Workshop on Rights-based Management and Buybacks in International Tuna Fisheries

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1. Introduction

In simplest terms, the standard paradigm for fisheries management is that a fish stock is able to provide catches that can be replenished by the reproduction and growth of fish. If the gains to the stock due to recruitment and growth are equal to the losses to it due to fishing and natural mortality the stock is in equilibrium. At low stock sizes the sustainable catch is low, with increasing stock size the sustainable catch increases to a maximum at an intermediate stock size, and then it decreases again as the stock size approaches the carrying capacity of the environment. Fish are generally easiest to catch when stock sizes are large and become more difficult to catch as stock sizes diminish. Thus the harvesting costs increase as stock sizes decrease. Excess fishing capacity causes reductions in catches, and even greater reductions in catches per unit of effort.

One of the aims of fishery management is to restrict harvest to optimum levels, evidently those that are no more than sustainable catch for a given stock size, and those which maintain harvesting costs lower than the value of the catch. This paradigm can be elaborated in many ways; one such example is that fishing imposes costs on society other than the cost of catching fish (bycatch, environmental modification, reduced accessibility for other sectors of society), which must be taken into account in addition to the sustainability of the target species. Another thing that must be taken into account is making allowances for the unpredicted short- and medium-term variations in the environment that require management response.

Management is achieved by restricting fishing in some way. In techniques referred to as "command and control," an authority sets catch limits, or restricts fishing effort, or limits the characteristics (normally size or breeding status) of individual fish that may be taken legally. These measures apply to all fishers and to those who wish to enter the fishery. This approach pits fishers in a struggle against the authority and each other, as they try to maintain their profitability by adapting to management controls. Their reaction often takes the form of additional investment in vessels or fishing gear to maximize their catches. The increased costs reduce the net return from the fishery. Further, the management system ensures that the economic interest of the fishers in the fishery is only their current or immediate catch. They may participate in the fishery without an interest in long-term conservation of the fish stocks.

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As an alternative to command and control, rights-based fishery management techniques aim to allocate rights in the fishery to entities (individual fishers, companies, or communities) in a way so that the sum of the fishing rights ensures that no more than the optimum catch may be taken in accordance with those rights. The stronger the rights of the participants are, the more the incentives of those rights holders are aligned toward the long-term conservation of the fishery. Grafton *et al*. (2006)[4] refer to this approach as an incentive-based approach to sustainable fisheries, argue that much greater emphasis must be placed on fishers' motivation when managing fisheries, and provide examples of successful application of this approach.

The international community has in recent years taken a keen interest in the performance of fisheries management in general and that of international fisheries regulated by Regional Fisheries Management Organizations (RFMOs) in particular. However, entrenched positions of fishing states and the problem of over-capacity of the world's fishing fleets have made progress in satisfying that interest slow. Fisheries management is more difficult when it requires cooperation among states, and rights-based approaches have been slower to develop in the international arena than within national jurisdictions.

2. Rights-based management systems

Rights-based fishery management methods have been used within national jurisdictions to provide systems within which the participants can rationalize their investment in harvesting equipment, and, equally important, enjoy valuable property rights that strengthen their interests in the conservation of the stocks that support the fishery. Scott (2000)[5] provides a discussion of important characteristics of property rights, and has highlighted exclusivity, duration, security, and transferability as important characteristics of property rights.

The individual transferable quotas or individual fishery quotas for fisheries in New Zealand, Australia, Iceland, Canada, and the United States provide examples of rights-based management systems in which the characteristics of the rights are well developed. Individual quotas with exclusivity, security, and a long duration foster a collective interest of rights holders in conservation. An investment in reduction of quotas provides real benefits for the quota holders who made the investment. Transferability allows the quotas to be used by those to whom the quotas are most valuable, leading to economic efficiency.

Territorial use rights systems for individuals or communities can also have well-developed property rights characteristics. Examples include prefectural management systems in Japan, the Challenger scallop fishery in New Zealand, and small communities that manage to exert exclusive control of local fisheries. As long as the fisheries in the

[4] Grafton Q. R., Arnason R., Bjorndal T., Campbell D., Campbell H. F., Clark C. W., Connor R., Dupont D. P., Hannesson R., Hilborn R., Kirkley J. E., Kompas T., Lane D. E., Munro G. R., Pascoe S., Squires D., Steinshamn S. I., Turris, R., and Weninger, Q. 2006. Incentive-based approaches to sustainable fisheries. Canadian Journal of Fisheries and Aquatic Sciences, 63 (3): 699-710.

[5] Scott A. 2000. Introducing property in fisheries management. FAO Fisheries Technical Paper, 404/1: 1-13.

areas of each territorial use holder do not affect those of others, the territorial use holders can expect to benefit from their investments in conservation. Again, transferability increases the value of the right, and allows efficient operators to purchase property rights from less efficient ones.

Limited entry, which provides a weak user right, is a simple rights-based system that, provided the rights are guaranteed for a long time, gives those with the right an interest in conservation, but on its own does not promote economic rationalization.

The examples above are all from a national context, within which a fishery can be managed by a single government authority.

Stocks of tunas generally occupy areas that encompass more than one zone of national jurisdiction, and also the high seas, and are exploited by vessels of many nations. Thus international agreement is necessary to conserve tuna stocks. The fact that the movements of tunas are so extensive means that territorial use rights could not be used to control the catches of tunas, and makes limited entry and quota management systems the most likely rights-based systems that would be applicable. Only those systems are considered as candidates for rights-based management of tunas in the remainder of this paper.

The problem of over-capacity in tuna fisheries has been examined in detail by a Food and Agriculture Organization (FAO) of the United Nations project, *Management of Tuna Fishing Capacity: Conservation and Socio-economics*[6]. While most tuna fisheries are not yet overexploited, the problem of excess fishing capacity seems to be common to all.

In addition to the issues that all fisheries management systems must cope with (for example those of compliance, enforcement, and illegal, unregulated, and unreported (IUU) fishing), the use of rights-based systems in internationally-managed fisheries raises additional difficult questions. These include to whom would the rights to fish belong, how would the rights allocated, who would be responsible for recording the rights, and who would be responsible for ensuring that an individuals' fishing does not exceed the allocated rights and how that would be achieved. Typically, more extensive systems for monitoring and compliance are needed for rights-based management systems than for command and control systems.

Serdy (2007)[7] has examined the legal issues surrounding transferability of quotas among members of RFMOs and found that rudimentary systems for quota trading among states are allowed in some RFMOs, and that any such systems depend on decisions of the RFMO concerned, rather than on the development of new international law.

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[6] Bayliff W. H., de Leiva Moreno J. I., and Majkowski J (editors). 2005. Second meeting of the Technical Advisory Committee of the FAO project Management of tuna fishing capacity: conservation and socio-economics. FAO Fisheries Proceedings 2: 336 pp.

