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AN ECONOMIC PERSPECTIVE FOR THE RESOLUTION OF FISHERY RELATED RESOURCE ALLOCATION PROBLEMS*

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Conflicts over the use of fish and their habitats are becoming more common as Australia's marine environmental resources become scarce relative to the demands being placed on them. With a growing and more affluent population, such disputes are expected to become more complex and more acute in the future.

This paper presents an economic framework within which the problems relating to resource allocation in fisheries can be addressed. The objective of this approach is to provide a rational and consistent approach to natural resource allocations decisions by laying a foundation for analysing both the nature and source of the conflict and the important tradeoffs to be made in reaching a resolution.

It is argued that a market will provide an efficient solution if well-defined property rights to the resource can be established and if all user groups can effectively participate in a market for the resource. Where such conditions cannot be established, alternative incentive structures are needed, and a greater degree of government intervention may be justified from an economic viewpoint in order to obtain an efficient outcome.

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Introduction

The use and management of the water, shoreline and land resources of the Australian coastal zone have become the subject of controversy and, in some cases, intractable conflict in recent years. The tradeoffs to be made in resolving coastal zone management problems are difficult because these resources are the primary focus of most of Australia's recreational, tourist, residential, conservation, agricultural, mining, industrial and commercial pursuits. Potential for conflict between development and conservation in the coastal zone is expected to strengthen as both the quantity and quality of the resources diminish relative to the competing demands from a growing and more affluent population.

In the case of fish resources, such problems stem from the narrow continental shelf and nutrient deficient waters that produce a relatively small resource base. Given these natural constraints to resource expansion, the increase in the level of human exploitation, including the indirect effects of coastal zone developments, has inevitably led to conflict over the use of fisheries related resources.

Conflicts among direct users of fish resources have included disputes between commercial and recreational fishers over Northern Territory barramundi, between conservationists and commercial fishers over the incidental catch of dolphin in pelagic driftnet fisheries, and claims by indigenous people for sea bed rights in the far north of Australia. Other conflicts have focused on land, water and shoreline activities which incidentally deplete fish stocks through detrimental effects on fish habitats. Major issues connected with the indirect use of fisheries resources include offshore oil and gas exploration, coastal resort development, and sewage, pulpmill and other marine wastes.

Whether the conflict is specifically related to fish resources or to the broader issues of coastal zone management, the common difficulty faced by decision makers is the selection of policies and mechanisms to resolve the resource allocation problem.

This paper presents an economic framework within which such issues can be addressed. Applied in broad terms to fisheries related conflicts, the economic framework is shown to provide a foundation for the analysis of the nature and source of conflict, as well as of the important tradeoffs to be made in reaching a resolution.

Analysis of these issues is divided into three stages. The first stage asks whether there is an economic problem; the second involves determining whether a market solution is feasible; and the third stage looks at the role of alternative regulatory mechanisms in resolving the conflict. This paper gives special attention to the type of economic information decision makers need if they are to compare the value of competing activities.

The role of economics in natural resource use decision making

While no single strategy or discipline is likely to be able to resolve resource use conflicts, economics provides a useful decision-making framework because it is concerned specifically with that allocation of scarce resources that maximises the benefits to society as a whole. In relation to resources such as fisheries, the economic objective is efficiency, requiring that resources be placed in their 'highest valued end-use or end-uses' both currently and in the future. These uses will include

preservation, conservation and commercial exploitation. In this manner the economic approach incorporates society's preferences for the less easily quantifiable benefits obtained from environmental resources. The aim of using the broad efficiency criterion for making resource allocation decisions is to ensure that greater consistency is achieved and that decisions take all social interests into account. With explicit consideration of the costs and benefits arising from resource use, economics can be very helpful in the design and selection of means to minimise the cost of achieving natural resource use targets. In this sense the economic approach allows rational debate on all the issues raised by resource use disputes. Further, by focusing the analysis on the source of the problem, namely, the demand for the services of natural resources and the constraints on the supply of those services, the economic approach is capable of responding flexibly to the needs of decision makers in a world of changing social preferences and resource availability.

While the efficiency objective provides a useful benchmark for assessing alternative resource allocations, this criterion cannot often be used for decisions about the degree of fairness with which wealth and income are distributed among individuals. In fishery management decisions issues of distribution and other non-efficiency objectives often override the aim of achieving the maximum net social benefit. Despite these limitations, the socially highest valued use may still be determined within these broader constraints on government decision making. Alternatively, the efficiency criterion can be used to assess 'inefficient' allocations in terms of the opportunity cost (the benefits foregone) of the highest valued activity.

Existing framework for conflict resolution

Fish resources are classified as renewable resources because they are capable of regeneration indefinitely. If a resource is being harvested, however, its capacity to regenerate depends on whether it is subject to a level and type of use appropriate to the reproductive biology of the fish. Renewable resources, if over-used, may diminish to the point of extinction. Inappropriate use, evidenced by a persistent trend toward excessive use of the resource and consequent severe depletion of fish stocks, is a common problem in open access fisheries. In such fisheries users are completely free to maximise their own net benefits without having to consider the economic costs they impose on others in either current or future periods (Waugh 1984).

