

ANNEX 2: ASSESSMENT AND MANAGEMENT OF MEDITERRANEAN FISHERIES (by J.F. CADDY)

A. Fishery assessment problems and approaches relevant to managing Mediterranean fisheries

The role of fisheries scientists in management,

Studies of fishery biology, although well advanced, are not always linked to applied issues, and research has often been without clear formulation of any overall research objectives related to fishery sector. The role of scientists, in the Mediterranean and elsewhere, should be to provide options as to how to approach an agreed management objective, and to specify its consequences and risks of error. They should not be asked to determine the objective itself, which is the responsibility of fisheries managers and politicians. The countries in the Mediterranean area are poised to make rapid progress once agreement on objectives is realized since this region is not burdened with fixed commitments towards output controls such as quotas, and can more easily move towards controlling the level of inputs, e.g. investment on the primary and secondary sectors, and the corresponding potential fishing effort controls this implies.

Fishery management measures which have been based on scientific analyses have usually been set in a single-species context. An understanding of the interactions between stocks due to mixed species fisheries (technical interaction) and by predation (biological interaction), is now beginning to provide a more realistic basis for management outside the Mediterranean, particularly, when economic parameters are included. In the single species context it is theoretically possible to maximise the long-term yield from a stock by selecting an appropriate level of fishing mortality, and this could be a management objective. In practice, of course, no stock is independent of others, or unaffected by other fisheries. In the multispecies context it is not possible to maximise the yield from each stock simultaneously, and if such analyses are to provide the basis for management, managers will be forced to decide on broader objectives. One possibility would be to aim to maximise the overall yield for the ecosystem in terms of weight or value, but this would inevitably imply losses some fleets fishing some resources, and this may be socially or politically unacceptable.

Management of extensive trawlable shelf areas

From table 1 in Caddy + Oliver (this volume) it is evident that in most cases, the management framework for these larger shelf areas need involve only few coastal States, plus those distant water industrial vessels from other coastal States within and outside the Mediterranean that fish these shelf areas and the straddling resources that extend offshore from them. (Incidentally, there seems little evidence at this point that vessels from coastal States outside the Mediterranean are fishing Mediterranean demersal or small pelagic resources).

In the several cases identified in the above cited table 1 where two or more coastal States are involved, if vessels from States other than those with adjacent territorial seas are not important, one logical management framework would be a simple bilateral or multilateral commission or consultation. This could operate within the broader framework provided by the General Fishery

Council for the Mediterranean. The presence of vessels from non-local States (from elsewhere in the Mediterranean or elsewhere) in areas which are not protected by existing narrow territorial seas poses a particular problem. These vessels also pose an extra cost to the hypothetical bilateral or multilateral Commission that we have proposed as the only feasible management solution presently available.

The problem of effort control could be serious, given the low investment in systems of Fisheries Control and Surveillance in most countries, and would have to be taken specifically into account in the case of management by either quota or effort control of the demersal resources of these regions.

Management of the resources of fringing shelves within territorial waters

It is difficult to avoid the conclusion that the fringing shelves described earlier do not fit easily into the classical approach of managing by unit stock. We could simply regard these shelf resources as falling within the appropriate GFCM Statistical subunit, and manage them as such, but this does not seem to reflect their biological and socioeconomic context. In the context of a closed sea, they may on the one hand, receive recruits from larger stock components spawning elsewhere, or may even provide a refuge from trawling for spawners. They may contribute recruits to adjacent, more extensive trawlable areas. The model that appears to best apply here, is one more typical of narrow fringing tropical shelves, namely, a series of local resource management units consisting of a port or landing place, and the adjacent fishing grounds within one days voyage from them: recalling of course that larger vessels from distant ports of the same coastal State may also fish on these grounds unless excluded by an enforced non-trawling coastal zone.

This particular context offered by the locally valuable resources of fringing shelves is so typical of much of the Mediterranean, and led to the early development in France, Spain and Turkey of 'confraternities' of fishermen in the various ports. These de facto, took the decisions on allocating the resource, and more importantly, shared the local/seasonal fishing opportunities amongst themselves. The loss, or dilution of such autonomous decision-making (or the withdrawal of the delegation of local autonomy by the State), has been described elsewhere. To a significant extent, this resulted from economic and/or political decisions in favour of the 'industrialization' of fisheries, that began in the northern Mediterranean in and around the 1930's, but still prevails today in some countries.

As elsewhere in the world, the presence of larger scale vessels fishing the same grounds or stocks, implies in practise, a degree of conflict with local structures set up to resolve questions of equity by the small scale fleet; especially when resources are limited. The autonomous activities of larger scale vessels, which may belong to state or private sector companies, are not necessarily associated with a particular coastal community. Measures such as the division of grounds by depth or distance from the coast, as provided for in various fishery legislations, do not seem to have been very successful to date.

To a certain extent (e.g. in the case of Spain), the rights for autonomous decision-making on resource allocation have been partially restored in recent years; recognizing that the local fishermen have the most accurate knowledge of both the resource and the equity considerations implicit in their fair usage, as well as providing for the distribution of a fresh, high priced product to its various outlets, in the most flexible fashion.

A degree of autonomy and local decision-making in these areas, following the model of the Japanese coastal fisheries, and excluding industrial scale vessels from operating in narrow shelf areas, within the context of integrated coastal area management, could have the benefit of allowing these fisheries to evolve away from open access conditions, and experiment with a variety of socioeconomic contexts. From these experiments, the best mix of coastal activities, including fisheries, could eventually be chosen. These could include for example, habitat improvement using artificial reefs and eventually, sea ranching, with some degree of exclusive area/resource user rights assigned at the community or even individual level. Implicit here of course, is the retention of a degree of national control of these largely resources, but the advantages are apparent of promoting economic self-sufficiency for local governmental (or even municipal) bodies where these exist.

B. Methods of resource evaluation in the Mediterranean context

Direct evaluations

Where the problems of commercial sampling and statistics are most severe, there has been a considerable and continuing investment in random trawl surveys of demersal and macrobenthic stocks. For countries such as Italy, the years of data accumulated now approaches a decade in some cases. These activities culminated recently in simultaneous surveys carried out in the different national waters of the Community under the title of the programme MEDITS, funded by the ED, which used a specially designed trawl and standardised fishing procedure throughout European Mediterranean waters. One problem evinced by this study is that the bottom conditions for trawling, and hence the optimum trawl design, vary considerably, reflecting the wide range of conditions to which fishermen on demersal resources have adapted themselves throughout the Mediterranean.

The advantages and problems of trawl surveys may be briefly summarised by noting their relatively high cost in terms of vessel purchase and in permanent crewing and skilled research manpower, and in the problems faced in storing and analysing large quantities of data. Their advantages in providing a direct estimation of the exploited fish population become apparent when a large number of different gears or fleets fish the same resource, leading to problems of effort calibration, which are not easily resolved.

