

TUNA RESOURCE MANAGEMENT

Buybacks in transnational fisheries

Dale Squires, James Joseph and Theodore Groves

US National Oceanic and Atmospheric Administration (Fisheries); Independent Consultant;
and Department of Economics, University of California–San Diego

Buybacks of fishing vessels, licenses, access and other use rights, and gear can be key management tools to address over-capacity, over-exploitation of fish stocks, and distributional issues. Buybacks can also contribute to a transition from an open-access fishery to a more rationalised one built upon rights-based management. As a strategic policy tool, buybacks can help restructure relations among participants in a fishery, creating positive incentives that reinforce conservation and management objectives. By reducing vessel numbers, increasing profitability, strengthening positive incentives, improving attitudes, and lowering exploitation pressures on fish stocks, buybacks can also help in the establishment of self-enforcing voluntary agreements among industry participants. Selectively targeted buybacks can also help conserve ecological public goods, such as the incidental by-catch of species other than tuna, such as dolphin.¹

Transnational fisheries for tuna and other highly migratory species are at a pivotal point in their history. The threats posed by fishing over-capacity and potential or actual

over-fishing to the health of the fish stocks, and the ever-growing ecological costs of fishing, and indeed potential losses for some nations, have brought the situation to this juncture.^{2,3}

The time is ripe for the transformation of the high seas from open access to rights-based conservation and management protected by strong international treaties. Only in this way will the incentives faced by individuals and groups harvesting the resources shift from the 'race to fish' to favour conserving the resource stocks and ecosystem and maximising the sustainable economic surplus. In this way, the actions of individuals and groups more closely align with the interests of society as a whole. Such a shift will also address the transnational externality that arises in transnational fisheries due to jurisdictional issues and weak or absent property rights.

Buybacks of fishing vessels, licenses, access and other rights, and gear can be key management tools to address fishing over-capacity, over-exploitation of fish stocks, and distributional issues. Buybacks can also contribute to a transition from a limited entry

fishery to a more rationalised one built on rights-based management. Buybacks were instrumental in the transition to individual transferable quotas in New Zealand and are currently playing such a role in the transition to structural readjustment and individual rights-based fishing in Australia.

Under these circumstances, buybacks may play a special role in transnational tuna and other highly migratory species fisheries as one of the few ways to reduce fishing capacity and improve economic conditions in the near and intermediate terms—but only if entry into the fishery is first deterred through a limited entry program in a Regional Fishery Management Organization (RFMO) (Joseph et al. 2006). Otherwise, potential free-riders will enjoy the benefits of reduced capacity by subsequently entering the fishery managed by the RFMO. Illegal, unregulated and unreported fishing outside of the international agreement will also enjoy the benefits from free-riding on the conservation and management measures of states and cooperating parties to the buyback program. In the absence of rights-based management, protected by a strong international agreement, and because buybacks do not change the underlying property or use rights, buybacks in and of themselves do not address the long-run incentives to over-invest in an open or limited access fishery. Ironically, buybacks can aggravate this problem over the long run by strengthening investment incentives through growing profits.

Nevertheless, an ongoing buyback program, coupled with limits on individual vessel capacity and limited entry, are one of the few policy tools available to reduce fishing capacity in transnational fisheries in the absence of rights-based management supported by a strong international agreement. Critically, buybacks may form part of a transitional strategy to a more rationalised fishery based on rights backed

by a strong international agreement that fends off potential free-riders.

As a strategic policy tool, buybacks can help restructure relations among participants in a fishery, creating positive incentives that reinforce conservation and management objectives. Buybacks, by reducing vessel numbers, increasing profitability, strengthening positive incentives, improving attitudes, and lowering exploitation pressures on fish stocks, can also help in the establishment of self-enforcing voluntary agreements among industry participants. Buybacks also accelerate the exit of excess capacity from a fishery, even one regulated by rights. Selectively targeted buybacks can also help conserve ecological public goods, such as the incidental by-catch of species other than tuna when sets are made, for example, on dolphins or floating objects.