[7] Serdy A. 2007. Trading of Fishery Commission quota under international law. Ocean Yearbook, 21: 265-288.

While it is usual for RFMOs to make allocations of quota or fleet capacity among their members, there is little precedent for allocations being made either directly or indirectly to individuals. However, there are two such examples in the eastern Pacific Ocean (EPO). The first is the allocation of annual dolphin mortality limits (DMLs) by the Agreement for the International Dolphin Conservation Program (AIDCP), and the second is the limited-entry system used by the Inter-American Tropical Tuna Commission (IATTC), which maintains a closed Regional Vessel Register (RVR) to record the rights of individual purse-seine vessels to fish for tunas in the eastern Pacific Ocean (EPO).

The allocation of quotas directly to individuals, for example by an RFMO, has not been analyzed legally, but, of course, national quotas may be allocated to individuals. Some examples are the Australian quota for southern bluefin tuna, Chinese Taipei's bigeye tuna quotas, and Pacific halibut quotas allocated to fishers of Canada and the United States.

The closest example of allocation of quotas to individuals by an international agreement is provided by the AIDCP and its predecessor, the La Jolla Agreement of 1992, which have allocated annual DMLs to individual vessels since 1992. The DML is a relatively weak right because it does not provide full exclusivity (there are national mortality limits, which, if reached, would curtail individual rights), their duration is for only one year (or a shorter period), and their security is subject to the ability of the various governments to renounce their DMLs or to reallocate them among vessels of their fleets. In respect to transferability, the agreement provides that a vessel that changes flags retains its DML and its record of dolphin mortality during the year to date, and that its obligations under the AIDCP be enforced by its new flag. The AIDCP also provides some limited transferability[8] of the limits among vessels, in that limits from vessels that renounce or forfeit their assigned limits are redistributed among other vessels. In practice, however, the parties to the AIDCP have also allowed *ad-hoc* transfers[9] among vessels.

The limited-entry system of the IATTC is also a relatively weak rights-based system, because, while the system provides exclusivity (the place of a vessel on the RVR[10] is not affected by other vessels moving off and on the RVR) and the duration of the right is permanent, the security, and transferability is subject to government decisions, as all changes to the RVR are made at the request of the governments under whose jurisdictions the vessels operate.

The two examples discussed above also provide answers to the questions noted earlier in this section. For both DMLs and places on the RVR, the ability to exercise the rights, belong to the vessels. In other words, a vessel with a DML is entitled to fish for yellowfin tuna associated with dolphins, and a vessel that is included on the RVR is entitled to fish for tunas in the EPO. DMLs are allocated to all qualified vessels that seek them. The original places on the RVR were allocated in June 2002 to vessels that were

[8] Annex IV(III) 2 of the Agreement for the AIDCP

[9] See Agenda item 11 Minutes of the 15th meeting of the Parties to the AIDCP, June 2006. http://www.iattc.org/PDFFiles2/MOP-15-MinutesREV.pdf

[10] The IATTC's RVR is the definitive list of purse-seine vessels authorized by the Commission to fish in the EPO. (http://www.iattc.org/VesselRegister/VesselList.aspx?List=AcPS&Lang=ENG)

fishing (or had recently been fishing) at that time, with some additional space provided for five coastal states that were in the process of developing their tuna industries. The staff of the IATTC is responsible for recording which vessels have DMLs and also for maintaining the tally of dolphins killed against each DML. The staff also maintains the RVR. Finally, subsidiary bodies of the AIDCP and the IATTC, the International Review Panel and the Working Group on Compliance, respectively, maintain the oversight of compliance with the allocated right.

3. Mechanics of management, monitoring, control, and surveillance for rights-based management systems

All fisheries management systems require systems for monitoring, control, and surveillance to ensure compliance with the system. This section discusses mechanisms that are required, particularly for limited-entry and quota-based systems. In both cases, the required mechanisms are much more complicated if the rights include transferability than if they do not include transferability.

3.1 Limited entry

Limited entry can be directed at vessels or at participants. Because the effectiveness of vessels can be increased by investing in equipment or increasing their size, additional controls on investment that increases fishing capacity are usually necessary to make limited entry effective. However, these additional controls can limit only certain attributes of vessels, and over time normal investments will increase the fishing power of the vessels. Limited entry requires relatively simple mechanisms that include a list of all those entitled to fish, and, if there are controls on investments that increase fishing capacity, mechanisms to ensure they are complied with.

For example, the IATTC limited-entry system has an RVR[11] of purse-seine vessels that have the right to fish in the EPO. In addition to not allowing new vessels to be introduced except as replacements for vessels that leave the fishery, there is a rule that prohibits increases in well[12] volumes of vessels unless equal well volumes are removed by other vessels leaving the fishery or decreasing their well volumes. This provision, of course, envisages the transferability that is allowed by the Resolution[13] that established the limited-entry system. Because the fisheries authorities responsible for compliance with the rules of the RFMOs do not always have adequate communication with the maritime authorities responsible for registration and flagging of vessels, states do not always have the mechanisms in place to monitor compliance with vessel changes that may include increased capacity. Thus, systems maintained by the Commission itself, including information collected by at-sea observers and inspections by staff members employed in fishing ports, have been used to monitor compliance with that aspect of the Resolution.

A formal register must be maintained to preserve the integrity of the system. The register must be easily accessible to participating governments and, preferably, to others with

[11] http://www.iattc.org/VesselRegister/VesselList.aspx?List=AcPS&Lang=ENG
[12] Purse-seine vessels store their catches in brine contained in spaces known as wells.
[13] Resolution C-02-03 on http://www.iattc.org/ResolutionsActiveENG.htm

interest in the fishery. If transferability were not allowed among participating governments, it would be possible for each state to maintain its own register. However, if, as is the case for the IATTC, transferability of vessels across participating governments is allowed, it is essential that a central register be maintained, and that there be a centralized system to ensure that any controls on investments that increase capacity are complied with. (Even if each state maintained its own register, these would have to be accessible to participating governments, as otherwise nationals of the various states might suspect that other states were not complying with the agreement for limiting fishing capacity.)

In the IATTC's limited-entry system, transferability is allowed by Resolution C-02-03 in several ways. First, a vessel that is included in the RVR may change flag from one participating state to that of another without affecting the status of the vessel on the RVR. Vessels may also be replaced on the RVR by other vessels, providing the well volume of the new vessel is no greater than that of the vessel or vessels being replaced. The well volume of a vessel may be increased only if an equivalent amount of well volume is removed from the RVR. In 2004[14], the Commission agreed that when a vessel is removed from the RVR and its well volume is not replaced completely the state concerned would retain the residual well volume. Thus, in addition to maintaining the list of vessels on the RVR, the staff of the IATTC maintains a record of the residual well volume for each participating state. To permit transparency in the operation of the RVR, it is necessary that every transaction be recorded. Between 30 June 2002 and 31 December 2007, there have been 317 such transactions recorded.