The problem of cost may be greatly reduced by jointly hiring or 'time sharing' the same vessel between different laboratories or adjacent national institutes sharing the same stock (a relatively promising but little-used option, that removes the need for vessel intercalibration if two or more vessels are used), and could be one useful focus for cooperative international programmes. One difficulty evinced for analytical methods applies here also: if the trawl survey reveals a serious decline in abundance, the managers of the resource still need to have some measure of the current fleet size and fishing power if measures other than a complete ban on fishing are to be carried out.

One particular variant of the trawl survey that has particular value and predictive power, relates to surveys of juvenile fish abundance in well established nursery areas (figure 1). These could be carried out with small chartered commercial trawlers using fine mesh beam or 'rapido' trawls, during and immediately after the main period of recruitment to the bottom of the young-of-the-year. This approach, if repeated in a standardized fashion from year to year, could provide

important information on changing conditions and recruitment. Such data could be used as input to simple yield models; and hence could provide information on the likelihood of better or worse than average fishing conditions, one (or optimistically!) two years into the future. Such an approach could also be used to control the effectiveness and timing of the seasonal closures discussed later in the document.

Mapping, GIS, and fishery models with spatial components

A tradition for mapping fishing grounds in the Mediterranean dates from at least the 1930's, and was revived in the Atlas of Western Mediterranean fisheries issued in the early 1980's by GFCM. The revival in interest in mapping all kinds of information, including bottom type, fauna, coastal populations and their activities, was developed further in a multi-thematic map developed for the Mediterranean by the World Bank. A further more generalized interest shown in systems of Geographical Information Systems in recent years lets the manager easily absorb various management options that in the real world are not always easily related to 'unit stocks', and figure 3? of the text shows how these new methods of display lead to representations whose implications are immediately evident.

Spatial factors often concern the partition of a fishing area between different interests that may have special claims to part of the stock area. Examples here in the international arena concern shared or straddling stocks, but can also provide solutions to national administrations in assigning areas to different fishing fleets. Sharing also occurs between fisheries and non-fishing interest such as aquaculture, sports fishing, marine reserves and tourist and coastal industries. Fishing within coastal lagoons and estuaries are also subject to restrictions in many countries, and in general, zonation of human activities is now seen as a very effective management tool. In the Mediterranean context this has been evinced by the rather successful seasonal and area closures imposed by some countries.

A new class of fishery models (The recent FAO SPATIAL package) is now allowing administrators to explore the impacts of different geographical factors on the way a particular area is used. This approach can be used to describe the consequences of (e.g.) adding 20 new boats to either one of two different ports on the common profit margin to be gained from the three common fishing grounds as a result of the combined activities of fleets from the two ports.

One consequence of the growing socio-economic dimension of fisheries is the way that assignment of specific rights to limited numbers of fishermen is generally seen as the way to avoid the evils of 'The Tragedy of the Commons', through assigning user rights through schemes such as 'Individual Transferrable Quotas'. This is not a panacea, and poses problems in the case of many Mediterranean fisheries, but certainly such schemes have proved one way for the State to recuperate some of its investment in the marine environment. As we have seen, however, there may be more socially-acceptable and traditional approaches to achieving the same end in the Mediterranean, which could involve a return in the direction of delegation of some strictly defined user-rights to coastal communities and/or local fishermen's associations.

More specific rights of this kind would open the way to habitat and stock enhancement measures such as are widely practiced for example, in the Japanese inshore fishery: the other principal marine coastal fishery which shares similar high landed prices for fresh, locally-landed demersal fish with the Mediterranean.

Production models

One of the first cooperative evaluations made during the late 1970's was the calibration and fitting of a model of production for multispecies trawl fisheries in the Gulf of Lions, but production models continue to be occasionally used elsewhere, where a time series of catch and effort are available. The Gulf of Lions model was criticised in part because it provided no specific advice on individual species (a criticism which led to a rapid development of analytical methods in the context of the EC-funded FARWEST programme), but the model had an important role in pointing to the general degree of overexploitation of the demersal resource assemblage, as well as drawing attention (during the calibration of the effort series) to the 'creeping' increase in fishing power of a trawl fleet, even despite attempts to control individual engine power. Subsequent more detailed analyses on the hake and other key 'indicator species' have confirmed the need for specific technical measures, but so far, without providing a multispecies approach at the level of the species assemblage.

Analytic methods

The lack of time series on catch and size or age composition of the catch may not be easily corrected for most demersal stocks, given the generally feeble levels of investment in data collection in most countries. The high dockside prices paid discourage catch sampling in port. These problems, and the general absence of systems of measuring fishing effort, have led to a continued dependence on methods (e.g. yield per recruit; VPA with size frequencies) that are more typical of tropical fisheries. Such methods depend significantly on assumptions of the continuation of steady state conditions, which, as elsewhere, seem less and less likely to apply. These methods (e.g. VIT, widely used in the northwest Mediterranean) are nonetheless very useful. They can show the effects of changes in composition of the different gear types in use, and the effects of changing effort and size at first capture on the stocks.

C. New approaches to fisheries assessment and management

Reference points and the precautionary principle

DEFINITION: A Reference Point (RP) is: "A conventional value derived from technical analysis which represents a state of the fishery or population whose characteristics are believed to be useful for the management of the unit stock in question".

The tendency nowadays seems to be to provide assessment workers with explicit objectives for the type of fishery that the administration wishes to see in place. Some examples of different objectives and the reference points they imply are given in Appendix table 1.

Discussions on resource management at the recent UN Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks, focused on the above two points as representing areas where a degree of consensus could, and did emerge. When expressed in terms of the rate of exploitation, the different objectives mentioned above may be arbitrarily categorized into low, medium and high rates of exploitation (Annex Table 1).

Fisheries objectives may be expressed in general terms such as "the need to maximize employment in fisheries" or "to minimize variations in fish supply". In translating these objectives into concrete management measures, it should be recognized that the actions available to managers of a fishery for wild stocks are largely limited to changes in the rate and conditions of exploitation, and the allocation of access or total catch among stakeholders. There has therefore been the tendency to associate certain objectives with one or more so-called Target Reference Points.

