

FISHING REGULATIONS -
CONFLICTS IN EXPLOITATION OF FISHERY RESOURCES

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Summary

This paper is an attempt to set out the main features of a general theory of fishing regulations. These regulations are formulated and enforced to prevent (or reduce the consequences of) conflict between people with regard to the use of natural, common-property resources; the theory, therefore, must be concerned with these conflicts and with the effects of regulations on the actions of conflicting persons. This theory will start where theories on natural populations, gear behaviour, economic choice, etc. leave off. Therefore, distinction is made between (1) a theory of fishing regulations and (2) the theories of fish populations, gear behaviour, economic choice, etc. Distinction is also made between (1) regulation to control fishing operations, (2) regulations which determine the allocation of resource-use opportunity, and (3) regulations which relate to working conditions and similar matters. The origins, nature and consequences of conflict are discussed, and the purposes and effects of regulations are examined.

INTRODUCTION

Fishery administrators in general are heavily preoccupied with fishing regulations. The examination of situations in which regulation might be required, the framing of the regulations in legislative form, the enforcement of regulations, and the study of their effect, occupy much of the time of administrators and their staff, to whom, therefore these regulations are a matter of great importance, even if it were only because of the work load involved. But, since these regulations can have considerable effect on a fishing industry, with economic and other consequences to individual fishermen and to the industry as a whole, they impose heavy responsibilities on administrators. Moreover, fishing regulations are a principal instrument of policy with respect to the use of natural resources and to industrial productivity. They also are a means to a preservation of law and order. It would seem therefore that, being of such importance, fishing regulations would be the subject of a formally developed theory and practice; yet it is somewhat astonishing to find that such formal theory and practice do not in fact exist. It is probably not unfair to say that a very large proportion of the body of fishing regulations throughout the world owes its origin simply to political assessment of pressures brought to bear by commercial fishermen, sport fishermen, and local communities. It is also fair to say that the form of fishing regulations derives chiefly from some understanding of what has been said by fishery biologists about the characteristics of natural populations of fish and about the effect of fishing operations, but nowhere does there yet exist a comprehensive treatment of the subject which takes into consideration all the characteristics of the natural

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and social systems to be influenced by regulation.

We take it that regulation in human society is by definition a stipulation of permissible courses of action and of those that are not permissible. We take it as an axiom that regulations are (or perhaps we should say, should be) drafted only where, as matter of physical practicability, both permissible and prohibited courses of action could be taken and where the public good would be impaired if the latter course of action were to be taken. Impairment of public good could follow from either the consequence to the system in which the courses of action could be taken, or conflict between those who would take the different courses of action. If only a single course of action is open, or if there is agreement (reached out of recognition of economic or other advantage) to follow only one course of action, there is no need to regulate. Indeed, in spite of a common feeling that there is an excessive number of regulations in all walks of modern life, only relatively few matters are subject to regulation.

Many fisheries are subject to almost no regulation whatsoever, and very often the minimum size at which fish can be taken is the only element of a fisherman's operations subject to any control. However, it is generally the case that a regulation relates to the most critical issue in the range of fishing operations and that the issue so regulated is that on which there is greatest divergence of opinion as to the appropriate manner in which to act. That is to say, regulations are formulated and enforced where conflict between individuals arises or is likely to arise. It is part of our thesis that a study of fishing regulations with the aim of erecting a general theory of them must begin with an examination of conflict situations. We further hold that conflicts have their origin in differences with respect to the objectives that can be sought in conducting fishing operations and in the motives of those who nominate these objectives both in their choice of and their argumentation for those objectives.

Conflict, after all, is a normal feature of human affairs. Man is competitive by nature, and people differ in the objectives they set themselves and in their views as to the methods by which objectives are to be attained. Even when objective is agreed to, disagreement may remain as to method*. But it cannot well be argued that there ought not to be difference of opinion as to objective or method, for to do so would be to fly in the face of fact, and to reject the counsel of philosophy. On the contrary, an administrator should canalize and put to good use the energy that gives rise to conflict; in any case, he must seek to avert the damage that can come from overheated conflict. Moreover, a conflict situation is likely to be more heavily loaded with information than a non-conflict situation, and a study of it is likely to be illuminating; in a sense it is an experimental opportunity.

The problem of conflict is especially real and urgent in fisheries because in this field the decisions that must be made with regard to matters that give rise to conflict lie very much in the public domain. This situation is the consequence of the common property character of fishery resources - property common at least to the individuals of one nation, and in many cases to the

* Although, as pointed out later, a disagreement as to method is essentially a disagreement as to some subsidiary or prior objective.

people of all nations. It is natural that different views should be held as to the use to which common property should be put; it is also proper that those who hold these views should seek, within current law, to pursue aims consistent with their views. To some point the pursuit of these separate aims may not involve interference by one with the other, and there may be benefit from conflict which is at the level only of competition. However, some third party must arbitrate if the conflict is such that it could cause damage to the resource and/or harm to one of the contending parties. Generally in such cases the third party is a fisheries administrator acting on behalf of the community, and in this sense a major responsibility of fisheries administrators consists of arbitration.

To summarize, we believe that a theory of fishing regulations will deal with (1) an identification and assessment of objectives and motives in fishing; (2) an appraisal of conflict situations; and (3) an assessment of the effectiveness of regulations singly and in combination.

Although much, if not the bulk, of fishery literature has a relevance of some kind to regulations, or more generally to decision-making functions within the industry (for which regulations provide particular guide-lines), most of these papers deal with fishing regulations in a technical sense with reference to particular situations; the number of them dealing with regulations in a general and theoretical fashion is relatively small.

