Chapter 2

Lessons from Fisheries Buybacks

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Introduction

Buybacks of fishing vessels, licenses or access rights, other use or property rights, and gear, as discussed in Chapter 1, are one of the key management tools used to address overcapacity, overexploitation of fish stocks, and distributional issues that arise in fishing industries. Two more objectives can be added: the conservation of ecosystems and biodiversity (also known as ecological public goods and services), and the provision of a transition period to a more rationalized fishery.[1]

This chapter builds upon the general foundation of Campbell (1989), Campbell and Lindner (1990), Holland, Gudmundsson, and Gates (1999), Weninger and McConnell (2000), Cueff (2004), Hannesson (2004b), and World Bank (2004), plus the 11 case studies presented at the National Oceanic and Atmospheric Administration (NOAA) Fisheries-University of California San Diego workshop in 2004, "International Workshop on Fishing Vessel and License Buyback Programs." The chapter synthesizes and develops the existing discussion on fisheries buybacks, drawing upon new case studies and other papers in the literature.

The chapter is organized with the follow sections:

- The reasons for buybacks of vessels, licenses, gear, or rights
- The consequences of buyback programs
- Buyback program design issues
- Issues from an industry perspective
- Who pays for buyback programs
- Buybacks as a transition to a restructured industry
- Buybacks in transnational fisheries
- The main lessons to be learned from the international experience with buybacks
- Concluding remarks

Why Buybacks?

The need for public or private buybacks of vessels, licenses or access rights, other use and property rights, or gear most fundamentally arises as a result of ill-structured property rights, particularly open access or no property rights, and the overcapacity and overfishing that follow. Buybacks also arise due to the additional problems of limitations to governance, pervasive uncertainty, and the conservation problems encountered with public goods, such as ecosystems and biodiversity. On a more concrete level, we discuss eight principal reasons, which are not necessarily mutually exclusive, for the application of buybacks: (1) directly increasing economic efficiency; (2) modernizing fleets and adjusting their structure and composition; (3) facilitating the transition from fisheries with overexploited stocks and overcapacity to private or common rights-based conservation and management; (4) providing alternatives when individual transferable quotas or common use or property rights with effective management are infeasible; (5) providing disaster or crisis relief; (6) addressing compensation and distributional issues; (7) conserving common resources or fish stocks underlying a fishery; and (8) conserving biodiversity and ecological public goods, such as ecological services from mangrove swamps or coral reefs, turtle nesting grounds and associated offshore areas, dolphins caught with yellowfin tunas, and bycatch caught with drifting fish aggregator devices (FAD). We discuss each of these situations in turn and in greater detail.

Increase Economic Efficiency

Private Profitability

In many instances, a primary goal of vessel or license buyback programs is to improve the profitability of the remaining fleet by reducing fishing capacity through removal of capital and variable inputs (Campbell 1989, GAO 1999, Holland et al. 1999, Weninger and McConnell 2000, World Bank 2004). Potential welfare gains accrue to exiting vessel or license owners in the form of buyback payments, to the remaining owners through potential gains in profits, to remaining crew members through higher crew shares, and in a very few instances, to exiting crew members through specifically targeted payments. Publicly financed buyback programs also enhance private profitability through another channel, since a transfer of funds takes place from public to private hands.

Owner profits and economic rent to the fishery may rise in the short run, because rent is shared among 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 reduced overall vessel and industry costs (especially capital).[2] Rents to crew members are also shared among fewer crew members on the remaining vessels. 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.

Profit gains enjoyed by vessel or license holders may be, at least partially and perhaps temporarily, capitalized into increased vessel and/or license prices, which can only be realized through sale. The distribution of profits and increased crew shares among vessel and/or license holders and crew members depends on the specifics of the buyback program, such as eligibility criterion, specifically targeted groups within the fishery, and other such factors.

Economic Welfare

The net economic welfare effects on the fishery of a buyback depend on the opportunity for remaining fishers to replace the removed capacity, the irreversibility of their capital investments, and the speed of replacement of fishing capital (Weninger and McConnell 2000).[3] Resource rent in the short run may rise as redundant fishing capacity is removed, thereby lowering costs and possibly raising catch rates, and remaining vessels may also be able to exploit previously unattained scale or scope economies.[4] Long-run rent gains depend on the ability to replace or even expand purchased capital. Welfare can fall with additional investment in the post-buyback fishery if the technological resource stock externality remains, so that some of the replacement investments are redundant from the perspective of society.[5] In the absence of property rights or taxes, increased resource rent can reinforce the very investment incentives that led to the initial overcapacity.

Continued technical change can increase rent in the short run, but countervailing pressures can be created that lower rents over a longer time to the extent that resource stocks are adversely impacted (Squires 1992). Campbell (1989) observes that the net benefits of a buyback vary positively with the share of the restricted input(s) as a proportion of total costs and inversely with the ability to substitute between restricted and unrestricted inputs. Clark, Munro, and Sumaila (2005) suggest that to the extent buybacks come to be anticipated by fishers, fishers will be motivated to acquire vessels, even if the prospects of making a normal return on their investments are low. As a result, to the extent that fishers anticipate future benefits, there can be greater overcapacity than would otherwise occur.

Economic efficiency for the economy as a whole from a buyback weighs the economic benefits of the buyback against the opportunity cost of public and private funds employed to finance the buyback and the alternative uses for the released inputs, such as vessel and crew. The economic benefits include the gains in consumer and producer surplus (economic rent) from the fishery, in which all costs and benefits are valued by their opportunity costs or willingness to pay.[6] Changes in consumer surplus, a measure of consumer benefits, are likely to be minimal in fisheries with buybacks managed by total allowable catches (TAC), since overall supply and consumer prices can be expected to remain fairly constant.[7] Over a longer period, consumer surplus could rise to the extent that there is less fishing capacity and mortality and resource stocks recover, making more fish available and possibly at a lower price (some or all of which could be transferred to consumer surplus from producer surplus).[8] Consumer surplus could also rise if there are any quality gains, such as from a decline in the race to fish.

The economic cost of publicly funded buybacks, directly borne by society, is the economic benefit forgone by allocating public funds to buybacks rather than funding the next best alternative elsewhere in society. Economic cost could also include any deadweight losses arising from taxes levied in the nonfisheries sectors that are used to finance the buyback, where these taxes are not specifically levied for such a purpose.[9] For industry-financed buybacks, taxes or fees on landings or elsewhere in the fishery specifically imposed to finance buybacks may not impose deadweight losses, since they are Pigouvian taxes to correct an externality and the resulting market failure, and hence represent a double-dividend tax. These taxes also represent the "polluter pays" principle.

External benefits or costs could arise with buybacks.[10] External costs, through the technological resource stock externality or congestion, could be generated to the extent that fishing capacity is redirected to other fisheries that are themselves the subject of overcapacity and overfishing. External benefits could arise to the extent that other fisheries or gears that are not part of the buyback, but which fish the same resource stock, gain from any reduced mor-

tality in the buyback fishery and resource stocks increase. Asymmetric, downstream external benefits could also arise if the reduced mortality in the buyback fishery affects stocks that are migratory, and hence fished elsewhere, or are fished in a later stage of the life cycle (and therefore possibly larger and sexually mature) by other fishers, such as various small pelagic species, swordfish, or tunas. Such an example arose with the Italian drift gill-net buyback, which lowered fishing mortality on the shared Mediterranean swordfish stock exploited by multiple countries. Pecuniary externalities can also arise, affecting the distribution of economic rent among different participants, but not affecting the overall net economic benefits. For example, in the British Columbia salmon fishery, the increase in demand for licenses by the government through the publicly funded buyback and by other fishers for stacking multiple licenses on a single vessel certainly increased license prices, and thereby increased the returns to exiting fishers by more than they otherwise would have experienced.

Modernize Fleets and Adjust Fleet Structure

The goals of some buyback programs include modernization of fleets and adjusting fleet structure. The aim is to improve competitiveness, enhance safety, improve storage and quality of fish products, and satisfy social objectives. In some cases, modernization in the form of vessel construction, and hence the embodiment of new technology in a new capital stock, is only allowed with the removal of an equivalent amount of fishing capacity as measured by one or more characteristics of the capital stock, such as vessel tonnage or engine power kilowatts (kW).

The European Union's (EU) Multi-Annual Guidance Programmes (MAGP) is a notable example of fleet modernization. The MAGP reduced the older and less efficient vessels within the fleet. The MAGP also facilitated financing vessel replacement, at least until simultaneous financing of scrapping and the replacement of vessels withdrawn with public aid was prohibited. In Denmark, funding for vessel construction was only made available if the vessel owner removed capacity from the fishery, with the grant size dependent on the investment cost, tonnage of the new vessel, and tonnage removed in conjunction with the new investment. Modernization that increased capacity (vessel tonnage or kW) could only be funded if capacity was simultaneously removed from the fleet.

The modernization goal can conflict with the goal of capacity reduction to the extent that a fleet embodying new technology raises productivity (fishing power) or the buyback program fails to account for heterogeneity of the capital stock, both of which can raise fishing capacity. Reductions in measurable attributes of the capital stock, such as tonnage or kW, generally fail to remove equivalent amounts of fishing capacity measured by the potential ability to catch fish, since differences in productivity (especially technology) are not considered. Productivity growth, especially technical progress, exacerbates the fishing capacity problem. Moreover, simply focusing on one or a limited number of the measurable attributes of a heterogeneous capital stock, such as vessel tonnage or engine power, or treating the capital stock as homogeneous, overlooks the uncontrolled components of the capital stock that may expand through investment and thereby contribute to increased fishing capacity (Wilen 1988, Campbell and Lindner 1990, Townsend 1990, Squires 1994).

Reduce Fishing Capacity When Strengthened Rights May Be Infeasible

In a number of instances, a rights-based approach (whether private or common property or use rights, and whether centered on catches, resource stocks, or areas) is preferred as a first-

best management approach to resolving overcapacity and overexploited resource stocks. Under some circumstances, private use rights for catches of individual species (i.e., individual transferable quotas [ITQ]), may be deemed infeasible, such as in complex multispecies fisheries, for political or social reasons, or fisheries in developing countries. Even when ITQs are desired, it may not be feasible to implement them when fishers cannot borrow the funds to finance ITQ acquisitions, such as when fishers are incurring losses. Nonetheless, there may still be a compelling need to reduce fishing capacity and protect or rebuild resource stocks. Buybacks may then provide a second-best management measure, and may create a limited window of opportunity for a transitional stage to a more rationalized fishery, as discussed in greater detail later in the chapter. Moreover, as in the Australian South East trawl fishery, the ITQ program may not lead to a rapid industry restructuring, and a vessel or license buyback can accelerate the transition to a restructured and rationalized fishery. The Government of Australia is currently initiating a nationwide buyback prior to extending mandatory rights-based management. The Government of New Zealand used buybacks as part of the transition to ITQs.

Provide Disaster or Crisis Relief

Buybacks have often been initiated as disaster or crisis relief (Holland et al. 1999). Public support for the raising and disbursing of public funds often requires such a major issue as an impetus. The funds are intended to alleviate economic hardships and as income transfers. In these instances, the level of overcapacity and overfishing of the resource stock may be such that there is little or no positive economic rent in the fishery, and often there may be widespread losses throughout the fishery; only a limited number of vessel owners make profits, and many owners may desire to exit the fishery. The stated goals may or may not explicitly include disaster or crisis relief.