Annex 2, table 1: classifying some different fishery objectives, in terms of their equivalent rates of exploitation, and (in the bottom row) some roughly equivalent target reference points for management. (See FAO Fish. Circ. C-864 for definitions of R.P's)

Low exploitation	Medium exploitation	High exploitation
Optimize management of larger, long-lived species	Maximize economic return to the fishery sector	Maximize annual multispecies yield irrespective of low catch rates, variable yields, and low economic returns
Maintain steady supply of large, high quality fish to market at favourable prices	Minimize socio-economic impacts on coastal communities dependent on fisheries	Fishery is aimed at short-lived species with no interest in longer-lived demersal species
Optimize sports fishery/tourism	Optimize conditions for food security and intergenerational equity	Attempting to maximize employment in fisheries in the absence of entry controls leads to subsistence fisheries
Extract economic rent from fishery	Extract economic rent from fishery	No economic rent extracted from fishery
Rebuild stocks and reduce impacts of fishing on biodiversity	Create conditions for economic development in coastal communities	Impose subsidies to rescue fishermen/enterprise from economic collapse, but . increase risk of resource collapse
Relevant technical reference points: F_{LOW} , F_{MCY}	Relevant technical reference points: F_{MEY} , $2/3 F_{MSY}$, $F_{0.1}$, F_{MBP}	F_{MSY} , F_{MAX} , F_{HIGH}

With respect to Reference Points, the interim summary by the UN Conference Chairman seems to reflect growing consensus on three major points:

- (i) Management of fisheries in the past, whether by catch or effort control, has been aimed at Target Reference Points such as F_{MSY} , F_{MAX} , $F_{0.1}$ etc, which are well defined in the literature, and whose characteristics are believed to represent desirable conditions for the fishery.

- (ii) It is now recognized that the accuracy with which these targets can be reached by fishery managers is relatively low, and that accidentally exceeding them may be difficult and painful to reverse. In particular, aiming for the mortality rate corresponding to the Maximum Sustainable Yield (FMSY) is seen to be a risky strategy, and target levels corresponding to lower rates of fishing are more precautionary, and more likely to avoid stock collapses.
- (iii) A supplementary strategy is now proposed, which defines Limit Reference Points (LRP's) as representing states of the fishery which should not be closely approached, and certainly not exceeded. A management strategy that prenegotiates a drastic reduction in effort when these LRP's are reached is suggested.

Clearly, the new emphasis on not exceeding limits to exploitation is precautionary, in the sense that it is less likely to lead to risks of stock collapse due to unperceived errors in the information available to managers. Other aspects of the precautionary approach are described in the Management Chapter of the Code of Conduct for Responsible Fishing (GFCM: CFM/IX/94/Inf. 8), and essentially involve considering an explicit statement of the risk of a management action leading to stock collapse because our knowledge of some aspect of the state of the resource, the fishing power of the fleet, or the effects of environment on recruitment, either leads to overestimates of the stock size, or its capacity to support sustainable exploitation.

One fundamental aspect of the precautionary approach is the way that it reverses the burden of proof that precedes a proposed management action affecting the resource. Classically, a more restrictive fishing regime had to be supported by an assessment that showed unambiguously that a proposed action could lead to stock or catch declines. Under the precautionary approach, it must be demonstrated that a new fishing strategy will not result in stock declines before it can be approved. One result of the reversal, is that we should expect fishing strategies to be very cautious when information is limited, but to allow an increase in fishing rate towards some predefined target as evidence improves on the state of resources.

D. The main objectives for management of mediterranean fisheries

In designing a management system for living marine resources, experience has shown that such a system inevitably has to reflect compromises between often conflicting multiple requirements. The most basic compromise is that between the maintenance of sustainable populations of living resources and the environment they require, and the satisfaction of the socioeconomic requirements of the consumers and the fishing industry that supports them. Particularly for the Mediterranean, fisheries also take place within a coastal environment subject to multiple uses, such as recreation, tourism, shipping, aquaculture etc, so that the fisheries management scheme must take into account these multiple usages.

In considering alternative management options, these should be evaluated on the basis of costs and benefits, so that results (and priorities) can be presented to decision makers. It may emerge in the course of the analysis that the overall objective for a fishery should be reassessed, and perhaps changed in response to a particular opportunity which may occur in a given fishery. Economic analysis is required both at the level of the fishermen and his costs and earnings relative to individual vessel operations, and for the fishery as a whole, and its contribution to the national revenues, employment and protein supply.

In many Mediterranean countries the Department of Fisheries is small, so this economic analysis will either not be carried out, or be carried out at a rudimentary level. In other countries it may be possible to call on central economic services, or perhaps subcontract analysis to an economic consultancy.

In considering the multiple objectives mentioned above, it may be helpful to suggest three main categories of tactical measures that have been suggested for fisheries management in the Mediterranean and elsewhere, before discussing to what extent they may be desirable and compatible in a 'real-life' Mediterranean fishery management regime:

1) Measures that aim to conserve the resource and its critical environment

Here we include those measures that fall under the title of "Resource Management", which, as for North Atlantic fisheries, have been specially concerned with ensuring that an adequate resource base is maintained. Among these can be listed the following:

- Maximizing landings from the fishery
- Maintaining an adequate spawning biomass or escapement
- Protecting young fish from overexploitation
- Protecting critical habitats from degradation and habitat enhancement
- Maintaining ecosystems at an acceptable level of diversity

2) Socio-economic measures

In situations where the fishery is recognized as a distinct sector of the national economy, with its own social and economic characteristics: Some relevant measures here may be the following:

- Maximizing earnings from the fishery
- Maximizing employment in the fishery sector
- Fleet replacement policy and reducing fleet size
- Maintaining equity of current participants in the fishery
- Reducing imports or promoting import substitution
- Providing a product for consumers at a reasonable price
- Maintaining stability in coastal communities

3) Measures that fall under the title of Integrated Coastal Zone Management

Here we take into account the mutual impacts of fishing and other human activities in the coastal zone:

- Integration and integrated planning of fisheries all coastal zone activities (e.g., agriculture, aquaculture, shipping, tourism?)
- Zonation for alternate uses of coastal waters
- Pollution abatement measures

E. A brief commentary on the above objectives and their associated management measures in the Mediterranean context

Following the above classification, we describe some of the main management measures that follow from them:

Resource management measures:

1) Maximizing landings from the fishery: If this is the main motivation for management, a significant reduction of fishing effort would be needed to achieve it for most Mediterranean countries, given exploitation ratios at or beyond MSY levels for many demersal species, especially in the near-shore coastal areas. Given the generally lower rate of exploitation of sardines and other small pelagic fish (except anchovy), their potential to support further fishing will need to be evaluated based on local criteria, (predominantly economic, given generally low market prices for these species). We note however that for fisheries such as the Mediterranean mixed demersal fishery where landed prices for fresh fish are higher than the global average, economic criteria are likely to be predominant in effect.

The management measures to be considered here might be quotas or some form of effort or license control (however, the arguments against quota control for Mediterranean mixed species fisheries have been made in earlier Council Meetings), or could in some cases, involve controls on the credit available for purchase of fuel, or the construction of new vessels to accepted criteria of limited fishing power.

