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**MANAGEMENT OF COASTAL FISHERY RESOURCES  
IN THE SOUTH PACIFIC REGION**

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## MANAGEMENT OF COASTAL FISHERY RESOURCES IN THE SOUTH PACIFIC REGION

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### 1. INTRODUCTION

#### 1.1 Stages in the development of a management regime

All fisheries must, at least theoretically, pass through a four stage process if they are to be managed on the basis of the best available scientific and socioeconomic information. These stages include the appraisal of an unfished resource, the development of the fishery, monitoring of the fishery and periodic or continuous assessment of the status of the resources.

Appraisal, in essence, includes all of the exploratory fishing activities which have characterized the efforts of many development agencies over the past few decades. Clearly, fishery appraisals have been an ongoing process ever since people first ventured near the shores of lakes, streams or seas in search of food and there are now very few fisheries which have not yet been fully appraised. In the context of the South Pacific region the activities aimed at developing fisheries for the hitherto unutilised or underutilized deep-dwelling snappers and groupers are an example of a fishery appraisal. Market research is also an important part of an appraisal.

Where initial appraisals are favourable, development of fisheries usually follows. On a global basis there are now very few fisheries which are not yet exploited. Those that are unexploited or are only lightly exploited and thus producing less than their maximum biological potential, usually fall into these categories for economic reasons, in that the costs of fishing and/or of transporting the catch to market are uneconomically high or that the local markets are oversupplied

and the catch therefore almost worthless. Many of the coastal fisheries of the South Pacific region fall into this category, although there are examples of intensive local exploitation close to major urban centres.

If a fishery is developed or is in the process of developing it should, under ideal circumstances, be continuously monitored in terms of the total catch, catch rates and catch composition and in terms of economic factors. Unfortunately, there are relatively few fisheries on a global basis for which monitoring has extended back over any significant period of time and for most of the world's fisheries neither current nor historical data are available. Reasons for the lack of data include the high costs of the data acquisition process, reticence of dealers and fishermen to divulge information which could be of assistance to their competitors or to tax collectors and, most often, a lack of any clear perception of the possible value of such records. The latter point is not surprising because it is only in the past 30 years that significant use has been made of such information in the developed countries and only in the last decade that the credibility of the agencies which use such data have been widely recognized.

The final stage leading up to management of a fishery is that of assessing the status of a resource. The principal question to be asked is whether or not the resource is producing its optimal biologically- or economically-sustainable yield and if this is not so, whether the resource is under- or over-fished. The whole question of the need for stock assessments is concisely reviewed by Gulland (1983a), together with a brief outline of the scientific basis for current methods, and this paper is recommended to those who have no formal training in this field.

Irrespective of the status of a resource, management options arise and decisions need to be taken; for example, on whether or not more investment is required or more controls should be placed on a fishery. Management measures need to be based on a very wide array of often conflicting, biological, social, economic and political considerations and, if the resource is shared with adjacent countries, might also have international implications.

## 1.2 Resource appraisals and fishery development

In the context of the South Pacific region the basic appraisal of resources has to a large extent been accomplished over the past few thousand years and these appraisals are embodied within the traditional knowledge and sealore that has been passed down over the generations. However, technological innovations also lead to a need for reappraisals of fisheries when previously unavailable resources are made accessible as a result of a technological development. For example, the development of modern purse seining technology in conjunction

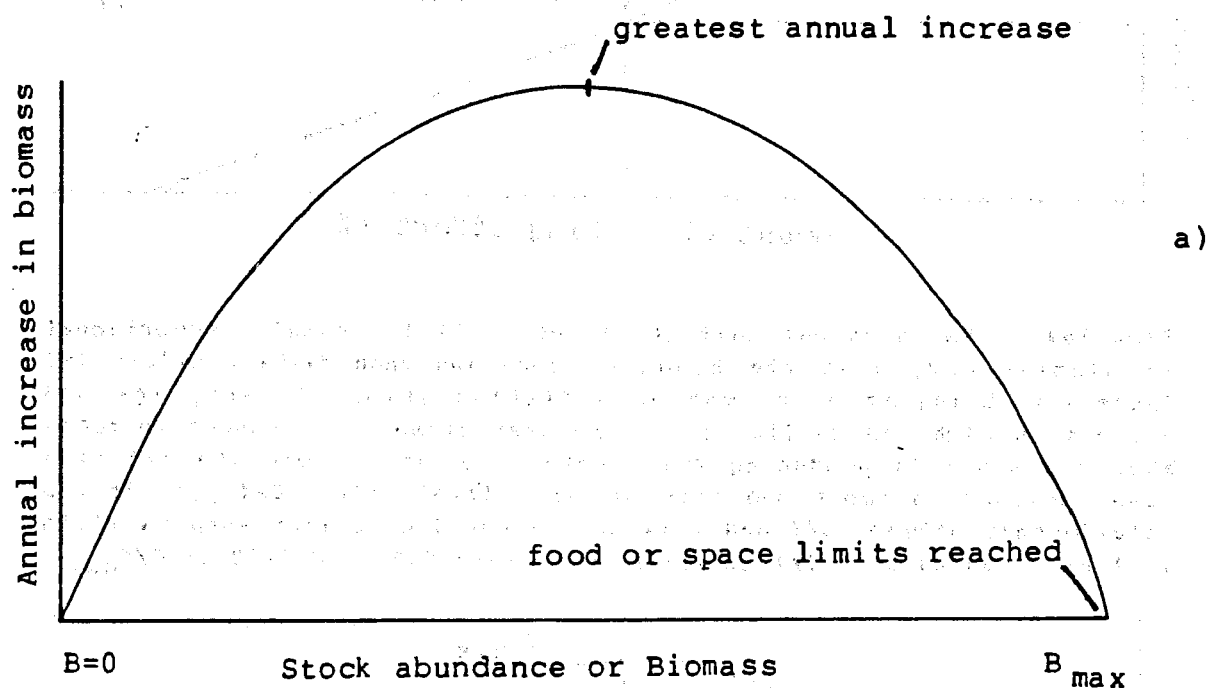
with fish-attraction devices appears to have dramatically increased the harvest of skipjack tuna from the South Pacific region by opening up fisheries in areas which were previously constrained by a lack of baitfish.

