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Buyback Programs for Capacity Reduction in the U.S. Atlantic Shark Fishery

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Declining fishery stocks, increasing fishing effort, and adverse market conditions have produced difficult financial situations for fishermen worldwide. Several high-valued fisheries are considered to be overcapitalized. The purchase and permanent retirement of fishing vessels and/or permits under a buyback program is one approach for reducing fishing capacity. Evidence from previous programs, however, suggests that buybacks are not a panacea for solving overcapacity problems. Whether such programs can help rebuild stocks and improve the financial condition of fleets in any specific fishery depends on a multitude of factors. We consider the potential of a buyback program for the U.S. Atlantic shark fishery.

Key Words: buyback programs, fishing capacity, fishing permits, latent permits, marine fisheries, vessel decommissioning schemes

JEL Classifications: Q22, Q28

Governments throughout the world are implementing programs that seek to reduce capacity (effort) in fisheries in order to reverse the excessive harvesting conditions associated with many economically important fishery stocks. The focus on capacity reduction programs was initiated by adoption of the Food and Agriculture Organization (FAO) Code of Conduct for Responsible Fisheries (FAO 1995) and the subsequent FAO 1999 International Plan of Action for the Management of Fishing Capacity, which called for countries to ". . . develop, adopt and make public, by the end of 2002, national plans for the management of fishing capacity and, if required, reduce fishing capacity in order to balance fishing capacity with available resources on a sustainable basis. These should be based on an assessment of fish stocks and giving particular attention to cases requiring urgent measures and taking immediate steps to address the management of fishing capacity for stocks recognized as significantly overfished" (FAO 1999, Part III, Section II, Item 21).

As a signatory to these agreements, the United States developed its own national action plan for the management of fishing capacity with a goal ". . . to eliminate or substantially reduce overcapacity in 25 percent of the U.S. federally managed fisheries by 2009 and in a substantial majority, including fish-

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eries that most seriously exhibit this problem, by 2015, the latter deadline corresponding to the target date for recovering overfished stocks agreed at the recent World Summit for Sustainable Development" (U.S. Department of Commerce, 2003a, p. 1).

As redefined in the 1996 reauthorization of the Magnuson Act, a fishery is considered to be "overfished" if fish are being taken faster than the stock can replenish itself or if the stock size is too small to be sustainable at current fishing levels. "Overcapacity" is said to exist in a fishery if the harvest capacity exceeds the management target (e.g., total allowable catch) or the sustainable productivity of the resource. The U.S. action plan identified three major approaches to managing capacity, including permit management programs, exclusive quota programs, and buybacks of permits and/or vessels. Permit management programs, such as establishing a maximum number of permits assigned to a fishery, can be used to restrict entry and participation. Programs that restrict access, however, have met with only limited success as a means of controlling fishing effort because of the pervasive effects of "capital stuffing" and input substitution (European Parliament; Wilen). However, a simultaneous effort to reduce capital stuffing by incorporating restrictions on the allowable characteristics of vessels often creates technical inefficiencies. As was aptly stated by Hannesson, "It is difficult to control all dimensions of fishing power; restrictions on vessel size can be compensated for by more powerful engines or better fish-finding equipment; it is like pressing a balloon in one place, it just expands in other places. More seriously, this is a question of the degree of substitutability between different components of fishing power and how easily they can be monitored and controlled. The experience seems to be that fishermen and boat designers tend to beat fisheries regulators at the game of getting more fishing power out of a vessel while still satisfying a given set of regulations" (Hannesson, p. 264).

In contrast to permit management, exclusive quota programs directly address the issue of individual incentives by allowing ownership of quota shares. The most effective of these programs are based on output shares, because the management target in the fishery is usually output based.[1] As implemented in the United States, exclusive output quota programs assign ownership shares to individuals, industry groups (e.g., communities and processors), and fishing cooperatives. A key element of these programs is that quota users know in advance how much they will be harvesting and are no longer in competition with other fishermen. Long-run economic efficiency can occur in the fishery if the quota shares are transferable and the transfer market is perfectly competitive. Under such conditions, the harvest sector will go through a "rationalization," or restructuring, process due to the changes in fishing incentives. Several exclusive output quota programs have demonstrated a potential for reducing overcapacity and increasing efficiency (National Research Council), but they have been the subject of considerable debate because of equity issues surrounding share allocations.

