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Key issues in the conservation of fisheries

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Summary

Fish stocks represent valuable natural resources which, if properly conserved, are capable of renewing themselves forever, thus providing a sustainable yield to man. Unlike crops and forests on land, however, they are not easily visible, and the effects on them of exploitation by man are not obvious. Some simple facts about the management and conservation of fish stocks are therefore often misunderstood. These key issues are discussed very succinctly in this paper.

1. management and conservation of fish stocks are necessary, because economic forces do not usually lead to a satisfactory stable state;

2. conservation measures are needed permanently, not only while the stocks are in poor shape; they cannot normally be discontinued once the stocks have recovered;

3. technical conservation measures (such as minimum mesh sizes) are not usually sufficient on their own; direct conservation measures (restrictions on catches or fishing effort) are also needed in most cases;

4. closures of fisheries during the spawning season are not necessarily a very effective conservation measure;

5. stability of catches cannot be achieved at the same time as stability of fishing effort;

6. properly calculated Total Allowable Catches (TACs) and quotas do not necessarily allow the fleet to fish all year; restrictions on the fishery do not mean that the scientific assessment must be wrong;

7. TACs and quotas are an indirect method for controlling fishing effort: direct limitation is another way of achieving the same objective.

More detailed explanations of these issues can be found in the following Laboratory Leaflets:

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KEY ISSUES IN THE CONSERVATION OF FISHERIES

1. Management and conservation of fish stocks are necessary, because economic forces do not usually lead to a satisfactory stable state

Fishing increases the death rate of fish, and this reduces the size of the stock of fish left in the sea. For most fish, a smaller stock size means a lower catch per unit of fishing effort, and thus a lower profitability for the fishermen.

When total fishing effort is low, and the stock size is high, fishing is therefore likely to be profitable, and there will be a natural tendency for individual fishermen to increase their effort, if they can, and for new fishermen to join the fishery. This causes total fishing effort to increase, and over a few years the stock size and profitability falls, until the earnings from an extra trip fail to cover the extra costs involved.

Conversely, if fishing effort is high, so that the stock size is low, fishing is likely to be unprofitable, and there should be a tendency for fishermen to reduce their effort or leave the fishery. This would reduce total effort, and the stock size should recover, and the profitability of fishing should increase, until the earnings from an extra trip do balance the extra costs involved. In practice, this may not happen: fishermen may respond to reduced profitability by increasing their effort to maintain their earnings, so that the normal economic regulatory processes do not work.

In an unregulated fishery, economic forces are therefore likely to lead to a situation where, on average, the earnings from fishing are at best only just sufficient to balance the extra operating costs of actually going fishing, leaving no operating surplus to pay for depreciation, loan repayments or replacement of old fishing boats. This means that an unregulated fishing industry is expected to drift into a state of chronic poor profitability, with continual demands for the government to do something to help, through operating subsidies, grants and loans, decommissioning payments and so on.

In this situation the stock size is usually reduced a long way below the point at which the maximum sustainable yield can be obtained. This small stock size also means that there is little to buffer the stock (and thus catches and earnings) against the fluctuations caused by occasional runs of strong or weak yearclasses recruiting to the stock.

When the stock is being exploited at or near this state of ‘unregulated bio-economic equilibrium’, one therefore finds a situation with:

- chronic unprofitability, especially inability to service capital (fixed) costs
- yield and earnings from the fishery which are below the maximum that could be achieved
- fishing effort, and costs which are well above those needed to take the maximum yield
- instability of catches and earnings, because of vulnerability to occasional runs of good or poor recruitment
- increased risk of poor recruitment (and possibly stock collapse) because of the small size of the spawning stock

Classically, these problems are regarded as the result of the failure of the market mechanism because the fish stock is a common property resource. Rational decisions by individual fishermen lead to a situation which is unsatisfactory collectively, and certainly far from that which would be

desired by a rational owner of the resource, or for the common good. However, to a hard-line *laissez-faire* economist, even these problems may not seem sufficient to justify government intervention to regulate the fishery by restraining fishing effort in one way or another, in order to conserve the stock.

Unfortunately, doing nothing is a very dangerous strategy for the stocks, and the industries which depend upon them, because things are actually rather worse than is suggested by the simple argument above, for several reasons.

First, at low stock sizes recruitment may not decline gradually as stock size falls, as was implicitly assumed above. Below some threshold size it may decline rapidly or catastrophically, leading to a complete collapse of the stock from which it is very hard to recover.