The question of flag changes of vessels on the RVR has been one of the key difficulties in the administration of the RVR. The IATTC Resolution C-02-03 considers the flag of a vessel as being the sole determinant of the government with authority over the vessel. It has been troubled by the complex situations of bare boat charters in which the registration in one country is temporarily suspended and the vessel is allowed to fly another flag during the duration of the charter. Also the resolution does not explicitly require approval from any government to retain a vessel on the RVR when its flag is changed. A government does, however, have the ability to remove a vessel from the RVR before it changes its flag. Some IATTC member governments would prefer that the rights to places on the RVR belong to the governments, rather than to the vessels, and have sought to achieve this with an explanatory note in the minutes of the 73rd meeting[15] of the IATTC or via an instruction to the Director that he remove any of their vessels from the RVR if they change their flag.

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[14] Minutes of the 7th meeting of the IATTC Permanent Working Group on Fleet Capacity

[15] Page 8 of the Minutes of the 73rd meeting of the IATTC, "A change of flag by a vessel from one CPC [party, cooperating non-party, or fishing entity] to another, and the vessel's status on the RVR, shall not be considered effective until the Director has received official notification of the change from both governments involved". The Commission endorsed this statement, and noted the importance of each government establishing adequate internal procedures to ensure the necessary coordination between the various domestic agencies involved in the process of flag transfers. (http://www.iattc.org/PDFFiles2/IATTC-73Minutes-Jun05-REV.pdf)

3.2 Quota-based systems

Monitoring compliance with quotas requires systems that are more complex than those discussed above for limited entry. In this case, it is necessary to have registers of quotas (possibly for multiple species and areas) and records of catches against those quotas. At the minimum, a register of quotas would require a system similar to a register of vessels permitted to fish in a limited-entry system, but it may be considerably larger if there are quotas maintained for more than one fish stock, area, or time period. While owners of vessels will maintain their own records of catches against quotas, it will also be necessary for those records to be verified by authorities, requiring a near real-time data recording system that now could rely on reports by at-sea observers or estimates reported electronically from sea, and verification at the time of unloading. In practice, balancing of catches[16,17] against quotas in the fisheries managed with the aid of such systems has led to some creative and rather complex balancing systems, including banking quotas from one year to another, the imposition of deemed values for catches in excess of quotas, and, for multi-species fisheries, substitution of a quota of one species for a quota for another. The problems associated with quota balancing are far more serious in multispecies fisheries than in single-species fisheries, because it is common for such fisheries to include stocks whose productivities are different from their representation in normal catch. The use of these balancing systems complicates greatly the basic system for recording quotas and catches against them.

If there is no transferability across participating flags, each could maintain its own quota register and record catches against the quotas of its own vessels. If transferability is allowed, of course, a central register of quota holding and reporting of catch against quota would be required.

Transferability includes several possibilities. It might involve sale or leasing for determined periods of quota. It could also be used to address over- and under-catching referred to above. The combination of provisions for over- and under-catching and of transferability requires a complex and carefully-defined system for recording quotas and for counting catches against them.

The basic system for registering DMLs under the AIDCP is relatively simple. There is only one limit for each vessel, the total number of mortalities of dolphins in the EPO allocated to that vessel in a given calendar year. If a vessel kills more than its limit of dolphins in any year, the excess, plus an additional 50% of its limit, is deducted from its DML for the following year. However, in addition to this basic system, there are complex rules that relate the vessel's performance in achieving a low mortality rate and in compliance that affect the vessel's DML in the next year. In addition, the DML system operates under, and may be constrained by, a wider quota system that provides global limits for each stock of dolphins involved in the fishery, for the total number of

[16] Sanchirico J. N., Holland D. Quigley K., and Fina M. 2006. Catch-quota balancing in multispecies individual fishing quota. Marine Policy. 30 (6): 767-785.
[17] Squires D., Campbell H., Cunningham S., Dewees C., Grafton Q. R, Herrick S. F, Jr., Kirkley J., Pascoe S., Kjell S., Shallard B., Turris B., and Vestergaard N. 1998. Individual transferable quotas in multispecies fisheries. Marine Policy, 22 (2): 135-159.

dolphins that may be killed and for the number that may be killed by vessels of any participating state.

3.3 Registers

For most limited-entry and all quota systems it is essential that there be a Register of rights that is maintained by an agency that is trusted by all states and participants in the fishery. This might be operated by the RFMO concerned, as is the case for the IATTC limited-entry system, or by an independent agency, such as the FAO. Even in the relatively simple IATTC system the operation of the Register is a sensitive issue that has led to controversies, which, in several cases, are still unresolved[18]. Some vessels are recorded on the Register under two flags or two names, indicating a difference of views of governments about the probity of particular flag transfers.

This highlights the importance of ensuring that rules concerning transfers are unambiguous so that the administrator of the system is not subject to differing interpretations of participating governments. It is also desirable that those operating the Register be as far removed as practical from the influence of governments or individuals whose interests are recorded in the Register.

4. The tuna fisheries in the eastern Pacific Ocean as a capacity management example

The IATTC is the RFMO responsible for the management of the fisheries for tunas in the EPO. The IATTC has 16 members, Colombia, Costa Rica, Ecuador, El Salvador, France, Guatemala, Japan, Mexico, Nicaragua, Panama, Peru, the Republic of Korea, Spain, the United States, Vanuatu, and Venezuela. In addition, there are an additional 10 states, regional economic cooperation organizations, and fishing entities involved in the fishery, among whom 5 cooperate formally with the IATTC and the others informally. The agreement area for the IATTC is the EPO, generally taken to be from the coastline of the Americas to 150^{o}W longitude (Figure 1), and is so defined in the new "Antigua Convention" (which has not yet entered into force).