The third and final program identified for managing fishing capacity involves the purchase of permits and/or vessels for the purpose of permanently retiring them from the fishery. As stated in the U.S. action plan, "... the most direct and explicit response to overcapacity is to remove it through a buyout program" (U.S. Department of Commerce 2003a, p. 22). In addition to the potential conservation benefits from the removal of fishing capacity, buyback programs can also improve the economic efficiency of the fleet through the removal of inefficient effort and improve equity in the fishery by making transfer payments to industry participants (Holland, Gudmundsson, and Gates).

Whether or not a buyback program can achieve its goal hinges on a number of factors, including the actual efficacy of the asset removal scheme (Holland, Gudmundsson, and

[1] Quota programs can also be based on input shares (e.g., a share of the maximum number of traps allowed in a lobster or crab fishery), but this approach allows for unrestricted use of other inputs and often results in technical inefficiency.

Gates; Sun) and the degree of capital malleability in the fishery (Clark and Munro; Gréboval and Munro). Perhaps more fundamental is whether there is an agreed-upon goal. This issue is particularly relevant for buyback programs that include migratory stocks or multiple species that are managed by different entities that are not required to collaborate. Given the recent international attention to managing fishing capacity raised by the FAO and the relatively large budgets associated with some programs, previous buyback programs have been subjected to intense scrutiny (U.S. Department of Commerce 2003a; U.S. General Accounting Office). The conclusions and suggestions from these reviews will be instrumental in the development of effective buyout programs for overcapitalized fisheries.

To review the potential effects of a buyback program for the U.S. shark fishery, we first briefly describe the overall fishery and then review U.S. experiences with buyback programs in other fisheries. Next, the development of a buyback program for the fishery is discussed. The discussion will focus on how the characteristics of the fishery, available data, and program objectives affect a buyback program's design and potential effectiveness. The article concludes with some remarks on the usefulness of buyback programs as a policy instrument.

The Southeast U.S. Shark Fishery

The recent U.S. action plan identified 75 fisheries over which the National Marine Fisheries Service (NMFS) has primary responsibility for developing management plans (U.S. Department of Commerce 2003a). Of the 42 U.S. fisheries identified as satisfying at least one of seven qualitative indicators of overcapacity, four are Atlantic shark complexes (large coastal, pelagic, small coastal, and deepwater) encompassing nearly 70 species. Although fishermen have harvested sharks sustainably in coastal waters for centuries, recent advances in harvesting technology and access to distant markets have increased effort and catch (FAO 1999). Aside from being overcapitalized, the Atlantic shark fishery is of interest in the U.S. action plan because sharks have a low reproduction rate, which places their stocks at a higher risk of biological depletion. Most notably, the large coastal shark group (the primary shark group in terms of landings and value) has continually been overfished.

Commercial quotas for 2004 were expected to be 1,017 metric tons dressed weight (mt dw) for the large coastal sharks (LCS), 853 mt dw for the pelagic sharks with separate quotas for two of the five species, and 454 mt dw for the small coastal sharks (SCS) (Table 1). For comparison, LCS landings totaled 2,080 and 1,866 mt dw in 1998 and 2002, respectively (U.S. Department of Commerce 2001, 2004). Commercial landings in the shark fishery are monitored by permit type, which can be either "directed" or "incidental." Fishermen who specifically target sharks are required to have a directed permit. Both the directed and incidental fisheries are considered to be limited access, because permits are limited in number and are required for participation in the fishery. A moratorium was established on the issuance of new permits in 1999, at which time 2,200 total permits were outstanding. As of September 2003, 607 total permits (256 directed and 351 incidental) were outstanding (U.S. Department of Commerce 2003b). This reduction in permits was thought to be a major step toward reducing overcapacity, but fewer than 100 directed permit holders have reported shark landings in recent years (e.g., just 85 in 2001). The current financial condition of the fleet has resulted in a significant amount of idle fishing capacity, especially in Florida, where relatively large shares of directed and incidental permits are located (57% and 39%, respectively). Thus, even with the success in reducing the overall number of permits, overcapacity is still thought to exist, especially for the directed fishery that targets LCS with bottom longline gear (Kirkley et al.).