Examples of explicit relief include the U.S. Pacific coast salmon troll, Italian clam, Atlantic Canada, and New England vessel buybacks. The U.S. Pacific coast groundfish trawl buyback, intended in part as crisis relief, was industry-financed, but with an initial public financing to be paid back by the industry. The Danish buyback program, from 2004 until phase-out in 2005, instituted a new round of decommissioning to alleviate economic hardships, especially resulting from reduced quotas, cod recovery plans, and moderate fish prices. The program also prioritized the removal of old vessels and fishers.

Address Other Compensation and Distributional Issues

Selective buybacks can help achieve social objectives, including recognition of aboriginal treaty rights, accommodation of new entrants, and shifting capacity regionally, by gear type, between commercial and recreational fishers, or between small-scale and large-scale vessel groups. Vessel buyback programs may also be intended, at least in part, as compensation, and as such represent income transfers. For example, the British Columbia salmon troll vessel buyback was partially intended to compensate existing vessel owners for replacement by aboriginal vessel owners. In 1997, the EU imposed a complete ban on drift gill nets beginning in 2002, and the Government of Italy approved two plans for the withdrawal and conversion of drift gill net gear. In the Italian driftnet fishery, plans were approved for financial compensation to both vessel owners and crew through the "Spadare Plan," a buyback program intended to reduce the social and economic impact on fishers who complied with the driftnet fishery ban. The vessel buyback in the Australian South East trawl fishery was intended, in part, to

remedy the acrimony over the initial allocation of ITQs and its associated uncertainty and litigation. Vessel buybacks may also compensate fishers when removing fishing from shipping lanes or oil fields, for losers when fish stocks rebuild and the industry restructures, and for changes in legislative initiatives.

Buyback programs can also create unintended distributional consequences in that some regions, gear groups, or vessel size classes may benefit more than others. For example, when the United Kingdom introduced a decommissioning scheme under the EU MAGP, between 1993 and 1996, there was still slight overcapacity compared with gross registered ton (GRT) targets by 1996 so that the bidding scheme resulted in the envisioned capacity reduction (World Bank 2004). However, the capacity reduction was unevenly spread over different fleet segments and geographical areas, with overcapacity remaining in beam trawl, demersal trawl, seine, and shellfish potting vessels.

Conserve or Rebuild Overexploited Fish Stocks

One of the more common intentions of vessel buyback programs centers on conserving, or more typically, rebuilding overexploited fish stocks. Nursery grounds may also be protected through buybacks. All of the EU MAGPs included rebuilding overexploited fish stocks as one of the intentions of the programs, as did the buyback for the Taiwan offshore fishery. In contrast, the Australian South East trawl fishery buyback's goal did not include protection of overexploited resource stocks, because the fishery was already managed by ITQs and the corresponding TACs were not fully fished.

In some instances, fish stocks had fallen to low or critically low levels (Holland et al. 1999). Buyback programs were started in the Canadian and U.S. salmon troll fisheries following a severe decline in the numbers of returning salmons. The Australian northern prawn and barramundi buybacks were initiated because of overfishing that was believed to be sufficiently severe to threaten future recruitment. The effectiveness of a buyback program aimed at reduced fishing mortality, and more specifically at rebuilding overexploited fish stocks, depends upon the amount of fishing mortality removed from the fishery through the buyback. Removal of only a limited amount of fishing capacity or expansions in fishing activity by the remaining vessels serve to limit the reduction in fishing mortality. Subsequent replacement of existing vessels by larger and more productive vessels, or expansions in inputs and adoption of technological innovations by remaining vessels also limit any lasting reductions in fishing mortality. Also, as noted elsewhere, the benefits of a one-shot buyback by itself, including reductions in fishing mortality, are of limited duration.

Protect Ecological Public Goods and Conserve Biodiversity

In addition to conserving overexploited fish stocks, buyback programs may aim to conserve other environmental assets, including coral reefs, protected species such as sea turtles, unintended bycatch, and biodiversity in general. The employment of ecologically damaging gear and fishing methods, such as bottom trawl, can destroy or harm the bottom and the benthic habitat. Damage to ecosystems lowers public goods, such as biodiversity and the ecosystem services supporting fish populations.

One of the key issues in establishing marine-protected areas that include existing fishing grounds is the forced redirection of fishing to grounds that are usually already exploited, even overexploited, unless the displaced fishing capacity is removed and the fishers harvesting those grounds are compensated. Buyback programs can serve to reduce or even totally re-

move the vessels, licenses, or gear. Because the entire public benefits, fishers should not bear the burden by themselves and may require compensation.

The Nature Conservancy, working with Environmental Defense, in 2006 initiated such a program along California's central coast. Analyzing the threats to 25 hotspots of marine biodiversity, the Nature Conservancy targeted bottom-trawl fishing as particularly destructive. Trawlers catch bottom-dwelling fish, primarily flatfish, sablefish, and rockfish, by use of a weighted net dragged along the ocean bottom. The method destroys the bottom habitat, since the net scoops up everything along its path, and also harvests a large percentage of bycatch other than the target species, some of which are juveniles of the target species. The Nature Conservancy worked with central California coast fishers, particularly in Morro Bay, and approached the Pacific Fishery Management Council with a proposal to close a section of the coast to trawling. The Nature Conservancy would buy back permits and vessels from the fishers to offset the fishing loss. In May 2006, trawling was banned on 3.8 million acres off the California coast between Point Conception off the coast of Santa Barbara and Point Sur south of Monterey Bay. The Nature Conservancy purchased six permits and four boats. The buyback program, by retaining the permits and redirecting the vessels to nonfishery uses, ensured against reentry into the fishery. Currently, the Nature Conservancy holds the permits, and if the stocks recover, they may lease them back to select fishers with constraints built into the leases to ensure responsible fishing, moving in the direction of conservation easements on land. For example, a lease could specify that fishing be done with vertical longlines or traps, methods that more carefully target desired species and have substantially lower bycatch of undesired species.

The buyback program in the Australian northern prawn fishery helped reduce environmental damage through reduced bycatch and protection of sensitive sea grass beds (World Bank 2004). In another instance, compensation was paid to Australian fishers when the area of "no fishing" zones in the Great Barrier Marine Park was expanded by about one-third in 2004. The current two-round Australian buyback of statutory fishing rights includes provision for a buyback of fishers who will be adversely affected by the establishment of several large Marine Protected Areas in the southeast marine region. Similar terrestrial programs include the Conservation Reserve Program of the U.S. Department of Agriculture, Wetlands Reserves, Nature Conservancy reserves, and New York City's purchase of watershed in the Catskill Mountains (Heal 2000). Although property rights are often required on land, a limited access program with spatial and/or temporal dimensions restricting use rights could serve a similar role.

To the extent that ecosystems and their services and biodiversity are pure or impure public goods, an additional externality arises, one associated with public choice. This issue of mechanism design, however, is beyond the scope of this chapter.

Consequences of Buyback Programs

Following a buyback program, changes in vessel-level behavior generate several important results, both intended and unintended.

Short-run Advantages to Remaining Vessels

The remaining vessels receive additional profits, especially if the resource stocks rebuild and more profits are generated, but also through sharing the overall profit with fewer players. If

public financing occurs, the cost of removing vessels is a direct income transfer from taxpayers to owners, and there can be windfall gains to both those remaining and exiting. The transfer payments from the public to vessel, gear, or permit owners can be higher than their minimum willingness to accept in order to remove their fishing units. Further, rents from the program are capitalized into the remaining vessels and licenses.

Increased Investment by Remaining Vessels

The buyback program can be self-defeating over a longer time by creating incentives to invest in more capital, increase capacity utilization by fishing longer, and adopt new technology. Positive profits from rebounding fisheries reinforce the incentives to invest in existing vessels, fish longer, and adopt new technology. Publicly funded buybacks also transfuse money into the industry and raise the derived demand for vessels, licenses, or gear, and thereby their prices. Publicly funded buybacks and transferred funds allow investment in new boats and gear to replace bought-out boats, and the remaining vessels increasingly use their capital by fishing longer. Jorgensen and Jensen (1999) observe that the publicly funded buybacks in the EU stimulated investment in fishing capacity, both directly and indirectly through bankers and other financers who offered credit on easier terms than would otherwise be expected. There can be spillover effects onto other fisheries, where a successful buyback in one fishery can result in effort expansion in another related but uncontrolled fishery.

Exiting Vessels May Be the Least Efficient or Fish the Least

Exiting vessels may be older, embody older and less efficient technology, require upgrading, etc., and hence may be less efficient than those vessels that remain in the fishery. The actual removed capacity may be less than the number of exiting vessels suggests. The purchased vessels may have exited the industry anyway, but the buyback facilitates and accelerates their departure (a moral hazard question as addressed in the following section of this chapter). In addition, because of the expanded market for vessels and increased derived demand, owners of the purchased vessels would then receive a higher price than they otherwise would have received without the buyback.

Considerable international experience bears out these conclusions. The purchased vessels in the voluntary Italian Adriatic bottom trawl vessel buyback were older than those that chose not to participate in the buyback program and which instead remained in the fishery. These older vessels would otherwise face higher maintenance and repair costs, inadequate safety, and older technology. The withdrawn vessels also had lower revenue, relative to costs, than the remaining vessels, and the bulk of the decommissioned vessel owners had no intention to invest to further modernize or purchase a new vessel. In short, the decommissioning scheme facilitated the exit of less competitive and obsolete vessels, a process that would have otherwise taken longer without the vessel buyback program. Similarly, a data envelopment analysis (DEA) of capacity output suggests that less efficient vessels were decommissioned by the Danish buybacks. Moreover, the Danish structural policy favored removal of marginal players of little capital value.

Asymmetric Information: Moral Hazard and Adverse Selection Problems

During market transactions, the characteristics of goods and services may not be fully observable to all market participants. Market participants often asymmetrically hold this type of in-

formation; that is, some participants hold information that other participants do not hold. Market equilibria when there is asymmetric information may differ from market equilibria when there is full information, and the effects of asymmetric information lead to inefficient outcomes. Vessel, permit, and gear buyback markets are prone to these problems, because owners of vessels, permits, or gear are much more knowledgeable about the performance and characteristics of their assets than is the buyback agency. Two types of asymmetric information issues arise in buyback markets: moral hazard and adverse selection.[11, 12]

Consider first moral hazard, where the actions of vessel or license owners are not fully observable by the buyback authority. Vessel (or license) buybacks can bail out unprofitable or loss-making enterprises, which could otherwise remain in the fishery for some period of time, exit the fishery, or sell the vessel, perhaps for substantial losses, particularly if the alternative fisheries are subject to limited entry. Vessel owners then receive a higher price under the buyback program than they otherwise would have, given the increase in demand created by the program. Vessel buybacks can also signal that capital losses in the industry will always be limited. This reduces the overall risk in the industry, enticing risk-averse investors to invest more in fishing boats than they otherwise would have.