[18] See IATTC-75 Prop F1 VVen Capacity at www.iattc.org/IATTCandAIDCPMeetingsOct07ENG.htm

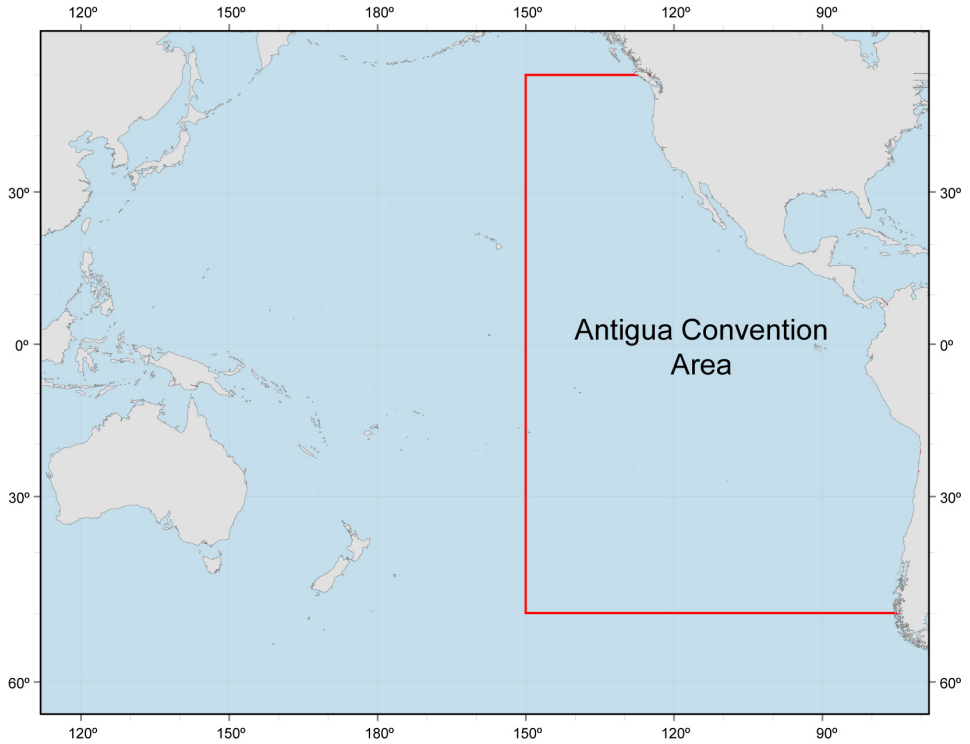

Figure 1: IATTC agreement area.

The retained catches of the principal market species of tuna in the EPO from 1986 through 2006 are shown in Figure 2. The catches in the EPO, which range from about 500,000 to 900,000 metric tons, constitute between 10 and 20% of the world's total catch of tunas. Normally, yellowfin tuna is the largest component of the EPO catch, followed by skipjack and then bigeye tuna.

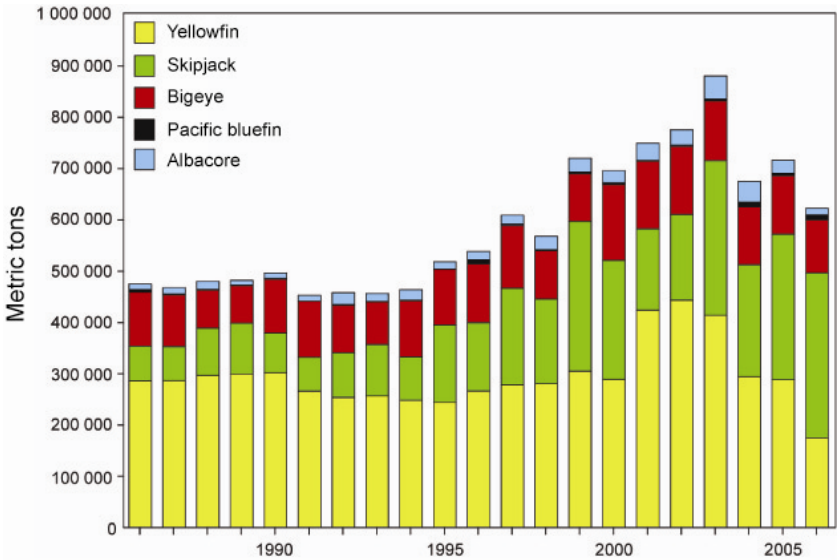

Figure 2. Catches of the principal market species of tuna in the EPO, 1986-2006.

The catches of yellowfin tuna, by fishing method, and bigeye tuna, by gear, in the EPO, are shown in Figures 3 and 4, respectively. Most purse-seine fishing on schools associated with floating objects is carried out using fish-aggregating devices (FADs) deployed by fishers. FADs have been used in the EPO since 1993, and are particularly effective at attracting skipjack and small bigeye tunas. Sets on schools of tuna associated with dolphins seldom take anything but medium to large yellowfin tuna. Purse-seine vessels are specialized with different equipment to make them suitable to fish for either tuna schools associated with dolphins or schools associated with FADs, but not both. However, any vessel will take advantage of an unassociated school that it comes across. Longline vessels generally direct their effort at bigeye tuna, and take smaller amounts of yellowfin tuna (and other species of tunas and billfishes). This method catches the largest tunas and has the least impact on the populations. The catches by pole-and-line fishing, which used to be the predominant form of fishing for yellowfin and skipjack prior to about 1960, are also shown in Figure 3. This fishery but has now practically disappeared from the EPO.

It can be seen in Figure 3 that the greatest catches of yellowfin are taken in schools associated with dolphins, followed by sets on unassociated schools and sets on schools associated with floating objects.

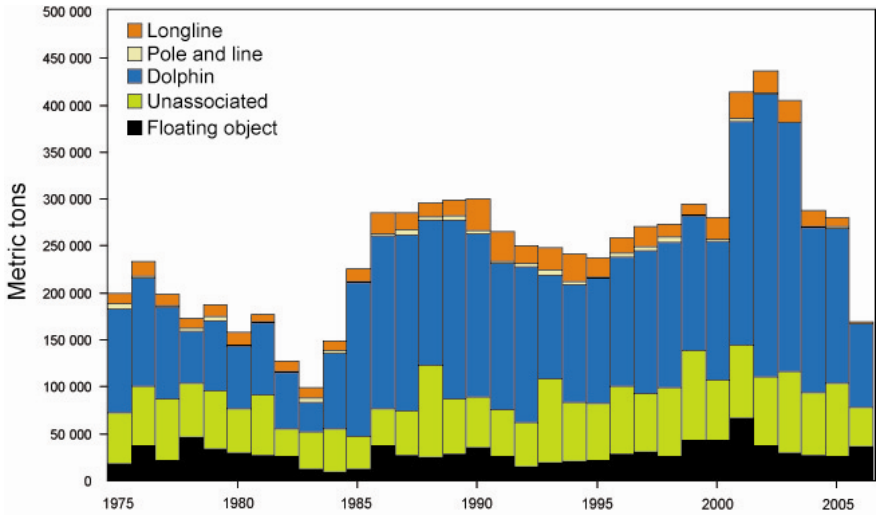

Figure 3. Catches of yellowfin tuna by fishing method, 1975-2006.

Only small amounts of bigeye are taken in purse-seine sets other than those of fish associated with FADs, so the catches of bigeye by purse seines are combined in Figure 4. Previous to 1994, an overwhelming majority of the catch was taken by longline. Bigeye tunas associated with FADs tend to be quite small and it would take these fish several years before they became available to the longline fishery. The purse-seine fishery is growing at the expense of diminishing longline catches. At the same time, because purse-seine caught bigeye are smaller than longline caught bigeye, purse-seine fishing is causing a reduction in the total yield from the fishery in the EPO.