Buybacks and property in transnational tuna fisheries⁴

The binding constraints faced in transnational tuna fisheries are the sovereignty of nations and the state of international law, particularly the Law of the Sea and the United Nations Implementing Agreement. States may well remain the central actors in the RFMOs rather than individuals or groups. As such, property is likely to be first established as common through the RFMOs and then use rights allocated to states, which in turn allocate shares of rights to individuals or groups within each state. In short, use rights for individuals or groups are likely to be mediated by the principal actors, the states and the RFMOs that they constitute, under a binding international agreement.

Use rights in the form of individual transferable quotas represent the first-best option for the target tuna. Such rights might

be simply allocated directly by the RFMOs as a share of the overall total allowable catch. Such rights are more likely to be a system of overlapping or hybrid rights in the form of

- common property through the RFMOs
- state use rights following an allocation of shares of the total allowable catch by the RFMO to states
- private use rights after shares of the state share of the total allowable catch to individuals.

Some states may decide upon other forms of rights for their participants, such as group rights through fishing cooperatives or simply access rights through a state-limited entry program. States could even decide to not regulate their share of the total allowable catch.

In any of these cases, property in the form of the overall stock of fish is likely to be retained by the RFMO as a property held in common by the participating and even cooperating non-members. Dolphin Mortality Limits (DMLs) established by the binding Agreement on the International Dolphin Conservation Program serve as a likely guide to the future for tuna rights.⁵ DMLs function as a hybrid or overlapping system of rights in which shares of the Total Dolphin Mortality Limit (TDML) established by the Inter-American Tropical Tuna Commission (IATTC) are first allocated to states as state use rights, which in turn allocate shares of the state DML to individuals as individual use rights. The dolphin stocks themselves can be viewed as a form of common property established by the legally binding Agreement on the International Dolphin Conservation Program.

Expanded state property is possible, comparable to the extension of exclusive economic zones, if total allowable catch and shares of the resource stock itself are allocated to individual states. Finally, states might simply extend their exclusive economic zones to encompass the entire ocean.

The most tractable and effective initial step in controlling capacity limits entry through a closed Regional Vessel Register for each RFMO, with strong measures to deter entry for the purse seine, longline, and pole-and-line fleets. Such a step forms common property for each RFMO.⁶ Fishing cooperatives or associations may also have a role to play in the formation of common use rights.⁷

Without limits to capacity, however imperfect, such as limited entry through a closed Regional Vessel Register, pressure invariably builds to expand total allowable catches, exploiting the uncertainty that is inherent in estimates of fish stocks and sustainable target yields from these stocks.⁸ If the RFMO retains ultimate control over the resource stock and even the total allowable catches, then a form of common property will underlay the state and individual or group rights.

In short, overlapping combinations or hybrids of property and use rights are the likely future outcome, with limited entry, or some form of access limitation, as a precondition to other and more effective conservation and management measures, particularly rights-based management as a centrepiece. Critically, a form of limited entry may be the only tractable possibility in the near and intermediate terms, and this is the context within which buyback programs can be expected to function. Even if RFMOs leap ahead to some form of state rights, with an allocation of total allowable catches, there may well be an important role for buybacks.

Buybacks to address over-capacity and over-fishing⁹

By directly reducing fishing capacity through removing vessels and relieving pressures on resource stocks, vessel profits and resource rents can potentially rebound, fish stocks recover, and income and wealth distribution change through redistribution of access and

compensation and transfer payments. The objectives of most buyback programs often include a mixture of all goals, and simultaneous pursuit of these objectives is possible.

A successful buyback can raise profits in the short run. Fewer vessels mean that rent is shared among these fewer vessels. Lower fishing capacity can lead to higher catch rates for the remaining vessels, possibly allow gains in economies of scale and scope for the remaining vessels, and reduce overall industry costs (especially capital) and vessel costs.¹⁰ To the extent that the volume or timing of landings is not substantially altered, fish processors are likely to be unaffected in the short run and to gain in the long run through more sustainable supply.

Buybacks do not, by themselves, necessarily sustain profits to vessels and rents to the fisheries over the long run. Long-run rents depend on the ability to limit the expansion and even replacement of fishing capital. Economic welfare can fall with additional investment in the post-buyback fishery if the use right conditions underlying the 'Tragedy of the Commons' are not eliminated, so that further investments are redundant from the perspective of society. In the absence of property rights or taxes, increased resource rent can reinforce the very investment incentives that lead to the initial over-capacity.