2) Maintaining an adequate spawning biomass or escapement: The arguments for giving high priority to this type of measure, particularly for demersal fish, stem from the relatively high proportion of the larger species (e.g., hake) that are captured prior to sexual maturity. There appears to be an urgent need for further research on the sources of current recruitment, and of measures to protect larger, mature components of the key stocks from over exploitation. In general however, the management measures to be recommended are similar to the previous category.

3) Protecting young fish from overexploitation: This has long been a concern in the Mediterranean given the early ages at first capture of many species, and classically has been approached for trawl fisheries by regulations on cod-end mesh sizes. The 40 mm cod end limit recommended by the Council at its session in ? has been adopted into legislation by a number of countries, but for a variety of reasons discussed at the last meeting of the Council, has not been fully enforced. Arguments for enforcement of this measure have been more vigorously promoted in the Western Mediterranean. At the last meeting of the Council, the argument was made that given the higher efficiency of larger mesh trawls, the adoption of significantly larger mesh sizes in the absence of effort reduction, might divert effort onto the spawning stock, and result in the loss of smaller valuable species from the catch. Where this measure is to be fully implemented, such a possibility should be investigated further by comparative fishing and population simulation for the main target species and by catches concerned, and hence would require similar measures to 2) above.

4) Protecting critical habitats from degradation and habitat enhancement: We may note here two other measures that appear to result in similar effects, namely, closures of fishing areas during the season of recruitment (applied with positive effect in fisheries where for various reasons, effort control measures have been unsuccessful), and the protection from inshore trawling of critical inshore habitats for juvenile fish, by banning trawling in or near estuaries, or placing

mechanical obstructions such as artificial reefs, in areas such as sea grass beds which are important nurseries for young fish.

5) Maintaining ecosystems at an acceptable level of diversity: Pressures are growing in many countries for the introduction of measures that protect at least a proportion of the marine habitat from heavy exploitation, in order that the original species diversity of the habitat be in part maintained. Involved here may be the use of marine parks or closed areas to fishing, which have already been adopted by some countries. One other alternative to full closure of a depleted resource was discussed at the last meeting of the Council, notably the use of a rotating closure strategy in the case of Mediterranean red coral resources. In general, a real concern with the maintenance of species diversity in the Mediterranean context appears justified at this point in time, and a prime measure, as for earlier categories is the reduction of fishing effort.

Socio-economic measures:

6) Maximizing earnings from the fishery:

At the level of the fisherman or vessel it is necessary to know the main costs, and the earnings. This can be based on declared accounts of the vessel, and indeed in some countries it is obligatory for fishermen to declare annual audited accounts as a precondition for continued participation in the fishery. Where such accounts are not available, as in most Mediterranean countries, then government will need to undertake estimates of the costs and earnings. In fact this is not difficult to undertake, and any trained and experienced fishery officer should know what fishermen are investing, catching and spending in order to make a living.

If the main government priority is to maximize earnings of fishermen the temptation is to introduce grants and low interest loans to reduce their costs of investment, or provide subsidized fuel, allow duty free imports of engines or materials for boat or fishing gear construction. One other option of this type designed to guarantee reasonable revenues, has been through setting a floor price for certain species. This may then turn into a subsidy if the government has to regularly pay out that price for buying fish which is then discarded or sold at a lower price.

The above types of strategy has been followed in a number of Mediterranean countries, but however attractive, have several serious long-term defects, especially if there has previously been no attempt to restrict access to the fishery (see SOFA Document and fig). In many cases worldwide, the over-exploitation resulting from the incentive provided by this type of measure has given further impetus to overcapitalization. It has meant not only that the low interest loans have not been then reimbursed to government finance institutions, but further impetus have also been provided to overexploitation, with consequently, reduced catch rates, and still less potential for repayment of loans. These expedient measures are at a cost to the national treasury, and ultimately to the taxpayers of the nation as a whole.

A slightly different type of 'hidden' subsidy may also include government investment in infrastructure; for example, where government contributes to earnings by building a ports, markets, freezer plants, etc. and where the cost of construction or operation is not charged to the users. To some extent however, such investment is also aimed at other objectives such as rural health and welfare, and by food producing industries other than fisheries.

In some countries the government supports fishermen's associations, confraternities of fishermen in the different ports, and cooperative movements as a measure of assistance to the sector. Some of these organizations have a long history in the Mediterranean, and prior to industrialization of fisheries, played a key role in management of small scale 'petit metier' fisheries, particularly in southern European countries. Apart from the advantages that such organizations provide to government, in that they form a well informed 'interlocuteur' for government-industry meetings, they allow a degree of delegation of some governmental functions, reduce the costs of providing credit and other services to individual fishermen, and may assist in regulation and fisheries surveillance if they are in agreement with the measures introduced.

Government may choose to eliminate all subsidies in the form of cash payments, or reduced charges for services, and concentrate on reducing entry to the fishery with the intention to extract rent. This may still bring considerable benefits to those fishermen who have permits to fish. However, the cost of regulating entry to a fishery may be quite costly, and could be considered a subsidy if full costs are not recovered from the remaining fishermen.

Alternatively, the government could set higher fees for annual licenses for the fishery, and then use the revenue for expenditure in other sectors. In addition, such license fees or landing taxes may discourage excessive investment in the fishery, especially when stocks are depleted. It may however be more appropriate that such revenues be used to promote conservation, or associated functions such as environmental protection, coastal community welfare, etc., where local coastal populations could see the benefits of such license fees.

7) Maximizing employment in the fishery sector:

A national objective for the fishery may be to maximize employment in the sector, and this could be aided by facilitating investments in small scale fishing vessels, but placing strict controls and other restrictions on larger vessel categories; thus stimulating the inshore fishery at the expense of the offshore fishery. With modern developments in engines and gear, small scale vessels have greatly improved range and versatility, so that this would not necessarily lead to declining catches and low earnings, since costs of fishing would be significantly reduced. Smaller vessels may more easily switch from one target species to another, and are more easily able to respond to seasonal changes in availability and markets.

8) Fleet replacement policy and reducing fleet size:

Most fisheries resource assessment and economic models assume that the fishery remains in equilibrium with the level of fishing effort exerted on the fleet, but rarely is account taken of the need to control overall effort levels so as to avoid abrupt changes in harvesting policy. Frequently, investment in fishing vessels is centred during a relatively short period of time when financial resources are available, leading to fleets with age structures dominated by a few age groups, reflecting a few years of past peak investment (e.g., fig). Given that the carrying capacity of the resource is poorly known, there are considerable risks in this strategy, as opposed to a gradual replacement policy, notably the risk of overexploitation, as well as promoting oscillations in resource production due to sudden stresses on the natural resources.