Inefficient use of fishery resources may also arise in managed fisheries where incentives still exist for fishers to increase their fishing effort and thus lead the fishery away from the socially optimal level of resource use. This tendency to overcapitalisation results in a loss of economic rents, that is, profits in excess of a return on capital employed that would be normal for the particular risk characteristics of the fishery (Geen and Nayar 1989). For example, before the introduction of individual transferable quotas to the southern bluefin tuna fishery in 1984, it was argued that the management system then in place (a total allowable catch quota) had added to the overcapitalisation already evident in the fishery (Industries Assistance Commission 1984).

Under the Commonwealth Fisheries Act 1952 (amended 1979), the Commonwealth government has authority to intervene in all Commonwealth fisheries. Similar in concept to State fisheries management legislation, the Commonwealth act provides for the 'conservation' of fishery resources, as well as their 'optimal utilisation'. In principle, these objectives allow the government

to make decisions about the level of use of a fishery resource for a range of different end-uses, both commercial and non-commercial. In practice, the Commonwealth Fisheries Act has been used mainly to conserve stocks and to maximise the economic return to commercial fishers; it has not been used explicitly in any attempt to maximise net economic returns to society. The provision of benefits to other user groups is often simply an incidental effect of such management (Haynes, Geen and Wilks 1986).

A number of fishery resources are regulated to provide benefits primarily for conservationists, biologists, sport and traditional fishers. To this end legislation has been enacted on the taking of whales, porpoises, dugong, marlin and other marine species; other legislation controls marine pollution or protects the marine environment. This process of fisheries resource allocation is carried out with little explicit assessment of the net benefits to society which arise from such decisions, policies and management regimes. Resource allocation decisions have generally been made in accordance with one or more considerations, including socio-political pressures, biological or technical standards and demonstrated historical or cultural associations. The importance of these issues cannot be dismissed, but if they are used as the sole basis for resource allocation decisions such criteria are rarely adequate for ensuring that all the costs and benefits of a proposed change in resource use are explicitly considered. While the balance of costs and benefits is never the sole basis on which public decisions are made, without this information it is difficult to judge whether resource use decisions will result in the best possible allocation of resources for society.

In the past there was little need for any extended analysis of the costs and benefits which arise from changes in resource use because of the high degree of indifference on how best to use the resource. The availability of substitute resources and the limited number of parties involved have generally made it possible to reach simple solutions. However, with the increasing scarcity of fish, the growing diversity of interest groups and the changing social values and demands, conflicts over the use of fish and their habitats are becoming complex and acute. The cumulative effects of coastal development on fisheries, for example, is a major issue at all levels of government and for all users of the resource.

Countries like Canada and New Zealand have acknowledged the conflict potential of mixed activity or multi-purpose fisheries and related resources, and they have formulated uniform principles for the allocation of fish resources. The conceptual and practical difficulties of resource allocation in mixed activity fisheries are also receiving greater attention in the fishery economics literature (see for example, Anderson 1980a, Edwards 1980, Joseph 1980, Sutinen 1980, Tisdell 1986, and Easley and Prochaska 1987).

In Australia, the Commonwealth government has acknowledged the need for a more consistent approach to the resolution of such issues with the establishment of the Resource Assessment Commission (RAC) in 1989. Among other things, the RAC is to enquire into the environmental, cultural, social, industrial, economic and other values of a resource, and the losses and benefits to be had from the various alternative uses, or combinations of uses. The government's intention is to use the information provided by the Commission to make resource use decisions that seek to optimise the net benefits of the nation's resources to the Australian community (Resource Assessment Commission Act 1989).

The nature of fisheries-related conflict

Physical sources of conflict

Conflicts among users of fish resources arise for one of two reasons. First, even if there is enough of the resource for all user groups, one group may be prejudiced toward another groups' use of the resource or to its social behaviour. For example, an investigation into resource use conflict on the Houtman Abrolhos islands off Western Australia among fishers, tourists and conservationists revealed that much of the conflict was based on misunderstanding and distrust of each others' motives (Fishing Industry News Service 1988). Resolution of such disputes may be achieved by arbitration and accurate appraisal of the situation, possibly making reallocation of resources unnecessary. Secondly, conflicts may be caused by a genuine overlap of activities such that use by one group cannot be expanded without a corresponding reduction in the amount of the resource available to another group. Conflicts of this nature can generally be classified into four categories: locational, migratory, gear and ecosystem disturbance. A description of each of these sources of conflict is provided in Table 1.

Is there an economic problem?

Although the above classification of fisheries conflict describes the physical causes of disputes, it does not provide any guide to the solution of such conflicts.

From an economic standpoint, the type and level of use can be regarded as problems only in cases where there are net social benefits to be gained by changing to some other pattern of resource use. Economic over-exploitation is broadly defined as any level of resource use beyond the social optimum (Waugh 1984). Defined in this manner, the economic objective of fisheries management is to maximise the net benefits that society receives over time from the use of fish resources. The objective is thus not necessarily to minimise resource depletion, but to ensure that all resources are applied to their highest valued combination of end uses, both currently and in the future. 'Value' includes not only the commercial value of fishing but also unpriced values, such as the knowledge that a fish species exists. Ideally, the broad economic objective takes into account the cost of catching fish as well as the cost of managing the fish stock and the value that society places on the existence of the resource.