Buybacks as a transitional strategy

Buybacks may form part of a transitional strategy to a more rationalised fishery. As long as management is based on input controls or total allowable catches and without strengthened property rights, buybacks may not be the long-term answer, since vessels can expand fishing capacity by increasing investments and use of uncontrolled inputs (Wilén 1979, 1988; Townsend 1992; Squires 1994) and technical progress (Squires 1992). Moreover, when

fisheries are mired in debt and an absence of vessel profits and resource rent, cooperation is difficult to achieve among fishers. As a transitional strategy, buybacks can help counter these adverse forces.

After a successful buyback, when a fishery resumes profitability, increased cooperation can follow. The smaller number of fishers also contributes to increased cooperation, and the remaining fishers tend to be those most committed to the long-term economic viability of the fishery.

Autonomous adjustment following a management change may be relatively slow. A key factor influencing the rate of change is the alternative uses for retired capital. If there is not another fishery in which a vessel can be used it may be rational for an operator to delay exiting the fishery until the vessel is at or near the end of its economic life.

In practice, when the overall level of fishing capacity is high relative to the sustainable target yield for the fishery, these target yields are subject to considerable pressure for upward adjustment. Unless the level of fishing capacity is reduced, pressure remains to exploit the considerable uncertainty that is inherent in stock assessments and the subsequent sustainable target yields, such as total allowable catch.

Vessel buybacks in transnational fisheries¹¹

Unilateral buybacks in fisheries exploiting transnational resources simply remove fishing capacity from one country, thereby reducing pressures on profits and resource stocks, which in turn allows free-riding through growth in another country's fishing capacity. The Italian buyback of fishing capacity in the drift gillnet fishery for swordfish simply allowed expansions of fishing capacity by other nations fishing swordfish in the Mediterranean (Spagnolo and Sabatella forthcoming).

The Organisation for the Promotion of Responsible Tuna Fisheries (OPRT) buyback of high seas tuna longline vessels in the Pacific is a second example of a buyback in a transnational fishery. Nonetheless, there was some free-riding through expansion of longline vessels by non-cooperating parties in this fishery, which in turn mitigated against some of the gains from the buyback.¹² A key factor contributing to potential success is that Japan is the primary market for sashimi-grade fish, and if that market were denied to a longline vessel, that vessel would face difficulty in turning a profit (Joseph et al. 2006).

Gains to international cooperation through gains from participation and compliance, and deterring entry and expansion by non-parties, are perhaps the biggest challenges to a buyback on shared resource stocks such as tuna. Gains to multilateral cooperation from reducing fishing capacity due to a buyback come from saving on losses due to fishing over-capacity and excessive exploitation of common resources, that is, from lowering the losses due to the 'Tragedy of the Commons'.

Success requires that a buyback ensures that every party is better off with the program than without it, but to succeed the program also needs to ensure that each party would lose by not participating. That is, free-riding through non-participation must be addressed by some credible means, such as limited entry and a credible trade restriction. There is a positive incentive for participation by the remaining vessels through the aggregate gain from participating, in the form of increased profits, and to sellers of vessels and/or rights through compensation in the form of the buyback payment.

National sovereignty: individual vessels or flag states?

National sovereignty complicates buybacks in transnational fisheries. Buybacks and the

critical preconditions of limited access and vessel registry, and various forms of property and use rights in general, can be defined either in terms of the individual vessel or the flag state. That is, what is the basic unit in the program, flag states or vessels and their associated measures of fishing capacity (potential output, gross registered tonnage, well capacity, length, and so on)? Can vessels and their associated measure of capacity freely transfer among flag states, or are vessels and their associated capacity directly tied to the flag state?

The closed Regional Vessel Registry developed by the IATTC incorporates the concept of transferability, but there has been reluctance on the part of some states to recognise this provision of the program. A limited access and vessel buyback program defined solely in terms of vessels rather than flag states can be expected to lead to greater economic rents and overall healthier profits in the fishery, since there can be greater gains from trade (arbitrage efficiency) as fishing capacity and the right to fish shift to lower-cost vessels.

Coastal and distant-water states

An additional issue that arises is the distribution of vessels and fishing capacity (or any form of right) among coastal and distant-water states, and more generally, the unique nature of the required multilateral cooperation to manage fishing capacity when there is asymmetry among states. This issue is not unique to fisheries. Major international environmental agreements, such as the Montreal and Kyoto Protocols, addressed similar asymmetries between developed and developing nations with global atmospheric public goods. Coastal states control entry into their exclusive economic zones and special privileges are enshrined in international law.