Almost all this special section of fisheries literature is to be found in the reports of three meetings (Turvey and Wiseman 1957; Crutchfield 1959; Hamlish 1962) or listed in the bibliographies of the papers submitted to those meetings. Although the second of these meetings discussed biological and economic aspects of fisheries management whilst the third discussed economic effects of fishing regulations, and thus covered much of what might lead to a general theory of fishing regulation, we venture to express an opinion that the general theory is yet to be formulated.

A general theory of this matter would embrace biotic, technical, and social elements, since all three are present in every situation for which a fishing regulation can be formulated. However, such a theory would not extend to the determinants of operation of each of the subsystems of these situations; that is, the theory of the dynamics of fish populations under exploitation, physical theories of the operation of craft and gear, and theories relating to economic choice, would all lie outside a theory of fishing regulations. A theory of fishing regulations would take the predictions of these several theories and compound from them a rationale for prediction of the closeness with which chosen objectives might be approximated in particular situations, given certain expectations as to the behaviour of the resource, the fishing gear, the men, and the society to which the men belong. Such a theory would accommodate all types of objectives in the use of fishery resources and would not assume, for example, that the objectives are solely economic, much less that they are solely monetary; nor would it assume that a fishery must be regulated toward a single objective, much less that it must be regulated for the maximization of some single economic objective. Such a theory would draw heavily on general theories of the behaviour of human society since it would be much concerned with what decisions need to be influenced by regulation (in contrast with those that can be left to individuals) and how influence can best be exercised.

The significance of the distinction we make between a theory of regulations and the several theories concerning fish populations and so forth, is that whilst the usefulness of a theory of regulation will in application depend upon the strength of the theories of population, etc. on which it has drawn, the converse does not hold. How a fish population will react to a particular regime of fishing depends in no sense upon whether or not that regime is dictated by a regulation, nor on whether, being framed, the regulation is effectively enforced; the accuracy of predictions about a population depends upon how well the population characteristics have been measured, and if the regime changes so will the prediction, without impeachment of the theory on which it was based. Discussion of population characteristics is out of place in a discussion of regulations; what needs to be said about populations must be said by populations researchers without regard for regulations, and if what they have said seems unsatisfactory, it must be sent back to them for review. The same principle holds for behaviour of fishing nets and other elements of these situations. Often in the past the discussion of regulations has been obfuscated by discussion of prior matters and rarely has it been conducted at its own proper level.

FISHERY OBJECTIVES

(a) Definition of Fishery Objectives

As our starting point we think of fishery objectives as: "what people want from the use of a fishery resource".

Some sports fishermen go fishing "to get a feed", whilst others go fishing for the fun of it, but although most amateur fishermen go fishing for both reasons, we would suppose that one or other reason is uppermost in the mind of each person who engages in fishing. Since, also, each sports fisherman is greatly influenced by his main objective when choosing his equipment and deciding how to operate, we suppose that an assessment of prevailing objectives will be of both technical and social significance.

In subsistence fishing the operative is entirely concerned with obtaining, for himself and his family, what is an important and necessary part of his food supply. We would suppose the motivation, in subsistence fishing situations, to be of increasing intensity as a result of population growth.

Professional fishermen, in contrast, go fishing for a livelihood, even if they eat some of the fish they catch. But, in fishing for a livelihood, professional fishermen are acting in response to, or in anticipation of, a community wish, and this community wish, rather than by their own personal predilections, determines what they do in fishing. The identification of major objective in these situations is more critical than it is in the case of sport fishermen.

In allocating labour and capital, either expressly by direction (as in the case of directed economies), or through the play of economic processes of supply and demand, or by the employment of special devices such as subsidies, a community seeks some objective or a set of objectives and exercises an

TABLE 1
CLASSIFICATION OF FISHERY OBJECTIVES

Class of Objective		Particular Formulations
<u>Primary</u>	I. Food or other commodity	(a) Weight of catch (b) Number of fish in catch (c) Composition of catch (sex, size, and/or species) (d) Condition of fish in catch
	II. Human activity	(a) Remunerative employment (i) numbers engaged (ii) earnings (iii) working conditions (b) Recreation
	III. Capital employment	(a) Use of capital equipment (b) Investment opportunity
<u>Derivative</u>	I. Development of secondary and tertiary sectors	
	II. Market for producer goods or sports goods	
	III. Decentralization	
	IV. Development of tourist resorts	
	V. Maintenance of sea-going fleet	
	VI. Training for sea-going activity	

important influence on operational decisions in the fishing industry. The fact that these objectives are seldom set out in print or otherwise stated explicitly does not make the effect of pursuit of them less real.

Whilst in general, and in most cases, two or more benefits flow from exploitation of a natural resource, it is seldom possible to maximize more than one benefit from any exploitative activity.

For the purposes of this paper we define fishery objective as some benefit or set of benefits (to be had from the exploitation of fishery resources) particularized as to kind (e.g. food for humans, employment) or to magnitude (e.g. maximized weight or income) or both, whose attainment necessitates deliberate action and may involve a sacrifice of other benefits and hence requires economic judgment in the allocation of scarce resources*.

(b) Classification of Objectives

In considering what people may want in their use of fishery resources, we can make a division between primary and derivative objectives. Those of the former class are the benefits, such as food, employment and recreation, and the use of capital, that come directly from fishing activity itself; those of the latter class are the benefits that come from the existence of the fishing activity and from attainment of the benefits sought as primary objective.

In considering commodities to be obtained from fishery resources, the aim may be to have total weight, a total number of fish, or a catch of some special composition. In considering human activity, the wish may be to ensure remunerative employment or recreational activity; and particular levels of activity, productivity, or efficiency may be sought. In considering employment of capital, the wish may be to utilize equipment which might otherwise be idle, or to take advantage of a favourable investment opportunity.