One potential method to reduce overcapacity in the shark fishery is a vessel buyback program. Similar capacity reduction programs have been used to reduce capacity in other fisheries, and a buyback program for the entire Gulf of Mexico and Atlantic shark fishery had been proposed by some sectors of the com-

Table 1. Overview of Changes to Shark Regulations from Final Amendment 1 to the FMP for Atlantic Tunas, Swordfish, and Sharks

Management Unit	Species	Limits for 2004	Allowable Gears
Prohibited	Whale, basking, sand tiger, white, dusky, night, bignose, Galapagos, Caribbean reef, narrowtooth, longfin mako, bigeye thresher, sevengill, sixgill, bigeye sixgill, Caribbean sharpnose, smalltail, Atlantic angel	Cannot be kept	None
Commercial			
Large Coastal (LCS)	Sandbar, silky, tiger, blacktip, bull, spinner, lemon, nurse, smooth hammerhead, scalloped hammerhead, great hammerhead	Quota: 1,017 mt dw (SA 54%; GM 42%) Directed: 4,000 lb. dw/trip Incidental: 5/trip	Longline,[a] gillnet, rod and reel, handline, bandit
Pelagic	Shortfin mako, thresher, oceanic whitetip	Quota: 488 mt dw	Incidental: 16/trip
	Porbeagle	Quota: 92 mt dw	
	Blue	Quota: 273 mt dw	
Small Coastal (SCS)	Atlantic sharpnose, blacknose, finetooth, bonnethead	Quota: 454 mt dw	
Recreational			
LCS, Pelagic, SCS	Same as commercial	1 shark/trip	Rod and reel, handline

Source: U.S. Department of Commerce (2003b, p. viii). Note that deepwater/other sharks species (33 in total, including catsharks, lanternsharks, and dogfish) were removed from the management unit under this amendment.

[a] Bottom longline gear is subject to time/area closures, specifications regarding onboard equipment, and movement requirements after interactions with protected species. See the source for complete details.

mercial shark fishery. Funding to examine this capacity reduction option was provided by NMFS and will be used to examine the target capacity reduction level for the Atlantic shark fishery, identify the various types of buyback programs, develop an implementation plan for the most appropriate buyback program, assess the fair market value for a vessel (and all associated permits), and provide insight into the potential effects to the local communities that have a degree of dependence on the commercial shark fishery.

Characteristics of Recent Buyback Programs

The general objective of any buyback program is to permanently reduce fishing capacity. Each specific program, however, has different characteristics with respect to how it is implemented, the buyback target (e.g., vessels and/or permits), participant selection, and funding. Although these topics are discussed in turn, decisions involving each are interconnected and will affect the ability of buyback programs to contribute to stock conservation and/or profit enhancement objectives (Holland, Gudmundsson, and Gates; U.S. Department of Commerce 1999; U.S. General Accounting Office).

Impetus

There are several reasons why buyback programs are implemented. First, buyback programs, in general, can satisfy a wide range of equity objectives and issues, including a desire to transfer income to producers—an objective that can reflect a government's affinity for maintaining or reducing high-cost (Hueth) or low-cost (Chambers) producers. One of the Washington state salmon buybacks, for example, was implemented after an unforeseen change in quota allocation that reduced the share to current participants by 50%. Programs in the United Kingdom have targeted the removal of the oldest and largest vessels (Department of Agriculture and Rural Development). Second, buyback programs can be one means to distribute disaster funds that are allocated when unforeseen environmental conditions (e.g., poor weather conditions) adversely affect stocks and cause severe financial hardships. When buyback programs are used as a form of disaster relief, however, they need to be viewed as a social insurance program. Rather than requiring universal insurance and protection against all possible hazards, providing assistance after the fact may be in the best interest of society (U.S. Department of Commerce 1999). From this perspective, buybacks can be beneficial to society if the disasters are truly unforeseen events and if the effects from the disaster are expected to continue over an extended period of time. When buybacks are funded as a part of a comprehensive economic aid package, they are essentially focused on short-term effects. In contrast, buyback programs that are enacted out of concern for the long-term sustainability of a fishery and the associated fishing-dependent communities are focused on long-term effects. The distinction between short- and long-term effects has important implications for program development and evaluation.

Reduction Targets

The target of most buyback programs has been either fishing licenses/permits (which we used interchangeably) and/or fishing vessels. Of course, the decision of which reduction target to select is directly associated with the amount of funding available. If the funding level is sufficient, both vessels and permits could be purchased. Buying back vessels without permits, although affording the immediate removal of capital from the fishery and potential revenue from resale, results in an imbalance between the number of available permits and the number of vessels attached to those permits. These "excess" permits may provide incentives for additional vessels to enter the buyback fishery, particularly if the fishing history is associated with the permit. Hence, over time, capacity in the fishery may return to or exceed prebuyback levels. Buying back permits or licenses without the vessels can also lead to an imbalance in which there is an excess supply of "available" vessels in relation

to "allowable" vessels in the fishery. Vessels that are no longer able to fish the permitted fishery are likely to gravitate to other, potentially already overcapitalized, fisheries (although recent buyback programs have included titling restrictions on future vessel use in fisheries).