Potentially viable limited entry and buybacks have to allow for the expansion of

vessels and fishing capacity by coastal states. More generally, buybacks can be used to restructure fisheries in ways that favour coastal states. Buybacks can remove vessels and/or permits from distant-water fishing nations, leaving a fishery more oriented towards the coastal states. Buybacks of unused permits allocated to coastal states create a form of side payment from existing vessel owners to coastal states in general.

Fractional licensing is an alternative to vessel buybacks. Vessels are allocated only some fraction (not the entire amount) of the access right required for the fishery and must purchase the remaining amount from other, existing vessels (Townsend and Pooley 1995; Joseph 2005).

Illegal, unregulated and unreported fishing can also undermine the effectiveness of any buyback program established under the auspices of regional fishery management organisations. Cooperating parties may be deterred when non-cooperative nations reap the external benefits flowing from the sacrifices of cooperating parties, i.e. there is free-riding.

Limited access: a critical precondition for buybacks

The ability to legally deter free entry into the fishery by new vessels under existing international law is a critical precondition for a buyback. Evolving customary law may be reshaping conditions to deter free entry through the formation of regional vessel registries in the IATTC, IOTC, International Commission for the Conservation of Atlantic Tunas (ICCAT), and the Commission for the Conservation of Southern Bluefin Tuna (CCSBT). Hallman et al. (2006) provide further discussion on limited entry in transnational tuna fisheries.

Financing the buyback

Buybacks within regional vessel registries that limit entry can be financed, in part, by

industry participants, perhaps seeded by an initial low-interest loan by a development bank or consortium of governments. In fact, the World Bank observes that in view of the high level of funding required, and the policy nature of those schemes, the World Bank and other major international financial institutions could support buyback of surplus vessels through broad sector instruments, such as Sector-Wide Approach Programs (SWAPs) or Poverty Reduction Support Credits (PRSCs) or perhaps even the Global Environmental Facility (GEF) (World Bank 2004).

Buybacks aimed at protecting ecosystem health can, in principle, be legitimately financed by governments and international public institutions to the extent that these funds reflect the public's willingness to pay for the 'existence value' of the ecosystem's health. In principle, buybacks financed by governments solely for capacity reduction without loan repayment constitutes a subsidy, but since government subsidies contributed to the over-capacity problem, government subsidies may be called for, in part, to correct this problem. As the fleet is reduced toward the target size, the average catch per vessel increases and profits rise, so that the industry can better fund the buyback. Thus the initial loan and ongoing payments for buybacks could be funded by an assessment on each vessel; a landings tax would raise funds proportional to the amount of fishing. Increased profitability with success of the buyback would provide the needed pool of funds. Alternatively, as Joseph (2005) notes, all or part of the tax or assessment could be applied to the processed product, since the processors would reap the benefits of a well-managed fishery. Ultimately, the relative price elasticities of producers, processors, and consumers would determine the incidence of the tax among these groups. The

assessments and development of a pool of buy-back funds would be region and gear specific.

Recreational fishers can also be expected to contribute to financing the buyback, thereby reflecting their share of the resource's exploitation. Such co-financing of a buyback occurred in the Texas shrimp fishery (Riechers, Griffin and Woodward forthcoming).

Buybacks to address ecological issues

Reductions in the total level of fishing capacity through buybacks can directly reduce catches of non-target species (as well as the targeted tuna) and thereby strengthen ecosystem health; but the reduction in fishing capacity may be insufficient to fully address this ecological issue. Buybacks of vessels and/or use rights—the carrot approach—can instead target vessels harvesting in ways that have the most detrimental ecological impacts in sectors of the fishery facing the greatest ecological issues. Historically, economic incentives to address ecological issues, such as incidental takes of dolphins or sea turtles taken when shrimp trawling, have generally relied upon negative economic incentives through trade measures and boycotts (see also Joseph 1994).

Further discussion on the use of buybacks to address by-catch and other ecological issues is provided by Gjertsen, Hall and Squires (2006).

Purchase vessels and gear, or licenses (permits)?