Among derivative objectives may be considered the opportunities to develop the processing and distributing sectors of the industry which take the raw materials drawn from the resource and convert, carry, and store them, the market that a fishing industry creates for certain producer goods or sports goods, and the training in sea-going activities that fishing gives to people.

For purposes of discussion these classes of objective are set out in Table 1. Obviously the objectives listed in this table could not all be attained simultaneously in any fishery. In many cases the appropriate and attainable objective thrusts itself before our attention, often without debate. In many more cases, however, an issue is settled only with difficulty: which or whose objective should determine the pattern of operations is a matter to be decided. It is of value, therefore, to attempt an analysis of the compatibility of objectives and of the grounds of conflict between people with regard to objectives.

* The word "resources" is used in this place in the sense of "means of production!"

(c) Compatibility of Objectives

Some objectives are incompatible with others to the extent that if one is sought, certain others must be abandoned. These are inescapable incompatibilities leading to win-or-lose, tug-of-war conflicts. However, there is between most objectives a conditional incompatibility in the sense that conflict in simultaneous pursuit of two of them arises only under certain conditions. Indeed, most incompatibilities are conditional, arising from a wish for quantity rather than for a particular kind. For example in an estuarine or inland fishery a wish to obtain maximum production with greatest efficiency cannot be reconciled with a wish to obtain maximum recreational opportunity; the resource might be quite capable of supporting both commercial and sport activities but the benefits of both cannot be maximized.

In some fisheries the taking of maximum weight of catch means also the taking of maximum number, but in many fisheries to take maximum weight means to take less than maximum number, or to take maximum number means to take less than maximum weight; and it is therefore impossible in those cases to take at the one time both maximum weight and maximum number. If the agreed objective of a fishery for a particular species is to maximize (either in weight or number) the take of a particular size-range (because the fish in this range have greatest market value), the total catch may be less than a possible maximum weight or number.

Again, in some, perhaps most fisheries, it is impossible to have maximum employment and at the same time to carry out the operations with maximum efficiency and thus to have maximum human productivity. Similarly, it is impossible to have maximum remunerative employment in exploitation of a particular resource and at the same time to have maximum recreational opportunity*.

CONFLICT

Since a regulation should be framed to promote achievement of a chosen objective, it is obviously necessary not only to have chosen an objective, but to ensure that achievement of the chosen objective can be expected if the regulation should be observed. Thus, there are three principal questions: (1) what is the objective to be achieved; (2) which regulation or set of regulations would, if observed, secure the achievement of the objective; and (3) what are the prospects that the regulations will, in fact, be observed? It is obvious that objectives are only part of these conflict situations, even if, for present purposes, they are the critical part. Nevertheless, in analysis of a conflict situation assessment must be made of certain others of the elements of these situations. Importance of these other elements lies chiefly in the measure they will afford of the forces in play in the situation. In the front rank is to be considered the matter of motive. A sports fisherman, for example, may fish "for a feed" because he needs food, or because he wants fish in place

*In this paragraph, the maxima are, of course, maxima within particular economic contexts, and involve value judgments. They differ from resource yield maxima to which limits are set by resource characteristics.

of other available food since he prefers its flavour, or because the cost of catching the fish is small, or because he wishes to maintain a reputation of being able to win his food from nature. Doubtless this does not exhaust the list of possible motives in this case. The important thing to observe here is that whilst all these motives relate to the one identified objective, they are not equivalent in the sense of the vigour with which a sports fisherman would wish to press his claim to secure his objective in the face of determined opposition. In simple terms, the problem here is of trying to assess the importance that the individual or group would attach to achievement of a chosen objective.

We believe that it is of considerable importance to make a sharp distinction between objectives as we have discussed them in an earlier section and motives. It is true that the term motive is often applied to a result or object which is desired, but we use the term here in a perhaps stricter sense to signify "that which moves or induces a person to act in a certain way; a desire, fear, reason, etc. which influences a person's volition". We believe that motives in the stricter sense should, wherever possible, be accurately identified. We also believe that it is important to recognize that motives differ with respect to the energy they import into a situation. If, in addition, there is difference of numerical strength between parties with differing motives, there can be important difference in the vigour with which respective parties will advance their cause. It is the administrator's task not only to measure these motives, but also to attempt to assess their social, political, or other significance. This is so because if an administrator has to regulate in favour of one objective against some other, he may find that although the regulation he has chosen to secure the particular objective is theoretically the appropriate one, the motivational forces of those who support the rejected objective may be so great that they will seek means (if necessary illegal ones) to circumvent the regulation.

In some cases superficial analysis of conflict leads not merely to a wrong estimate of motivational forces, but to misidentification of them, and sometimes to formulation of regulations to serve purposes other than those for which a regulation is intended. A major area of confusion surrounds the question of licence limitation. Confusion arises because whilst licence limitation is primarily a measure to place restraint upon fishing effort, it almost inevitably operates to protect, for those people to whom licences are granted, the opportunity to exploit the resource concerned, and thus raises the problem of how to decide upon to whom the licences shall be granted. It often happens that fishermen ask for licence limitation, having in mind certain particular objectives of their own with regard to the last of these problems, namely, the identity of the persons to whom licences are to be granted. In any case, they certainly have in mind that they should maintain their income at a level as high as possible. An administrator obviously has a task of making accurate identification of these objectives and of ensuring that any regulations he formulates are appropriate to acceptable objectives and have due regard for the motives of those who have nominated the objectives.