The biological objective of fisheries management is to achieve the level of fishing effort which produces the maximum sustainable yield (MSY). Biological overfishing could therefore refer to a level of effort that causes the population to fall below the point where it is able to provide the highest yield that the fishery is capable of producing. More commonly, biological overexploitation is used to describe 'recruitment failure', a situation in which the number of juvenile fish entering the population is below the level necessary to sustain it. The southern bluefin tuna and southern shark fisheries are considered biologically overexploited because there is thought to be a real danger of recruitment failure (Scott 1988; McGregor 1988). A summary of the degree of biological exploitation of selected fish stocks in the Australian Fishing Zone is presented in Table 2. The biological approach to fisheries management, being concerned with the effect of human exploitation on the population dynamics of a fish stock, measures the return from a fishery in physical terms and ignores the opportunity costs of maintaining fish stocks at the MSY level.

Table 1: CLASSIFICATION OF PHYSICAL SOURCES OF FISHERIES RELATED CONFLICT

Source of conflict	Definition	Example
Locational	Disputes that are confined to congested fishing sites where fish caught by one user group are unavailable to other users at the same site.	The conflict between commercial and recreational fishers seeking tailor off the beach at Fraser Island.
Migratory	Disputes at the local, national and or international level arising from the sequential exploitation of a fish stock across a number of fishing sites. Dispute arises because fish taken at one point depletes the number of fish available at other fishing locations.	The conflict between Australia, New Zealand and Japan over negotiations to introduce a global catch restraint on southern bluefin tuna.
Gear/method	Disputes caused by the use of a particular catching technology by one user group that directly or indirectly affects other users adversely.	The dispute over pelagic driftnetting for albacore tuna because of the potential of this method to rapidly deplete targeted and non-targeted species of commercial and conservation value.
Ecosystem	Disputes that result from the incidental depletion of fish stocks as an outcome of food chain disturbances or degradation of fisheries habitat.	The Exxon Valdez oil spill and its impact on fisheries habitat for species of recreational, commercial and conservation value.

Nevertheless, pursuit of the maximum economic yield is generally compatible with the biological objective. This is because prevention of economic over-exploitation will usually ensure the maintenance of a fish stock larger than that required for a maximum sustainable yield (Tisdell 1985). Furthermore, if there is social value attached to the existence of a species, biological overexploitation is incompatible with the aim of achieving the socially optimal level of resource use.

Table 2: BIOLOGICAL STATUS OF MAJOR FISHERIES IN THE AUSTRALIAN FISHING ZONE IN 1989

Fishery	Exploitation level
Northern prawn	Fully exploited
Other prawn	Fully exploited to slightly overexploited
Torres Strait prawns	Fully exploited
Rock lobster	Fully exploited
Scallops	Dangerously overexploited
Abalone	Some stocks overexploited
Southern shark	Overexploited
Southern bluefin tuna	Dangerously overexploited, commercial viability threatened
East coast tuna	Nearing full exploitation
Jack mackerel	Uncertain, probably full exploited
Great Australian Bight demersal fisheries	Exploitation low overall but increasing with development
South-east trawl, shelf and slope component	Some stocks overexploited
Orange roughy	Unknown, but present catch levels probably not sustainable
Gemfish	Eastern stock over-exploited
Western and north-western deepwater	Probably fully exploited in parts of NW deepwater crustacean fishery, resources unknown elsewhere
Northern and north-west shelf demersal	Northwest shelf over-exploited, and others fully exploited
East coast seamounts	Little known; probably unable to support large fishery

Source: Adapted from: Minister for Primary Industries and Energy (1989b).

An economic perspective to fisheries conflict

From an economic perspective, an inefficient allocation or use of fishery resources can most often be attributed to the failure of markets or institutions. Such failure occurs because of difficulties in obtaining a true valuation of the benefits that resource users receive.

This source of market failure is particularly evident when conservation and recreational goods are obtained from fishery resources. The main problem is that benefits of this nature tend to be obtained even when the beneficiaries do not meet the full social cost of their use of the resource. This problem, known as 'free-riding', arises if the benefits obtained are not reduced when others share the good or if they cannot be made the exclusive property of those who pay for the right to obtain benefits from the resource.

In the first case, conservation or recreational benefits received by one individual are usually not reduced when others share the good. For example, the enjoyment an individual gets from the knowledge that whales are conserved does not reduce the enjoyment that others receive from the same knowledge. Once a whale population has been conserved, it costs no more to provide the existence benefit of whales to 17 million people than to 16 million. The benefits from recreational fishing also tend to be shared non-competitively (at least in an uncongested fishery) to the extent that the opportunity to relax outdoors is more important than the number of fish caught (Cauvin 1980; Australian Recreational Fishing Confederation 1984). In contrast, the benefits obtained from commercial fishing tend to be more clearly competitive because the entire profit (benefit) from that fish becomes unavailable to other commercial fishermen.