Should the buyback program purchase the vessel and gear, license, or both? Purchasing only the license tends to be cheaper than purchasing the vessel and gear, which in turn is generally cheaper than purchasing both the vessel and license. License prices may be set at the market rate (although the expectation of increased revenues after the capacity reduction may cause license prices

to rise sharply) or at the value required to encourage the chosen proportion of fishermen to surrender their licenses.

Many vessels hold licenses for more than one fishery. If the program buys back only the license, the vessel remains free to fish elsewhere, and in doing so, shifts fishing capacity to another fishery. If the program buys back the vessel and gear but not the license, the license, if allowed to be transferable to another vessel, can be used by another vessel in the fishery. In this instance, pressures on the fish stocks and economic rents may not be abated, and may even increase if the license is used with a vessel that is even more productive than the vessel that was removed.

Purchasing only the license frequently removes vessels from the fishery that are inactive or with low levels of fishing, but which could potentially increase their fishing as the profitability of the fishery improves. Inactive or low activity vessels may have their primary focus on fishing in other fisheries and be holding licenses more as options to fish; the license price may fundamentally reflect option value. Purchasing the lowest priced licenses tends to remove the least active vessels, such as vessels fishing part time or in multiple fisheries, or which are the most marginal in some other sense.

Purchasing inactive licenses affects the longer-term effectiveness of the buyback. The long-term effectiveness of the buyback program can depend upon whether previously inactive vessels or buyback beneficiaries return to the fishery (US Government Accountability Office 1997).

The license can be locked to the vessel, so that a separate market for licenses does not emerge. In this case the buyback would make no distinction between the vessel and the license, and the buyback price would include the value of the two assets. Fishing capacity would not be allowed to shift to

another fishery. If a bought-out vessel also held licenses for other fisheries, and these licenses were also attached to the vessel, the buyback price could include the license values from the other fisheries and reflect the expected profitability of the other fisheries.

Multiple licenses for the same fishery may be held with the vessel—are ‘stacked’. When licenses are attenuated by limits to capacity, stacking then allows a larger vessel or catch. The buyback price can be expected to increase with stacking.

Economic rents from a fishery are capitalised into all capital assets, which, in the fishery without some form of private or common property right for area or catch, are the vessel and the license. Rising economic rents following a vessel buyback program would consequently lead to rising values of the vessel and the license. Purchasing only the vessel leaves the license as the recipient of any gains in economic rent, reflected by a gain in license value. Purchasing only the license leaves the vessel as the recipient of any gains in economic rent, reflected by a gain in vessel value.

Other considerations arise when deciding whether to buy back vessels or licenses. There is a trade-off with affordability, since it is less expensive to buy permits. Another factor is whether or not there are strong spillover effects onto other fisheries. Also, if the permit is removed from the vessel through the buyback, can the vessel still participate in other fisheries? Part of the answer relates to the scope of the program.

Conclusion

Buybacks are a strategic choice that affects incentives and thereby can play a strategic role in a transition to a more rationalised fishery. Buybacks can restructure incentives and relations among participants through improving the economic conditions during

a window of opportunity following a buyback. If buybacks sufficiently reduce the number of participants and profits sufficiently rebound, the remaining participants are likely to be the most committed and to enjoy growing cooperation and more favourable attitudes toward more complete individual or common rights.

Ultimately, because buybacks do not change the underlying property or use rights, the long-run incentives remain to over-invest in an open or limited-access fishery. Ironically, buybacks with ill-structured rights even aggravate this problem over the long run by strengthening investment incentives through growing profits that eventually overwhelm the positive but temporary economic incentives created by the buyback. In a nutshell, buybacks create a window of opportunity to rationalise a fishery that erodes over time.

In different ways buybacks induce changes in behaviour through the choices that are made in the design of the buyback program. Every substantive choice can affect incentives and thereby behaviour of the remaining participants, even the decisions of who chooses to stay and who chooses to leave the fishery through participation in the buyback.

Linkages of program design features can also be a strategic choice. For example, requiring purchased vessels to be scrapped or preventing owners of purchased vessels from using the proceeds to reinvest in the fishery affect not only the level and growth of fishing capacity but also affect who elects to participate, the purchase prices, and fishing capacity and profits. A buyback can be linked with requirements for conservation of biodiversity and ecosystem health or with time-area restrictions on fishing.