Considerable experience has been gained outside the Mediterranean area in limited license schemes, or other measures that reduce access to the resources to a level that can be sustained.

Obviously these measures are more easily introduced when the resource is newly exploited, which is not the case in the Mediterranean. Nonetheless, hard choices may have to be made in seeking to redimension fleets to a more reasonable size, and many of these focus on creating a free market for a limited number of licenses, and focus on measures which control the modality of transfer of the license to a new vessel. Regulations may require a 'build down' of fleet capacity, by requiring the new vessel to be smaller or less powerful than that replaced, or may require 'two for one' swaps, in which the new owner is required to purchase two old licences before substituting an old vessel.

9) Maintaining equity of current participants in the fishery:

Loss of an existing right can often cause more problems politically than the allocation of a new type of resource to a limited number of users. Those persons that have traditionally participated in the fishery expect to continue doing so, and to pass this right on to their offspring. This can cause difficulties when the objective is to reduce the number of participants to a level commensurate with the productivity of the resource. Other difficulties may occur in imposing effort regulations when granting the right to enter the fishery is seen to be a result of a political intervention. It is for this reason that a licensing committee with senior fishermen represented on it, can ease acceptance of decisions on controversial topics such as limited licensing. Such issues cannot be addressed simply through economic analysis, but have a strong socio-economic and community component, which will require government to encourage local involvement and comprehension of the reasons for decisions made.

10) Reducing imports or promoting import substitution:

Another issue which politicians may wish to consider is the substitution of imports of fish by a locally caught product. This strategy is not easily achieved however in the Mediterranean given that demand exceeds supply for demersal species, while others are not locally available. There does appear however to be a pressing need and opportunity to promote the use of sardines and other cheaper small pelagics, and this will require judicious government intervention. Direct interference in the import/export trade of a country is often ineffective however, because parallel markets can develop, and earnings then pass through informal channels so that ultimately the government loses any possibility of extracting rent from its resources.

There may well however, be benefits under some circumstances in allowing the sale abroad of high quality fresh fish, and allowing imports of low value imports to meet consumer demand. The wide differences in prices recorded between individual Mediterranean countries suggests that these mechanisms may be inhibited by tariffs or regulations and procedures that have the effect of inhibiting trade.

11) Providing fish to consumers at a reasonable price:

As populations increase there is an increased demand for food, and fish is an important protein resource in many countries. The consumers, above all in urban areas, can form become a strong political force, and may encourage politicians to think that fish prices can be decreased. This can have serious negative consequences for fishermen's earnings. If politicians ban or discourage exports of fish the prices obtainable by fishermen will be lower than otherwise. This will have negative effects on fishermen's earnings.

12) Maintaining stability in coastal communities:

One option for fishery management may be to promote stability in certain coastal communities which have no other opportunity for making a living. If the fishery activity was taken away then such communities would disintegrate and disappear. In these situations, local and national government may wish to protect interests of these communities, by restricting access of outside fishing vessels, and by assistance to landing and market facilities. These operations should be reviewed after analysis of the social and financial costs of acting or accepting the status quo.

13) Surveillance and enforcement of regulations:

Surveillance and enforcement of fishing operations are crucial to good fishery management. However in many countries there is a lack of real commitment by the authorities to undertake surveillance and enforcement of the regulations. It is necessary to introduce regulations which are realistic in the circumstances and which are enforceable. A single entity should be given overall control for surveillance and enforcement, and not, as is so often the case, a number of authorities like the police, the navy and the coastguard. It is suggested that overall responsibility for surveillance and control be vested in the Department of Fisheries, and that the Department have the power to charter naval vessels, coastguard vessels, etc., to ensure full compliance with fishery regulations.

At the same time close attention must be given to cost of surveillance and enforcement, because overall costs should be well below overall value of the fishery, and here again the importance of economic analysis in the fishery sector cannot be overemphasized.

14) Zonation for alternate uses of coastal waters:

Current fisheries management concerns in the Mediterranean and Black Seas are compounded by the problems resulting from loss or degradation of the estuarine, riverine and coastal sea environments. Sustainability of marine fisheries is now not only threatened by excessive and destructive fishing practices but also by coastal habitat degradation of many species that spend their early life stages in nearshore, estuarine-brackish, or fresh waters. In fact, maintenance of present levels of fish production, and future growth, will be difficult in the absence of fisheries and environmental management of coastal and enclosed seas.

Marine and brackish water aquaculture is among the fastest growing sectors of the coastal zone; it provides for a valuable supplement to local diets and is a means of earning foreign currency through export. Aquaculture depends on a clean environment, but in intensive form, it can give rise to environmental concerns due to excess feed and chemical inputs, the alteration of the coastal ecosystem, and the encouragement of destructive fishing practices to provide for feed supplies. Rapid and uncontrolled expansion of coastal aquaculture has led to the loss of wetlands and nursery grounds. It has also led to the realization that certain types of culture may be environmentally unsustainable, result in long-term economic losses and have undesirable socio-economic consequences.

15) Integration and planning of coastal zone activities:

Other coastal activities which have an impact on fisheries include oil and gas exploitation, waste disposal, marine transport, mining, tourism, urban development, agriculture and forestry. Strong interactions exist between these primary sector activities, and there are potential conflicts in use of the coastal zone.

Available experience indicates that comprehensive coastal management planning is difficult to achieve and is rarely followed by comprehensive plan implementation because of the lack of adequate institutional structures, trained manpower and, possibly, political will to bring about the changes needed. Thus, whereas management on a sectoral basis is generally inadequate and needs to be complemented by an integrated approach, the problems of coordination may place practical limits on the number of sectors that should be covered in coastal management schemes. These limits are likely to differ between countries and regions and localities.

16) Quality control measures:

With few exceptions, the demand for fish and fish products is strong in GFCM member countries. This has contributed to a high degree of resource exploitation in the Mediterranean, and to a high proportion of imported products, in particular, for the Northern Mediterranean. With the limited resource availability from local production in relation to demand, there is virtually no scope for further substitution from local catches, except possible for sardines. In view of the pressure of local demand, it is doubtful that improved management would greatly improve the prospects for import substitution, although the prospects for fish culture to assist may be better in the long run.

The strong demand and supply limitations contribute to the high prices for, especially fresh, fish products in some Mediterranean countries, and reflect consumer's preferences which also have a seasonal component for some species. Management measures can assist in improving net earnings to the sector by taking these aspects into account, and proper control of product quality and markets could make a major contribution in this respect. This market control could also include enforcement of bans on sale of undersized specimens, which is the subject of legislation in some countries.