Another form of moral hazard may have appeared in Norway. There is anecdotal evidence that the boat owners themselves, realizing the gains that could be obtained from rationalizing the fleet, had a preliminary plan for an industry-financed buyback program, but this was quickly shelved when it transpired that the authorities were prepared to use public money for this purpose.

Adverse selection may arise when asymmetric information exists between the buyback agency and the vessel or permit owners. Prior to market participation, the owners have more information about their vessel, permit, intention to fish, and performance in the fishery of concern or other fisheries than does the buyback agency. For example, the level of information differs among the participants in these potential market transactions, and the costs of acquiring information for the purchasing agency may be high or even prohibitive. The owner knows if the vessel requires repairs and maintenance, has high operating costs, and overall is less effective at catching fish than other ostensibly comparable vessels.

A clear adverse selection problem arose in several buybacks of vessels. The vessels that were sold were often older, more in need of repair, and less productive at catching fish. The owners were, in many instances, older and reaching the end of their career. The buyback then simply accelerated their exit, which would have occurred in any case in the near future, and by increasing the demand for vessels and firming up the market, gave the sellers a higher price than they otherwise would have received. Moreover, the rate of fishing capacity reduction was less than it would have been without the confounding effect of adverse selection from otherwise exiting vessels.

In principle, owners who really want to sell can find ways to signal information about their unobservable knowledge through observable actions. The idea is that a market signal is an action that has economic consequences, and observation of the action by the buyback agency may reveal information that is otherwise hidden. For example, a vessel seller could offer to employ a certified marine surveyor, perhaps one working for the buyback agency, to evaluate the prospective vessel and classify the vessel's status. Along similar lines, there could be a costless test that reliably reveals a minimum standard or greater, creating a signal so that owners with a vessel of at least acceptable quality will submit to the test and owners who choose not to submit to the evaluation will be treated as being no better than the worst type of vessel. In both examples, because sellers with good vessels are more likely to be willing to take such an action, this offer can serve as a signal of quality. This signaling can lead to a market equilibrium that distinguishes classes of owners.

An alternative market response to the problem of unobservable vessel quality and productivity can occur, in which the uninformed party, the buyback agency, takes steps to distinguish or screen the vessels on the other side of the market. That is, buyback agencies can develop mechanisms to distinguish vessels or permits and their differing information. Some buyback programs, notably New England, used a screening approach based on a pricing metric. Pricing on a physical capacity basis, such as per vessel, GRT, or kW, does not fully capture all of the information of a vessel. Pricing on the basis of revenue, estimated fishing capacity, or catch (aggregated by value of different species if in a multispecies fishery and including undesirable catches such as endangered species) can more closely capture the information on actual and potential catch or fishing capacity. Different pricing metrics can thus differentially improve the performance of the buyback market by helping the purchaser set prices or accept bids based on more accurate measures of expected fishing capacity reduction.

The adverse selection problem can be exacerbated when offer prices are established by the buyback agency, and the offer price is lower than otherwise warranted or expected in comparison to existing second-hand market prices or an expected equilibrium price in the buyback market. If the price that can be received by selling a vessel is very low, only sellers with the worst vessels will offer them for sale. Little trade may occur, even if a great deal of trade would occur were information symmetrically held by all market participants, and the equilibrium fails to be a (Pareto) optimum.

Coordination failure can also arise if the buyback agency expects that the productivity of vessels accepting a buyback offer is low and, at the same time, only owners of less productive vessels accept the buyback offer price because the price is low. The buyback agency can improve the competitive equilibrium by increasing the offer price. These problems suggest that multiple rounds of pricing or allowing bids rather than setting offer prices can be helpful.

Improved Attitudes and Cooperation in a Transition Stage

Attitudes toward further changes in a fishery improve when the fishery is no longer in a crisis stage after buybacks (Young 2005 personal communication, Leipzig 2005 personal communication). Prior to significant capacity reduction after a buyback, an open access fishery, or even one under limited entry that does not function well, may be plagued with losses or low profitability. In such a fishery, fishers' attitudes may border on desperation or despair. Incentives favoring cooperation are impaired, and attitudes are more likely to be contentious and highly competitive. Once a buyback removes vessels, lower vessel numbers contribute to higher vessel profits and the possible exit of malcontents, and the remaining smaller number of fishers is more likely to be committed and receptive to alternative management regimes. Having fewer participants in general also favors cooperation. That is, buybacks that restore profitability also give breathing room for players to decide what to do next and enhance positive economic behavior, since players behave very differently when a fishery is profitable than when it is unprofitable, and when there are fewer players. Under this more favorable environment, fishers may be more open to rights-based management, such as ITQs, or to forms of common-property or otherwise coordinated behavior among coalitions of remaining players, such as voluntary associations managing portions of the resource. Fewer numbers of license holders can also begin to coalesce and to act like de facto collective owners of the resource.

The U.S. Pacific coast groundfish trawl fishery provides an excellent example (Young 2005 personal communication, Leipzig 2005 personal communication). Prior to an industry-financed buyback of vessels, the industry was absent rent, vessel owners were saddled with difficulty in paying for mortgages, and crew members' shares and incomes were declining.

The buyback removed a sufficient number of vessels to lift the profits of the remaining vessels, and thereby create a smaller number of committed fishers, who are now in the process of designing a program of individual transferable quotas. Prior to the buyback, an ITQ program would have been unimaginable.

Not Everyone Benefits

Buyback programs create distributional impacts, with gainers and losers. Crew members or other participants in the fishery are usually ineligible for payments under a vessel or license buyback program, even though most buyback programs are fully or partially funded by the public. Instead, the vessel and/or license owner is usually the only recipient of the buyback funds. At least in the short run, prior to any increase in resource stocks or profits, overall employment can be expected to fall, although sustainable employment levels can rise if resource stocks rise. Remaining crew members can gain through higher profits creating larger crew shares.

A few buyback programs have explicitly targeted payments to crew members. In the Italian swordfish driftnet buyback program, crew members were entitled to receive a retirement allowance if they agreed to forgo any fisheries activities or a reconversion allowance if they shifted to other fishing activities involving gear other than driftnets or to other economic sectors. Under the first Italian clam buyback program, each withdrawn vessel was paid 130,000 Euros and each crew member quitting the dredge activity received 6,500 Euros.

Supplementary programs in conjunction with buyback programs create benefits or compensate for losses by stakeholders left out of the benefits. Examples include crew members and workers in processing and other fishery support industries. These supplementary programs include unemployment compensation, early retirement pensions, job training, and grants to develop new businesses (World Bank 2004).

Distributional impacts differ by vessel and gear types, vessel size classes, ports, ethnic groups, and other specific groups in the sector. The bidding and selection process for the distribution of buyback funding often induces distributional issues (World Bank 2004).

Buyback Program Design Issues

Program Goals and Objectives

Clear goals and objectives are a critical, if sometimes underappreciated, element of any successful buyback program for vessels, licenses, or gear. Without a clear set of objectives and goals, the program is less likely to be designed to succeed. There may also be conflicting objectives, such as removing fishing capacity and modernizing the fishing fleet financed by public subsidies. The EU MAGPs, for example, attempted to simultaneously satisfy the multiple and conflicting objectives of reducing fishing capacity and modernizing aging fleets.

Scope of the Program

A clearly defined scope of the buyback program also contributes to success. Which gear types and fisheries, vessel size classes, geographic areas, full-time versus part-time (latent) vessels, commercial or recreational, licenses and/or vessels are all questions that arise and that also

affect program size and budget. These are strategic choices that affect the structure of the postbuyback fishery.

The scope may also shift over time. The French buyback programs under the MAGP are a notable example of broad programs with a shifting focus. Another buyback program started with only trawlers but moved to other permits, shrimp, and crab.

Some programs target the underutilized or inactive permits, such as the New England groundfish permit buyback. Although the average vessel age in the New England groundfish permit buyout was nearly the same as in the subsequent vessel buyout, the average length, gross tons, and vessel horsepower were all much smaller. Other programs target the permit or vessel owners most dependent on the fishery by basing requirements directly on historical catch or revenues. In the New England groundfish vessel buyback, eligibility required the vessel owner to demonstrate that at least 65% of fishing revenue was derived from landings of large mesh groundfish species in 3 of 4 years from 1991 to 1994. Vessels targeting rockfish were more likely to sell in the U.S. Pacific coast groundfish trawl fishery buyback (Bustic and Bromley 2006).

Some programs target potential rather than demonstrated capacity, where bids are based on some physical measure (Holland et al. 1999). Bids based on a per unit value of some physical measure of capacity, such as GRT, rather than some measure of performance, such as historical catch or revenue, should provide relatively greater benefits to less efficient owners since the permit or vessel surrendered is worth relatively less to them in terms of profits, but they will receive the same compensation for surrendering it (Holland et al. 1999). When there is compensation for potential fishing capacity combined with a reverse auction bidding system, the less active owners can be expected to make the winning bids.

Critical Preconditions

There are several critical preconditions for a buyback of licenses or vessels.

Well-defined Group

One of the first steps starts with proper registration of licenses and vessels to create a well-defined group of eligible owners and to provide well-defined boundaries to the fishery and program. Because of the prevalence of eligibility requirements and different buyback pricing formulae (discussed below), the registration typically includes some combination of measures of the capital stock, such as vessel size (GRT, GT, length, well capacity) and/or engine power (horsepower or kW), plus catch history, revenue, home port, gear type, methods of fishing, vessel age, crew size, area fished, and so forth. The EU register of fishing vessels, for example, was not yet established prior to the first two EU MAGP programs, and there were disparate units of fishing capacity (vessel tonnage and kW), which hindered monitoring. In some instances, a time series of some of these measures, such as catch history, is required for each vessel, such as when a window of multiple years is used to establish eligibility. For example, the vessel buyback program in the Taiwan offshore fishery from 1991–1995 purchased only vessels older than 12 years.

Organization and Communication

A well-established mechanism for organization of the program and for communication between regulators and industry (and other involved stakeholders) and among industry (and

other stakeholders) itself facilitates success. Some of the factors that can affect organization and communication include the number of participants, existing relationships and obligations among industry members and with the regulator, relative power of subgroups, economic and biological state of the fishery at the time of the buyback, and strength of leadership.

Limited Entry

In situ measures to prevent new boats from entering the fishery in place of the ones that have been removed are critical. Without a preexisting program of limited entry, ITQs, or some form of common or private property or use rights that strengthen the exclusive use characteristic of property or use rights, funds from purchased vessels or licenses can be used to purchase an upgraded or new vessel for the fishery, or new participants may enter the fishery as it becomes profitable. In the Norwegian purse seine fishery, limiting new entry was accomplished through restricting the total cargo capacity of the fleet. In the Italian Adriatic trawl buyback, the Italian government introduced a moratorium on new licenses and a limit on construction of new vessels, whereby building a new trawler was only allowed if a larger vessel, not less than 120% of the new one, was scrapped. The latter reduced the average GRT per vessel, but had less effect on kW per vessel, since the regulation was limited only to GRT and not kW. The buyback program in the Australian South East Trawl Fishery was established under the auspices of a preexisting ITQ program.