Second, increasing or decreasing fishing effort takes some time, especially if new boats have to be built or old ones scrapped. The fishing effort therefore never actually succeeds in reaching a level which is in equilibrium with the stock, but always lags behind. There is in fact a tendency to overshoot the mark when any change is being made, and it is easily possible for any increases of capacity and effort to become operational just when the stock is already declining, driving it down further and faster just when it needs to be allowed to recover. The ideal of a stable bio-economic equilibrium may therefore be out of reach. It is rather more likely that one finds a state of continual (and delayed) over-reaction to any natural changes, with violent fluctuations about the supposed equilibrium state.

Third, an increase in effort usually leads to a short-term gain of catches and earnings. As a result, the stock size declines, but may take a few years to do so. This means that the short-term gains are succeeded in the longer-term by losses. If, however, effort continually increases, either by increased activity or increased efficiency, it may be possible for the fishing to remain profitable; the continual short-term gains associated with the increasing effort enable the fishermen to stay ahead of the longer-term losses which are continually deferred. This only works, however, for a while. The stock size is driven lower and lower by the continually increasing effort, and eventually goes into a catastrophic, and in practice irreversible, decline, leading eventually to complete collapse, once the effort has risen to the point where the new 'equilibrium' stock size is zero.

Practical experience all over the world bears out the conclusion that, except in rare cases where there is little tendency for effort to expand when fishing is profitable, the goal of a desirable 'bio-economic equilibrium' when the fishery is unregulated is a mirage. The tragedy of the commons is repeated over and over again. Co-operation among fishermen to control and regulate effort at a relatively low level would be enough. However, government intervention to do it usually seems to be required in the real world.

2. Conservation measures are needed permanently, not only while the stocks are in poor shape; they cannot normally be discontinued once the stocks have recovered

Fish stocks respond more or less progressively to the level of fishing effort to which they are subjected. With low fishing effort, the death rate due to fishing is low, and the stock size can become (or remain) high. Conversely, with high fishing effort the stock size becomes or stays low.

Conservation measures, including both direct controls on catches and/or fishing effort, and 'technical' measures such as minimum mesh sizes and closed nursery areas, are designed to reduce the death rates due to fishing, especially on small juvenile fish, in order to maintain stock sizes at levels which are higher than they would be in the absence of any regulation. For most fish, a higher stock size means a higher catch rate, and this is likely to make the fishery more profitable. In the absence of restrictions this would naturally lead to a tendency to increase fishing effort. Similarly, there will always be an incentive to reduce mesh size again, or go fishing in previously closed areas, to catch the more abundant fish preserved by the conservation measures. Thus if conservation measures are introduced, and the stock recovers as desired, and the conservation measures are then discontinued, the natural reaction of fishermen will lead to the death rate on the fish increasing again, and the stock size will return over a few years to its previous depressed state. In general, therefore, if conservation measures are needed at all, they are needed forever.

This simple situation sometimes gets confused by the ever-present variations of recruitment of young fish to the stock. These mean that very often TACs have to be decreased even if there is no intention to reduce fishing effort, simply because there are expected to be fewer fish in the sea. Conversely, TACs are sometimes recommended to increase even when fishing effort is being decreased, if there is a particularly strong yearclass passing through the fishery. These short-term changes to 'track' variations of yearclass strength are quite separate from the longer-term changes associated with increases or decreases of fishing effort. They mean that an increase or decrease of a TAC cannot be interpreted simply as relaxation or tightening up of the conservation measures, which is really determined by the underlying increase or decrease of fishing effort on which the TAC is based.

3. Technical conservation measures (such as minimum mesh sizes) are not usually sufficient on their own; direct conservation measures (restrictions on catches or fishing effort) are also needed in most cases

Technical conservation measures such as minimum mesh sizes affect the composition of catches of fish, and usually aim to prevent the capture of too many small immature fish. They do not however restrict the total quantity of fish caught. Unless the minimum mesh size is large enough that at least one mature age group escapes capture entirely, any increase of fishing effort, and the associated deaths of immature fish, will cause a decrease in the spawning stock size. This is not usually possible, and with practicable restrictions on mesh sizes, etc., it is therefore usually possible to deplete the size of the spawning stock to a very low level by excessive fishing effort.

To prevent this it would be necessary to introduce technical measures which were sufficiently restrictive that a reasonable proportion of fish were guaranteed the opportunity to spawn at least once. For large fish, such as cod, this would mean minimum landing sizes (about 60 cm) and mesh sizes (about 200 mm) which are much larger than those presently in use. This would of course prevent the capture of smaller fish such as haddock and whiting, and is hardly practicable.