Buybacks of vessels, licenses, access and other use rights, or gear have been demonstrated to be a useful policy tool under certain conditions and for a limited period

of time before the benefits erode. By themselves, buybacks are not a panacea or a long-term answer to over-capacity, over-fishing, and ecosystem degradation, but they may be the only feasible option for a transnational fishery to reduce fishing capacity.

Buybacks can accelerate the transition to a rationalised fishery and enhanced ecosystem health when coupled with limited entry, scrapping of bought-out vessels, limits on re-entry into the fishery through purchase of formerly inactive licenses by owners who have sold an active license, and co-management through partnership with the industry. Financing the buyback may be a mixture of public and industry financing with initial loans or grants by an international institution.

Buybacks in a transnational fishery are not a replacement for rights-based management protected by a strong international agreement. Nonetheless, an ongoing multilateral buyback of vessels, licenses, other use rights, or gear, coupled with vessel capacity limits and limited entry, may be the only tractable approach to reduce capacity until a system of rights, protected by a strong international treaty, is instituted.

Notes

- ¹ This paper draws heavily from the papers in Curtis and Squires (forthcoming), especially Groves and Squires (forthcoming) and Hannesson (forthcoming). The paper also draws from Barrett et al. (2004), FAO (1998, 2000), US Government Accountability Office (1999, 2000), Holland et al. (1996), Joseph and Greenough (1978), Joseph (2003, 2005), Joseph et al. (2006), Weninger and McConnell (2000) and World Bank (2004).
- ² Joseph et al. (2006) observe that most of the tuna stocks are in reasonably good health, sustaining high levels of catch, but that the available fishing capacity is far greater than that necessary to harvest the fish at levels

corresponding to these. This excess fishing capacity poses a threat to the sustainability of the tuna resource, represents a waste of capital, and decreases the economic returns to the fishery. Unless effective management measures are implemented in the near future, it is likely that the tuna stocks that are currently overfished will become further overfished and that those that are currently maintained at sustainable levels will become overfished.

- ³ Reid et al. (2005) recently demonstrated over-capacity in all of the major purse-seine fisheries for tuna in the Regional Fisheries Management Organization regions. High seas longline fisheries are similarly believed to face such over-capacity (Miyake 2005).
- ⁴ This discussion is derived from Joseph et al. (2006b).
- ⁵ Joseph (1994) discusses the IATTC dolphin issue.
- ⁶ Closed regional vessel registers established under the auspices of a binding international agreement, much like the Agreement on the International Dolphin Conservation Program, create a form of common property under formal international law. Closed regional vessel registers established without an explicit binding international agreement form common property under customary international law.
- ⁸ Limited entry and allocation of total allowable catch to individual states was first suggested by Joseph and Greenbough (1978).
- ⁹ The economic welfare analysis is based on Campbell (1989) and Weninger and McConnell (2000).
- ¹⁰ Economies of scale are reductions in unit harvesting costs when costs, especially fixed costs, are spread out among higher levels of output or catch. Economies of scope are cost savings from joint production of multiple outputs or species.
- ¹¹ This section largely draws on Barrett (2003, 2005), Bjørndal and Munro. (2003), Curtis and Squires (in press), Joseph and Greenough (1978), Joseph (2003, 2005), Barrett et al. (2004), Munro et al. (2004), Joseph et al. (2006a), Groves and Squires (forthcoming), and Hannesson (forthcoming).
- ¹² Joseph et al. (2006a) observes that Japan has targeted 130 vessels for removal from its fleet,

and Taiwan has agreed to limit its fleet to 600 vessels. Taiwan will require that Taiwanese-owned vessels under flags of convenience be transferred to its registry. Some of the recalled vessels will be bought back and scrapped along with the 130 Japanese vessels. Moreover, funds were loaned to the industry groups by the Japanese government on a 20-year payback schedule. This buyback was partly in response to the reduction of fishing areas when national waters were extended into what had been international fishing grounds (Holland et al. 1999).