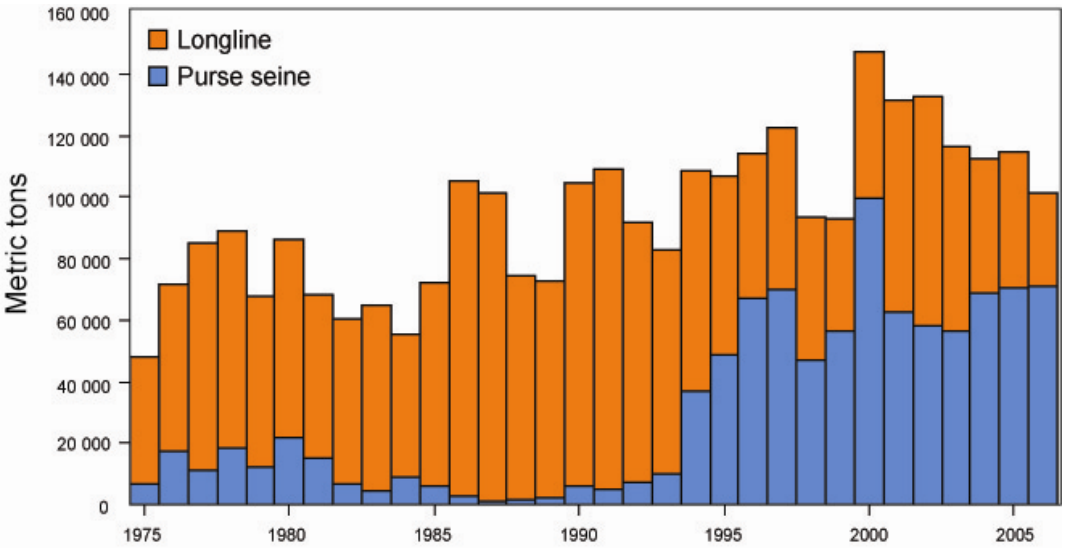

Figure 4. Catches of bigeye tuna by gear, 1975-2006.

4.1 Capacity issues in the EPO

The major management issue in the fishery today is that there is too much fishing effort for the productive capacities of yellowfin and bigeye tuna. The situation is complicated by the fact that small bigeye and, to a lesser extent, yellowfin are taken while purse-seine fishing for skipjack tuna, a valuable species for which there are currently no conservation concerns. The aggregate well volume of tuna fleet in the EPO has been increasing since 1991. Figures 5a and 5b show the changes in the well volumes of the purse-seine and pole-and-line fleets and the numbers of hooks deployed by the longline fleet.

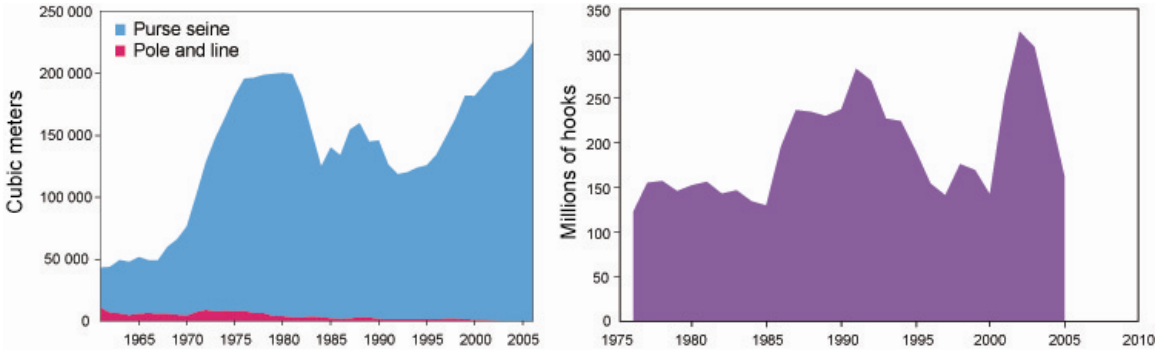

Figure 5 (a) aggregate well volume of purse-seine and pole-and-line vessels in the EPO, and (b) numbers of hooks deployed by longline vessels in the EPO.

Controlling the size of fishing fleets is not on its own an ideal method to manage the fishery. Every effort at controlling the numbers and sizes of fishing vessels can be met by investment to increase the ability of vessels to catch fish by focusing on some uncontrolled aspect. Nevertheless, keeping the fleet size near that which can take the optimum catch will make other management measures easier to implement and more effective.

Between 1988 and 1998 the fleet was not large enough to require restrictive management measures. However, since 1998 the IATTC has agreed on closures for the purse-seine fishery and quotas for bigeye tuna to maintain the yellowfin and bigeye stocks at levels that would produce the average maximum sustainable yields (MSYs) of those species. Currently, the IATTC is having great difficulty in agreeing on appropriate measures, as demonstrated by the need for it to hold two special meetings addressing conservation measures following the 75th meeting of the IATTC in June 2007.

The size of the fishing fleet in relation to the productive capacity of the resources has been assessed in a number of ways.

In 2005, in its Capacity Management Plan, the IATTC adopted a target level for the capacity[19] of the purse-seine fleet of 158,000 m^3 of well volume. This was based on the fleet size that would normally be able to fish through the year without requiring management intervention to maintain the yellowfin tuna stock at the level that would produce the MSY. At that time (June 2005), the actual capacity of the purse-seine fleet was 209,000 m^3. Thus the actual capacity was 32% greater than this measure of optimum capacity. Since then the purse-seine fleet has continued to grow, and at the end of 2007 its capacity was more than 230,000 m^3, 46% greater than that target capacity.

Another indication of overcapacity is the recommended closure of the purse-seine fishery. The recommended closure is used because the actual closure chosen by the IATTC takes account of factors other than the capacity of the fleet to take the MSY. Overcapacity[20] could be measured by the percentages of the year which the yellowfin fishery would, according to the recommendation, be open. Between 2003 and 2007 the recommended closure for yellowfin varied from 2 months to 74 days, equivalent to overcapacity of between 20 and 25%.

The FAO has defined capacity of a fishing fleet as its capacity to catch fish. Whereas the two previous examples were based on the previous average utilization of the available fleet, the FAO definition takes account of potential of the fleet to catch fish. Reid *et al*. (2005)[21] assessed the capacity of the purse-seine fleet in the EPO (and other areas), using the technique of data envelopment analysis, which accounts for increases in capacity if all vessels were used as effectively as the most efficient vessel. That analysis provided an estimate of average excess capacity divided by capacity output during 1998–2002 for yellowfin and bigeye tuna of 39%.