Furthermore, unless the technical measures were so restrictive that they made the fishery completely uneconomic, they would not prevent any increases of effort if, for example, fish prices increased, with adverse effects on the stock in consequence.

Realistic technical conservation measures – including spawning season closures – on their own are therefore not sufficient to ensure effective conservation, and they need to be supported by direct conservation measures such as limits on catches and/or on fishing effort. These limits could however be made somewhat less restrictive, if the technical measures employed were made sufficiently effective.

Exclusive reliance on technical measures has in fact been tried in several parts of the world – with the expected consequences that fishing effort continues to increase until the stocks become seriously depressed, and the fisheries become uneconomic.

4. Closures of fisheries during the spawning season are not necessarily a very effective conservation measure

It is often suggested, especially by fishermen, that closure of fisheries on spawning grounds during the spawning season should be a very effective conservation measure. Indeed, if the spawning fisheries were closed and the fishing effort which would have been exerted, and the catches which would have been taken were foregone entirely, this could be quite helpful. To be effective, it would be necessary to ensure that catches in the rest of the year and in other areas did not increase to make up for the loss of catches in the closed area. This means that the TAC and national quotas would also have to be reduced by the catch that would have been taken in the closed area.

Unfortunately, however, such a permanent reduction of fishing effort and catches is rarely what is proposed. The question of what should happen to the effort displaced and the catches foregone is rarely considered in any detail. It is in fact usually assumed, at least implicitly, that it would be possible for the fishermen to catch the same quantity of fish somewhere else, or at another time of the year. If this were the case, a spawning season closure could actually make matters worse, because it could shift effort off mature (spawning) fish and on to juvenile fish: this is just the opposite of what is required.

Fishing on small juvenile fish is usually more damaging than fishing on spawning fish, because more fish are taken to make up the same weight of catch, and because the juveniles are often vulnerable to the fishery for several years before they mature. If caught in any of those years, they never get a chance to spawn, while not all of the mature fish on the spawning grounds will be caught, and they do get at least one chance to spawn.

Even if the effort merely shifts to the same fish later on, the effect is only a relatively small one-off boost to the spawning stock. In the first year of implementation, more fish would get a chance to spawn than did previously. After that, however, the numbers being caught between one spawning season and the next would be just the same, and the effect is at best just the same as delaying the age of capture by a few months. If – as is quite likely – the effect is in fact to move the fishery on to pre-spawning rather than spent fish, then the effect would be equivalent to decreasing the age of first capture, which would make matters worse.

Closures of spawning fisheries are therefore not so effective as conservation measures as they may seem at first. Where spawning fish are highly concentrated in small areas, or especially easy to catch, a spawning season closure may help simply by making fishing less efficient. Even this, however, would only be effective if the total catch and/or effort were still controlled, since there would otherwise still be no limit to the mortality that could be inflicted even by the less efficient fishing effort.

5. Stability of catches cannot be achieved at the same time as stability of fishing effort

Almost everyone would prefer more stability of fish catches. This includes fishermen, fish processors, scientists, politicians and administrators. It is sometimes thought that instability in fisheries is a new development, brought on by efforts to manage fisheries by TACs and quotas in the last decade. This is wrong – there is abundant evidence that fish stocks have fluctuated in size since time immemorial. What is new is the size of the fluctuations from year to year. This has increased because, with the current very high levels of exploitation, many stocks depend on only one or two yearclasses at any time. There is therefore now little or no buffer against natural fluctuations in yearclass size, and the problem is amplified. In addition, yearly negotiations about TACs make the variations highly visible, whereas in the past the good years and the bad years would simply have been accepted and recorded after the event, in fishermen's bank balances and the official statistics.

Greater stability is difficult to achieve, because the numbers of young fish recruiting to the stocks may vary by as much as ten to one from one year to the next. These ever-present and large natural fluctuations cause the stock sizes to vary. For most fish stocks, the quantity of fish a fisherman can catch is determined by both the amount of fishing effort he exerts, and the abundance of fish in the sea. If fishing effort is kept broadly constant, the quantity of fish caught will vary from year to year, just because the size of the stock is varying. The calculations on which TACs are based take account of these natural fluctuations, and the variation of catches and TACs from year to year is mostly a natural phenomenon, not something imposed deliberately (and perversely) by "the managers".