Reentry and Reinvestment

In a related issue, funds received from the buyback may be used to finance further investment in existing vessels held by the same owner, or used to finance a remaining vessel or license already owned by the seller, or to reenter the fishery by selling a vessel or license and using the proceeds to purchase an existing vessel or license. If there are permit holders not actively fishing but eligible to enter the fishery, one of these permits could be purchased for far less than the funds received to exit the fishery, and fishing effort could potentially expand. Public funding of buybacks can exacerbate this problem of capacity expansions through investment and technical progress for the remaining vessels, since additional funds from outside of the sector are now potentially available for owners of existing vessels, permits, or gear. The New England groundfish buyback program was adversely affected by sellers reentering the fishery after purchasing previously inactive licenses.

Purchasing Vessels and Gear or Licenses

Should the buyback program purchase the vessel and gear or the 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 a 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 (Read and Buck 1997).

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, may easily shift its fishing capacity to another fishery. If the program buys back the vessel and gear but not the license, the license, if transferable, can be used with 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 nearly so, but that could potentially increase their fishing as the profitability of the fishery improves. Inactive or low activity vessels may have their primary focus in other fisheries, and hold licenses more as options to fish so that the license price reflects option value. Similarly, purchasing the lowest priced licenses tends to remove the least active vessels, such as vessels fishing part time or in multiple fisheries, or those that are the most marginal in some other sense.

The license can be attached and locked to the vessel so that a separate market for licenses does not emerge. The buyback would make no distinction between the vessel and license, and the buyback price would include the values of 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, or they may be "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.

Auction to Establish Buyback Price[13]

An important program design issue is the price formation process for the vessels, licenses, fishing rights, or gear to be purchased. There are many different ways to design an auction, but in all instances, a cost-effective process more efficiently removes fishing capacity for any given budget. 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 how much bids must be beaten by.[14] The program designers have to decide which approach mobilizes support for the program, is most cost effective, and fits the budget. This section considers most of these issues, with single or multiple rounds of price discovery discussed in the following section. There are several different price formation processes. Consider first reverse auctions, in which operators submit confidential bids to the scheme, the lowest bid wins, and that operator is paid that lowest bid. Additional information may be required to help discriminate between the bids and achieve the greatest impact for least cost, such as different metrics as discussed below, or length of time in the fishery. Second, the buyback program may instead establish an offer price, which vessel, license, or gear owners are free to accept or reject. Third, in sealed bid auctions, the bidder with the highest sealed bid wins and pays that bid. Vickrey auctions have a second price, sealed bid format. The bidder making the highest bid wins but pays the second highest bid.

Reverse Auctions

The U.S. Texas inshore bay and bait shrimp fishery implemented a single-bid reverse auction. The license owner evaluated the value of the license compared to the regulator's estimated license value (based on specific criteria) and submitted a sale offer (bid). Each offer was then compared with the program's reserve price for that particular license. The license owner's price was accepted if it was less than the calculated reserve price. Owners' prices with the

greatest monetary difference from the reserve price were selected for first purchase. The Italian clam fishery also implemented a single round of bidding, in which the government calculated the reserve price on the basis of the existing market value for licenses. In the French buyback program, premiums offered by vessel owners were generally higher than the vessel prices on the secondhand market, and the highest difference was especially noticeable for 1991. The government subsequently adjusted the premium levels to the secondhand market prices, since vessel owners decide whether or not to scrap their fishing unit by comparing the price of their fishing units on the secondhand market and the premium offered by decommissioning schemes.

Reservation Prices

In many programs, the buyback authority develops a reserve price against which all prices are matched. The reservation price may be the existing or previous year's market prices for licenses and vessels. The reservation price may also be formed from prices for vessels or licenses following a formula, or given by appraisers or marine surveys after they value the assets. Vessels in the Washington salmon vessel buyback were purchased at an agreed price based on two appraisals by independent appraisers. License prices were fixed, and gear was valued at a fixed rate of depreciation from original cost. The British Columbia salmon buyback of 1972 purchased vessels after valuation by an independent appraiser and were purchased on a first-come, first-served basis.

A possible rule of thumb when the program develops an offer price is that the addition to gross revenue generated in a year by a piece of capital equipment is roughly equivalent to its cost. In New England, NOAA Fisheries found that each vessel that leaves a fishery could be purchased for the equivalent of one year's gross revenue generated by the vessel. The approximate cost of the buyback program is then equivalent to the difference between total annual revenues of the present size of the fleet and the target fleet size.

Various bid models have been proposed. Kitt, Thunberg, and Robertson (2001) assume 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 vessel operating costs.

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. When there is excess demand or supply corresponding to the fixed offer price, some form of rationing criteria is required. In the Italian Adriatic fishery buyback, the national administration identified the first priority as vessels belonging to fleet segments that had still not attained the buyback objective. The second priority was vessels with gear that significantly impacted the environment. The third priority was vessels more than 20 years old.

Available Information with Auctions

In auctions, the public sector may have a role to play in price formation through the provision of public information. More or less information acquisition affects both the efficiency of the allocation implemented in the auction and the amount of capacity removed by the buyback program. Vessel or license owners hold some private information about the value of their vessel and/or license, while all potential participants hold some information in common. All

owners must form price expectations to submit a bid or to accept an offered price. Information acquisition can be either open or closed. Depending on the design, bidders may or may not observe information acquisition by other bidders (i.e., there can be an open process with freely available information or not). Information is a strategic variable when information acquisition is closed. The identity of bidders can also play a role in the outcome; that is, different information is revealed depending on whether the identity of bidders is revealed and who is actually bidding.

Increasing the common information available to owners about what are reasonable expectations if they submit a bid should increase the efficiency of the price formation process and reduce strategic behavior and transactions costs, especially in sealed bid auctions.[15] The public authority does not necessarily have to release all of the available information, such as bid price per meter on an individual vessel basis, but can disclose an average bid price per meter per vessel (or some other metric) and perhaps the funds available or capacity target, if any. That is, information common to all bidders can be released rather than individual, private information. The British Columbia experience indicates that release of public information is preferable. The experimental economics literature shows that releasing individual bits of information does not harm the price formation process. In addition, releasing information may help the process converge to equilibrium, as long as there are enough people in the market to preclude collusion. Fishers can practice with computer programs of simulated auctions and markets to fully learn the price formation process.

Irrevocable Bids

Bids can be specified as irrevocable or retractable by the submitter. Irrevocable bids prevent, or at least dampen, speculative bids that are not necessarily serious—"stink" or "Hail Mary" bids. Such bids can create extreme outliers and require payment of considerable sums with minimal reduction in capacity. In the New England groundfish vessel buyback, a single-round buyback, bids were not subject to negotiation upon acceptance by the government (i.e., they were irrevocable) (Kitts, Thunberg, and Roberston 2001). However, owners of the selected vessels were given an opportunity to reconsider their decision to participate in the buyback. Successful bidders that then decided not to participate were removed from further consideration and the next highest ranked vessel was selected.

Eligibility Requirements and Scoring or Ranking of Bids and Metrics

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 (i.e., the composition of the remaining fleet, and the amount of capacity that is reduced). A problem with most bid systems involving the sale of a vessel is that everyone offers a different product—there is no homogeneous metric (which can lead to asymmetric information issues discussed elsewhere). However, the use of units of meters, tonnage, well capacity, revenue, or fishing capacity militates against this problem. If licenses are for a given category, then the licenses are closer in equivalence than simply vessels, and hence easier to judge, and require less information.

In ranking bids, consideration can be given to permit or vessel category, home port, area fished, primary gear, size, length of time in the fishery, or any other characteristics that might be used to distribute payments among particular groups (NOAA 1996). Eligibility conditions in the Danish buyback follow the EU requirements, including the number of days fished dur-

ing the last 2 years and the age of the vessel (at least 10 years), and the grant size depends on vessel tonnage and age. In France, other restrictive criteria apply. For example, a minimum level of vessel activity is required (75 days per year) over the last 2 years and the vessels withdrawn have to be at least 9 meters in perpendicular length or 12 meters in the case of trawlers. The Italian clam fishery vessel buyback required a minimum number of vessels to be withdrawn in each fishing area, reflecting the spatial distribution of sessile clams.

Sealed versus Open Bid Auctions with Heterogeneous Bidders[16]

Some evidence on the effects of sealed versus open bid auctions is available from other industries. Using data from U.S. Forest Service timber auctions, Athey, Levin, and Seira (2004) document a set of systematic effects of auction format: sealed bid auctions attract more small bidders, thus shifting the allocation toward weaker bidders.[17] Revenue is often, but not always, higher with sealed bidding.[18] Bidder competitiveness may be an important issue in choice of auction format (Athey, Levin, and Seira 2004).

First- or Second-price Sealed Bid Auctions

In a second-price auction, all bidders submit bids, and the bidder submitting the highest bid pays the second highest bid. Therefore, the bidders bid their true valuation but pay the second-highest bid. The result is strategically equivalent to an English auction. In a first-price auction, all bidders submit bids, bidders submitting the highest bid wins, and bidders tend to bid below their true valuation but pay the highest bid.

Big Bang: Single Versus Multiple Rounds of Buybacks

Buybacks can occur all in one round—the "Big Bang" option—or in multiple rounds. Whether by design or by practice, buybacks were often preceded by multiple rounds. The EU MAGP programs were conducted in multiple stages. The New England buybacks in some sense represent multiple stages, although the focus differed in each round, with the first round buying back vessels and the second round buying licenses. Policy makers implemented five distinct buybacks of either vessels or salmon licenses in British Columbia. In the Taiwan offshore fishery, two buyback programs were implemented for used vessels to reduce the offshore fleet size, one from 1991–1995 and one from 2000—2004. Several rounds of buybacks, also targeting different gear types, were implemented in Norway. In the Texas inshore bay and bait fishery, 12 rounds of license buyback have occurred since the implementation of the buyback program in 1996. The current Australian buyback is in two rounds.

Advantages of Multiple Rounds

Buybacks conducted in stages offer several advantages: revealed common information allows gauging of the bid market and beneficial learning, adjusted payments target particular groups of fishers or desired vessel numbers or capacity level, 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 also help dampen the frequency of "stink bids" (i.e., those bids that aim to obtain a payment exceeding the amount the bidder thought the government would purchase). Buybacks in multiple rounds can also help governments target priority fisheries.

Disadvantages of Multiple Rounds

Buybacks conducted in stages also offer a number of disadvantages. Prices may increase as multiple rounds progress. With the removal of a license or vessel, supply falls and the remaining licenses increase in value, partly because fewer vessels or licenses remain, and also partly because of any gains in economic rents that are capitalized into the vessel or license price. 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 (i.e., there is an option, which can be factored into the price). Vessel and license buyback prices may also end up inadvertently serving as a price floor in the secondhand vessel or license market. Buyback programs could announce that the longer the delay, the lower the payment in order to reduce the strategic behavior of vessel or license owners who delay participation. Multiple rounds can also raise administrative costs.

Impact of Funding Availability

The availability of funding often determines whether to implement the buyback program in stages or as a "Big Bang." Funding may only be available to allow multiple stages. If the buyback is industry funded, do stages or "Big Bang" better allow the remaining vessels to have the funds necessary to finance a buyback? A "Big Bang" allows faster recovery of profits and hence the ability to finance. If an industry-funded buyback is initially financed by a loan from a government or international body, the funds may only be available for a once-off buyback.