Even relatively inefficient fishing methods can exert a significant mortality in a fish stock and it is most important that it be recognized that highly efficient modern technologies can often rapidly bring stocks into an overfished condition. It is therefore essential that, even in the early stages of development, the biological and ecological limitations of any natural system must be borne in mind. For example, there are clear limits to the tonnage of fish, crustaceans and molluscs or other edible organisms which can be removed from a coral reef each year without causing a long-term decline in production from the entire system. This is because the reef is functionally a system which either captures light energy by photosynthesis or entraps live or dead organic matter by filtering it from the waves or currents which pass over the reefs. Both of these activities are largely a function of the area of a particular reef and no amount of "development work" will persuade the reef to entrap more basic energy or to pass it along the food chain more efficiently.

A different aspect of the limitations of resources, which cannot be overemphasized, is that it is well established (e.g. Gulland 1983a) that the harvest that can be taken from a particular resource increases from zero in response to fishing effort, reaches a maximum and then declines back to zero at very high levels of fishing effort. The curve describing this is roughly bell shaped (a parabola) and a corollary of the shape of the curve is that if the catch is divided by the effort, the catch per unit of effort will decline from a very high value at negligible effort levels to very low values at high levels of effort. Depending upon the shape of the curve, when the maximum annual harvest is being taken, the catch per unit of effort will have declined to one half or one third of the initial values. This is illustrated in Fig. 1a, b. & c.

As an example of the foregoing, consider the appraisals of the snapper and grouper fisheries of the "deep reef" which are currently being conducted by the South Pacific Commission and other agencies (Crossland and Grandperrin 1980, Grandperrin and Brouard 1983). When the appraisals commenced, harvests on handreels averaged as much as 9.6 kg/line hour in the best areas and 5.4 kg/line hour in all areas (Brouard and Grandperrin 1985). The facts of fishery life dictate that these rates will fall to one half or less when the fishery is fully developed. It is imperative that economic planners use these lower values when planning for the development of a fishery. Unfortunately, this is often not the case - resulting in a fishery becoming overcapitalized, in intense competition for the remaining resource and a consequent failure of the least efficient operators.

**Figure 1.** Sequence of figures illustrating the basic concepts underlying "production" or "surplus yield" curves. Note that the curves are not necessarily perfect parabolas and may be skewed to either side.



**Fig 1a)** Curve illustrating the relationship between stock abundance or biomass (B) and the annual increase (in weight) in the biomass of that stock. When the biomass is zero there can be no increase and when it is low there can be very little increase because there are too few breeding stock to produce sufficient eggs and too few individuals which can grow. When stocks reach their maximum possible biomass ( $B_{max}$ ) they become limited by their food resources, starve and can neither grow nor reproduce. Therefore, if a stock is reduced to about one half of its greatest possible biomass the annual, removable, increase in biomass will be maximised. The annual increase in biomass is referred to as the "surplus production" and if this amount is removed the initial biomass or stock abundance will remain unchanged.

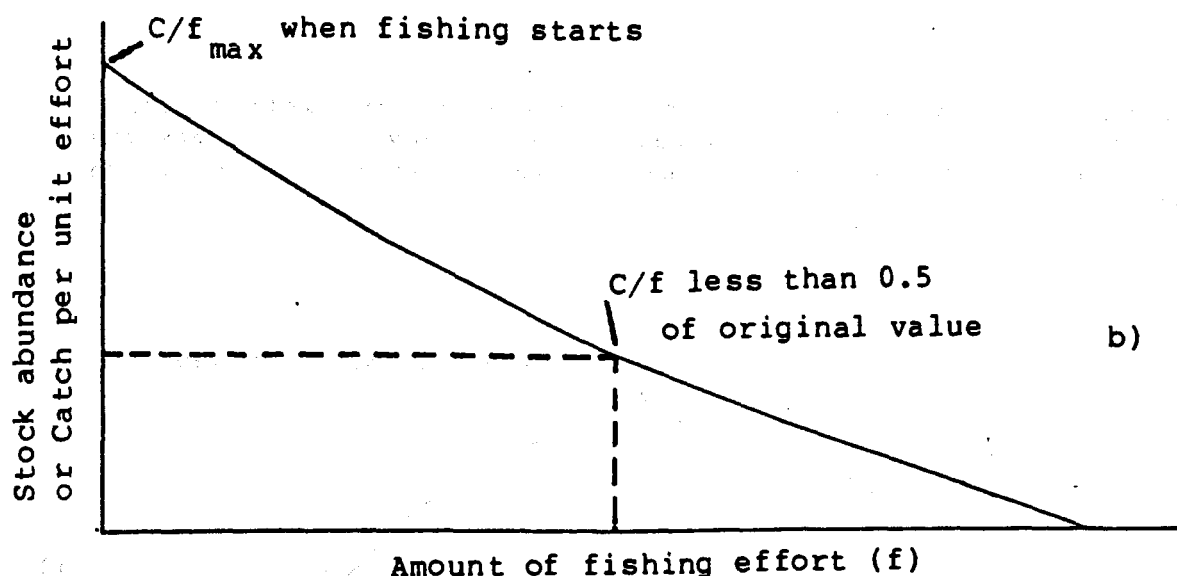


Fig. 1b) The catch per unit of effort ( $C/f$ ) is roughly proportional to biomass and, like the biomass, declines when fishing effort ( $f$ ) increases; being at a maximum when fishing effort is very low and biomass is high and declining to zero when biomass is reduced to zero. When the stock is producing the greatest possible yield the  $C/f$  will have declined to about one half of its initial value ( $C/f_{\max}$ ). If the relationship between  $C/f$  and  $f$  is not linear the maximum surplus yield will be produced when  $C/f$  declines to between 0.33 and 0.50 of  $C/f_{\max}$ .