It would be possible to arrange for lesser variations of catches, at least for lightly exploited stocks, but this would automatically mean that fishing effort would have to vary instead. When the stock was abundant, and catch-rates were high (and fishing was more profitable) fishermen would have to fish less (by fishing fewer days per month, or stopping altogether early in the year) to keep to the same total catch. Conversely, when the stock was depleted, fishermen would have to fish harder to sustain the level of catches, even though it was less profitable to do so. This greatly increases the chance of driving the stock into a collapse when there is a run of poor recruitment.

In general, the scientific advice therefore tends to assume that it is better to accept variations of catches from year to year as a fact of life, and keep fishing effort more or less constant, apart from the longer term progressive reductions of effort which are usually needed to improve the underlying state of the stock. Most variations in TACs are thus due to natural causes, and not to the scientists or managers trying to do anything suddenly at the expense of the fishing industry. Keeping catches and fishing effort constant at the same time is simply not an option which is on offer.

6. Properly calculated TACs and quotas do not necessarily allow the fleet to fish all year; restrictions on the fishery do not mean that the scientific assessment must be wrong

Most fish stocks in the North Atlantic are over-fished by virtually any rational criterion. This means that they are subjected to too much fishing effort, and that in the long run it would be desirable to reduce fishing effort. In some cases the stocks are believed to be close to the point of collapse, and the need for reduced effort is rather more urgent. The options for management produced by scientific advisers therefore focus on progressive reductions of fishing effort, usually at rates in the range 10% to 30% per year, and the recommended TACs are based on options of this sort.

If such recommendations are accepted by those responsible (the Council of Ministers in the EC) this means that the agreed TACs will correspond to some reduction of effort, and the TAC will not be enough to last all year **at the previous level of fishing effort**. The TAC will be based upon, and intended to achieve, some reduction of fishing effort. This means in practice either that fewer fishing boats are able to operate, or that each fisherman is able to fish fewer days per month, or has to stop fishing before the end of the year, or some combination of these.

How these consequences are brought about depends upon the type of quota management in operation. If this is effective, and achieves the reduction in the level of effort required, it should be possible to make the TAC last for the whole year. If, on the other hand, quota management is not effective in reducing fishing effort, the TAC will not last out.

The ability of fishermen to catch fish at a rate which will cause the TAC to be exceeded does not therefore normally mean that the scientific advice was wrong (although this may happen from time to time). It usually means that the consequences of the agreed TACs have not been followed through by effective quota management which takes proper account of those consequences. Any attempt to have TACs revised upwards just to make them last out the whole year is therefore likely to be counter-productive, since it will cancel the reduction of effort which was agreed to be necessary in the first place, in order to conserve the stocks, and it will make things worse the following year and thereafter.

7. TACs and quotas are an indirect method for controlling fishing effort: direct limitation is another way of achieving the same objective

Total Allowable Catches (TACs) are usually set in order to reduce the total fishing effort on a fish stock, in order to reduce the death rate of fish, or at least to prevent any increase. They are usually translated into national quotas, and then into sectoral quotas, and eventually into restrictions on the amount of fish an individual fisherman is allowed to land.

The amount of fish that a fisherman catches is however determined by the amount of fishing effort that he deploys, and the abundance of fish in the sea. Any restriction on his landings is supposed to restrict his fishing effort. The linkage is of course not quite direct. He could reduce his catches without reducing his effort by fishing in places where catch rates are low because there are few fish present. Fishing effort costs money, however, so this is not likely to be attractive. Alternatively, of course, he may simply continue to fish, and discard the excess catches. This does happen, especially in mixed-species fisheries, and this is recognised as one of the problems of managing using TACs and quotas. Even so, there must come a point when the lost earnings due to discarded fish make fishing unprofitable: there is little point in paying the costs of fishing if you are unable to keep the proceeds.

Control by catch quota is however intended to restrain or reduce fishing effort, and if quotas are properly managed, it should do so. There is therefore no fundamental difference between control of catches and control of effort. Catches and effort are closely related, and control of one implies control of the other, albeit indirectly and approximately. In fact, if properly enforced, catch quotas limit fishermen's earnings, even more directly than restrictions on fishing effort.

There is therefore no reason to suppose that limitation of effort is fundamentally more restrictive or economically damaging than limitation of catches. On the contrary, it should allow fishermen more control of their own affairs, and reduce the incentives leading to discarding of over-quota fish. It should also reduce the need for precautionary TACs, which result in restrictions which are particularly irksome to fishermen. The principal difference in practice may be that effort restrictions should be rather easier to enforce effectively than are catch quotas.

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