In the second case, it may be neither technologically nor institutionally feasible to assign and enforce rights of exclusive individual use to the resource (a situation known as non-exclusion). Conservation benefits, such as the knowledge that whales exist, are also non-exclusive because it is impossible to prevent individuals from enjoying them. Similarly, the benefits of marine recreational fisheries are usually available to anyone who wants to fish. In this case non-exclusion is attributed to the costs (relative to the benefits) of introducing and enforcing a licensing system.

For each of the above cases, individuals have the opportunity to escape from or minimise their contribution towards resource provision. Where there is non-competitive consumption, a private entrepreneur cannot tell how much benefit each individual receives and charge accordingly. An individual's valuation of the benefit received can be revealed only by the extent of that individual's willingness to pay for the good. Aside from the cost of gathering such information, the problem is that individuals have a strong incentive to misrepresent their valuations of the level of benefit they receive if any actual payment is required. Individuals can free-ride in the knowledge that the benefit will be provided without payment.

In situations of non-exclusion, because the benefits of any individual's investment are freely available to all other users, individuals have little incentive to invest in improvements to the productivity of the resource. This problem is common in unmanaged fisheries because it does not pay an individual to conserve fish stocks when all the benefits of doing so are likely to be gained by others. Free riding does not occur with privately produced goods because, if an individual does not pay the market price, that individual is automatically excluded from the benefits of consumption.

Because free-riders assume that the resource will be available irrespective of their investment, it is very difficult to attain an efficient price and level of resource provision by a market mechanism. The implications of free-riding for market-based resolution mechanisms to resolve fisheries disputes are discussed in the following section.

It should not be concluded that market failure and any ensuing conflict are sufficient to justify government intervention in these matters. From an economic standpoint, government intervention can be justified only if, first, the existence of a dispute is incompatible with maximising net benefits from the resource to the community over time; and, second, if the costs of resolution do not outweigh the benefits.

Given the possibility of market or institutional failure in the allocation of fishery resources, consideration should be given to the feasibility of restructuring incentives and institutional arrangements so as to bring about a more efficient allocation. Possible approaches to the allocation problem range from market based mechanisms to regulation. The major advantage of a market solution is that, once established and operating perfectly, a market will spontaneously direct resources to their highest valued end-use(s); managers are thereby spared the task of assessing the relative values of competing activities. A market can also respond flexibly to changing circumstances. Nevertheless, the suitability of various policy options must be assessed case by case and with full consideration given to the characteristics of the fishery, to the practicalities and costs of implementation and to the benefits likely to be derived from each policy.

Can a market solution be developed?

The precondition for a market solution is the establishment of clearly defined rights of access to and ownership of the resource in question. Because users of fish resource can own the fish only after it is caught, property rights in fisheries generally mean the right to participate in the fishery, not the right to any particular fish.

There is a variety of fishing rights, including licenses, endorsements, units of capacity and tradeable permits which grant access to a specified portion of the harvest and sole ownership. Of these, only the last two are close to being a well-defined property right: that is, the right to catch a certain quantity of fish, enforceable by law and transferable between buyers and sellers of rights. The other types of fishing rights are not so well-defined and may not permit resources to move to their highest valued end use. Holders of these rights, moreover, are often unable to capture all the benefits and must bear all the costs arising from use of the resource. For example, licence limitation confers only the right of access to the resource; it does not define the amount of the resource which may be extracted and therefore fails to prevent excessive competition between license holders and over-capitalisation within a fishery. For this reason, fishing licenses and endorsements are often combined with other input and output regulations in an attempt to reduce fishing effort.

Sole ownership and individual transferable quotas have been well explored in the literature of fisheries economics (see Clark 1973, Crutchfield 1979, Moloney and Pearse 1979, Copes 1985, and Geen and Nayar 1989), but theoretical discussions and practical applications of these mechanisms have usually been limited to single purpose commercial fisheries. Some of the advantages and disadvantages of sole ownership of and individual transferable quotas for single product commercial fisheries and mixed activity fisheries are considered below.

Sole ownership

Private sole ownership of an entire fishery would most likely ensure both resource conservation and economic efficiency because all the costs and

benefits of exploitation would accrue to the owner. If a single owner is motivated to maximise long run profit, pursuit of this objective should also maximise the net benefits to society. Extinction in a sole owner fishery is possible if the discounted flow of benefits from preserving a stock is less than the benefits of capturing the entire stock immediately. Because very few fish stocks could be physically exploited in this way, the likelihood of deliberate extinction in a sole owner fishery is very low. Extinction could inadvertently occur if deficiencies in information about the biological condition of the resource and the rate of resource depletion led to a level of exploitation at which the size of the stock became too small for its survival. The problem of imperfect information is critical to fisheries characterised by high value catches, low cost harvesting and slow reproducing stocks.

There are three other obstacles to the efficient application of the sole ownership policy. First, sole ownership of a commercial fishery may encourage monopoly profits when the demand for the product is not perfectly elastic and the owner is able to raise prices by restricting output (Menz, Geen and Collins 1986). Second, enforcement of sole ownership rights may be too costly, particularly for migratory fish stocks.