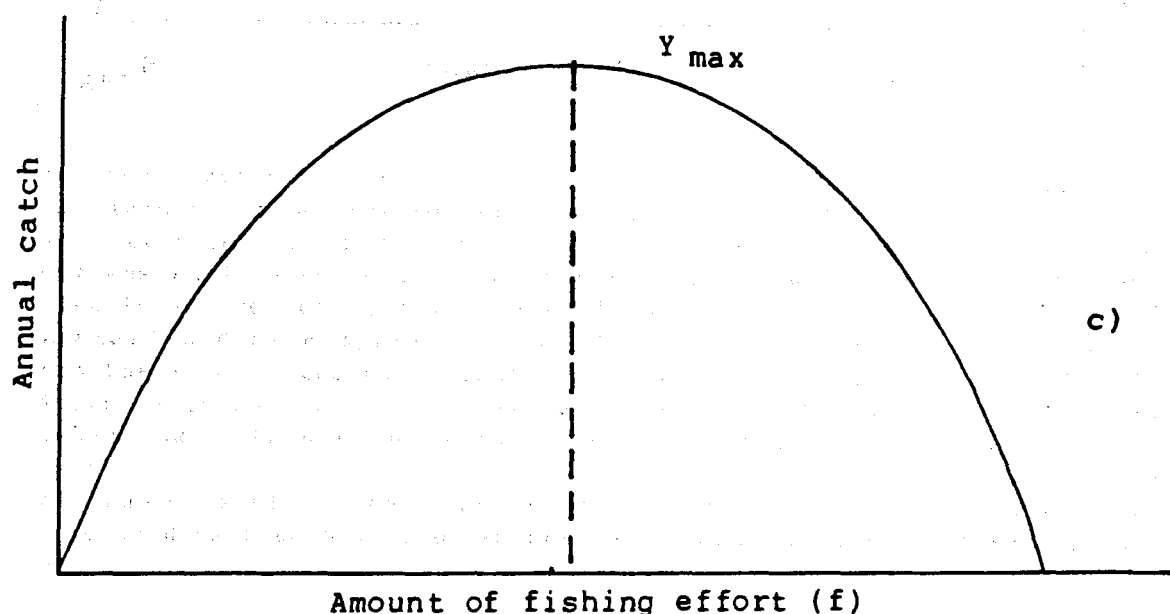


Fig 1c) The production curve is the product of the amount of fishing ( $f$ ) and the catch per unit of effort ( $C/f$ ) and rises from zero when fishing is zero to a maximum when the catch per unit of effort (and biomass) are reduced to around one half to one third of the original magnitude.

## 2. MANAGEMENT

In the South Pacific region many of the coastal fisheries are now reaching full development. The past decade was a time when efforts were spent on appraisals of deep-water fish stocks and now major efforts are being directed towards developing the identified resources.

Shepard and Clark (1984) and Fakahau and Shepard (1986) provide good coverage of the development of fisheries in the region. These two reports identified a definite move by countries towards fisheries management. As a result of the rapid progress of development, many countries now have strong needs for monitoring and continuous assessment of the status of the resources through research (Fakahau and Shepard 1986).

The purpose of management is to impose forms of control on a fishery in ways that ensure that it will continue to yield net benefits to the community in accordance with national goals (Lawson 1984). Fisheries management is relatively new to the region in terms of economic development and few governments have yet exercised significant measures of control on the exploitation of their fisheries resources.

Customary rights over sea areas are common in the region, and often signify ownership and jurisdiction over an area more than rights over fisheries resources. Customary rights are being reinforced by government legislation in Fiji. These rights are widely recognized in Solomon Islands and Papua New Guinea. Cook Islands has replaced customary rights with town councils and Western Samoa has customary rights but they have been much eroded. Tonga is exceptional in the region in having open access fisheries.

It is desirable to have a management regime because it can;

- (1) provide a means of preventing conflicts between users of resources and between users and owners of resources;
- (2) promote fishing at both economically and biologically sustainable levels;
- (3) conserve fisheries resources for future generations
- (4) provide a means for better utilization of resources, and
- (5) ensure a more socially desirable distribution of the economic benefits obtained from the fisheries.

### 2.1. The need for cost-effective systems

We believe that it is most important that cost-effective management systems be adopted in the South Pacific. That is, the systems adopted must produce results that are commensurate with the value of the resources, both in economic terms and in the eyes of the people.

In most Pacific Islands, fishing is one activity which, in

the social context, is an important part of the lives of islanders. It is not considered a form of employment. Halapua (1982) stated that for the fishermen of Tonga the "demand for cash is not a demand for profit but rather for some subsistence requirements, social obligations and occasional wants such as school fees, and church donations". Halapua further stated the participation of the fishermen of Tonga in marketing is confined to the allocation of catch between fish for sale and that for other obligations. The reality is that in the island situations, the monetary value of resources is often not great; thus it is important to consider and determine the levels of participation and interests the fishermen may have in any management systems. A sophisticated system could prove too cumbersome in the eyes of fishermen.