Of course, it is necessary to take into account longline fishing, at least, in addition to purse seining when considering fleet capacity. An approach to this is outlined in the next section.

[19] The IATTC has used well volume as its measure of purse-seine fleet capacity.
[20] Overcapacity here refers the difference between the actual capacity and a measure of optimum capacity.
[21] Reid C., Kirkley J. E., Squires D., and Ye J. 2005. *An analysis of the fishing capacity of the global tuna purse-seine fleet.* FAO Fisheries Proceedings 2: 117-156.

5. Buybacks to reduce capacity of the EPO tuna fleet to an optimum level

This section treats the use of a buyback of fishing capacity to balance the fishing capacity of the fleet with the productive capacity of the stocks. For this to be effective there must be a strong guarantee that there are mechanisms that will ensure that the capacity bought out cannot be replaced. Also, a vessel buyback should be assessed taking account of how effective limited entry would be in contributing to the management of the fishery. A buyback program should also consider the potential spillover effect on other fisheries. If the buyback involves just the license to fish and not the vessels themselves, the owners of those vessels would likely look for other fishing opportunities. The risk of this undermining the management of other fisheries should be carefully considered.

In the EPO, the Resolution on the Capacity of the Tuna Fleet Operating in the Eastern Pacific Ocean (Resolution C-02-03), adopted in June 2002, has the potential to provide a mechanism to ensure that purse-seine capacity that is bought out cannot be replaced. However, there has not been complete compliance with the Resolution [22]. Further, there has been a great deal of pressure from members[23] who are dissatisfied with the fishing opportunity the resolution allows them, and who are seeking to increase the capacities of their fleets. A vessel buyback would be expected to be successful only if there is a consensus among IATTC members that the allocation provided by the RVR is fair to all and that they all do whatever is necessary to ensure full compliance with the Resolution.

The technical issue, that controlling the aspect of capacity addressed by Resolution C-02-03, the fact that the well volume of the fleet is not necessarily proportional to the fishing capacity in the sense of the FAO definition must be considered. Even with the well volume of the fleet limited, it would be possible for owners to invest to increase the overall *capacity of the fleet to catch fish*. This issue may be of less concern than compliance and the general acceptance of the limits on entry referred to above, given that a buyback program to reduce capacity is intended to facilitate management using other measures, rather than to be the only management tool for the Commission. However, the effort creep that is likely to occur following a buyback must eventually be addressed. This would be done most effectively by specifying the rights of the remaining fishers more completely (Fox *et al*. 2003)[24]

For longline fishing, the second most important method of fishing in the EPO, there is no IATTC control system similar to that used for purse-seine vessels. For a buyback to be successful there would need to be a similar control to limit entry of longline vessels, and

[22] The 2007 IATTC Compliance Report (http://www.iattc.org/PDFFiles2/COM-8-04-Compliance-report-2006.pdf) noted that four purse-seine vessels fished in the EPO while not being included in the RVR, and that three vessels used wells that were not authorized under the Resolution.
[23] For example, see IATTC-75 PROP F2 PER Capacity and PROP F3 GTM Capacity, http://www.iattc.org/IATTCandAIDCPMeetingsOct07ENG.htm
[24] Fox K.J., Grafton R.Q., Kompas T., and Che T.N. 2003. Productivity and capacity reduction: the case of a fishery. International and Development Economics Working Paper IDEC 03-2. http://www.crawford.anu.edu.au/degrees/idec/working_papers/IDEC03-2.pdf

indeed for any other method. However, it should be noted that the Organization for the Promotion of Responsible Tuna Fishing (OPRT) was founded in Japan in 2000, and it has now been joined by organizations representing longline-fishing enterprises in China, Chinese Taipei, Ecuador, Indonesia, the Philippines, the Republic of Korea, and the Seychelles. According to Joseph (2005),[25] "about 43 Japanese and Taiwanese flag of convenience (FOC) longline vessels had been bought back and scrapped by the Japanese and Taiwanese longline industries" at the time of writing. It should also be noted that longline vessels less than 24 m in overall length are subject to less regulation than larger longline vessels, and that in recent years highly-efficient longline vessels slightly less than 24 m in overall length have been constructed for the purpose of fishing without restriction.) For the rest of this section, only purse-seine and longline methods will be considered, with an analysis of the reductions required to balance the size of the two fleets with the productivity of bigeye tuna.

Combinations of longline and purse-seine fishing effort compared to 2004-2006 levels that will produce the average MSY of bigeye are shown in Figure 6 (dashed curve). The solid curve in the figure shows the MSY for the whole fishery with average recruitment for a given purse-seine effort when longline effort is adjusted appropriately to produce the MSY.

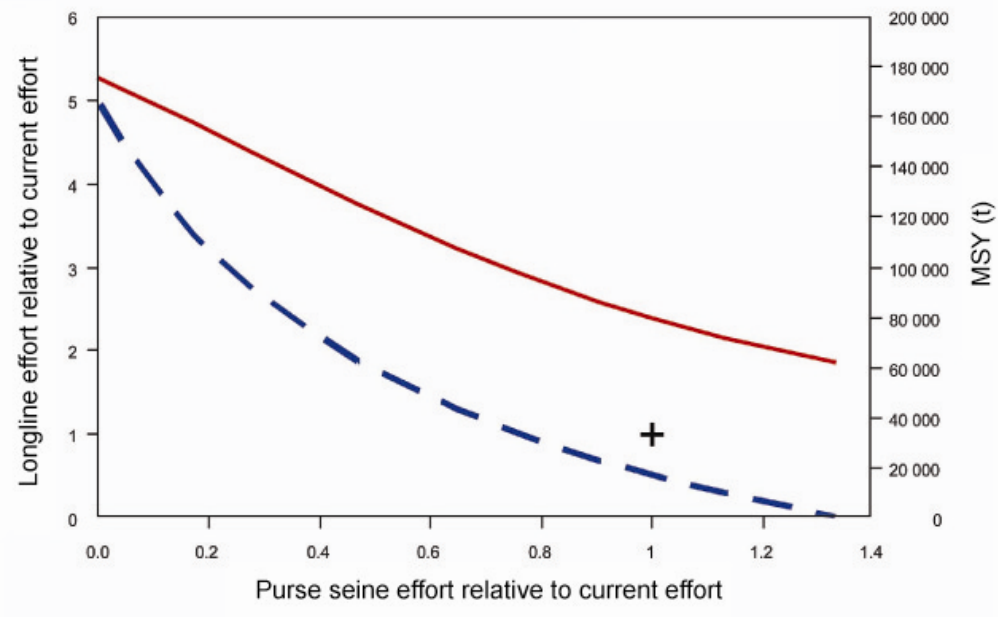

FIGURE 6. Combinations of longline and purse-seine fishing effort (compared to 2004-2006 levels) that will produce the average MSY of bigeye tuna (dashed curve). The cross shows fishing effort in 2004-2006. The solid curve shows the relationship between the MSY for the whole fishery and purse-seine effort when longline effort is adjusted appropriately to produce the average MSY.