Finally, the owner of the resource may not be able to capture all the benefits of certain uses, one of which is conservation. If rights to ownership over whales were owned by an individual (ignoring the problem of negotiating an international agreement to establish such property rights), that individual would have to choose the level of commercial exploitation and the level of preservation. While the return from commercial exploitation would be well known, the return from preservation would be uncertain, since it is difficult, and probably costly, for the owner to determine the conservation value for whales because of the free-rider problem. For this reason it is likely that a sole owner could provide sub-optimal conservation benefits.

Individual transferable quotas

This type of property right is usually allocated to commercial fishers (or vessels) in the form of an individual transferable quota (ITQ) to harvest a specified proportion of a total allowable catch (TAC) of the stock. In Australia, ITQs have been applied in the southern bluefin tuna fishery, the Tasmanian and South Australian abalone fishery and the Western Australian pearl shell fishery in an attempt to allocate the commercial fishery resource efficiently. There are no known applications of this scheme in a mixed activity fishery.

The application of ITQs in commercial fisheries allows operators the freedom to choose the most efficient configuration of boats, gear and labour. This enables fishers to achieve the least cost method of harvesting their quota. Such a system reduces over-capitalisation and fishing effort because each fisher will be willing to pay for a quota with a price equal to the net present value of the rents that can be obtained from harvesting it. Fishers who sell quotas are automatically compensated for leaving the fishery by those who purchase the quota.

By setting a total allowable catch, a system of ITQs can also help fishery managers to conserve the stock. Once a market for quotas is established, government intervention can be limited to the enforcement of quotas and the collection of the biological and harvest data needed for adjusting TACs. Such intervention is necessary to ensure a socially optimal level of

resource use. An ITQ system is thus of potential interest as far as allocation of fisheries between commercial and conservation interests is concerned.

ITQs do have disadvantages. They can encourage the dumping of less valuable catch; they can give fishers an incentive to under-report their catches; and it can be difficult to set TACs. For these reasons ITQs are best suited to fisheries in which the catching and marketing sectors are fairly simple or clearly defined (Menz, Geen and Collins 1986). Multispecies fisheries, dispersed points of access and many different marketing channels are conditions which are likely to increase the costs of implementating an ITQ system, but its benefits may also be high (see Geen and Nayar 1989).

Are market solutions suitable for mixed activity fisheries?

The enforcement, equity and information problems of sole ownership and ITQ systems for single product commercial fisheries are also relevant to a mixed activity fishery. The entry of additional user groups may add complexity to a quota market, though more buyers and sellers would tend to enhance the operation of a market for quotas rather than impede it. A more important question is whether non-commercial users are able to participate effectively in any market for the resource and whether the prices that emerge accurately reflect the cost to society of the resources used. This type of problem is avoided in a purely commercial fishery because the profitability of fishing and the scarcity of quotas will usually force fishers to pay for quotas at a price equivalent to the benefits they derive.

In a mixed activity fishery all user groups want fish to be available in sufficient numbers to meet their needs. As noted above, these needs are often fulfilled not just by catching the fish, which depends on stock densities and effort, but also by the (non-competitive) goods which arise from direct or indirect use of fish resources. Anderson (1980a) has expressed an individual's willingness to pay for a recreational fishing day as a function of the average size and number of fish caught, their market price, fishing expenditures, and the environmental and social elements of the fishing experience.

The free rider problem is the main reason why efficient prices and markets are unlikely to do the job of allocating conservation and other non-market goods derived from fishery resources. Recreational fishers are widely dispersed and value the resource in many different ways, so it would be very costly to conduct a process of negotiation and exchange of property rights among all users. As Sinden (1984, p.160) explains, non-market benefits cannot easily be paid for,

> '(a) at the time and point of use,
> (b) by all relevant users, and
> (c) in proportion to the quantity of use'.

Even if it were possible to identify and locate all the beneficiaries of recreational fishing, the collective bid obtained would undervalue the benefits received. This would tend to occur because individuals face an incentive to offer a token payment in the hope that the bids of other beneficiaries would be sufficient to provide the level of recreational fishing required by all recreational fishers. This means that the preferences and values of recreational fishers, conservationists and other like groups would be poorly represented. Accordingly, recreational goods may be under-provided because the property rights to the resource will be

concentrated in the hands of user groups who are able to dominate an auction by their ability to raise investment and confine its benefits to themselves.

Club ownership of resources

If fishing clubs or conservation organisations purchased rights, using donations or fees from members of the organisation, they could reduce the costs of organising a bid. Organisations may be able to reduce (though never eliminate) free-riding by stressing that benefits are gained only by those who contribute (Bennett 1984). While this could increase the amount of money collected, benefits secured by organisation ownership may still be enjoyed by non-contributors: for example, it is impossible to deny the benefits of whale preservation to those who did not donate money to ensure their survival. In other cases exclusion may be technically possible but too costly in relation to the benefits of enforcement: most marine recreational fisheries would require a high level of surveillance to prevent non-members from fishing the club resource.