It is important that the management system selected is one which the organization can operate. Adequate funds, manpower and equipment are required and it would be better to operate a modest monitoring and assessment programme in a few selected areas than to overextend resources by attempting an ambitious, countrywide coverage. Work programmes can break down because of equipment failures and care needs to be taken that essential equipment is rigorously maintained. Alternatively, the programmes need to be made independent of the equipment.

## 2.2. Possible methods for management of commercial and subsistence fisheries.

This section reviews the basic management methods which are being used in different parts of the world, some of them could be applicable to situations in the region. Munro and Williams (1985) give a synopsis of possible management measures in the context of coral reef fisheries. Parts of this synopsis are repeated here and the relative merits of the different approaches are then examined in the specific context of the coastal fisheries of the South Pacific states.

### 2.2.1 Traditional management practices

Munro and Williams (1985) comment as follows:

"One particular characteristic of coral reef fisheries is that over a large part of Oceania, customary law dictates that most nearshore areas, particularly coral reefs are usually owned by clans or larger communal groups, and are therefore not subjected to open access fisheries. There is much variation in the rights claimed by or accorded to these groups (Christy 1982) but where they are firmly established fisheries management problems will tend to be diminished to some degree; although localized decision making might mean that a coherent national or regional policy is difficult to achieve. These closed access fisheries have been managed in the past by communities practicing traditional conservation techniques. Although the degree to which these practices were successful in conserving resources can be questioned there is no doubt that in many communities a relatively sound concept of resource management existed and could be enforced within the relatively circumscribed communities. Most traditional management centered on restricting harvests from particular areas or of particular species and were often interwoven with other



aspects of the life of the community. However, in recent times, traditional ownership has been eroded or even abandoned in many areas, particularly near to major towns and in many parts of the Pacific such areas are now heavily fished (Johannes 1977,1978; Marriott 1984)".

Customary rights in fisheries are established and effective in many countries within the region and it may be worthwhile to attempt to re-establish these systems in those countries whose systems have been eroded as a result of colonization, commercialization or population increases.

The major advantages of customary rights are that controls are exerted at a local level and not from outside. This promotes self-confidence amongst members of the community and can create a good working relationship between the government and the community. If the system works effectively the costs of enforcement of management measures are minimized, as are social and political conflicts between the government and the community. However, the main advantage is that the fishing community is likely to have a better understanding and appreciation of management principles if they are discussed at a local level.

There is much variation in the region in the extent to which traditional management practices have been maintained. In some areas, particularly around capital cities, they have been abandoned completely as a result of population increases and the influx of people from other areas or were modified by colonial administrations. In other areas they are still strictly maintained and enforced.

Where the original practices or some modified versions still exist there is an opportunity for fisheries administrations to reinforce and encourage the systems by providing information upon which the councils can base decisions. We believe that understanding of the management process could be enhanced by a series of interesting, films, slides or videos accompanied by a text which could be translated into the local languages. Informative presentations explaining the basics of fish biology, larval distribution, recruitment of juvenile fishes and the yield concept could be presented by local fisheries officers and might do more for fisheries conservation and management than many of the technical and legal procedures described in the following pages.

The disadvantage of traditional system are that they can make it difficult to implement any national policy and that the area covered by a traditional management scheme is invariably only a part of the range of any fish stock. Thus, for example, conservation of a spawning run of fishes might be in the national interest but that same run might be locally regarded as a traditional resource. Boundary disputes can arise when payments are made for access to resources (e.g. tuna baitfish royalty entitlements) and there is an obvious need for formal legal recognition of boundaries if traditional ownership or

rights are to be incorporated into national fisheries management plans.

It needs to be emphasized that there are a huge variety of traditional fishing rights and management practices in the region, ranging from absolute individual ownership of marine areas and all of the resources therein, to transitory access rights to particular specified resources or to communal access to all resources. Management powers might therefore be vested with individuals or groups and the management options open to them are, in essence, no different from those normally imposed by governments (and described in section 2.2.2.).

## 2.2.2 Administrative management options

### 2.2.2.1. Restricted harvests

Restricted harvests are those in which the catch is limited by restraining the amount of the resource which is taken or by preventing certain parts of the resource from being taken. This can take the form of protecting small fishes, limiting the total catch of all animals, restricting the fishing by closure of the fishery at certain times to protect all fishes or by prohibiting the harvest of certain classes of fishes or invertebrates (e.g. berried female lobsters, or very large giant clams, trochus or other molluscs).

#### a. Minimum size limits

"Although the time-honored measure of establishing minimum legally retainable sizes for various species of fishes is theoretically feasible for various species its applicability depends very much upon the fishing methods in use. If the methods tend to seriously injure the fishes the imposition of minimum sizes does little to conserve the fishery and needlessly wastes resources. It has most relevance to the management of recreational angling fisheries. As a general case there is insufficient biological data available to establish size limits for most species of coral reef fishes in most fisheries. In some countries size limits have been established on the basis of the opinions of administrators and fishermen and without any scientific justification (Munro and Williams, 1985)".

We recommend strongly against the use of minimum size limits, except in the case of molluscs and crustaceans. For fin-fish size limits are largely impractical in that most fishing methods will harm any fish which is captured and it is likely to die even if returned to the water. Spiny lobsters caught by spearing are also likely to die if released. However, spearfishing does allow the fisherman to actually see the animal in the water and make some judgement about its size. Molluscs such as Trochus and giant clams could be subjected to minimum size limits but it then is necessary to stipulate that they be landed whole, including the shell. This is not a problem for Trochus. In the case of giant clams it would be difficult to prove that a small animal out of its shell was not an adult of a small species rather than a juvenile of a large species.

## b. Catch quotas

"The basic concept of allowable catches has been explored by the temperate water fishing nations in great detail and applied on a wide scale, often with unfortunate results. Although an allowable average catch can be calculated with a fair degree of confidence for a single species, the year to year variations in stock size as a result of variable recruitment, and changes in catchability and fishing conditions usually ensure that the quota is either reached within an unduly short time or that the quota is never attained.