References

- Barrett, S., 2003. *Environment and Statecraft: the strategy of environmental treaty making*, Oxford University Press, Oxford.
- , 2005. 'The theory of international environmental agreements', in K.G. Mäler and J.R. Vincent (eds), *Handbook of Environmental Economics*, 1(3):1,457–516.
- Barrett, S.J. Joseph, T. Groves, and Squires, D., 2004. 'Design of an effective and implementable plan to limit overfishing', Paper presented to the American Economic Association winter meetings, Philadelphia.
- Bjørndal, T. and Munro, G.R., 2003. 'The management of high seas fisheries resources and the implementation of the UN Fish Stocks Agreement of 1995', in H. Folmer and T. Tietenberg (eds), *The International Yearbook of Environmental and Resource Economics 2003/2004*, Edward Elgar, Cheltenham:1–30.
- Campbell, H., 1989. 'Fishery buy-back programs and economic welfare', *Australian Journal of Agricultural Economics*, 33:20–31.
- Clark, C.W., Munro, G. and Sumaila, U., 2005. 'Subsidies, buybacks, and sustainable fisheries', *Journal of Environmental Economics and Management*, 50(1):47–58.
- Curtis, R. and Squires, D. (eds), (forthcoming). *Fisheries Buybacks*, Blackwell Publishing, Oxford.
- Food and Agriculture Organization of the United Nations, 1998. *Report of the technical working group on the management of fishing capacity*, FAO Fisheries Report No. 586, Food and Agriculture Organization, Rome.
- , 2000. 'The international plan of action for the management of fishing capacity', Food and Agriculture Organization, Rome. Available from: <http://www.fao.org/fi/pa/capace.asp>
- Gjertsen, H., Hall, M. and Squires, D., 2006. 'Incentives to address bycatch issues', Paper given at a workshop organised by the Department of Economics, University of California San Diego and the Inter-American Tropical Tuna Commission at the Institute of the Americas, University of California, San Diego, 10–12 October.
- Groves, T. and Squires D. (forthcoming). 'Lessons from fisheries buybacks', in R. Curtis, and D. Squires (eds), *Fisheries Buybacks*, Blackwell Publishing.
- Hallman, B., Barrett, S. Clarke, R. Joseph, J. Restrepo, V. and Squires, D., 2006. *Regional vessel registries and limited access programs*, paper given at a workshop organised by the Department of Economics, University of California San Diego and the Inter-American Tropical Tuna Commission at the Institute of the Americas, University of California, San Diego, 10–12 October.
- Hannesson, R. (forthcoming). 'Do buyback programs make sense?', in R. Curtis and D. Squires (eds), *Fisheries Buybacks*, Blackwell Publishing, Oxford.
- Holland, D. Gudmundsson, E. and Gates, J., 1999. 'Do fishing vessel buyback

Focus

- programs work: a survey of the evidence', *Marine Policy*, 23(1):47–69.
- Joseph, J., 1994. 'The tuna-dolphin controversy in the Eastern Pacific Ocean: biological, economic, and political impacts', *Ocean Development and International Law*, 25(1):1–30.
- and Greenough, J.W., 1978. *International Management of Tuna, Porpoise, and Billfish—Biological, Legal, and Political Aspects*, University of Washington Press, Seattle and London.
- Joseph, J., 2003. 'Managing fishing capacity of the world tuna fleet', *FAO Fisheries Circular* No. 982, Food and Agriculture Organization, Rome.
- , 2005. 'Past developments and future options for managing tuna fishing capacity, with special emphasis on purse-seine fleets', in W.H. Bayliff, J.L. Leiva Moreno, J. de Majkowski (eds), *Second Meeting of the Technical Advisory Committee of the FAO Project Management Of Tuna Fishing Capacity: Conservation And Socio-Economic* Madrid, 15–18 March, FAO Fisheries Proceedings No. 2, Food and Agriculture Organization, Rome.
- , Squires, D., Bayliff, W, and Groves, T., 2006a. 'Addressing the problem of excess fishing capacity in tuna fisheries', paper given at a workshop organised by the Department of Economics, University of California San Diego and the Inter-American Tropical Tuna Commission at the Institute of the Americas, University of California, San Diego, 10–12 October.
- , 2006b. 'Property rights in transnational fisheries: the last ocean frontier', paper given at a workshop organised by the Department of Economics, University of California San Diego and the Inter-American Tropical Tuna Commission at the Institute of the Americas, University of California, San Diego, 10–12 October.
- Kaitala, V. and Munro, G.R., 1997. 'The conservation and management of high seas fishery resources under the new law of the sea', *Natural Resource Modeling*, 10:87–108.
- Kitts, A. and Thunberg, E. (n.d.). Economic considerations in the design of northeast US fishing vessel buyout programs, Northeast Fisheries Science Center, Woods Hole, Massachusetts (unpublished).
- , Thunberg, E. and Robertson, J., 2001. 'Willingness to participate and bids in a fishing vessel buyout program: a case study of New England groundfish', *Marine Resource Economics*, 15:221–32.
- Kuronuma, Y., 1997. 'An economic theory behind the Japanese coastal fisheries management policy on fishing rights in relation to the license system for off-shore and distant-water fisheries', in *Towards Sustainable Fisheries: Issue Papers*, Organisation for Economic Cooperation and Development, Paris. Available from [http://www.oecd.org/olis/1997doc.nsf/LinkTo/ocde-gd\(97\)54](http://www.oecd.org/olis/1997doc.nsf/LinkTo/ocde-gd(97)54).
- Miyake, P.M., 2005. 'A review of the fishing capacity of the longline fleets of the world', *FAO Fisheries Proceedings*, 2:157–70.
- Munro, G.R., Van Houtte, A. and Willman, R., 2004. *The conservation and management of shared fish stocks: legal and economic aspects*, FAO Fisheries Technical Paper No. 465, Rome.
- Organisation for Economic Cooperation and Development. 1996. 'Synthesis report for the study on the economic aspects of the management of marine living resources', AGR/FI (96)12, OECD, Paris.