F. Integration of resource management mechanisms into an overall management regime

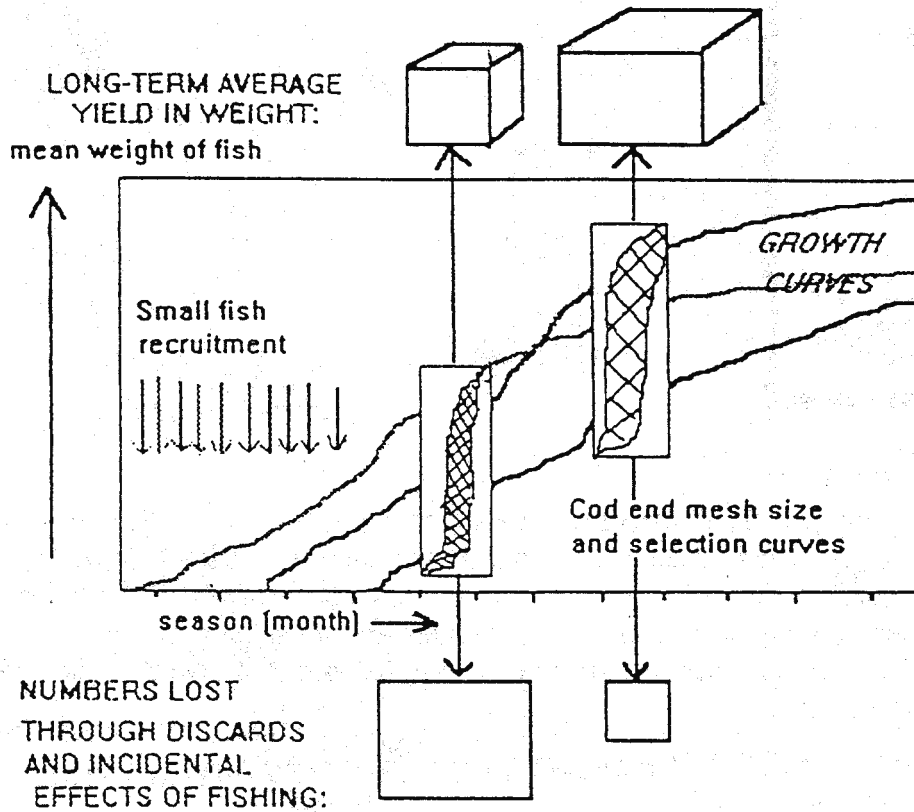
The above incomplete list of measures is suggested for discussion by the Council, which is invited to consider to what extent they are relevant in the national and regional context, to discuss which measures should be integrated into a fishery management regime, and how such measures may be implemented and enforced.

G. Mechanisms for assessment and management adapted to the mediterranean fishery situation, in the form of illustrations

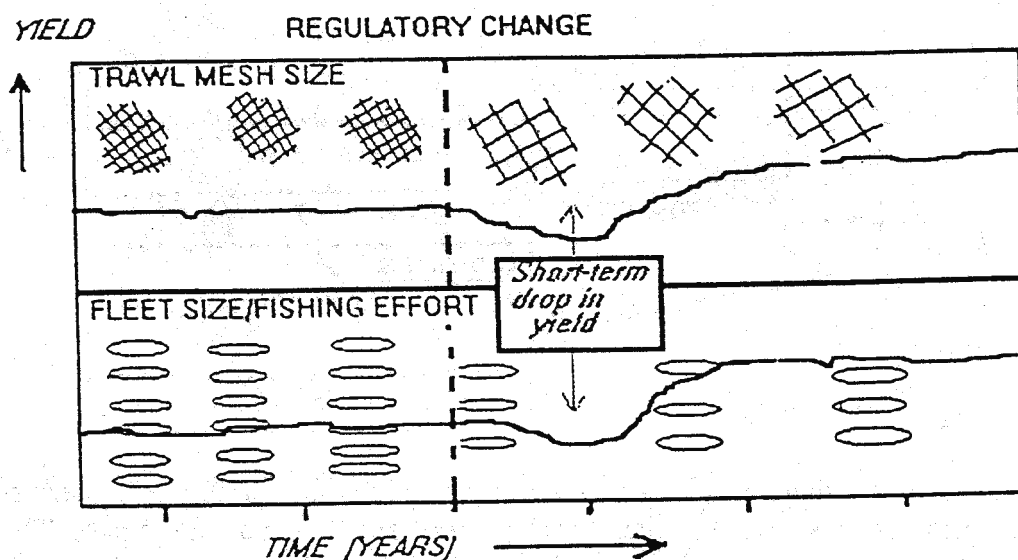
Size limits and closed seasons:

The perception is that young fish of different species settling to a bottom living stage in the coastal areas are vulnerable to fishing, and may be protected only in part by an increase in mesh size (Annex fig 1) which will reduce discards and waste of these fish and increase yield. Such fisheries will usually benefit from a decrease in fishing effort/fleet size (Annex fig. 2). In both cases, there will be a delay (not more than a year) before the reduction in fleet size and

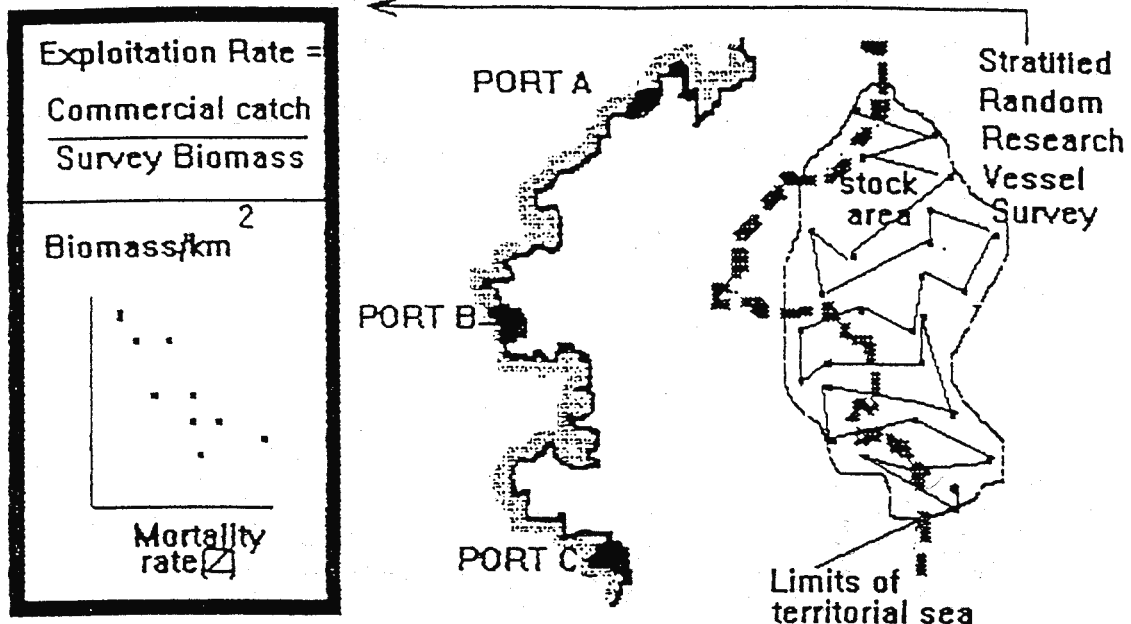
increase in trawl cod end mesh size results in an increase in yield; the time taken by the stock, through reproduction, to adjust to the new situation. In the case of a seasonal closure, it can be seen that (whatever the mesh size used) if young fish are left undisturbed to grow on the inshore grounds through the late summer and autumn (the optimum season depending on area and species), this measure will have more or less the same effect as an increase in mesh size (the so-called Cyprus effect).