Scott (in Hamlish 1962) attempted some examination of this question, and in answering the question "why are fisheries regulated" nominated the following

classification for motives for introducing regulations:

- (1) Safety
- (2) Rivalry
 - (a) Sovereignty
 - (b) Racialism
 - (c) Marine Luddism
- (3) Over-fishing

We find this classification somewhat unsatisfactory because it confounds the motives of different groups and also the motivation with regard to different objectives. We suggest that the basis for such a classification should be the motivation of the administrator as instrument of government which in its turn is representative of the community, and we would suggest that the administrator can wish to regulate with respect to

- (1) resource use;
- (2) allocation of opportunity to participate in resource use;
- (3) other social objectives such as safety at sea and conditions of employment.

The objectives of these grounds of regulation differ the one from the other, and it is important not to treat them as though they were identical.

(a) Conflict when Two or More Gears are Used to Fish a Single Stock

A typical and easily understood conflict situation is that which develops when two or more groups using different gears compete for the catch from a single stock. This is the nature of the conflicts that develop between amateur and professional fishermen in many parts of the world; in which the one side wishes to use an efficient gear to take fish at commercial rates while the other wishes to use a less powerful gear for recreational purposes. It is also the nature of the conflict, in commercial fisheries, between onshore fishermen with fixed gears (e.g. traps) or gears of limited mobility, and inshore fishermen with moving gears and powered craft. A case of this latter kind was examined in detail by the Indo-Pacific Fisheries Council at its 11th Session (IPFC 1965).

In a situation of this kind the technically weaker group (i.e. the group whose gear has least mobility and fishing power) generally seeks to have the stronger method prohibited. The ground of argument, and the consequences of its concession, obviously are not merely allocation of opportunity since by specification of the situation there is technical difference between the parties. In the case of conflict between amateur and professional fishermen the origin of the conflict is essentially as to whether or to what extent the resource should be exploited for commercial purpose or reserved for recreation;

beyond this there are, on the side of the professional fishermen, the benefits of commercial enterprise whilst on the side of the sport-fishermen there are the benefits of recreation and of tourism. Very often in the sport versus commercial-fishing situations, the issues are clouded by charges and counter-charges lodged by one against the other. Sport-fishermen almost traditionally allege that commercial fishing practices are wasteful and destructive; it is often alleged that the commercial fishing gear destroys small fish, or spawning grounds and spawn, or feeding grounds. Sometimes much the same charges are made by commercial fishermen against sport-fishing methods. It is rare, however, that a fishing method cannot be modified to remove undesirable features, so that even when such charges are well-founded the ground for them can be removed and the basic issues remain. Administration is then faced with the task of deciding whether a choice must be made between the two or a compromise can be effected. In part, the answer lies with evidence on the catch that can be sustained by the resource, the level of effort required for that catch, and the likelihood of that level of effort being exceeded if both methods continued in operation. Yet analysis of this kind may not resolve the problems entirely. Sometimes the activities of commercial fishermen make a locality unattractive to sport-fishermen by reducing stock to a level at which sport-fishing seems unrewarding, even if the total catch taken commercially still stands well below the maximum sustainable. In such a case the primary issue must still be faced.

The case of conflict between two technically disparate groups of commercial fishermen is very close to the sport-fishermen versus commercial-fishermen dispute, especially in the situation where the powerful group reduces the stock to a level at which the less powerful cannot succeed in making a livelihood. Here the administrator is faced with a choice between benefits such as total catch, efficiency in operations, profits, and so on against gainful employment although at low level of efficiency. Such a situation may resolve itself by the powerful group moving off to other grounds, but if it does not Government may feel itself constrained to intervene with controls anywhere between the extremes of prohibition of one or other method.

(b) Conflict when there are Differing Objectives with Regard to
Composition of Catch

Another type of conflict situation arises when the objectives of competing groups relate to what is to be got from a resource rather than to how the catch is to be taken (as in the preceding subsection) or to the way it is to be shared (as in the succeeding subsection). This occurs when one group wishes to take maximum total weight and another wishes to maximize the catch of some particular size group. The same situation sometimes arises in exploiting a stock composed of several species, as is often the case in demersal fisheries, where to take the maximum of one species means that the catch of another species must be less than the maximum. If the objectives are incompatible, either the competing groups must compromise by each setting its sights lower, or one objective must be chosen to the exclusion of the other and regulations introduced to give effect to this choice.

(c) Conflict when there is Excessive Fishing Capacity

The most common conflict situation is that in which the fishing units engaged in fishing a single resource are greater in number and fishing power than are needed to take the sustainable catch. Here each fisherman is competing with all others and the fishermen are in conflict with the community (either the nation, or the community of nations). Here we have incompatible objectives: it is impossible for fisherman X to take all the catch he wants and for fishermen Y, Z, and all the others at the same time to take all they want. Also, it is impossible for the fishermen to do what they wish and at the same time for the community to have what it normally wishes, namely full use of the resource into perpetuity.

A community objective of full use of the resource into perpetuity is to be obtained by some particular regime of fishing - essentially by taking fish only after they have passed some minimum size and by limiting the total effort, either directly or by limiting the amount of catch taken. Sometimes such a regime is further particularized by fishing only at certain times and in certain areas because to fish outside these would lead to significant catch of under-sized fish.

There will be some fishermen who will seek to maximize their own immediate catch by operating at variance with such a regime - by catching and retaining small fish, or by fishing with a gear or in places or at times that give a catch comprising a large proportion of small fish which are then thrown back and wasted. Evasions of a well-founded regime frustrate the effort at both the community objective and that of other fishermen; the community will normally want to resist such evasions, but whether the other fishermen also resist depends on how clearly they recognize the damage done to their interests.