- Read, A.G. and Buck, E.H., 1997. 'Commercial fishing: economic aid and capacity reduction', CRS Report for Congress, Congressional Research Service, Washington, DC. Available from: <http://www.cnie.org/NLE/CRSreports/Marine/mar-24.cfm>
- Reid, C., Kirkley, J., Squires, D., and Ye, J., 2005. 'An analysis of the fishing capacity of the global tuna purse-seine fleet.' *FAO Fisheries Proceedings*, 2:117–56.
- Spagnolo, M. and Sabatella, R. (forthcoming), 'Driftnets buy back program: a case of institutional failure', in R. Curtis and D. Squires (eds), *Fisheries Buybacks*, Blackwell Publishing, Oxford.
- Squires, D. 1992. 'Productivity measurement in common property resource industries: an application to the Pacific Coast trawl fishery', *RAND Journal of Economics*, 23:221–36.
- , 1994. 'Firm behaviour under input rationing', *Journal of Econometrics*, 61(2):235–57.
- Townsend, R. 1990. 'Entry restrictions in the fishery: a survey of the evidence', *Land Economics*, 66(4):359–78.
- Townsend, R.E. and Pooley, S.G., 1995. 'Fractional licenses—an alternative to license buy-backs', *Land Economics*, 71(1):141–43.
- United States Government Accountability Office, 1999. 'Federally funded buyback programs for commercial fisheries', Briefing for the House Committee on Resources, GAO Resources, Community and Economic Development Division, GAO/RCED-00-8R, Washington, DC.
- , 2000. 'Commercial fisheries: entry of fishermen limits benefits of buyback programs', GAO Report to House Committee on Resources, GAO/RCED-00-120, June 2000, Washington, DC.
- Weninger, Q. and McConnell, K.E., 2000. 'Buyback programs in commercial fisheries: efficiency versus transfers', *Canadian Journal of Economics*, 33(2):394–412.
- Wilén, J., 1979. 'Fisherman behaviour and the design of efficient fisheries regulation programs', *Journal of the Fisheries Research Board of Canada*, 5:313–24.
- , 1988. 'Limited entry licensing: a retrospective assessment', *Marine Resource Economics*, 5:313–24.
- World Bank. 2004. 'Saving fish and fisheries: towards sustainable and equitable governance of the global fishing sector', Report No. 29090-GLB, Agriculture and Rural Development Department, World Bank, Washington, DC.

Acknowledgments

This paper was originally presented at the Fisheries Economics Management and Tuna Management Workshop for the Pacific Islands, The Australian National University, 25 and 26 September 2006. The workshop was hosted by the Crawford School of Economics and Government with the support of the Australian Agency for International Development (AusAID).