The ability to exclude unentitled users is also necessary for a concessionaire scheme. Under this scheme, access to the resource is granted to the concession holder (a charter boat operator, for example) who in turn provides access for various user groups. Such a scheme may be suitable for watching whales in small bays, or for recreational fishing on selected reefs. There are a number of advantages in a concessionaire scheme. First, those who seek the concession could bid for it and thereby generate resource rents. Second, conservation objectives could be achieved by attaching special conditions of resource use to the concession. Third, concession holders (given their 'property right') would have an incentive to assist in the exclusion of persons trying to gain access to the resource illegally. While such schemes operate in mainland national parks, there are no known applications of them to marine fishery resources.

Inland stream fishery resources are more amenable to market solutions. Since medieval times rights to inland stream fisheries in England have been appropriated as part of a territorial right that goes with the ownership of land beneath or adjoining the fishery (Scott 1989). Although the owner of the land may transfer the right to the fishery to others, such rights are generally inapplicable to marine fisheries on account of the cost or the difficulty of enforcement.

In situations where free-riding and enforcement problems can be minimised, the property right solution could offer an efficient means of resolving conflicts in mixed activity fisheries. Progress is being made toward the application of property rights to other natural resources; in the United States, for instance, permit systems have been established for game hunting (Economist 1988).

Is other government intervention justified?

The preceding discussion points to the possible need for alternative mechanisms for resolving conflicts over conservation or recreational goods in mixed activity fisheries. In these cases some form of government intervention other than the establishment of property rights may be required. Regulatory mechanisms for fisheries resources can be classified into three groups: direct regulation, indirect regulation and zoning.

Direct regulation

Fisheries regulations, either directly through laws to prohibit certain practices or indirectly through taxes, subsidies or other financial incentives, can be used to alter the inputs or output (catch) of a fishery. Input control may be applied to one or more components of fishing effort by means of regulations governing the number and capacity of boats, the time and location of fishing, the type of gear used and so on. Output can be controlled by regulations that directly specify the quantity and quality of fish harvested.

In a regulated environment fishers have less freedom to choose the amount of capital and labour they use, the time and location of fishing and the number and type of fish caught, though the extent of their restriction depends on the type and mix of regulations. One of the major criticisms of regulations over commercial fisheries is that they interfere with the maximisation of economic rent. This occurs because fishers in a regulated environment are not free to choose the least cost combination of inputs (Anderson 1977).

In a mixed activity fishery different sets of regulations and administrative procedures are required for the different activities of each user group. The Northern Territory barramundi fishery is regulated by separate controls on the recreational and commercial sectors. Commercial fishers are regulated by a combination of area and seasonal closures and by restrictions on gear and the size of fish caught. Commercial barramundi licenses are also limited, transferable and subject (along with associated net entitlement) to a government financed buy-back scheme. Commercial fishers pay licence, endorsement and vessel registration fees annually. Recreational fishers, on the other hand, are entitled to take barramundi using a rod and line or a handline without having to pay an access or licence fee, though bag limit and size restrictions apply. Special limits on catch, gear and season also apply to specific fishing areas. Although the regulations are distinct for each sector, commercial fishers believe that the combined effect has been to reallocate resource away from the commercial and toward the recreational sector (Northern Territory Department of Primary Industries and Fisheries 1988). Consequently, commercial fishers have strongly criticised the unfairness of the procedure and have questioned the basis of the different regulations established for each user group (P. Mundy, President Northern Territory Commercial Fishermen's Association, personal communication, 1989).

Indirect regulations

Another approach, which may be capable of bringing about an optimal level of fish resources use in the commercial sector, is to alter market signals by means of a tax on landings (output) or effort (input). Although output and input taxes work in different ways, their aim is to unite the private and social costs of fishing. Less efficient operators - those who will find fishing unprofitable after the imposition of a tax - will be forced to leave the fishery. In this way taxes control fishing effort by reducing the incentive to overcapitalise.

Taxes may also be combined with levies imposed to recover the costs of regulations from the beneficiaries of fisheries management. The 'user pays' principle is already established in a number of important Australian commercial fisheries, such as the southern bluefin tuna and the northern prawn fisheries, where levies amounting to 75 per cent of management costs were collected from fishers in 1988-89. It is expected that this will increase to 90 per cent in 1989-90. In a regulated environment the

management levy has an important advantage over other regulatory methods. In particular, those who pay it will seek to maximise net benefits from regulations and will therefore encourage more efficient performance and accountability from fisheries managers.

Taxes could be applied to different user groups in order to manipulate resource allocation, but it is unlikely that this would be an effective method of securing an efficient level of non-commercial resource use. Although taxes are theoretically an efficient way of regulating commercial fisheries effort, attempting to collect payment from all non-market beneficiaries in proportion to their benefit would tend to make the tax inefficient.