Experience

The Taiwanese offshore fishery buyback instituted multiple rounds of single-offer prices by the administrator. The offer price in the initial rounds may have been too low to purchase the desired vessel reduction, leading to subsequent rounds at higher prices. It is believed that the flexibility of multiple rounds of bidding allowed the British Columbia license retirement advisory committee to retire a much greater number of seine vessels during the 1998–2000 buyback and at a lower cost than would have been possible in a single round (James 2004). No single approach is necessarily best. Instead, the program designers should look at the particular situation to determine which approach works best in the situation of concern.

Do Reverse Auctions Capture Total Economic Value?[19]

Buybacks are usually organized by reverse auctions solely on a commercial basis and hence capture consumptive (direct) use value for commercially harvested species. Buybacks could, however, potentially incorporate undesirable outputs, such as bycatches of undersized fish or incidental takes of protected species, or at least partially account for ecosystem damages or existence values. Such an approach is best from an ecosystem perspective and raises the issue of accounting for mixed goods, that is, impure public goods (goods that have features of both private and public goods) and places monetary values on goods and services that are not directly captured by consumptive (direct) use values. Reverse auction prices are more likely to solely reflect consumptive use values, and although prices offered by the buyback authority could in principle include all of the total economic value, the price could potentially be much higher. The "polluter pays" principle is also raised in the issue of who bears the responsibility and cost of damages.

Voluntary Versus Mandatory Participation

Virtually all license and vessel buyback programs have been designed on the basis of voluntary participation. One of the few buyback programs with mandatory participation was the Northern Australian prawn fishery, which was extensively discussed by Holland and others (1999). In this fishery, fractional licensing (Townsend and Pooley 1995) was used, in which vessels were required to purchase 30% of their vessel units from other vessels to remain in the fishery. The Japanese longline buyback made provisions for mandatory participation if a sufficient number of voluntary participants failed to materialize, but this provision was never required (Kuronuma 1997).

Conditions on Reuse of Vessel, Gear, or License

Buyback programs may place conditions on the reuse of the purchased vessel, gear, or license to prevent increases in fishing capacity or spillovers to other fisheries. One of the most important conditions for vessel buybacks is whether the purchased vessel is required to be scrapped or not. If a purchased vessel is not scrapped or sold quickly, then the government incurs maintenance costs as well as losses from vessels both sinking and depreciating in value. Vessels that are not scrapped (and not committed to a nonfishery 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.

In the New England groundfish vessel buyback program, the vessel owner was required to show that the vessel was being scrapped, sunk, or committed to some nonfishing use; most vessels were either scrapped or sunk. Vessel owners were required to surrender all federal fishing permits and to pay any costs associated with scrapping or transferring the vessel. Nonetheless, several program participants used the buyback funds to purchase new vessels and return to the fishery. In the MAGP I instituted in Denmark, France, and Italy, purchased vessels were to be scrapped, transferred to other nonfishing uses, or transferred outside of EU waters. Vessels had to be delivered to storage yards prior to resale by public auction, and were not allowed to return to the fishery (Read and Buck 1997). The State of Washington in the U.S. purchased commercial salmon licenses, and gave a higher price (30% of the vessel's appraised value) when the license was accompanied by a promise not to use the vessel in Washington's commercial salmon fishery for at least 10 years (Holland et al. 1999).

Some buyback programs allow construction of new vessels if the previous vessel is scrapped. There may also be a requirement that the scrapped vessel be no larger in terms of GRT or length or some similar measure of vessel size than the newly constructed vessel and may even require removing a greater amount of tonnage or engine power than the newly constructed vessel, in an attempt to limit growth in fishing capacity. The Italian government introduced a moratorium on new licenses and a limit on construction of new vessels, whereby building a new trawler was only allowed if a larger vessel, not less than 120% of the new one, was scrapped. During the first two MAGP programs, no controls were in place to prevent the replacement of decommissioned vessels by newly constructed vessels of the same capacity.

Some buyback programs restrict the use of the vessel or license in another fishery in that country. The Norwegian buyback program stripped the scrapped or transferred vessels of their fishing concessions (i.e., their rights to participate in specific fisheries such as purse seining

for capelin, trawling for cod or shrimp, etc.). Concomitant with these concessions, there is usually a right to a certain portion of the total quota for one or more fish stocks and so, by nullifying the concession, the quotas of the remaining vessels and their profitability can be raised.

Under the conditions of some buyback programs, vessels can convert to another activity or gear. Under the Italian buyback program for swordfish driftnet fishing, operators chose between reconversion or permanent withdrawal from any fishing activities. Vessel owners were entitled to receive a retirement allowance if they permanently exited from any fishing activities or a reconversion allowance if they continued fishing by shifting to other gear.

Some buyback programs allow the vessel to be exported to another country. The EU MAGP programs are an example, although vessels under 25 GRT cannot be exported to non-EU countries. The Norwegian buyback programs allowed the sale of vessels out of the country. If purchased vessels are sold abroad, then there may be simply an export of the overfishing and overcapacity problems if the vessel is used in a fishery with the same problems.

Vessels might be sold to help finance the buyback program, as in the British Columbia salmon troll buyback. Revenues from vessel sales helped raise funds, but many vessels could not be quickly sold, and the government incurred maintenance costs and losses from vessels both sinking and depreciating in value. The question remains as to the alternative use of the vessels that were sold.

A program that does not require scrapping may have an impact on the price of the vessel that is to be bought out, and the prices of secondhand vessels may fall. A buyback program that purchases only the license does not have to explicitly deal with a bought-back vessel; instead, the decision is retained by the vessel owner, as was the case in the New England license buyback program.

Conditions on Reinvestment of Funds Received

Conditions might be placed on reinvestment of funds received by vessel or permit owners, with an eye on limiting expansions in the capital stock and adoption of new technology that is embodied in the capital stock. In the Australian South East Trawl Fishery, the purchase of latent licenses, although partially limiting future increases in fishing effort, appears to have facilitated additional investment in the fishery, since public funds obtained from the sale of latent licenses were evidently invested by operators in the capacity of active vessels.

Conditions on Fishing Time: Trade-offs Between Capital Stock and Services

Buyback programs may also place conditions on the amount of fishing time allowed. Limits on fishing time can reduce the use of all stock inputs, notably the stocks of labor and capital, but also limit the use of variable inputs (e.g., fuel) that are closely tied to time. Critically, limits on fishing time attempt to manage the flow of capital services and hence use of the capital stock, and fishing capacity in general.

In the EU, the MAGP intended to reduce capacity expressed in vessel GRT, engine power kW, and time spent at sea. Reduced time at sea was not compulsory, and not all of the member states enacted it. Under MAGP II, for the first time an increase in capacity, measured by GRT and kW, offset by a reduction in fleet activity was allowed. Under MAGP III, member states had to achieve the prescribed effort reduction by capacity (GRT and kW) reduction, but they could also implement activity (days at sea) reductions to reach these objectives. Under MAGP IV, member states could meet their objectives either exclusively through permanently

eliminating fishing capacity (scrapping vessels) or by combining this measure with limitations in the activity of their fishing vessels (days at sea). In the view of the commission, schemes to limit activity (reducing the number of days at sea) have weakened the effectiveness of MAGP IV, because they are difficult to control.

Legal Issues

Legal issues include the definitions of access, property, and historical rights in different nations and fishing regions, and the ability of fisheries agencies to formulate and enforce capacity reduction programs in relation to national and local law (World Bank 2004). Buybacks in transnational fisheries present particular legal issues, which are discussed below.

Subsidies for environmental conservation goals are generally viewed at the international level as "good," while subsidies for the preferential support of national industries are considered "bad." World Bank (2004) observes, "Thus, publicly supported buyback programs are usually thought of as 'good' subsidies, despite the fact that in some cases they may increase the efficiency of national fleets and their competitiveness. This ambiguity would be eased by the greater contribution of industry funds to reduction of surplus capacity."

A key legal issue for industry-financed buybacks is the legal and institutional basis. What institution operating under which set of laws is legally responsible for the buyback? If the buyback is initially financed by a loan, which body bears the legal responsibility for the loan? If the loan is paid back by fees on the landings of remaining vessels or some other revenue-generating mechanism, who collects the fees?

Buybacks and Incentives

Buybacks by themselves do not directly address the ill-structured property right that underlies misaligned private and social incentives and, in turn, noncooperation, overcapacity, and overfishing in the fishery. Moreover, without the critical precondition of a strengthened property or use right, or most critically, limited access at a minimum, improved conditions from a buyback reinforce existing private incentives of open access that attract new entrants to the fishery, reinvestment by current participants, or expanded fishing activity in the race to fish.

Should Other Conditions be Placed on Vessels and Licenses that are Bought Back?

Buybacks themselves do not address the underlying property rights issue, but they can be coupled with other measures to align private incentives with socially desired goals. Buybacks can be tied to quotas, as in Norway, or an alternative livelihood support mechanism (World Bank 2004). Buybacks were tied to the preexisting ITQ program in the Australian South East Trawl Fishery. New Zealand conducted buybacks prior to implementing an ITQ program, and Australia is currently conducting a two-round buyback prior to implementing rights-based management. Catch histories have been attached, as in the United Kingdom since 1992, where track record fishing performances have been attached to, and transferable with, vessel licenses, rather than to vessels themselves. Buybacks can also be tied to gear restrictions, and as discussed elsewhere, limited access, prohibitions on resale or reuse of vessels, licenses, and gear. Buybacks can also be tied to the formation of voluntary agreements, whereby greater cooperation and self-management among industry members is strengthened.

Issues from an Industry Perspective

From an industry perspective, whatever program is put together has to make sense to participants. This is a particularly important issue if the buyback program is industry initiated and financed. Participants have to buy in and understand that a buyback program has to take place. Industry support is critical for success.

Industry support requires finding a champion, because leadership is required to bring a buyback program to fruition, particularly if the program is industry financed. Such a focal person helps to ensure that the necessary steps occur throughout the process. The leadership can come from industry, government, or even nongovernmental organizations (NGO). In most instances, government agency support is required, since they are typically the program administrators.

Dealing with nonsupporters throughout the process is an important leadership element in any buyback program, since not everyone will buy into the buyback need and program. Some nonsupporters will become deterrents. Nonsupporters can come from the fishery in question or from people outside of the industry who sincerely do not want such an approach.

Flexibility is required throughout the process, since the unexpected arises. This flexibility may require retracing steps or even starting over. Fishers and governments have to support the buyback, and realize that change has to occur, and that the process is not arbitrary.

Who Pays for Buybacks?

Governments have largely funded buybacks. The World Bank (2004) observes that public funding may be appropriate initially in terms of correcting past policy errors and that buyback schemes are effectively government subsidies for the improved performance of the fishing industry. The EU has largely funded the MAGP, although various EU member states have financed portions of the buybacks. For example, EU funding in France was supplemented by the French government and local communities (region and department). Public funding of the Australian South East trawl buyback, for example, was deemed necessary to help redress problems with the initial ITQ allocation and the need to encourage and stimulate ITQ trades through a more rapid period of structural adjustment. General public revenue funded the British Columbia salmon buyback program, although receipts from vessel sales helped raise funds.