If recruitment is poor, then fishing will continue for a long time and the diminished stock will have a large fraction of its total removed by the fishery, with possible adverse effects on recruitment in subsequent years. If recruitment is good, the fishery will be of short duration and much of the potential harvest will not be taken but, depending upon the stock-recruitment relationships (Ricker 1954; Cushing 1981) the future recruitment will not necessarily be enhanced.

In the coral reef environment the multiplicity of species and the generally unselective nature of the fishing gears would dictate that catch quotas would either have to be applied to the total catch from a given area or to a few selected and particularly valuable species, such as spiny lobsters. If it were applied to the total catch this could cause problems if the fishing communities did not have access to alternative areas. There is also some difficulty in applying quotas where it is not possible to have some degree of confidence about what species will be captured. Many species of fishes, do not readily survive being captured and are usually mortally injured as a result of being hauled to the surface. Thus, only species which can survive such treatment could be subjected to quotas (spiny lobsters, turtles, most molluscs) and the alternative would be to close the entire fishery when the quota was reached".

An additional complication is that in an artisanal fishery the extra fishing capacity to take advantage of a good crop is limited by the fishing gear available and, usually, a lack of capital to purchase additional gear even though extra manpower might be readily available. (Munro and Williams, 1985).

We see little role for quota systems in the coastal multispecies, multigear fisheries of Oceania. Exceptions might be found in fisheries for species which are largely destined for export markets such as spiny lobsters, Trochus or giant clams and where all of the product arrives at a few centralized points for processing. Under such circumstances a continuous tally can be kept of the individual or total catches and the fishing closed when the quota or quotas are filled.

An overall quota might be established or the total allowable catch might be apportioned between individual operators. The amount allocated in the quota may be altered from year to year in accordance with the abundance of stock. This involves precise and reliable stock assessments and continuous monitoring of the stock.

Monitoring quotas for locally-marketed species of fishes would require an impossibly expensive statistical system.

## c. Seasonal closures

"Closed seasons have also been used on a wide scale to protect fishes, usually at a certain stage of their life history. For example, prawn trawling grounds might be closed at the time when the recruits are moving onto the grounds and thus give those recruits a chance to grow larger before they are caught.

Problems associated with this technique relate to the enforced idleness of the fisherfolk and, in the context of coral reef fisheries, the problem of the closure of the fishery for one species decreasing the catch of another species which is not in need of protection. As is the problem with quotas, where subsistence and artisanal fishermen are involved it is simply not possible to have a closed season for all species of fish as such people seldom have reserves of food or cash to tide them through such a closure. A closure can then only be applied to specific targetable species or those which can be returned to the water alive if they are captured along with other species. Again, in common with quota systems, the mandatory closure of the fishery on a particular date might leave an unduly large proportion of the stock unharvested in a good year or result in the stock being overfished in a bad year".

As stated above, closed seasons function in much the same way as quotas and are subject to similar limitations. In a multi-species fishery it might not be possible for fishing effort to be directed at other species and enforcement of the closure might then become problematical. Seasonal closures of a fishery can also have adverse impacts on employment, on established shore facilities and on vessel utilization.

#### d. Other restrictions

Other restrictions which are intended to protect breeding stocks include the protection of berried female lobsters and maximum size limits.

The protection of berried spiny lobsters is mandatory in many areas although it is difficult to prove that it does actually have positive benefits on recruitment of future year-classes. It is often evaded by fishermen who simply scrub off the eggs. It is pointless to apply it in a spear fishery where the lobsters are injured.

Maximum size limits, intended to ensure that the largest adult animals survive to breed are based on the knowledge that the egg production in most animals is proportional to mass and that large females thus contribute the greatest numbers of eggs during a spawning season. It is also possible that large animals will have superior genetic characteristics in terms of growth rate and therefore should be preserved. It can be recommended in the case of trochus, giant clams, green snail, sea cucumbers and other targetable organisms. Maximum size limits cannot be applied in any fishery where the fish are injured during capture.

#### 2.2.2.2. Gear restrictions

"The limitation of use of various fishing gears is a widely used management technique which offers particular scope in enhancing harvests from coral reefs. Gear restrictions are often introduced in an attempt to exclude commercial fishing interests from near shore fishing grounds. In the context of coral reef fisheries it is clear that in most instances gear such as the muro-ami net should be banned. Other gear restrictions could be aimed at selectively harvesting different species. This gives an opportunity to optimize harvests of different components of the multi-species fishery by excluding generalized, non-selective fishing techniques which catch a wide range of species" (Munro and Williams, 1985).

This is a method used worldwide. The restrictions are imposed on specific fishing gears or on their specifications; for example, mesh size limitations on fishing nets. Both the composition of the catch and the size of individual fish caught are usually affected. The method works more effectively should it be used simultaneously with other forms of control; for example, restrictions on the number of vessels entering the fishery or on the number of units of a particular fishing gear that are permitted to be used.

Gear restrictions are very often applied in situations where it is politically unacceptable to restrict the number of individuals participating in the fishery. The most efficient items of gear are therefore most often banned and employment thus spread amongst a larger number of the population. It is also often used to exclude groups who use technologically advanced equipment from fishing grounds and stocks which have traditionally been fished by small-scale fishermen. The banning of the use of trawl nets throughout Indonesia is a particularly striking example of this restriction and it claimed to have had the desired effects. Very often, powerful political interests will attempt to intervene to ensure that such bans are not enforced.

Bans on the importation of illegal fishing gears can assist in the enforcement of gear restrictions.