FISHING REGULATIONS

By definition a regulation prohibits some kind or kinds of activity and this means that some objective, alternative to that held in framing the regulation, has been rejected. A regulation is usually framed because the majority of people want, of their own choice or accepting advice from authority, to do one kind of thing whereas some people want or are likely to do some other thing. Proclamation of a regulation prohibits the minority group of people from doing what they want to do; the express purpose of a prohibition is to increase the likelihood that the majority will be able to do what they want to do, that is, to achieve their kind of objective. The minority group is then free to participate in the benefits of the regime established by regulation. Thus, each regulation is in effect an "arbitration judgment" on a conflict arising out of incompatible objectives.

An eminent colleague has pointed out to us in a personal communication that in some situations there is a common wish to fish less, to use a larger mesh, or to adopt some other limitation, and that regulation is introduced to bring about what the people concerned do not trust one another to do by agreement. He takes this to mean that in such cases regulation is introduced in the absence

of conflict. However, we believe that our statement in principle here is valid. What the fishermen are really saying in such cases is that they do not believe there is unanimity and that under management without regulation conflicts would emerge because some individuals would allow their view of immediate personal advantage to prevail over the communal interest.

A fishery regulation has one or more of the following main effects*

- (1) It limits the total amount of catch taken in some specified period.
- (2) It restrains fishing effort by limiting
 - (a) the total fishing power,
 - (b) the total time spent fishing during a period.
- (3) It limits the level of fishing mortality, or confines the impact of fishing mortality to fish (usually particular groups) which need to survive beyond some point in their life cycle if optimum yield is to be achieved from the stock. It does this by prohibiting operations
 - (a) at certain periods or places,
 - (b) against certain age or size groups,
 - (c) against one sex.
- (4) It prevents the killing of fish which, temporarily, have little or no value (e.g. because they are in a bad condition, or have an unpalatable flavour).
- (5) It reduces opportunity for employment of labour and capital, and for recreational activity, by
 - (a) limiting the fishing power of individual units,
 - (b) limiting the time which individual units may spend fishing during a period,
 - (c) limiting the total catch of individual units,
 - (d) restricting operations of individual units to particular places or periods,
 - (e) restricting the number of licences issued.
- (6) It serves the convenience of fishermen and other operatives, and/or contributes to the efficiency of operations.

* Of course a regulation does not of itself produce these effects; the effects are a consequence of fishing being conducted in conformity with the regulations.

However, although a regulation may be introduced with the intention of producing a particular effect, it will inevitably produce others. In elementary fashion the duality of main effects of regulations can be represented by Figure 1 which emphasizes that every regulation has a double effect. Regulations relating to fish catch have a consequential effect upon fishing equipment and effort. Conversely those that relate to equipment or effort have a consequential effect on the catch.

In a broader sense, the possible effects of a regulation must be seen also in terms of the industrial complex into which it brings an influence. Figure 2 gives a representation of the complex, showing the principal groups of components of such a complex and some of the relations between them. Each of the lines between the rectangles in this figure represents one or more of the following:

- (1) material transfer or change;
- (2) operation of forces;
- (3) communication of information.

The speed with which these processes operate, and the volume of "traffic" through each channel, are features of the complex, determined by, inter alia, the structural characteristics of the components. The regulations considered here operate at the numbered points:

- at 1, with regard to size and composition of catch;
- at 2, with regard to period, places, amount, and intensity of fishing;
- at 3, with regard to structural features of gear;
- at 4, with regard to the number and fishing power of fishing units.

The immediate effect of any regulation is to place limits on fishermen's decisions at these points and thus to determine limits within which the amount of "traffic" of these processes can lie. A regulation can be considered in respect of its consequences to the operation of the complex as a whole, and to its operation for one part of the complex (e.g. the individual fisherman). In some cases restriction is on the decisions of individual fishermen, and whether this imposes a limit on the total process depends on the extent to which the number of fishermen is limited. Therefore, a limit on the catch per fisherman is a limit on total catch only if the number of fishermen is fixed; except of course that size of catch is determined also by the resource, and increase in number of fishermen may not take the catch above this other limit. In other cases restriction is on the total, and then what is available to each fisherman depends on the result of his competition with other fishermen.

Figure 2 thus represents a circuit of events. The use of gear by fishermen brings a catch for which they obtain reward from the community. The size of the reward to fishermen depends upon the size and quality of the products