Mixtures of funding have also been used. Commercial and recreational fishing interests may finance all or part of the buyback, usually in conjunction with public funds. Financing includes government grants, annual payments from license fees, and commercial or government loans. Industry-financed 80% of the Australian northern prawn buyback program through commercial loans serviced by levies on remaining fishers; a government grant also provided funding (World Bank 2004). In Norway in 1996, after nearly 500 million kroner of public funds had been spent on rationalizing the purse seine fleet, the industry itself took over the financing of further rationalization through the unit quota system. Several vessel owners took advantage of this; since 1996, the number of purse seiners with concession fell from 111 to 94. The U.S. Pacific coast trawl vessel buyback program was funded by a federal government loan that is to be paid back by fees on the landings of the remaining vessels. The Australian Northern Territories barramundi fishery buyback was financed by commercial loans against expectations of future license revenues, supplemented by government grants (World Bank 2004). In the early 1980s, fishing vessels remaining in the Japanese longline tuna fleet paid compensation to the 169 vessels that withdrew (Kuronuma 1997). Government loans provided 80% of

the compensation to the remaining vessel owners, and the remaining 20% was paid by private funds. In the Texas bay and bait buyback program, the cost is partially borne by the shrimp fishery through a surcharge on licenses, by society through public funds (including federal), and by the recreational fishery through an increased fee for the salt water fishing stamp.

A commercial fishery-financed buyback funds the program from the proceeds that are expected to rise following the expected recovery. Such a buyback can be initially funded by a public loan, which is paid back by the commercial fishery based on landings fees. In this case, the public bears a substantial portion of the risk of the loan. Recreational anglers can finance a buyback through licenses due to expected higher catch rates. NGOs can finance through purchases of licenses or vessels. The World Bank, Asian Development Bank, Inter-American Development Bank, and other such institutions may have an important role providing initial funding for industry-financed buybacks in transnational fisheries.

The debt obligation of a commercial or recreational fisher-financed buyback becomes collective rather than individual. Collective borrowing rather than by individuals also spreads the risk among remaining fishers.

Responsibility for payment can, in principle, be assessed by evaluating the recipients of the buyback benefits and their relative share of benefits. On this basis, the commercial fishery would pay that portion of the cost that is proportional to the share of economic rent in total economic value. Recreational anglers would fund that portion of the cost that is proportional to the share of indirect use values in total economic value. If significant external benefits accrue to society outside of the commercial and recreational user groups, society and NGOs would fund that portion of the total program cost that is proportional to the share of existence value in total economic value. Buybacks funded by user groups through forms of a Pigouvian tax create a double dividend through a tax addressing the externality and the receipts used to finance the buyback.

Fractional licensing provides an alternative to industry-financed buybacks (Townsend and Pooley 1995). The buyback authority determines the optimal number of licenses for the fishery for vessels, fishers, or gear (N). When the number of qualifying vessels, fishers, or gear (Q) is determined, the fractional value of the license is determined as N/Q. Fractional licensing reduces the number of licenses by Q–N. Freely transferable licenses allow consolidation of the fractional licenses into a whole license required to fish. Although only N vessels, fishers, or gear are allowed to fish, the economic rents are shared among all Q fractional license shareholders since fractions of licenses were sold on the market to assemble a full license. The costs of license reduction are also shared among all license holders.

Buybacks as a Transition to a Rationalized Fishery

One of a buyback's most important contributions is as part of a transitional strategy to a rationalized fishery. Buybacks can be viewed as a strategic policy tool in the transition to longer-term conservation and management built on strengthened use and property rights, taxes, marine reserves, voluntary agreements, or other major policy tools. Following an effective buyback, a window of opportunity can emerge to help transform behavior from noncooperative to more cooperative, and to replace expensive and often ineffective centralized command-and-control fishery management measures with comparatively more decentralized private and/or group incentives for fishers that more closely align with social goals. Buybacks are thus a strategic choice that restructures incentives.

The GAO (2001) observes, "The Bering Sea pollock buyback addressed the race to fish

that had previously existed among factory trawlers by facilitating the creation of a fishing cooperative by the owners of the remaining trawlers. This cooperative was designed to eliminate the race to fish by assigning a specific amount of fish, or an allocation, to the cooperative, which divides the allocation among its members. Because of this allocation, members of the voluntary agreement have no incentive to expand fishing capacity to catch the available fish before someone else does, as they have in another fishery. Members are able to catch their individual fish allocations at their own pace, at lower capital and operating costs, while increasing product quality. These changes resulted in higher profits and longer fishing seasons for the remaining factory trawlers."

As long as management is primarily based on input controls rather than enhanced use and property rights, taxes, or other policy directly addressing the root cause of the problem, buybacks may not be the long-term answer. Nonetheless, when fisheries are mired in debt and face an absence of vessel profits and resource rent, cooperation is difficult to achieve among industry players. Contributing to the noncooperative behavior found under adverse conditions, individual discount rates can be exceptionally high as vessel owners scramble to cover vessel mortgage payments, keep crews employed and together, and even cover operating costs, in which maintenance is ignored.

When a fishery becomes profitable again, incentives for increased cooperation can follow. The smaller number of remaining fishers also contributes to increased cooperation. The remaining fishers also tend to be those most committed to the long-term economic viability of the fishery, further strengthening incentives for cooperation.

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 (Newby et al. 2004). That is, capital with few alternative uses (i.e., which is relatively nonmalleable) has a low opportunity cost and may even be a sunk cost or zero opportunity cost.

A buyback can help facilitate structural change under a new management scheme (Newby et al. 2004). First, such a program reduces the disincentive for operators to leave the industry as vessel disposal becomes less of an issue, and, second, the quota-trading price is likely to be lower because additional output quota will come onto the market when boats are decommissioned. This should lead to quota consolidation and an associated reduction in overcapacity. However, this type of adjustment scheme is likely to be more costly than allowing the fishery to adjust autonomously. Although the final level of annual economic returns should be the same as that under autonomous adjustment, the scheme will have removed capital and labor (that have a low opportunity cost) prematurely from the fishery.

Buybacks in the Australian South East Trawl Fishery were intended to reduce the perceived overcapacity in the fishery and thereby allow a quicker transition to optimal catch levels. (TACs were not binding for the ITQ-managed species.) Buybacks played an instrumental role in the transition to ITQs in New Zealand and are currently playing this role in the transition to ITQs in Australia.

Buybacks in Transnational Fisheries

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,

but only if entry into the fishery is deterred through a limited entry program. Otherwise, potential free riders will enjoy the benefits of reduced capacity by subsequently entering the fishery or even by fishing outside of the agreement in illegal, unregulated, and unreported (IUU) fishing. Critically, buybacks may form part of a transitional strategy to a more rationalized fishery based on use rights backed by a strong international agreement that fends off potential free riders.

A unilateral buyback by a single nation in a transnational fishery would simply remove fishing capacity from the nation itself and open up opportunities for free riding, as other states increase capacity or enter the fishery. This is the problem of the transnational externality. Unilateral reduction in fishing capacity can boost profits and resource stocks for other nations. Free riding may also arise through opportunities in the reducing nation's import market, as imports of the species of concern from free-riding nations fill markets formerly supplied by domestic producers.

The Italian buyback of vessels in the Mediterranean swordfish drift gill net fishery created opportunities for other states and simply allowed expansions of fishing capacity by other nations harvesting swordfish (Spagnolo and Sabatella 2004a). The Organization for the Promotion of Responsible Tuna Fisheries (OPRT) buyback of Japanese and Taiwanese high seas tuna longline vessels in the Pacific is a second example of a buyback in a transnational fishery that helped create opportunities for other states' vessels. Considerable free riding occurred through expansion of longline vessels by noncooperating parties in this fishery, especially longline vessels less than 24 meters (m), which in turn countered some of the gains from the limited multilateral buyback.[20] 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).

Realizing potential gains to international cooperation is perhaps the biggest challenge to a buyback on shared resource stocks such as tunas, whether those gains come from participation and compliance, or deterrence of entry and expansion by nonparties. Gains to multilateral cooperation on reducing fishing capacity through a buyback come from reducing losses due to overcapacity and excessive exploitation of common resources (i.e., from lowering the losses due to the "Tragedy of the Commons."). Success requires that a buyback ensure 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 nonparticipation must be addressed by some credible means, such as a credible trade restriction. A positive incentive for participation comes to 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.

In sum, as with the North Pacific Fur Seal Treaty (Barrett 2003), a transnational buyback needs to do the following:

1. Create an aggregate gain so that all parties involved have a reason to participate.
2. Distribute this gain so that all parties would prefer that the agreement succeed.
3. Ensure that each party would lose by not participating, given that all of the other parties agreed to participate.
4. Provide incentives for all of the parties to comply with the buyback.
5. Deter entry by third parties.
6. Finally, in a broad sense, a transnational buyback needs to be self-enforcing. That is, there is no third party to enforce the buyback agreement. The buyback ultimately rests upon the voluntary agreement to participate by nations, such as the members of a

Regional Fisheries Management Organisation (RFMO), members of the OPRT, or signatories to other treaties and agreements.

National sovereignty complicates buybacks in transnational fisheries in ways beyond just entry deterrence and the necessity of self-enforcing agreements. Buybacks 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 metrics of fishing capacity (potential output, GRT, well capacity, length, etc.)? Can vessels and their associated measure of capacity freely transfer among flag states, or are vessels and their associated capacity metric directly tied to the flag state? Strictly on the grounds of economic efficiency, 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 as capacity, and the right to fish, shifts to lower-cost vessels. A means of entry into the fishery is also created.

An additional issue that arises is the distribution of vessels and fishing capacity among coastal and distant-water states, and more generally, the unique nature of the multilateral cooperation required 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 (EEZ), 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.

Besides the provision for expansion by coastal states, several other forms of side payment are possible, including decommissioning greater capacity from distant-water fishing fleets, assessing distant-water fishing fleets at a different rate than coastal fleets in industry-financed buyback programs, and fractional licensing in which coastal states receive a fraction of a license greater than one and distant-water fishing nations receive a fraction of a license less than one (or some other variation with differential impacts on coastal and distant-water fishing states). As with the Montreal and Kyoto protocols, side payments can be made for technology transfer or multilateral funds to finance fleet expansions by, in this case, coastal states. Limited allocation of unused capacity to coastal states creates a reserve held by these states and is a form of side payment; just such an approach was adopted by the Inter-American Tropical Tuna Commission (IATTC) with vessel capacity (Joseph et al. 2006). New entrants can purchase or lease this capacity with the proceeds accruing to the coastal states.

Alternatively, a limited percentage of license or capacity units, with limited duration of the right, could expire on a periodic basis, requiring repurchase for continued use or purchase by new entrants. Similar features appear in Chile's ITQ program, where this use right has a staggered and limited duration. New entrants might also be required to purchase additional units of capacity and retire some portion of the excess. Similar restrictions might apply to reinvestment, such as "stretching" of an existing vessel. Such features are common to many limited entry programs (Townsend 1990). Fractional licensing is another possibility and 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).