The interaction between small scale and industrial fisheries can be of particular importance and serious social consequences have been recorded where small-scale and capital-intensive fisheries compete for the same resources (e.g. in San Miguel Bay, Philippines, as documented by Smith et al (1983)).

#### 2.2.2.3. Closed areas

##### a. Permanent reserves

"The creation of permanently protected areas which will serve as nuclei of breeding stocks has been advocated and in some areas is taking the form of marine parks or other sanctuaries. Although in theory a fairly small nucleus of adult fishes might be able to produce sufficient larvae to produce recruits over a wide area, we have insufficient knowledge of current systems and of larval dispersal to be sure that this would be successful. Nevertheless, it can be suggested that for most reef areas the creation of such reserves is a positive step which can be taken very rapidly and which probably will be useful in maintaining recruitment" (Munro and Williams 1985).

Permanent reserves are recommended for island states. Current evidence suggests that juvenile fishes or invertebrates resulting from local-spawning will tend to mostly settle relatively close to where they were spawned and that preservation of dense fish stocks in selected areas might therefore have beneficial effects on the fisheries. Such areas would also be of much interest and value to tourists and could be combined with general marine conservation areas such as

marine parks and reserves. Areas which have been identified as important nursery areas should also be protected.

Problems can be foreseen in those nations where rigid traditional ownership of coastal waters has been maintained, as no one group is likely to be willing to give their area as a conservation zone.

#### b. Periodic closures

Rotational closures to rest given sectors of reef could also be a useful management tool. However, in areas where access is restricted to the adjacent land owners such a system would result in loss of income or food. In other areas where extensive tracts of reef are managed by a single authority (e.g. The Great Barrier Reef) such a policy might be useful. It would appear to have more application in relation to recreational fishing (Munro and Williams 1985).

This refers to closure of an area for more than a year, in contrast to the seasonal closures described in section 2.2.2.1. It has particular relevance to relatively remote areas (e.g. seamounts or isolated uninhabited atolls) when it might be desirable to "pulse fish" on a rotating basis every couple of years. In this way relatively good catches can be taken for a short period as the accumulated large fish are removed and then the area closed to enable stocks to rebuild.

#### 2.2.2.4. Limited entry systems

Limited entry systems are used to restrict the numbers of fishermen, vessels or gears in a fishery, with the prime intention of holding fishing mortality at a level which will optimize the harvests.

##### a. Annual licensing

The sale or issue of restricted numbers of annual licenses is a standard fisheries management practice. However, it can become inequitable in the context of the fisheries of developing countries where employment opportunities or alternative incomes may be extremely limited. In such places the system invariably breaks down if only because the fishermen are so impoverished that they are unable to afford a license. In some areas licenses are auctioned but this would not be applicable in a small scale artisanal fishery or in which failure to buy a license would result in a complete loss of livelihood" (Munro and Williams 1985).

In the context of small scale coastal fisheries it appears to us that the issue of renewable annual licenses will achieve little and could be perceived by the fishing communities simply as a revenue-raising device applied to what has conventionally been an open-access resource. Enforcement would be very difficult and, if not rigorously pursued, would render the exercise pointless.

##### b. Permanent licenses

The issue on a one-time basis of permanent, saleable, transferable licenses to existing fishermen with a buy-back scheme to retire excess fishermen has been advocated by Munro & Smith (1984).

Under such a scheme licenses would be issued to all fishermen, and a proportion of those licenses immediately brought back to establish a value. Those fishermen selling their licenses would have to retire from fishing. The system would ensure that numbers of fishermen did not increase as populations increased and would provide a means for reducing the numbers of fishermen if fishing efficiency increased. This would be impractical in areas which are already heavily overfished and in which no alternate form of employment is available. In areas which have not yet reached this sorry state it would provide a means for stabilizing fish production at a high level and providing employment for a strictly limited number of individuals. To some degree the average income earned could be predicted in advance.

One of the principal advantages of the system is that if successfully introduced it becomes self-regulating, in that fishermen would ensure that unlicensed individuals did not poach in their territory.

We believe that the system proposed by Munro and Smith (1984) could be quite widely applicable in the South Pacific region. Licenses could be issued to, and owned by, individual fishermen for operating at specific islands or fishing grounds or using specific gears and it would therefore not be necessary to introduce the scheme throughout a country. It would also be possible for the license to exclude certain specific resources such as trochus, giant clam or spiny lobster, which were the subjects of other management schemes. An important feature of the scheme is that the individual fisherman is licensed and all persons employed on a fishing vessel or participating in fishing activities would need to be license owners. This would ensure that if larger vessels were introduced into a fishery, the vessel owner would be constrained to use only licensed fishermen in the crew and control of the fishery would still rest with the licensed fishermen.

Koslow (1982) reports that a similar scheme in Alaska had adverse effects in that the poorer members of a salmon fishing community tended to sell their licenses to non-local entrepreneurs, resulting in a diminishing local participation in the fishery. However, in this example only a single license was needed per vessel and individual crew did not require licenses. There is therefore likely to be a need for residence requirements for license holders and a limitation of one license per individual.

If such a scheme were adopted, it would be most important that the authorities and politicians carefully explore the implications of initiating a restricted access system, in which unlimited access to the country's marine resources is abolished. Objections will be raised in many quarters, particularly if the system is not clearly explained. Problems which are immediately recognizable concern the positions of subsistence and recreational fishing interests. Subsistence fishing is of importance throughout the region and it would obviously be impractical to issue licenses to every man, woman or child who searched the intertidal flats or reefs for edible animals or plants or who cast a line into the water from shore. Likewise, it would be impractical and undesirable to exclude recreational fishermen, including tourists, from occasional fishing activities.