Annex fig. 1: Effects on average yield in weight and discards of an increase in mesh size



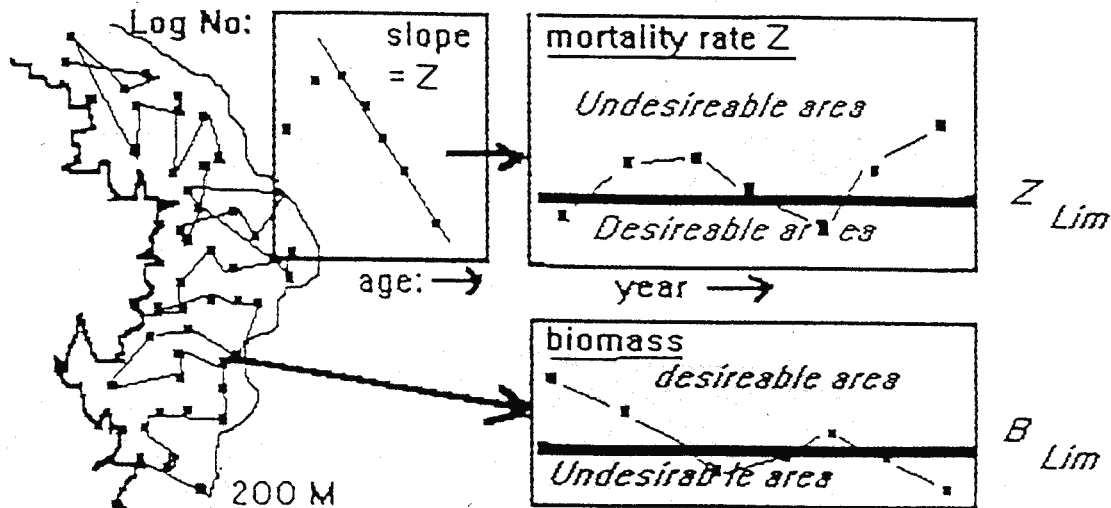
Annex fig. 2: Immediate and long term effects of (upper) increase in cod end mesh size of trawls, and (lower) decreases in excessive levels of fishing effort



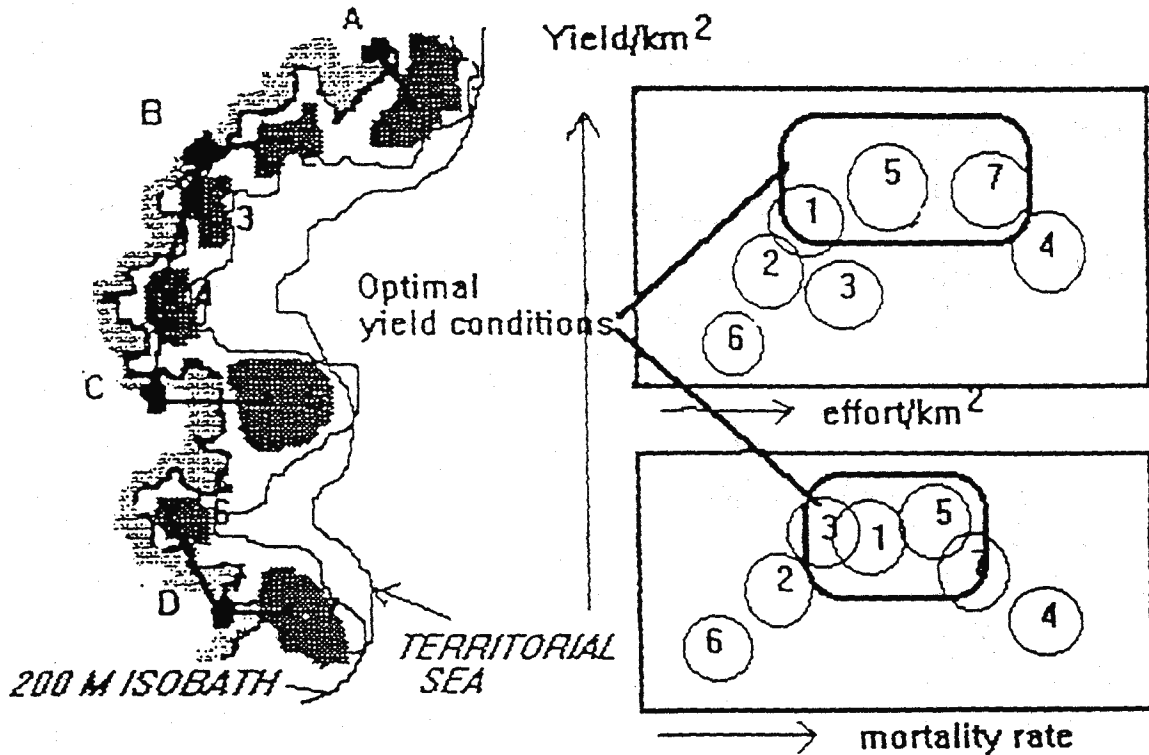
Research surveys:

Annex Fig 3: Properly planned surveys of the stock area by research vessel can provide estimates of stock size and biomass, which when compared with the commercial catch provides an estimate of the exploitation rate. Such estimates may prove difficult to obtain if, as in a number of Mediterranean countries, samples of commercial catches are not readily available for population analysis. Under these circumstances, the cruise data may be used to derive a relationship between overall mortality and biomass.

USE OF LIMIT REFERENCE POINTS FOR BIOMASS AND MORTALITY RATE IN MANAGEMENT.