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 (SWAP) or Poverty Reduction Support Credits (PRSC) or perhaps even the Global Environmental Facility (GEF) (World Bank 2004).

In addition to limited licenses and access, still another critical precondition for a buyback in a transnational fishery may be management of capacity units, denominated in one or more measures of vessel size. The traditional response in such fisheries has been changes in vessel design and increases in capital stock (e.g., expanding GRT and engine power when length is limited) and accelerated adoption of technical advances (e.g., electronics or FAD fishing). Nonetheless, limits on growth of measures of fishing capacity may be the preferred, albeit imperfect, management option. Replacement of existing vessels might require purchase of additional capacity units, which are then retired to counter productivity creep.

Buyback programs may need to be differentiated by sector. Transnational fisheries may be composed of different sectors (i.e., of different methods of fishing, such as sets on unassociated schools, dolphins, or floating objects). For example, one sector, such as the school fishery in the Western and Central Pacific Ocean (WCPO), may not be subject to overcapacity relative to yellowfin, bigeye, or skipjack tunas, but another sector, such as the floating object fishery, may be subject to overcapacity relative to bigeye and yellowfin tunas. Similarly, swordfish are caught by both drift nets and pelagic longlines, and fur seals can be harvested at sea (pelagic sealing) or on land at rookeries. A complicating factor is the differing participation in different sectors by different nations.

A buyback in a single RFMO for a transnational fishery for highly migratory species remains unilateral in a broad sense. Highly migratory species transverse ocean basins, and purse seine, longline, pole-and-line, and driftnet vessels harvesting these species can go a step further by spanning ocean basins. Coordination is therefore required between the two regional fishery management organizations. Buyback programs in one part of the Pacific might, in principle, only remove some of the fishing capacity creating fishing mortality on common resource stocks. More critically, vessels harvesting highly migratory species are highly mobile, and readily traverse from one part of the globe to another. Control of fishing capacity by one organization may simply create spillovers to other regions and regional fishery management organizations as vessels fish in other areas and/or re-flag. The potential also exists for vessels to enter IUU fishing.

Compliance in a transnational buyback can be more complex than in a domestic buyback because of national sovereignty and the ease of entry into most transnational fisheries. A buyback may require scrapping of a vessel or permanent retirement of a license. Without these requirements, the vessel may simply enter and participate in another transnational or even national fishery. Enforcement provisions for a buyback with such requirements will require special consideration. One possibility is a requirement that each of the parties adopt domestic legislation supporting the buyback. Domestic legislation is easy to observe. An RFMO-sponsored transnational buyback coordinated with other RFMOs faces the problem of ease of entry into the other fisheries.

A potential issue in a transnational buyback arises when one or more parties have already undertaken unilateral action before the multilateral buyback. Such parties may want compensation or credit of some sort. Such a possibility arises, for example, with a multilateral buyback of high seas longline vessels, where members of the OPRT have already participated in a buyback.

What Are The Main Lessons to Be Learned From the International Experience?

The global survey of buyback programs for vessels and licenses offers a number of lessons. First, and one of the most important lessons, is that it is much easier and less expensive to prevent overcapacity, overfishing, and ecosystem degradation beforehand than to reduce it after the fact. Other lessons gleaned follow here:

1. Buybacks are a strategic choice that affect incentives, and thereby can play a strategic role in a transition to a more rationalized fishery based on user rights. Buybacks 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 favorable 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 overinvest in an open or limited access fishery. In fact, buybacks with ill-structured rights ironically 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 rationalize a fishery that erodes over time.

   Viewed as a strategic opportunity, buybacks have a number of potential ways to induce behavior changes through various program design choices. Every substantive choice can affect incentives and thereby behavior of the remaining participants and even the decision 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 also be scrapped or preventing owners of purchased vessels from using the proceeds to reinvest in the fishery affects not only the level and growth of fishing capacity but can 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, with time-area restrictions on fishing, a requirement for rights-based management, or voluntary agreements that collectively manage some share of the TAC.
2. All other things being equal, buybacks are more likely to be effective at reducing fishing capacity when fleets are smaller in numbers and when there are fewer vessels and fewer permits that are largely inactive or active at low levels. Similarly, all other things being equal, larger budgets allow greater reductions in any given number of vessels and licenses. Buybacks can become expensive, and there is risk that their cost can exceed the benefits gained.
3. Buybacks can vary by their extent of inclusiveness, or equivalently, their focus on groups of vessels. The focus of buybacks can vary depending on the gear, methods of fishing with a gear, species fished, the amount of time fished ("active" versus "inactive" vessels), and recreational or commercial fishing. In this regard, the buyback can be broad but shallow, with all vessels and fishers eligible to participate, or narrower but deeper, focusing on a particular group or segment of the fishery. Every one of these

choices is a strategic one that affects incentives, and hence behavior, and shapes the type and structure of the post-buyback fishery.

4. The design of the buyback program has distributional implications. Different designs and program features, such as bidding metrics, create different sets of gainers and even losers. Moreover, crew members seldom directly gain from a buyback, although supplementary programs, such as job retraining or educational grants, can address this issue.
5. Several preconditions are critical for buyback programs to be effective. Proper registration of licenses and vessels creates a well-defined group of eligible owners and provides well-defined boundaries to the fishery and program. Establishing broad participation is critical in transnational fisheries. Limited access is another critical precondition in both domestic and transnational fisheries. Without limited entry, vessels enter the fishery as profits rebound following the capacity reduction induced by buybacks, and fishing capacity increases; the conditions for free riding are established.
6. Buybacks work best through comanagement (i.e., through cooperation among the public and private sectors and other interested parties). Comanagement can affect the strategic choice of the program design and the incentives for industry participants. Strong industry participation in all phases of the program strengthens the chances for success. Consultations and workshops with user groups help design better programs, prepare the user groups for the buyback, and critically, help build and enlist support from user groups.
7. Asymmetric information issues may arise. The purchased vessels are frequently older and less productive than the remaining vessels. The buyback may merely accelerate the departure of vessels marginal to the fishery that would have departed in any case, but the buyback facilitates and accelerates their exit and at a higher vessel purchase price than would otherwise occur. Purchased vessels or licenses may also be among the least active so that buybacks may have little effect in improving economic performance and helping resource stocks to recover. By absorbing risk and establishing a vessel or license price floor, buybacks may also strengthen investment incentives for the remaining vessels.
8. There is often no single, best answer to many program design issues. Nonetheless, clear objectives and a clearly defined program scope are critical. A pilot program can also be helpful. One or more champions, whether individuals, organizations, or public agencies, can play an important galvanizing role.
9. Decisions must be made to first purchase active or inactive vessels or permits, or both. Purchasing inactive vessels and/or permits has the advantage in that it is cheaper and it can allow ready expansion of fishing capacity as profits rebound and fish stocks bounce back. In most instances, vessels and their permits are purchased together rather than simply the permits alone, since removing the vessel eliminates capacity plus any spillover effects on other fisheries.
10. Beneficiaries of a buyback program can contribute to the funding of the program in all or in part. Commercial fishers can enjoy increased profits; recreational anglers can benefit from higher catch rates; and the general public and NGOs gain strengthened ecosystem health. The initial funding for a buyback, especially when the fishery is unprofitable, may have to be a loan from a national or state (regional or provincial) government or, in the case of transnational fisheries, from an international organization. In some instances, public funding might be viewed as compensation for past policy errors. Public loans to user groups mean that the public bears the risk of the loan.

Public or industry financing creates a debt that is a collective rather than individual responsibility. Public or private outlays can be recovered through user fees, such as licenses or entrance fees to marine parks, and landings taxes so that those enjoying the most revenue and revenue increases bear the most financial responsibility. Public funding without repayment from rent increases is ultimately a transfer payment, which can be capitalized into license or vessel values and raises prices and the cost of the buyback.

11. The net economic benefits of a buyback, particularly a publicly funded program, depend on the benefits that could be generated by these funds in their next best use elsewhere in the economy and the size of the overall benefits from the buyback in comparison to program expenditures and the alternative use of these expenditures.
12. Partial or completely privately financed buybacks may be preferred to full publicly financed buybacks because the tax for a privately funded buyback is a double dividend tax that helps to correct the resource stock externality, both as a Pigouvian tax and through funding a program that removes fishing capacity. The tax compels firms to confront some of the external costs for the resource stock and the ecosystem due to ill-structured property rights. Depending on the incidence of the tax between fishing firms, processors, and consumers, there may be incentives to curtail fish consumption, since consumers do not bear the full costs of fish consumption. Privately financed buybacks also force industry rather than the public to bear any potential moral hazard (i.e., risk and costs from expectations of future bailouts).
13. The administration of payments and the bidding process are critical program design issues. Should buybacks proceed on the basis of bids by vessel or permit owners or offer prices determined by the program? Capacity is usually purchased through vessel, license, or gear bids and reverse auctions and often on the basis of some metric of fishing capacity, such as dollar bid offered per GRT, horsepower, revenue, catch, cubic meters of well capacity, meters of length, and so forth. Bids can be in a single round or multiple rounds. Multiple rounds of buybacks increase administrative costs but may also reduce strategic behavior in offers. Multiple rounds also allow payment adjustments to target particular groups of fishers by adjusting the criteria for bid acceptance and allowing fishers to reformulate their bids. Pilot programs can help. Bids are typically sealed. Irrevocable bids prevent "stink" or "Hail Mary" bids, in which speculators bind up a large proportion of the available funds. The program administrator can help owners form price expectations and markets to develop by working to lower transactions costs and by providing market information such as average price per unit of capacity, total available funds, etc.
14. Selective buybacks can help achieve social objectives other than efficiency and resource conservation goals, including accommodation of new entrants or coastal states, aboriginal rights, and shifting capacity regionally, by gear type or set type. Buybacks compensate those in the industry that would otherwise lose out from rebuilding fish stocks and restructuring the industry. Buybacks have a differential impact on gear types or regions, but maintaining an equitable allocation of harvests among gear types or regions helps ensure political support.
15. Buybacks have largely focused on overcapacity, overfishing, raising profitability, and disaster relief, and have seldom been intended to address goals of ecosystem management and conservation.

    General buybacks are a blunt instrument, but to the extent they can target selective areas or times fished, gear types, or modes of fishing, buybacks offer a tool toward

restoring ecosystem health. Buybacks targeted at methods of fishing, such as sets on floating objects, can reduce bycatch.