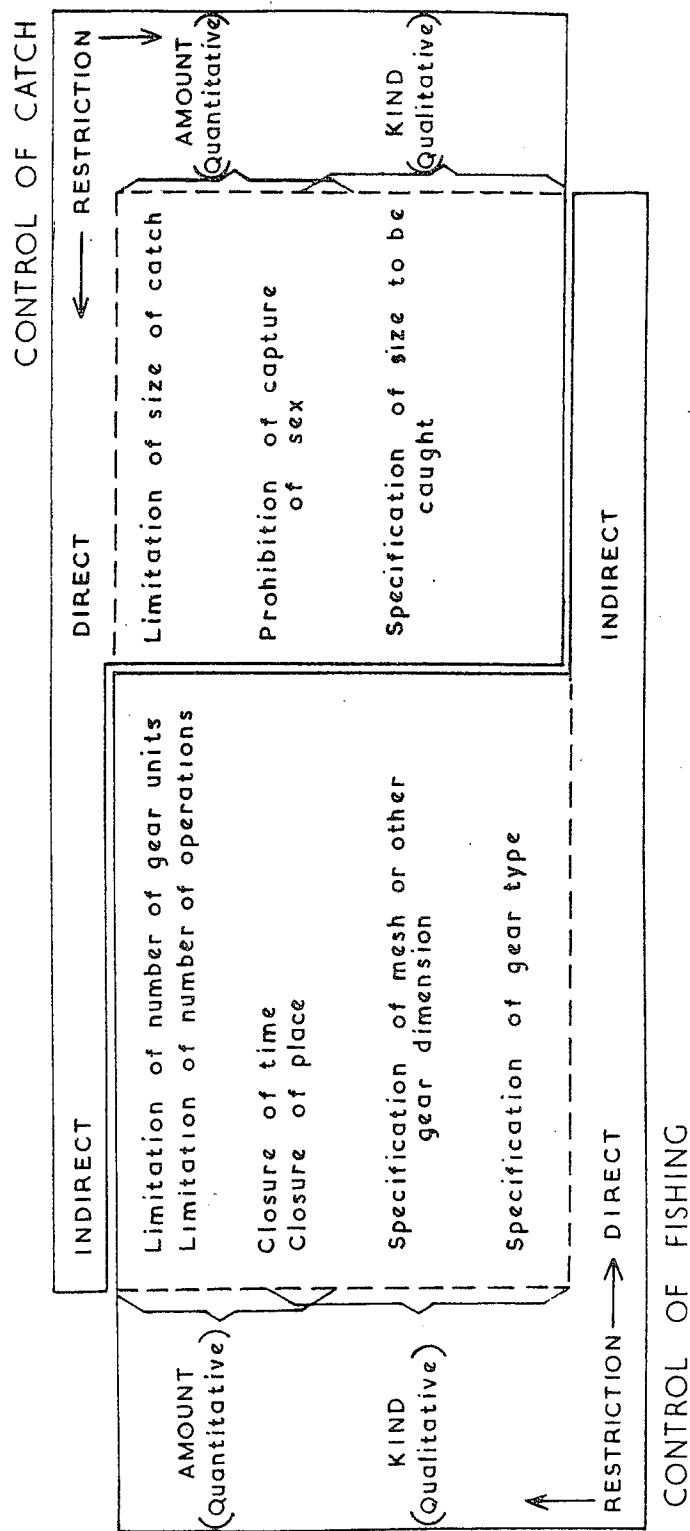


Fig. 1.- Illustrating the fact that each regulation controlling fishing operations exercises and indirect effect on catch and that each regulation controlling catch has an indirect effect on operations.

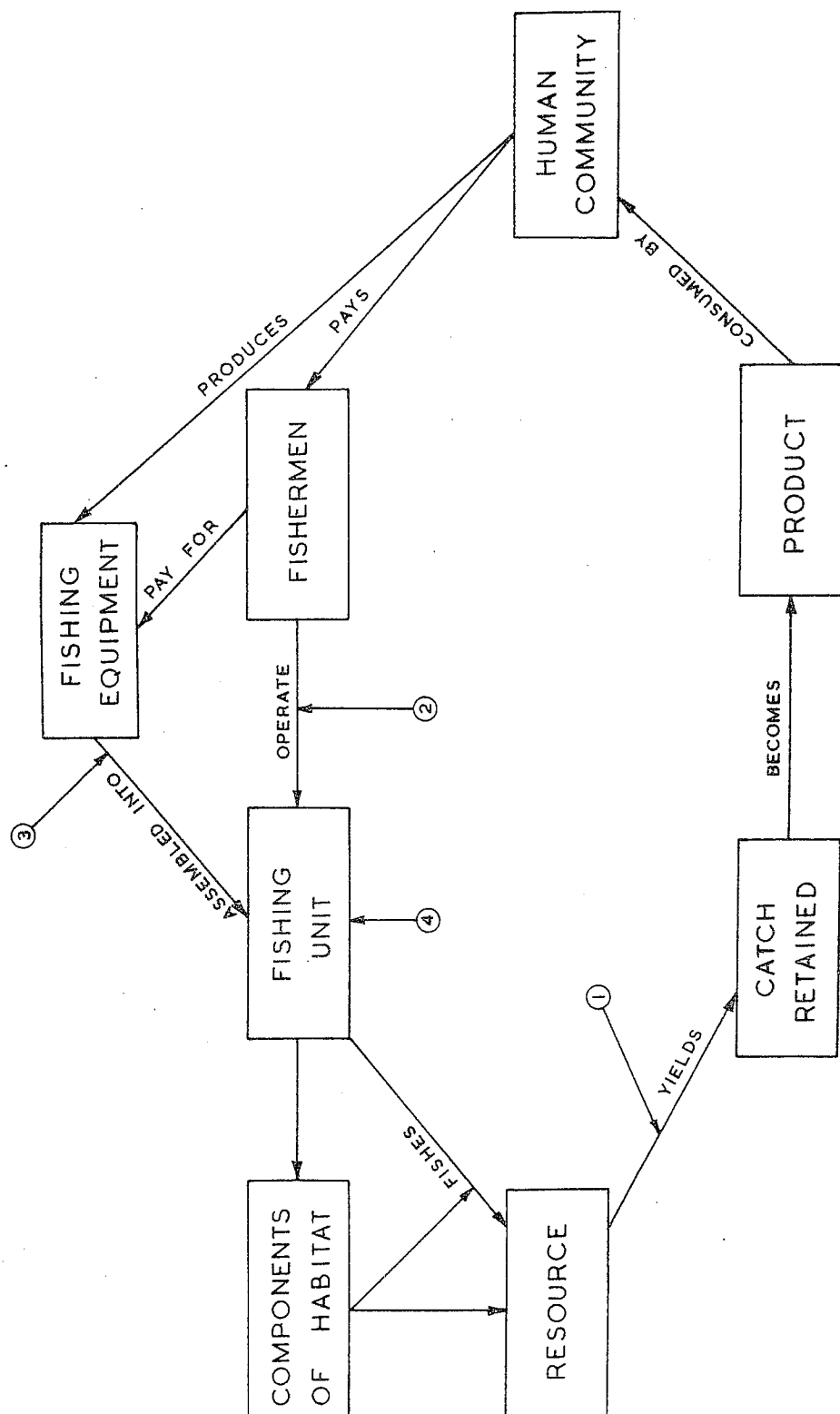


Fig. 2.- Illustrating the relations existing between the components of a fishing complex.

delivered to the community and upon those things that determine the value the community places on the product. At the same time the size of the reward determines the fisherman's economic position and hence his ability to maintain or replace his equipment. Thus the effect of a regulation is unlikely to be confined to its influence on a fisherman's decisions and the consequences of these on his operations and hence on his catch. The importance of this is that unless the total effect of a regulation, through the entire complex, is to the fisherman's benefit, or is of a kind that he can be persuaded or compelled to accept as necessary for the community, he will seek to evade it.