Ways of meeting this problem would include;

- (1) limiting subsistence or recreational catches taken without the use of a boat to, say, 3 kg/person/day,
- (2) limiting recreational fishing from boats to the use of hook and line and imposing a bag limit of, say, 3 fish/person/day.
- (2) prohibiting the sale or barter of fish by unlicensed fishermen or fish dealers.

Catch limits allowed to recreational and subsistence fishermen could be adjusted downwards as mortality rates in the fish stocks increased and if commercial catch rates started to fall to uneconomical levels. However, in the latter case the more obvious solution would be for the government to buy back an appropriate number of fishing licenses.

In any fishery the tendency of operators is to improve the catching efficiency of their gear and equipment by adopting technological innovations. For example, boat sizes may be increased, nets increased in size or quality, more or better hooks added to lines, the hauling power of line haulers increased or more powerful engines used. In such cases governments might also need to initiate a license buy-back scheme to reduce the numbers of active fishermen. It is possible that it might also be necessary or desirable to purchase their fishing vessels. Provision must therefore be made for funding to operate buy-back schemes.

#### c. Exclusive access

Situations exist in the region whereby fishermen or groups of fishermen require exclusive access to a part of the fishing grounds if they are to operate successfully. Examples of this are the licensed fish traps used in Tonga, in which persons unconnected with their operation may not enter the trapping area. Exclusive access rights are also needed for aquaculture ventures in order to protect the cultivator's investment of time, effort and capital. Artificial reef constructions, although not common in the region, would also require some sort of access rights if the persons doing the construction were to be the beneficiaries.

A question of more immediate concern to the region concerns rights of access to fish aggregating devices (FADs). Where near-shore FADs are successfully installed, serious competition for access can ensue, with resulting conflicts between fishermen. To date, costs of installation of nearshore FADs have been borne by governments (as opposed to offshore installations by tuna companies) and it appears that private groups have not yet expressed interest in investing in such installations, possibly because they would not have exclusive access rights. If exclusive access right to FADs were available they might become an attractive proposition to groups of fishermen or entrepreneurs. We are not aware of legislation in any country of the region which addresses this problem.



### 2.2.3. Indirect management methods

These are methods whereby the revenue or cost curves in a fishery are altered by the imposition of taxes, subsidies or other administrative devices. Great care has to be taken to ensure that unanticipated results do not emerge or that the costs of administering, implementing or enforcing the methods do not outweigh any gains.

#### 2.2.3.1 Taxes and subsidies

Application of tax and subsidy schemes to fisheries as management measures are quite extensively used in developed fisheries.

Disincentives are created by application of taxes to inputs such fuel, fishing gear and equipment. High prices of these items increase operating costs in the fishery, reduce profits and eliminate marginal operators or decrease the use of undesirable gears. However, increased fish prices might also be a consequence. Taxes are not imposed as a management tool anywhere in the region.

Taxes can also be levied on catches to decrease the revenue of fishermen and thus discourage fishing. In multi-species fisheries, taxes could be levied on certain overexploited species. However, fishermen could quite easily evade the taxes where marketing of fish is not centralized or where fish can be sold or transshipped at sea. Most importantly, such taxes are seldom politically acceptable.

Subsidy schemes are most often used as incentives to increase the amount of fishing by reducing capital and operating costs. However, they can also be applied to encourage the use of certain fishing gears or methods. For example, a subsidy on large-meshed nets could create a differential such that small-meshed nets were unattractive to use.

#### 2.2.3.2. Price and marketing strategies

Governments can create a monopoly on marketing of fish in which catches by local fishermen are marketed through state-owned establishments where prices are not set in accordance with forces of supply and demand. In this way the revenue of fishermen is reduced and there are disincentives against further entry into the fishery (Lawson 1984). However, it might also result in small operators being forced out of the fishery.

#### 2.2.3.3. Development of alternative fisheries

One of the major development thrusts in the region involves the creation of new fisheries which give fishermen alternative fishing opportunities. Examples in the region

include the construction and deployment of fish aggregating devices (FADs) which has promote the development of trolling fisheries and the development of droplining techniques for deepwater demersal snapper and grouper fisheries.

Introductions of new species of shellfish and other marine organisms have created new fisheries. For example, the introduction of Trochus niloticus to Cook Islands and Tuvalu. The cultivation of marine organisms such as seaweeds (e.g. Eucheuma sp.), giant clams or finfish could also have an impact on fisheries by reducing pressures on natural stocks.

Such development programmes give the fishermen the opportunity to move away from traditional fishing grounds and overexploited fisheries. The effectiveness of such a scheme would depend on fishermen moving out of overexploited fisheries and into the newly-developed one and on the resulting vacancies not being filled by new entries to the original fishery.

## 2.3. Problems of implementation and options for island nations

### 2.3.1. The consequences of development

In every fishery, in the pre-development stage the requirements are mainly technological and economic: how to catch, process and distribute the fish. No management requirements occur. Because of the socially self-sufficient settings of the societies in the South Pacific region, in contrast to Asia and Africa and the Americas, there has been relatively little commercialization in the fisheries, particularly in the traditional fisheries sector. Fisheries administrations, with the task of developing fisheries have had to provide incentives to encourage entry into the fisheries and to improve the efficiency of the fishing units. Fakahau and Shephard (1986) summarize the development objectives of most countries in the region as follows:

- increased production
- expand and improve technical capability
- improve fish marketing
- expand development of tuna fisheries
- increase participation of nationals and income
- earn foreign exchange
- improve recognition of needs for management of resources

Development schemes have almost always been financed by governments, often with the assistance of foreign aid, and not by the fishing communities. They all have aimed to increase fishing effort and to improve profitability. In economic terms and in reality, they constitute "fisheries growth", having a twofold effect on the country. Firstly, the fishing occupation is expanded and, secondly, occupations are created in ancillary activities, termed "linkage effects" (Lawson, 1984). Governments may face problems both in controlling or terminating incentive schemes without adversely affecting the

linkage effect.