Taxes on inputs to recreational fishing are not user charges, and the sum anglers pay does not fully reflect the proportion of the resource they use or the level of benefit they gain. Anglers who purchase expensive equipment yet fish infrequently may obtain less net benefits from the resource than someone who uses cheap equipment but fishes frequently. Further, if inputs are taxed to differing proportions, resource use may be distorted by the encouragement given to the use of non-taxed inputs. There may also be the administrative difficulty of separately taxing the equipment used by commercial and recreational anglers. Recreational licence fees may be a solution to the latter problem, but they also fail to meet the requirement of a true user-pays system because the fee is the same for all users, irrespective of the level of benefits obtained. In addition, given the very high costs of universal licence collection and enforcement, the potential for free riding is significant.

An alternative 'user pays' scheme is the 'compensation in kind' principle used by the Canadian government to control the negative impacts of proposed developments on fisheries habitats. As explained in the policy statement the principle is to

> 'balance unavoidable habitat losses with habitat replacement on a project by project basis so that further reductions to Canada's fisheries resources due to habitat loss or damage may be prevented' (Department of Fisheries and Oceans 1986, p.14)

While this action is not a statutory requirement to be met at all costs and in all cases, the principle offers flexibility in the search for solutions by fisheries managers and developers whose projects threaten fish habitats.

Zoning

Marine parks and zoning regulations are increasingly being used as a management technique and as a means of dedicating a resource to a specific activity. The Canadian approach outlined above is used in conjunction with a resource plan that identifies and classifies habitats into zones ranging from high conservation value to low risk. In cases where the productive capacity of habitats is very high, no loss of habitat is permitted.

In Australia, zoning is used to allocate the resources of the Great Barrier Reef Marine Park (GBRMP). The first priority in managing the Great Barrier Reef (GBR) is to prevent any use that would threaten its essential ecological characteristics. In allocating marine resources the zoning of the reef essentially relies on the safe minimum standards (SMS) approach, that is, on setting a level of conservation which stops development short of the

critical point beyond which further depletion of a resource is irreversible (Chisholm 1988; see also Ciriacy-Wantrup 1968, and Bishop 1978).

The main problem with this approach is that it does not ensure an optimal allocation of resources. As Chisholm (1988, p.12) points out,

> 'The basic decision rule of the SMS approach states that the SMS should be adopted unless the social costs of doing so are unacceptably large. How much is "unacceptably large" is seen ultimately to involve a political judgement.'

In order to reconcile the competing objectives of preservation and multiple use, the Great Barrier Reef Marine Park Authority divides the park into specific use zones so that conflicting activities are separated. The Authority develops a zoning plan after analysing resource capability and user demands. It assesses the physical, chemical, biological, human and human-built resources of the reef, and it assesses uses in terms of their physical, chemical and biological effects, their economic importance and their current and future intensity and distribution (Kelleher 1986). The Authority secures acceptance of the plan by making it available to other government agencies and for public comment.

The GBRMP Authority often combines zoning with other forms of government intervention to regulate certain activities within a zone. In zones where commercial fishing is permitted, input and output controls are used to regulate fishing effort. In recreational fishing areas, certain species may be protected and the use of certain fishing techniques prohibited.

This system is probably successful in reducing conflict on the Great Barrier Reef because the reef is not used very heavily, either for recreation or commercial purposes. The need for restrictions on use is low because competition among the different users is not currently at a high level (Kelleher 1986). Whether this system is applicable to other fish resources, especially those in which conflict over use is more acute and complex, is uncertain.

Assessing the value of competing activities

Whether direct regulations, indirect ones or zoning is used to allocate resources, resource managers need to know how much of the resource should be allocated to competing user groups if a socially optimal use of fishery resources over time is to be attained. This decision can be greatly assisted by appropriate economic measures of the relative values of competing activities. For example, while geographic and ecological factors will often define relevant zones, the allocation of the resource between particular zones should generally be based on a comparison between the marginal benefits which would arise from making the zone bigger and the resulting loss of benefits to other users.

In the absence of a market which would indicate the value of benefits received, information on the benefits to different users is often difficult and costly to obtain. Although techniques have been developed to help overcome these problems, there are a number of misconceptions about the interpretation of the estimates generated: some user groups have derived estimates of value using the gross expenditures method, an approach that is inappropriate to the matter at hand. In the case of recreational fishing, the gross expenditures method measures benefits as the total amount spent by those doing the fishing, including travel, equipment, food and drink,

accommodation and so on. While the method is popular (perhaps because of the large values it produces), these estimates of benefit are invalid for decision-making on resource allocation for two main reasons. First, such estimates can be incorrectly interpreted to imply that the more an individual spends on recreational fishing per unit of effort, the greater will be the additional benefits received. This is incorrect: even if an activity has a high gross value, the marginal benefits (the extra value generated by the allocation of one more unit of resource) that can be gained from the use of extra fish resources in this activity may be very low, and vice versa. Use of gross expenditure data for decision making could result in the allocation of a share of the available catch to a group of users who would derive less benefit than a competing group. Second, this method fails to include the costs of resources contributed by public agencies towards management, habitat protection and so on.

By comparing the net benefits of alternative allocations, decision makers will be able to predict which allocation will maximise net social benefits. For example, if they found that the benefits received by recreational fishers from an additional allocation of fish exceeded those consequently lost by commercial fishers, they could achieve efficiency by reallocating the resource in part or whole to recreational fishers. When benefits gained by one user group are equal to those lost by another, no gains can be made by a reallocation.