The various objectives and effects of the main types of fishing regulations are summarized in Table 2.

Fishing regulations relate in the main to the catch retained, as to its magnitude and/or its composition (objective I in Table 1). The amount of catch is determined by what is available from the resource, by the amount of effort expended by fishermen, and by the selectivity of their gear. If only the total catch is specified by regulation the fishermen are free to seek to maximize their individual catches, for example by taking small fish and by each exerting effort which in total exceeds what is needed; the latter may make it difficult to enforce the catch regulation. A similar situation occurs if regulation is applied at only one of the other points. The conclusion must be that where incentives for fish production are strong, the only secure way of ensuring a total-catch objective is to determine catch, effort, and selectivity; that is, by voluntary controls or by regulation of total catch (I (a))* , total effort (II (d)) and of gear characteristics (III (a)) (perhaps supplemented by regulation of catch composition (I (c))).

However, this then opens the question of objectives II and III in Table 1, i.e. of the opportunities for employment and investment. The choice here is between such considerations as maximum employment and maximum efficiency of labour and of capital. Choice of the appropriate maxima may be made by Government or it may be left to private enterprise working under the influence of the forces of competition. If Government should decide that it is more appropriate for it to set the maxima, certain additional regulations would become necessary. For maximum employment a regulation of total effort (II (d)) would be supplemented by regulation of the fishing power of individual boats (IV (b)), of gear dimensions (III (b)), of gear properties (III (c)), of gear use (II (c)), or of places where fishing may take place (I (b)), all of which tend to restrain attempts to increase efficiency. For maximum efficiency, a regulation of times of fishing (II (a)) would need to be supplemented by regulation of the number of fishing units (IV (a)) and by constantly reducing the number of units as individual efficiency increased. If Government should decide that the appropriate maxima would best be determined through the forces of competition, there would be no control supplementary to a regulation of the total amount of effort to be expended (II (d)).

* In this and the following paragraphs all numerical references to types of regulations are to sections of Table 2.

Of the other regulations typified in Table 2, those of catch composition with respect to sex (I (d)) are of doubtful validity, whilst those of fishing period (II (a)) and fishing place (II (b)) may be of some operational value as supplement to a regulation of size at first capture (I (c)) and of the total amount of effort to be expended (II (d)). The effect of regulation of catch composition with respect to sex (I (d)) is discussed in the literature; in essence the situation is that it does not greatly matter at what period of the year an allowable proportion of stock is taken, so long as the allowable proportion is not exceeded; in effect, a certain amount of reproductive capacity is destroyed in catching female at any time, whether before or after spawning. The case of whales is different since to abstain from killing a female accompanied by calf is to preserve a possibility of catch equal to something between 1 and 2, whereas to kill the female at that time kills 2 for a catch of 1. Regulations of time of fishing (II (a)) and of place of fishing (II (b)), when imposed to prevent fishing at times when, or places where the catch will inevitably be largely or entirely of undersized fish, are useful supplements to other regulations prohibiting the killing of undersized fish. These regulations also may be of sound practice when they serve to prevent capture of fish which cannot be sold because, for example, at those times or places they are in poor condition or, as in the case of mullet affected by muddy water.

Weekend or night closures (II (a)) are usually imposed in response to the wish of the majority as to how they should conduct their operations. Sometimes closures of this type are introduced to help regulate fishing intensity, but they are a poor substitute for regulation of total amount of effort to be expended (II (d)) or of the number of fishing units (IV (a)). Weekend and night closures tend to limit the efficiency of operations.

The problems posed by situations where sports fishermen conflict with professional fishermen correspond with those discussed above, in which an objective of maximum employment opportunity is set. However, since sports fishing is almost invariably less powerful (per operator) and less efficient, the terms of regulations of the amount of catch by each fishing unit (I (b)), of fishing places (II (c)), of properties of the materials of which gears are made (III (c)), of fishing gear dimensions (III (b)) and of fishing power of individual fishing units (IV (b)), as supplement to a regulation of total amount of effort to be expended (II (d)) would have to relate to units of relatively low fishing power. A more difficult problem relates, however, to allocating fishing opportunity simultaneously to two categories of operator whose gear differ significantly in fishing power. This is the problem discussed in an earlier section.