Many fisheries in the region are presently in the process of development and few fisheries management regimes have been implemented. However, it is essential that the fisheries administrations of the region recognize at an early stage the need to change or orientate directions of development programmes towards management. Already some countries have expressed concern about the likely effect of fisheries growth, particularly in coral reef areas adjacent to towns and villages. Concerns have also been aired about the vulnerability of deep water demersal stocks to intense fishing. The likelihood of problems occurring depends on whether or not development agencies recognize the biological finiteness of the resources.

It is therefore recommended that the following points be considered whenever development schemes are underway:

- (1) Fisheries administrations must recognize that sooner or later investment in development schemes has to cease in order to avoid over-exploitation of the resources:
- (2) Fisheries administrations should attempt to inform fishermen of the reasons for halting development or incentive schemes, preferably well before it happens:
- (3) Fishermen need to be convinced that the fish resources are not infinite. This could be done through education and training programmes:
- (4) Fishermen need to understand why it is necessary and desirable to impose management measures:
- (5) Efforts to obtain information required for stock assessment and management should be initiated at the inception of the scheme.
- (6) Entry of fishermen, vessels or capital into the developing fishery should be controlled from the start and additional entries prevented when the catch rates have declined to half of the initial catch per unit effort.

Much of the economic, social and political distress that occurs when the fishery is overcapitalized can then be avoided (Gulland, 1973).

Administrations should make efforts to understand the social and political setting of the fishing communities to which management programmes would apply and take these factors into account when formulating management systems in order to ensure acceptance and greater participation by the communities. It is important to note that the social and political setting of a fishing community is not a problem; rather, it is a "situation". It would prove very costly and time-consuming to try to change that "situation".

### 2.3.2 Problems of implementation

The authors do not wish to under-emphasize the difficulties likely to be encountered in getting management programs to work effectively. Although there is a large literature on management methods for fisheries covering the theoretical and practical applications, there have been relatively few successes on a global basis. Many methods cause conflict and confusion and many are costly to implement. Most importantly, failures of management schemes have occurred in developed countries, which have the means to obtain the required data for management through research, the manpower and skills to develop management policies and the resources to implement management measures.

This suggests that Pacific Island governments will face difficult tasks in making management decisions applicable to their respective fisheries situations and having them accepted socially and politically. It is thus important to take note of the key reasons for the lack of success when considering possible management methods to use, as outlined below:

- (1) Failure to implement in time to prevent serious overfishing.
- (2) Difficulties in enforcement which often arise due to lack of funds to meet costs of enforcement, the lack of appropriate legal powers and a lack of manpower to enforce management measures.
- (3) Evasions of management measures by fishermen arise from conflicts between government management objectives and the fisherman's profit motive.
- (4) Excessive costs of administration and implementation of management measures arising from unduly complex management systems.
- (5) Inappropriate and inadequate policies and objectives arising from ambiguous management plans, formulated as a result of conflicting administrative and political considerations.
- (6) Ignorance of the impact of control measures, leading to misunderstandings and misinterpretations of management objectives.
- (7) Division of authority and lack of co-ordinations between numerous government departments, ministries or other organizations involved in fisheries development and management.
- (8) Inadequate statistics and information upon which to base management objectives, coupled with a lack of appreciation of the usefulness of statistics or of which statistics and data are required for either fisheries management or stock assessment.

(9) Undue political interests causing the administration to make incorrect management decisions; the most notable problem being a lack of political will on the part of government to accept sound management advice and make the appropriate management decisions.

#### 2.4. Creation of a management regime

A cursory review of administrative structures for fisheries management on a worldwide basis will reveal a huge diversity of arrangements and it is impossible to make many meaningful generalizations. The arrangements adopted will depend very much upon the organization of governments, provincial governments, local councils and statutory bodies and on the expertise available in the relevant government departments and in the existence or otherwise of fishermen's organizations.

In the context of coastal fisheries we suggest that irrespective of other arrangements, mechanisms be developed to serve as links for consultation between government and the fishing communities. In most countries local councils or administrations already exist and this should not constitute a problem. In some countries it might be necessary for the fishermen operating in particular areas to nominate or elect a small number of their fellow fishermen to act as a conduit for passing the opinions of fishermen on to government and for ensuring that information flows from government to the fishing community.

#### 2.5. Environmental management

A point which cannot be overemphasized is that conservation of the environment is an essential prerequisite to managing the fisheries. If degradation or pollution of reefs, lagoons and coastal waters is permitted, yields will decline despite all other management measures. In the Philippines, for example, it is estimated that a large portion of the country's reefs have been damaged and some have been completely destroyed (Gomez et al. 1981). In such areas the highly productive coral reef fisheries have lost.

### 3. CONCLUSIONS

We conclude that it should be possible to implement cost-effective systems for monitoring and managing coastal fishery resources in the South Pacific region. There are a wide range of possible management systems and methods, both direct and indirect. However, in the longer term it seems inevitable that steps will have to be taken to limit entry into the fisheries to prevent overharvesting.

In the imposition of any management system much thought should be given to their likely effect on the fishing communities, because without the support of these communities it is unlikely that any management regime will ever be successful.

Finally, we believe that it is necessary to draw attention to the fact that, to a greater extent than is the case for many other nations, the island states of the Pacific have an enormous dependency on their marine environments and resources. In some cases they are virtually the only resources which can be exploited and developed for the benefit of the nation. Managing, conserving and protecting these resources is not an easy task and it is most important that governments do not delay in making the the difficult political and administrative decisions needed to ensure the wise use of these resources.

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