From IATTC-75-07b Conservation Recommendations, http://www.iattc.org/IATTCandAIDCPMeetingsJune07ENG.htm.

[25] Joseph J. 2005. Past developments and future options for managing tuna fishing capacity, with special emphasis on purse-seine fleets. FAO Fisheries Proceedings, 2: 281-323.

The actual 2004-2006 effort in relative terms was at the point marked by the cross. If fleet capacity is approximated by fishing effort, the figure can be used to show reductions in the purse-seine and longline fleets. For example, a reduction to 83% of existing levels of both purse-seine and longline capacity would bring the fishing effort to about the level corresponding to the average MSY.

Because the two fishing methods are mostly associated with different flags, discussions about the appropriate reduction required in each method to reach MSY levels inevitably involves competition between groups of countries, which are difficult to resolve. Instead of negotiating reductions for each fishing method, a buyback could be structured to allow that decision to be made as a consequence of owners being prepared to sell their interest in the fishery. One method to achieve that could be asking all owners to bid at the price at which they would be prepared to quit the fishery, and to accept the set of bids that moved the effort toward the dashed curve in Figure 6 at the minimum cost. This process could be elaborated in various ways. For example, a system to ensure that all those bought out would receive the same amount of money per unit of capacity could be adopted, or the Commission could set constraints on how far the relative composition of purse seining and longlining might be allowed to move from the current fleet composition.

6. Considerations in designing a buyback

Vessel buybacks can be designed in a number of ways to achieve particular ends.[26,27] Some of the issues that should be considered in designing a buyback are described below.

A buyback could be carried out all in one round or in multiple rounds. Inadequate initial funding may lead to several rounds. A buyback conducted in stages offers several advantages: revealed common information allows gauging of the bid market and beneficial learning, adjusted payments target particular groups of fishers or combinations of desired vessel numbers and levels of capacity, the criteria for accepting bids can be adjusted, and fishers have the chance to reformulate their bids as they better understand the buyback market and buyback program. Multiple rounds of bidding may help dampen the frequency of those bids that aim to obtain a payment exceeding the amount the bidder thought the purchaser would be willing to pay. Buybacks in multiple rounds can also help target priority fisheries.

Multiple rounds also offer several disadvantages. Prices may increase as multiple rounds progress. With the removal of a vessel (or its place in the RVR), the supply of vessels falls and the remaining places may increase in value, partly because fewer vessels remain, and also partly because of any gains in economic rents that are capitalized into the vessel. In addition, with multiple rounds, there can be strategic behavior in which the sellers know that they can submit bids in later rounds and may try to increase their bids by delaying. The buyback program could announce that the longer the delay, the lower

[26] Squires D., Joseph J. and Groves T. 2006. Buybacks in transnational fisheries. Pacific Economic Bulletin, 21 (3): 63-74.
[27] Groves T., and Squires D. 2007. Lessons from fisheries buybacks. *In* Curtiss, R. and Squires, D. (editors), Fisheries Buybacks, Blackwell Publishing.

the payment in order to reduce the strategic behavior of vessel or license owners who delay participation. Multiple rounds can also raise administrative costs.

Buybacks are usually organized by reverse auctions. Some of the key issues include the choice between seeking bids or making offers, single price or reverse auctions, single or multiple rounds of bidding, sealed or open bidding, irrevocable bids, whether bids are responsive or nonresponsive to the criteria and conditions established, the length of the bidding process and buyback program, and by how much the bids must be exceeded. The program designers must decide which approach mobilizes support for the program, is cost effective, and fits the budget.

In reverse auctions, the operators submit confidential bids to the scheme, the lowest bids (until sufficient are accepted to meet the goal of the buyback) win. Provision of common information to potential bidders may help achieve the greatest impact for least cost. The program may instead establish an offer price, which vessel or license owners are free to accept or reject. Second price systems can also be used, during a buyback of catch histories of multiple fish stocks was carried out in New Zealand preceding the introduction of its quota management system, all bids were ranked and sufficient of the lowest price bidders to meet the program's objectives were accepted and all were paid the bid of the highest bidder in this group.

A reverse auction is the most widely-used process to form prices. This process is called a reverse auction because a single buyer receives bids from several would-be sellers and chooses the lowest bid, whereas in a standard auction a single seller receives bids from several would-be buyers and chooses the highest bid. Bids are usually sealed. The buyback program may calculate and offer single-round prices, which asset owners are free to accept or reject. The program's offered buyback price may not equilibrate supply and demand, and the number of applicants can exceed or fall short of the funds available.

A reserve price against which all prices are matched may be set. The reserve price may be the existing or previous year's market prices for vessels or places on the IATTC RVR. The reserve price could also be formed from prices for vessels or licenses following a formula, or given by appraisers or marine surveys after they value the assets. Several different bid models have been proposed. One such model assumes that a vessel owner's bid equals the present value of expected future net earnings, plus the difference between the cost of scrapping the vessel and its salvage value. An owner's bid price in this model is influenced primarily by factors that affect the future net earnings of the vessel, including the remaining years of serviceable life of the vessel, the earning potential of the vessel, and the vessel operating costs.

The offered buyback price may not equilibrate supply and demand, and the number of applicants can exceed or fall short of the funds available. If there is excess demand or supply corresponding to the fixed offer price, some form of rationing criteria would be required.

Bids can be specified as irrevocable or retractable by the submitter. Irrevocable bids prevent, or at least dampen, speculative bids that are not fully serious. Such bids can cause payment of large sums with minimal reduction in capacity.

Price and distribution can be affected by eligibility requirements, bid ranking systems, and direct allocation of funds among groups. The scoring or ranking of bids affects who stays and who exits. A problem with most bid systems involving the sale of a vessel is that everyone offers a different product–there is no homogeneous metric, but the use of units of meters, tonnage, well capacity, revenue, condition of the vessel, or fishing capacity can militate against this problem. In ranking bids, consideration can be given to vessel category, primary gear, size, or other characteristics that might be used to distribute payments among particular groups.

A buyback program could place conditions on the reuse of the purchased vessel, or place on the RVR to prevent increases in fishing capacity or spillovers to other fisheries. One of the most important conditions for vessel buybacks is whether it is required that the purchased vessel be scrapped or irrevocably assigned to some other use. Vessels that are not scrapped or irrevocably assigned to some other use may be used in another fishery, which itself may face overcapacity and overfishing, thereby simply transferring the problems from one fishery to another while providing windfall gains to those vessel owners whose vessel was purchased and subsequently transferred. Even if a vessel is not transferred, funds from the buyout might be used to purchase vessels in other fisheries.

