pacific halibut has been reflected only partly in increased economic yield from the resource. Much of the gain has simply been dissipated in excessive numbers of boats and men and in higher marketing costs.

Much the same evaluation could be made of the equally successful rehabilitation program in the Fraser River salmon fishery. The very high price of red salmon has made the operation so attractive that the very structure of the control program itself has been threatened on several occasions. The day is

not too far away when we may see this fleet fishing less than one day per week in order to provide proper escapment. And always there lurks the spectre of an off shore, uncontrolled foreign fleet.

Under these conditions it is hardly surprising that the regulated fisheries are no more enterprising with respect to research and development than the fishing industry as a whole. This weakness is to be expected of an industry dominated by relatively small units with consistently low average incomes, and could be rectified in part by research efforts of government and university supported agencies. What is really discouraging is the apparent necessity, in the name of conservation, of legislating out of existence many types of gear already more efficient than those in use. As long as we deny the fishing industry access to existing technology there is certainly little incentive for the industry (or even government) to spend much effort in further development. It might be added, parenthetically, that many foreign and domestic competitors of the fishing industry do not indulge in this luxury.

In summary, the crucial weakness of all present methods of fishery regulation is their failure to deal with the normal response of fishermen to an improvement in physical stocks. Even if they do not specifically reduce the economic efficiency of the individual unit, any achievement in building up available stocks will simply attract more entrants and increase total costs. The consumer will obviously benefit; even poor regulations are better than no regulations at all where valuable fish are subjected to levels of fishing intensity that cannot be sustained. But the gain to the economy as a whole—the possibility of getting more output at lower cost—will not be realized in full as long as the common property status of sea fisheries is interpreted as permission for anyone to enter the fishery at will. Excessive use of labor and capital, lower efficiency, and poor technical progress are virtually assured.

For these reasons, most fishery economists have come to the conclusion that some method must be found to limit the number of fishing units wherever physical depletion is a threat. Ideally, regulation would involve licensing only that number of optimal fishing vessels required to take the permitted catch while operating on a full time basis. Within the limits imposed by seasonal patterns of weather and availability of fish this would guarantee, for any given level of output, a maximum economic yield from the resource. Regardless of what might be done with the resulting increase in net income—whether it accrues to fishermen, processors, government, or some combination of the three—the economy as a whole is clearly better off if the same output can be taken with fewer inputs. Expressed in other terms, any hope of real economic progress in the fishing industry must rest on our ability (and willingness) to take advantage of the known possibilities for cost reduction.

I should like to stress the fact that this is by no means a revolutionary proposal. It is precisely the way in which the public holdings of grazing and forest lands are managed. Although production from these lands is actually carried on by private enterprise, rights to exploit them are leased by government, acting as a landlord. In effect the government acts as any wise resource-owner would do: it requires good conservation practice in the use of the land; and, by making it available to the highest bidder, it provides reasonable assurance of efficient cropping. In a very real sense of the word, intensively exploited fisheries are "over-regulated" to overcome the glaring weakness imposed by the lack of private ownership of the basic resource itself. If it is free to anyone, it will be abused by all. It might be noted that the petroleum industry has strug-

gled with the same kind of problem for decades, and only in recent years has it been possible to reconcile in part the objectives of wise conservation of the physical resource and economic efficiency in its production and use.

This is not to say that reduction of a number of fishing units in our overcrowded fisheries can be accomplished without considerable difficulty. If the desired catch can be taken with fewer vessels and men, with better incomes and an incentive to use the best techniques, we can hardly fail to be better off as a nation. But the problem lies with the outs: who is to leave, and how is this to be accomplished with reasonable fairness to all? Clearly this is not something that can be accomplished overnight. However, fisheries, like fish, age and are replenished. A program of licensing to prevent further expansion could be followed by a slow, staged reduction in the number of licenses, well publicized in advance, and accompanied by a government repurchase program. It should be possible to reduce overcapacity in such fisheries as the Pacific salmon, halibut, and lobster to much more manageable proportions within five to ten years with little or no forced retirement of individual fishermen. It is equally essential that at least some of the increasing incomes which would accrue to those remaining in the fishery should be recovered through taxes or license fees. The first charge on these receipts should be against the costs of research and management programs in the fisheries effected, since these are clearly a part of total production costs.

It has also been suggested that the necessary reduction in rights to participate and restricted fisheries might be accomplished by some form of auction. In either case, the ultimate objective would be to place fishing rights on a limited basis and then to allow them to be purchased and sold as property rights. Either method would provide an opportunity to realize the benefits of cost-reducing innovations by further gradual reductions in the number of fishing units as the catching power of the fleet is increased.

Obviously our knowledge of the physical factors conditioning the yield-effort relationship in any fishery will never be sufficiently accurate to permit this precise adjustment of the number of fishing units. Where depletion is a really serious threat, some reliance must still be placed on more traditional methods of control, particularly where flexibility is essential. However, no really significant improvement in the economic health of the industries effected can be expected until a more rational use of capital and labor, with a minimum number of highly efficient operating units, is achieved by limitation of entry.

Admittedly, these ideas involve a substantial departure from traditional ways of viewing the regulation of commercial fishing. I can only point out that the existing state of the fishing industry of the United States suggests the need for some revision. The stakes are very high for all concerned. From the standpoint of the biologist and the administrator, limitation of the number of participating units to a more economical level offers the possibility of far simpler and more enforceable regulations. The present situation, with many of the regulated fisheries literally bulging at the seams with excess capacity, puts tremendous pressure on each individual vessel owner to violate. The pressure becomes even more dangerous where regulation forces the fisherman to use gear and methods which he knows to be grossly inefficient. Far from criticizing the work of the physical scientist, the economist is begging that we make good the gains which he has offered us.

From the standpoint of the industry, the reasons for introducing economic criteria into the objectives of fishery regulation are even more compelling. The

blunt truth is that many of our major fisheries, even those which have been successfully rehabilitated in a physical sense, cannot survive in their present form against foreign fishermen and the equally severe competition of domestic suppliers of other high protein foods. Tariff and quota protection is at best a temporary measure, and in the long run it would lead to a wave of retaliation that could hardly fail to leave all of the world's fisheries in worse condition.

The driving force behind the remarkable growth of the American economy has been its insistence that all who use resources must use them effectively or give them up to those who will. It is within the power of most parts of the fishing industry to meet that challenge, but it will require vision, a good deal of courage, and a willingness to accept the fact that the principal problems involve people rather than fish.

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Financial Aids Available to You and Your Foreign Competitor

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Abstract

Under provisions of the Fish and Wildlife Act of 1956, the Department of the Interior makes loans for fishing vessel construction and operation from a \$13,000,000 revolving loan fund. In addition, mortgage insurance is provided and a fishing vessel differential construction subsidy applicable to only certain segments of the fishing industry is paid. A long list of other countries throughout the world provide similar credit and vessel construction aids. Some of these countries go much further in their financial aid programs than we do.

In general, where the efficiency of a nation's fishing fleet can be improved by a sound government financial aid program, it would appear wise for governments