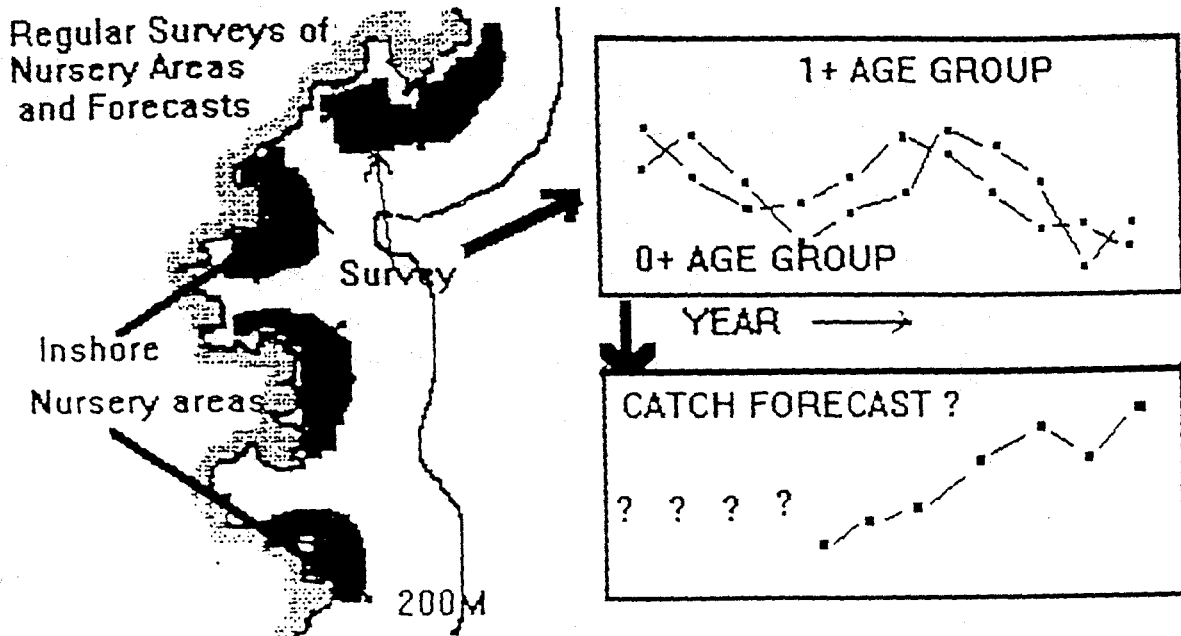


Annex Fig 4: Cruise sample data may be used to plot trends in mortality rate (derived from size and age composition of the research catch for a species), and/or trends in biomass. The conditions corresponding to a known unfavourable condition (the limit reference point) based either/and on overall death rate (Z) or biomass left on the ground (B) indicate when the fishery has passed into an 'undesireable' area Z (lim) and B (lim). At this time urgent management action to decrease fishing effort is required.



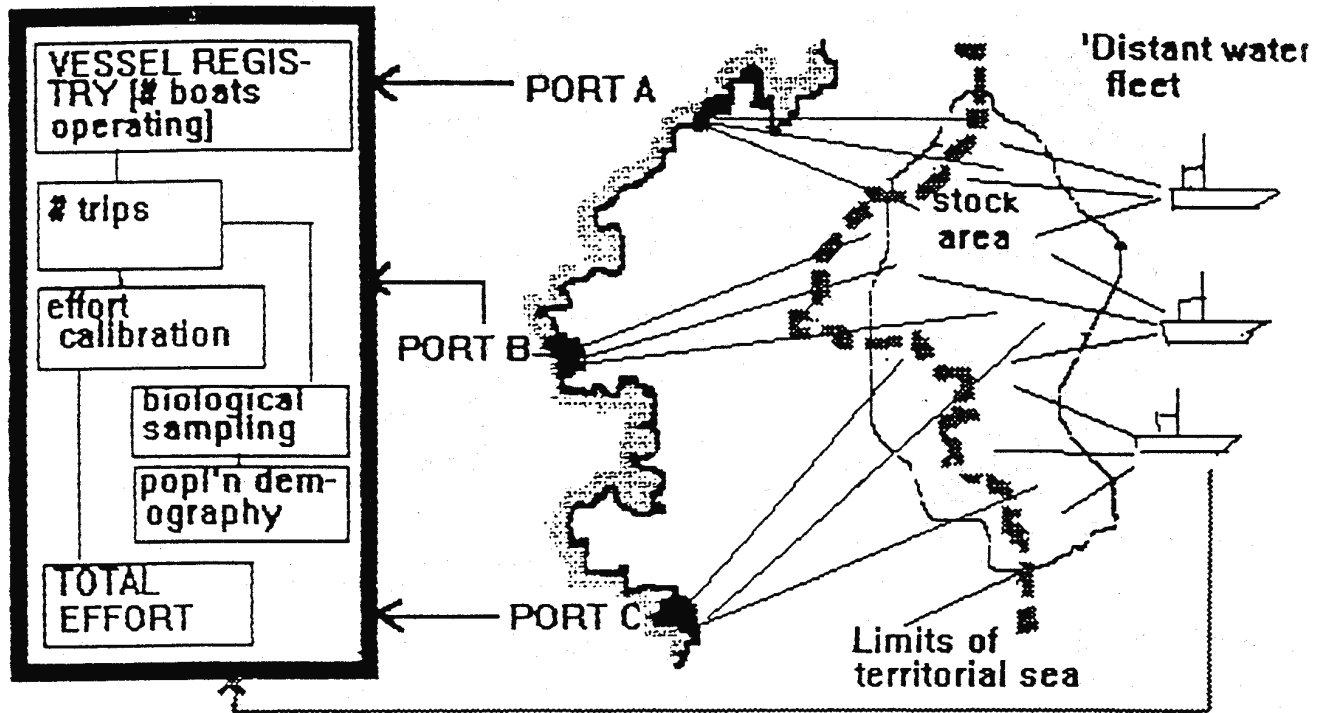
Annex Fig 5: Special annual surveys of the nursery areas, if repeated annually, can be used to show fluctuations in catch, and could be used for fishery forecast purposes.

Composite production modelling approaches



Annex Fig 6: Monitoring catches and local fishing effort/mortality rate by ports and their associated grounds can be an option for fringing national shelves. Here, a plot of yield per ground against either effort exerted per ground from e.g. a log book system - (upper part of figure), or mortality rates determined by surveys on each ground plotted against catch per ground, (lower part of figure), can be used to gain an idea of the mortality rate or fishing intensity (standard days fished/square km) corresponds to MSY (the so-called composite model approach).

The effort control problem: one approach



Annex Fig 7: Illustrating the technical requirements and difficulties involved in setting up a fisheries management system for a straddling fish stock, whether the management system is by TAC's or fishing effort control. Here the geographical extent of a unit stock (stock area given by red outline) is supposed to be exploited by three coastal ports and a distant water fleet fishing beyond territorial seas.

In order to manage the fishery properly, in this case by effort control, a management system must register nominal days fished by each fleet, calibrate the fishing power of each fleet component to arrive at an overall effort level, and ideally, compare this figure against a standardised catch rate or age composition determined by port sampling.