The foregoing discussion, and Figure 2, give an impression that the regulations discussed can operate like taps to regulate accurately the play of forces and the flow of materials. That this is not so is obvious. The operation of a complex such as represented in Figure 2 is determined by a great many factors and the effect of regulations is only to set limits to some of the characteristics; they do not determine how much fishing effort is expended in any period: that determination is a function of economic forces. Again, whilst regulations on effort and selectivity have an influence on the amount and incidence of fishing mortality (and through this have an effect on the structure and dynamics

TABLE 2
FISHERY REGULATIONS - OBJECTIVES SOUGHT AND EFFECTS PRODUCED

Regulation	Examples	Objective Sought	Main Effects Expected*	Other Effects Produced	Comment
I. Of catch, with respect to:					
(a) Amount as total	Blue-whale limit Catch quotas	Maintenance of catch	Stock should remain "stable"	Individual fishing units tend to increase fishing power in order to maximize "share"	Direct controls on effort may become necessary
(b) Amount per fishing unit	Bag limit Trip limit Boat limit per season	Spread of employment or recreational opportunity	Sharing of allowable catch among optimum number of participants		May lead to under-exploitation; or to increase in operational efficiency so as to increase number of trips and hence to over-exploit
(c) Least size of individuals	Legal minimum: total length; carapace length	Maximum yield from fishable stock	Survival and successful growth by significant proportion of "exempted" individuals and hence maintenance of "best" average size in catch	Rejection at sea of significant amounts of captured undersize fish	Need to be supported by appropriate operations and gear regulation (II & III (a))
(d) Sex composition	Prohibition against taking female crayfish in berry, female whales with calves	Maintenance of catch	Survival and successful reproduction by significant individuals and hence preservation of stock reproductive capacity		May lead to unnecessary abstinence from exploitation of this part of stock, especially if natural mortality is high

* These are the main effects expected in resource, catch, or operations, other than those which constitute the objective sought.

TABLE 2 (Cont'd)

Regulation	Examples	Objective Sought	Main Effects Expected*	Other Effects Produced	Comment
II. Of fishing operations with respect to:					
(a) Periods of fishing ⁺	Close season in many fisheries (e.g. whaling)	(i) Maintenance of catch	Exemption from fishing of fish, vulnerable in the close season, which, it is thought, should not be caught. Fishing power restricted and total catch limited	Concentration of fishing capacity in open season	Direct controls on amount of effort and catch (I (a) and (b)) may become necessary
		(ii) Prevention of capture of unsalable fish			
	Prohibition against night fishing (e.g. Tasmanian scallop fishery) Weekend closure	Preservation of conditions of employment	Ensuring a common rest period		
(b) Places of fishing ⁺	Close areas in many fisheries (e.g. whale sanctuaries)	(i) Maintenance of catch	Protection against fishing of fish, vulnerable in the close area, which it is thought should not be caught	Concentration of fishing capacity in open area	Direct controls on amount of effort and catch (II (a) and (b)) may become necessary
		(ii) Prevention of capture of unsalable fish			
	Partitioning of grounds (e.g. Western Australian rock lobster fishery)	Spread of employment opportunity	Development of separate fleet for each portion of fishing grounds	Imposes operational limitation on each fleet	Does not limit effort

⁺ For time, includes closure of all or only part of fishing grounds; for place, includes closure for part or all of the year; in combination these range from closure of entire ground for whole year to part of ground for part of year.

TABLE 2 (Cont'd)

Regulation	Examples	Objective Sought	Main Effects Expected*	Other Effects Produced	Comment
(c) Frequency or amount of use of gear by each unit		Maintenance of catch	Fishing capacity restricted and total catch limited		If intended to limit total effort can be defeated by increase in number of fishing units
(d) Total effort expended		Maintenance of catch	ditto		May produce intense competition among fishing units Enforcement involves very close supervision of fishing operations
III. Of fishing gear with respect to:					
(a) Characteristics determining selectivity	Specification of mesh size, escape gaps	Maximum yield from fishable stock	Small fish allowed to escape and grow to optimum size		Does not limit effort
(b) Gear dimensions	Specification of length or other dimension of net, width of dredge	Maintenance of catch	Fishing power restricted and total catch limited	Limits efficiency of fishing unit	Can be defeated by improvements of non-regulated characteristics of gear
(c) Properties of materials of which gear is constructed	Prohibition of use of monofilament nylon nets	Spread of employment opportunity	Fishing power restricted and total catch limited	Prevents development of improvements and of increased efficiency	
IV. Of fishing units with respect to:					
(a) Number	Licence limitation in Shark Bay prawn fishery and in Australian whaling	Maintenance of total catch and catch per fishing unit	Limitation of effort. Orderly operations to take allowable catch		At one extreme, less incentive to improve efficiency; at other extreme, allowable effort and catch may be exceeded by increasing the fishing power of the licensed units.

TABLE 2 (Cont'd)

Regulation	Examples	Objective Sought	Main Effects Expected*	Other Effects Produced	Comment
IV. (a) Number (cont'd)					Regulations III (c), IV (b) and (c) may be necessary
(b) Individual fishing power	Limits on: No. of lobster pots No. of dredges	Maintenance of catch; spread of employment	Limitation on effort and on total catch		Can be defeated unless number of units is also limited or amount of effort is directly limited

of a population) obviously it does not determine in each year the amount of catch actually available.

Over a period of time, fishing operations conducted according to the specifications of well-based regulations will take a maximum average catch from what is available, but in particular years may take less than could be taken and in other years may take more than should be taken. Fishery regulations do not ensure that full allowable effort is expended; they are, therefore, most effective in boundary situations when there are tendencies for components to exceed allowable limits.

These observations have two implications which can best be illustrated by reference to research and regulations concerned with the resource itself*. First, since stock assessments, and controls making use of them, are approximations, fishermen naturally wish to take advantage of any leeway open to them for independent action. Also, they are likely, quite naturally, to take the deviations in practice from the stock assessment approximation to mean uncertainty on the part of the scientist, or even a mistake. This means that fishermen must be educated to an understanding of the bases on which regulations are framed, and of their effects. Second, regulations should be introduced only in response to a real need, e.g. when the danger of limits being exceeded has become truly apparent. Again fishermen should be taken into confidence in these matters; they should be told of the progress of assessment work and of its implications; they should be assisted to develop their operations to the allowable level, but given the earliest possible notice of the limits that might be set to these operations.

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*Similar implications can be drawn with respect to regulations designed to achieve economic or sociological objectives.