It is likely that older vessels or vessels that utilize older and less efficient technology, require upgrading, *etc.*, and hence may be less efficient than other vessels, will accept lower prices to leave the fishery. Those vessels may have exited the industry anyway, but the buyback facilitates and accelerates their departure. A buyback could address this by including a rating for vessels' catching capacity.

7. Financing a vessel buyback

In a hypothetical situation with a limited catch in which a single person or company owned all the vessels, there would of course be no need to discuss a buyback. The owner would realize that there was too much fishing capacity and retire that part of the fleet that was unnecessary. The total catch would remain the same and the costs could be reduced, immediately improving the profitability of the fishery.

Similarly, in a hypothetical situation in which there were two owners, each owning about half of the fleet, the owners could agree to each retire the same percentage of their vessels, and each improve the profitability of his or her fleet.

In fact, in a fishery such as the EPO tuna fishery there are many owners, some with large fleets and some owning individual vessels, and decisions about which vessels to retire are more difficult. An owner with only one vessel can permanently affect capacity only by withdrawing his vessel, and then receiving no benefit, in the form on increased catches per unit of effort, from the reduction he contributed. However, in aggregate, if a means is

found to reduce the fleet capacity to the lowest level that can take the available catch, the total costs would be reduced and the total profitability increased.

Given that, a buyback could be organized by all owners contributing to a buyback fund in proportion to their own capacity, and using the fund to buy out those who were willing to leave the fishery. Again, in the aggregate the total profitability will have increased. The buyback results in a transfer of funds among the pool of owners. If all participants act in an economically rational way, those who sell their right to fish should do so at price that at least reflects their expectations of future profits if they had remained in the fishery, and those who remain should have been prepared to pay up to their expectations of the increase in their future profits after the buyback.

In fact, it would be very difficult for owners collectively to agree on what they would contribute to a buyback program, and it is likely that such a scheme could proceed only if it were initially funded by an external agency that would provide the capital for the buyback with the expectation of being repaid over time by the remaining owners, for example via the use of a landings tax.

Assuming the RVR measure for purse-seine vessels in the EPO permits a vessel to transfer to another flag without the flag state it is transferring from replacing it, the participants in the fishery would be in a position to implement a buyback program that could be effective in reducing fleet size. It is clear that any such buyback scheme would not work unless the governments agreed with this concept of transferability of capacity quota, and when a vessel transferred to another flag or was bought out of the fishery it could not be replaced. Given these facts, it is of interest to have an idea of what the costs of a buyback program might be for the purse-seine fleet in the EPO. There would be two components determining the cost of a buyback program to reduce the overall capacity of the fleet; one would be the value of the vessel, the other would be the value of buying a place on the RVR, which gives the right to bring a vessel into the fishery, to include it on the register, and for it to participate in the fishery. The value of a vessel, or the right of inclusion on the register, would vary with the success of fishing and the price of fish. For example, during 2001-2003 fishing was very good, but during 2006-2007 it was poorer. Assuming ex-vessel price did not change, buying back a vessel during the latter period would theoretically be less costly than during the former period.

The well capacity of the purse-seine fleet operating in the EPO is about 229,000 m^3, and the scientific staff of the Commission has estimated the optimum size of the fleet to be about 158,000 m^3. This suggests there are about 70,000 m^3 excess capacity in the fleet, which represents about 59 vessels of about 1200 m^3 each (the average size of a vessel in the fleet). It is difficult to predict what vessel costs might be in the future, but over the last couple of years prices paid for a 1200 m^3 vessel ranged between $5,000,000 and $8,500,000. If a buyback were used to purchase vessels, the cost to buy back the 59 vessels would be somewhere in the neighborhood of $290,000,000 to $470,000,000. To put this into perspective, the annual landed value of the catch of tunas by the purse seine fleet fishing in the EPO averaged over the last several years was about $600,000,000.

In addition to the existing purse-seine fleet, many participating countries have rights to add additional capacity to the fleet, either as a result of vessels that have been withdrawn after June 2002 when the limited-entry system for purse-seine vessels was established, or through an initial allocation to coastal states whose fisheries were developing. The aggregate of this unutilized capacity is 54,000 m^3. The prices in recent experiences in selling places on the register ranged from $150,000 to $300,000. Some of this unutilized capacity is associated with a right of an individual to replace a vessel, but the bulk of it is a national right that is not currently allocated to an individual. If all of it had to be purchased at between $150,000 and $300,000 per vessel this unused capacity would be worth between $6.2 and $13.5 million. However, more than half of it could simply be written off by governments that do not currently intend to further develop their fleets or are willing to forego further expansion of their fleets in the EPO.

A complete buyback would have to remove the combination of the 70,000 m^3 in the existing fleet and the 54,000 unfilled cubic meters.

The cost of buying back the 59 vessels and some part of the options for countries allocated quota but that have no vessels is substantial. The preferable way to finance such a program might be through the industry, but because there is currently so much excess capacity, the catch per vessel may not provide large enough profits for the vessel owners to provide the capital needed for the buybacks. If loans and grants sufficient to cover the buyback of the 59 vessels were made available, the buyback could be immediate. Per-vessel catches and profitability would increase, making it possible for the industry to repay the loans. Alternatively, if loans and grants sufficient to buy back a portion of the 59 vessels were made available, per-vessel earnings would be expected to increase somewhat, thereby placing the vessel owners in a position to fund the buyback of the remaining capacity. It seems clear that to initiate a buyback program either international financial assistance, national government assistance, or both, would be needed, but once the program was operating responsibility for maintaining it should fall to the industry.

8. Conclusions

Fisheries management is most effective when the interests of all the participants are aligned to produce the same results. It is particularly important for the fishers to have an economic incentive to ensure the conservation of the resources they exploit. This can be achieved by providing them secure and exclusive rights to the fishery that extend into the future.

This arrangement has been achieved within some national systems for fisheries management, but will be much more difficult to achieve for internationally-managed fisheries, such as those for tunas, where the participant in the management process are fishers, states, and an RFMO, and the stakeholders include the international community, including nations that do not currently participate in the fishery.

Rights-based systems used within national jurisdictions, particularly systems for limited entry of individual quota management, can be extended into the international arena.

Tuna fisheries in general, and those of the EPO in particular, suffer from overcapacity of the fishing fleets that exploit them. This overcapacity should be addressed by the establishment of a rights-based management frame work with well-defined fishing rights that could be preceded by a buyback of existing fishing rights. An advantage of an initial buyback is that it could sidestep the very difficult negotiation of shares in a fishery among competing states.

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