16. Buybacks for transnational fisheries exploiting shared resource stocks are unlikely to be effective without a multilateral program among those countries contributing the bulk of the fishing capacity on the common resource stock. Simply put, unilateral rather than multilateral buybacks face failure. The participation and free-riding issues must be addressed. Buybacks in transnational fisheries must also be predicated upon deterrence of new entrants (other than through purchase of licenses), which requires changes in, at a minimum, customary international law. Negative economic incentives, such as credible trade measures, may be necessary to deter entry and to ensure compliance by participating parties. Allowing capacity to transfer among individual owners, rather than restricting it to flag states, allows more efficient capacity reduction. Coastal states, when resource stocks span both EEZs and high seas, are typically afforded special accommodation for growth, which can represent a side payment.
17. Buybacks alone are not the long-term solution to the overcapacity and overfishing problem in the open access or limited access fishery, although they may be the best option available in the foreseeable future for transnational fisheries given the limitations of international law pertaining to individual user rights protected by a strong international treaty.
18. Buybacks, essentially an input control, primarily address the capital stock and only indirectly the relationship between inputs and catches. Under command-and-control input controls, uncontrolled inputs can be substituted for controlled inputs. Examples include investing in additional capital for the remaining vessels, fishing longer to increase utilization of the capital stock and fishing capacity of those remaining vessels, and advancing and adopting technologies, such as the addition of vessel electronics. Vessel buybacks unaccompanied by a comprehensive use right thus have the same shortcomings as limited entry, in that the underlying ill-structured property rights continue to generate incentives for continued investment, and incentives spawning overcapacity and overfishing remain.
19. The long-run success of a buyback program in reducing fishing capacity and mortality without strengthening the use or property rights requires controlling future growth in fishing capacity through restrictions on investment and increased fishing time, ideally through positive incentives. Additional rounds of buybacks may be necessary to counter the ongoing growth in fishing capacity occurring through investment and technical change.
20. Buyback programs need to be evaluated to identify lessons learned that might help improve future programs.[21] Planning for such evaluations, including developing measures to evaluate program outcomes, should be an important part of the design of future programs, as should developing performance measures that relate to program goals and broader legislative goals, such as the need to better manage fishing capacity and sustain fish stocks.

Concluding Remarks

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

fore the benefits erode. Buybacks are not a panacea or a long-term answer by themselves to overcapacity, overfishing, and ecosystem degradation. Buybacks are often simply no more than disaster or crisis relief, to allow governments to address problems and make transfer payments without regard to efficiency, capacity, and overfishing issues. Nonetheless, buybacks may be the only feasible option for transnational and some other fisheries where politics preclude other policies, or for tackling social issues such as disaster relief, or aboriginal rights, or ecological damages. Critically, buybacks can accelerate the transition to a rationalized fishery, as demonstrated by their use in Australia and New Zealand prior to rights-based management, and enhanced ecosystem health. At a minimum, an effective buyback needs to be coupled with limited access, scrapping of bought-out vessels, limits on reentry into the fishery through purchases of formerly inactive licenses by owners who have just sold an active license, and comanagement through partnership with the industry.

Buybacks by themselves do not resolve the "race-to-fish" incentives created by incomplete use or property rights, inadequate governance, and uncertainty. Gains from buybacks are transitory. Unless specific steps are taken, previously inactive vessels and permits will likely be used and the gains from the buyback eroded. Moreover, continuous, ongoing buybacks and automatic attrition through reductions in some specified percent of vessel capacity units with every vessel transfer would need to be a permanent feature. Such continuous structural adjustment counters the ongoing increases in fishing capacity as fishers invest in their capital stock and adopt new technology, driven by the incentives of incomplete property, inadequate governance, and uncertainty over the longer term.

In a nutshell, buybacks are not a replacement for a first-best policy that directly addresses the ill-structured property and use rights underlying the "Tragedy of the Commons" or inadequate governance. Buybacks are often simply transfer payments. Nonetheless, buybacks can in certain instances offer a Pareto-improving second-best policy of limited duration that can hasten the transition to a more rationalized fishery based on property and use rights that align individual and group incentives with social goals, voluntary agreements and collective action, taxes, improved governance, or other forms of conservation and management as dictated by the situation at hand. Industry-financed buybacks provide a double-dividend tax and help establish incentives aligning private behavior with social goals. Publicly funded buybacks bear an implicit cost of what is foregone from the alternative use of the funds and any deadweight losses from taxes levied in other sectors of the economy to finance the program.

Endnotes

1. Public goods are neither excludable (people cannot be excluded from its use) nor rival (one person's use diminishes another person's enjoyment). That is, people cannot be prevented from using a public good, and one person's enjoyment of a public good does not reduce another person's enjoyment of it. Because public goods are not excludable, people have an incentive to be free riders so that they enjoy the benefit of a good but avoid paying for it.

2. Economies of scale are reductions in unit harvesting costs (costs per kilogram of catch) 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.

3. Weninger and McConnell (2000) observe that the potential replacement of capital in the postbuyback fishery has been discussed by Campbell (1989), Campbell and Lindner (1990), Holland and others (1999), and Kitts and Thunberg (no date).

4. Resource rent can be viewed as the difference between the total revenue and the total economic costs of the inputs used in the harvesting process, where the economic costs are valued by opportunity costs. An opportunity cost is the value of the benefits enjoyed by the next best course of action. That is, when choosing a course of action, the benefit from the next best alternative is necessarily forgone, which is the opportunity cost to the proposed action.

5. An external effect, also called an externality, is the uncompensated impact of one person or firm on the well-being of a bystander person or firm. A positive externality creates a positive effect (i.e., an external benefit), and a negative externality creates an adverse effect (i.e., an external cost). Externalities are seen as a special case of market failure due to incomplete or missing markets.

6. In principle, opportunity cost and willingness to pay (and willingness to accept in more limited circumstances) equal market prices and are the economic values of market and nonmarket goods and services. In addition, economic welfare gains to society can be classified as those enjoyed by consumers of market and nonmarket goods and services, called consumer surplus, and those accruing to producers, called producer surplus.

7. Consumer surplus, a measure of consumer welfare, is the difference between what a consumer would have been willing to pay and what the consumer actually had to pay. Producer surplus, a measure of producer welfare, is equivalent to short-run profit (and quasirent) under most conditions, and can be measured as the difference between a firm's revenues and its variable costs of production.

8. Consumer surplus is transferred from producer surplus if prices fall but the overall quantity of fish caught and consumed remains constant (say because of the presence of a TAC). Consumer surplus increases if there is increased quantity consumed through an increase in the overall quantity of fish caught (say through an increase in the TAC as resource stocks recover, allowing a higher catch level).

9. That is, the levied taxes are not Pigouvian taxes imposed to directly address the technological resource stock externality and market failure. Deadweight loss from a tax is due to the consequent reduced production and consumption of a good or service. For discussions of taxation and the environment, see Bovenbag and Goulder (1999) and Goulder (1998).

10. A technological externality occurs through a real impact on consumption or production rather than through prices. Pecuniary externalities redistribute costs and benefits of events through changes in prices, creating gainers and losers, but in themselves do not alter the overall level of net benefits.

11. Moral hazard refers to a problem of asymmetric information whereby the actions of one party to a transaction are unobservable (Mas-Colell, Whinston, and Green 1995). For example, holders of insurance premiums without deductions or penalties are more likely to undertake actions that are less careful toward loss than if deductions or penalties are required. This information problem arises because the fishery manager does not have complete information about all variables relevant for regulation. Hence, the regulator cannot easily and at low cost monitor fisher behavior. Fishers face economic incentives to shirk through remaining in the fishery waiting for a buyback to receive a higher price than they would otherwise receive.

12. Adverse selection arises when an informed individual's trading decisions depend on that individual's privately held information in a manner that adversely affects uninformed market participants (Mas-Colell, Whinston, and Green 1995). In a vessel-buyback market, an individual is more likely to decide to sell his or her vessel when that owner knows that the vessel is not very good. When adverse selection is present, uninformed traders, such as buyback agencies, may be more wary of any informed trader wishing to sell and the agency's willingness to pay for the vessel or permit offered may be lower.

13. Kitts, Thunberg, and Robertson (2001), Musenezi, Rossi, and Larkin (2006), and Bustic and Bromley (2006) econometrically analyze bids in the New England groundfish buyback, discuss the bidding process in considerable detail, and discuss the econometric issues involved.

14. These can be viewed as a private rather than common value auction, since each bidder knows his or her value for the license, gear, or vessel, whereas in a common value auction, there is a single although unknown value and bidders differ in their valuation of this common item. In a standard open auction, the price rises from the reserve price and the auction terminates when all but one participating bidder has dropped out. In an open auction, it is a dominant strategy for each participant to bid until the price reaches his or her valuation. In equilibrium, each bidder enters if his or her expected profit exceeds his entry cost. Also, there is less uncertainty about the value in an open auction than in a sealed bid auction because of the information revealed during the bidding process. With sealed bidding, participating bidders independently submit bids, and the highest bidder wins and then pays the bid.

15. The sealed bid auction is a static game in which the only information revealed occurs when the auction is over, whereas the open auction is a dynamic game in which there is a lot of information revelation along the game, particularly all of the losing bids.

16. See Milgrom (2004) for a comprehensive overview of auctions. On sealed and open bid auctions with heterogeneous bidders, Athey, Levin, and Seira (2004, page 1) observe, "The seminal result in auction theory, Vickrey's (1961) Revenue Equivalence Theorem, states that under certain conditions, the two formats have essentially equivalent equilibrium outcomes. Specifically, if bidders are risk-neutral, have independent and identically distributed values, and bid competitively, the two auctions yield the same winner, the same expected revenue, and even the same bidder participation. In practice, however, these assumptions often seem too strong. Further work points out that as they are relaxed, auction choice becomes relevant, with the comparison between open and sealed bidding depending on both the details of the market (e.g., bidder heterogeneity, entry costs, collusion, common rather than private values, risk-aversion, transaction costs) and the designer's objective (e.g., revenue maximization or efficiency)."

17. Athey, Levin, and Seifra (2004, page 2) observe, "To see why sealed bidding favors weaker bidders, observe that with an open auction, the entrant with the highest value always wins. This makes weak bidders hesitant to spend money to participate if strong bidders are also likely to be present. In contrast, in a sealed bid auction, strong bidders have a relatively large incentive to shade their bids below their true valuations, so a weaker bidder can win despite not having the highest valuation. This handicapping effect promotes the entry of weaker bidders and discourages the entry of strong bidders. We observe, however, that only weak bidder entry is likely to be affected if bidders have similar costs of entry."

18. Athey, Levin, and Seifra (2004) state, "The competitive theory does not generate unambiguous predictions about revenue. Existing examples suggest that with a fixed set of heterogeneous bidders, revenue is often (but not always) higher with sealed bidding. Endogenous entry generates an additional complication because participation varies with the auction format. A revenue comparison, therefore, depends on all the primitives of the model: the bidders' value distributions together with entry costs."

19. Total economic value includes both market and nonmarket economic values. Market value includes direct (consumptive) and indirect (nonconsumptive) use values. Use values entail some sensory contact with the environment, where direct use value entails direct sensory contact and indirect use value entails more indirect sensory contact, such as ecotourism. Nonmarket economic value includes existence and option values. Existence value is the will-

ingness to pay for the continued existence of an environmental asset; preservation is sometimes separately distinguished from existence value. Option value is a willingness to pay related to uncertainty over the continued existence of the environmental asset. Quasioption value is sometimes included as a nonmarket value, where it is the economic value of future information when a decision is to be made concerning an irreversible action or investment.

20. Joseph and others (2006) 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).

21. This recommendation draws almost verbatim from GAO (2001, pages 5–6). Kitts and Thunberg (no date) and Kitts and others (1998, 2001) are extremely useful for practical design and evaluation.

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