While the number of fish caught is only one of the pleasures in sport or recreational fishing, the marginal net social benefit from an increase in the number of fish allocated to a particular user group is appropriately measured as the net benefit arising from the extra fish which become available to that group. The reasoning behind this statement is that disputes and their resolution are fundamentally concerned with how a given quantity of the resource (that is, the number of fish) should be allocated among users. The marginal net social benefit will vary according to the number of extra fish which are allocated. For example, the additional benefits from allocating an extra one per cent of the resource to recreational users when only a low proportion of the resource is already allocated to them is likely to be higher than when they already have a high proportion of the resource. The size of the marginal net benefits will depend on how critical an additional allocation of fish is to the user group. As mentioned above, where these benefits are equally shared among user groups, an optimal allocation has been attained.

Estimates of the net social benefit of an additional allocation to commercial fishing include the marginal net returns to commercial fishers, plus any additional non-profit satisfaction they obtain from an additional allocation of fish (known as workers' satisfaction bonus after Anderson 1980b). Also included is any additional consumers' surplus (the value of commercial fish consumption to consumers above the price paid) and the net benefits arising from the additional economic activity (employment, output and income effects) generated from commercial fishing. On the recreational side, the marginal net social benefit includes an estimate of fishers' willingness to pay for the opportunity to catch an extra allocation of fish and the net benefits which arise from the additional economic activity generated by the additional recreational fishing. Any increments in the cost of stocking and management for either activity are included in this calculation.

While the market may be able to provide most of the data needed for valuing the marginal net social benefits of commercial fishing, non-market valuation

techniques must be used together data on the net social benefits derived by recreational fishers. Valuations are complicated by the problem of variations in benefits to different user groups across a broad range of stock sizes (Bishop and Samples 1980). In a sport fishery a large stock size may reduce the pleasure of fishing because it is too easy to catch fish. Interaction among species and different user groups may also affect estimates of the marginal net benefits of alternative resource allocations. An exotic species introduced for recreational fishing may inadvertently lead to a decrease in native fish species which have high conservation value.

In evaluating the benefits derived from recreational fishing and other non-market goods, two economic procedures - the related market approach and contingent valuation - are generally regarded as appropriate. The related market approach requires that the good or service in question can be closely associated with observable market behaviour. The demand for an unpriced good is inferred by examining the relationship between the good and substitute or complementary private goods. Contingent valuation is usually applied in the valuation of conservation related benefits, such as existence value, which are unrelated to any observable market behaviour. Both approaches rely on the fundamental economic measure of willingness to pay for any beneficial changes (implying an income constraint) and willingness to accept compensation for unwanted effects. In both cases payment may be either potential or actual.

Such techniques have been applied to the valuation of recreational and other non-market benefits derived from fisheries (see, for example, McConnell 1979, Vaughan and Russell 1982, Edwards and Anderson 1984, Loomis, Sorg and Donnelly 1986, Milon 1988). The Exxon Valdez oil disaster in Alaska and the ensuing compensation case is likely to produce further work in non-market valuation of fisheries as economists attempt to estimate the cost of the damage to wildlife and recreational users (Mandel 1989).

Despite substantial progress in developing and implementing these techniques there is no universal agreement about which is better. The conceptual and practical difficulties encountered with these techniques are reviewed in detail in Dwyer and Bowes (1978), Cauvin (1980) and Bromley (1986).

Conclusions

Acute problems with fishery resource allocation have emerged as the availability of fish resources has diminished. Such problems are expected to become more complex with a growing and more affluent population. Resource managers are now faced with resource allocation questions and the need to select mechanisms to achieve the best use of resources from society's point of view. The framework presented in this paper provides an economic perspective on the selection of conflict resolution mechanisms which might help to obtain such an outcome.

From an economic perspective, the type of fishery use can be regarded as a problem only if there are net social benefits to be gained by changing to some other pattern of resource utilisation. In particular, the costs of government intervention (measured by the foregone benefits from the alternative use of the resources which would be consumed by government intervention) need to be outweighed by the benefits obtained from any mechanism implemented to resolve a fishery related-dispute.

Possible government initiated mechanisms range from pure market solutions to pure regulatory solutions. One market based solution, individual

transferable quotas, have been successfully applied in some fisheries to encourage commercial users to manage the resource efficiently, but the general applicability of the market as a mechanism to bring about an allocation of resources among user groups is yet to be tested. The potential drawbacks of property rights solutions in a multi-activity fishery include the difficulty of enforcement and the potential 'free-riding' of non-contributors. Nevertheless, the success of property rights arrangements to promote the efficient use of other wildlife resources suggests that a market based solution could also be used in certain fisheries if these obstacles can be overcome.

Where markets cannot bring about an efficient resolution to a dispute, governments may have to intervene to determine the best uses of fishery resources. The decision would be improved by the use of appropriate economic measures which could compare the net benefits of alternative allocations of the resource to different user groups. In all cases, the selection of a remedy must be determined by the particular conflict to hand and by the costs and benefits of the various mechanisms that could be applied.

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