The simultaneous purchase of both vessels and permits somewhat negates the negative effects associated with the leakage of capital to nonbuyback fisheries. For a given funding level, however, the simultaneous purchase of both vessels and permits may result in less capacity being removed from the fishery than the purchase of either vessels or permits. In addition, even in cases where both permits and vessels are bought out, leakage can occur if fishermen reinvest buyout funds into other fisheries. A survey of participants in the Northeast groundfish buyback, for example, found that 9 of 54 respondents shifted fishing activity to the overfished Atlantic lobster fishery after voluntarily surrendering licenses/vessels associated with groundfish activities.

Note that the undifferentiated buyout of permits and vessels results in the potential elimination of effort but is less likely to reflect subsequent effects on stocks than buyouts that account for vessel size and power. Thus, some European programs measure capacity by accounting for vessel length, breadth, gross tonnage, and engine power (e.g., vessel capacity units) and develop buyback programs by targeting reductions in specified fishing capacity units. An alternative method to target specific parts of the fleet is through the participant selection process.

Participant Selection

The actual participants in the buyback program, either the specific vessels and/or permits, are determined by the eligibility conditions and selection mechanism. In the past, eligibility requirements often have been based on the location of homeport, primary gear used, minimum age and/or size of the vessel, and minimum landings. The first two factors are primarily for equity considerations but may also be used to focus in on sectors of the fleet affected by a natural disaster. Minimum age and size requirements of vessels have been used, for example, in U.K. decommissioning schemes that targeted the removal of older and larger vessels (i.e., over 10 years of age and 10 m in length) (Department of Agriculture and Rural Development).

The specification of minimum landings (or analogously the number of days fished) is critically important to the development and outcome of a buyback program if latent (unused) capacity exists. This is because a minimum landings or days fished requirement eliminates latent effort from the program. The concern is that latent effort can easily become active if economic conditions are even temporarily enhanced, such as can occur the season immediately after the buyback, when fewer participants are fishing the same level of quota. One extreme example of this is detailed in the U.S. General Accounting Office report that evaluated the effectiveness of the Northeast groundfish buyback program: "The 79 boats sold in the New England buyback caught a combined total of about 15 million pounds of groundfish in the 1996 fishing year. This total represented about 19 percent of all groundfish caught in that fishery. However, because of the number of unused fishing permits in the fishery, 62 previously inactive vessels have begun catching groundfish since 1996" (U.S. General Accounting Office, p. 7).

The lack of latent effort removal from a fishery during a buyback reflects not on buybacks as a concept but primarily on the eligibility restrictions and level of expenditures committed to the programs. Eligibility restrictions are often indirectly specified in the development of the selection mechanisms. Although there are various buyout methods (Holland, Gudmundsson, and Gates), fixed rate payments and auctions appear to be the most common and practical in buyouts with many potential participants. In a fixed-rate buyout, the government offers a nonnegotiable fixed price (per permit, vessel, or other unit of effort) at which it is willing to purchase the permit and/or vessel. The prices can be based on the observed market price (such as the value of recently traded permits or recent vessel

sales), appraisals, or insurance/book values (cost minus depreciation and salvage value). Under this approach, participants are selected in the order in which acceptance offers are received or by lottery.

In an auction-based buyout, the government structures a bidding process whereby the fishermen can specify a price that they would accept in return for relinquishing their vessel and/or permit (i.e., tendering a sealed bid). The bids are then ordered or used to create a bid score for ordering and selection. Selecting the lowest bids results in the maximum removal of vessels/permits per dollar of program funding. Selecting the lowest bid scores maximizes the removal of an effort-adjusted measure per dollar of program funding (i.e., a "blind, silent, reverse auction"). Typically, bid scores are derived by expressing the bid as a share of total landings or revenues over a specified period of time. Thus, vessels/permits associated with higher landings (which is assumed to proxy fishing capacity) will have lower scores (*ceteris paribus* to bid amounts) and will be selected first. In certain programs, acceptance of the bid by the agency results in a binding contract. In other programs, the tenderer of the bid has the right to refuse the acceptance. Programs that allow for refusal, and possible resubmission, are more akin to actual auction markets. Alternative bid prioritization measures are likely to have diverse capacity reduction effects for the same program expenditures (Walden, Kirkley, and Kitts).

The most suitable approach to selecting participants is dependent on situation, and the best choice appears to hinge on both the number of potential participants and the amount of information asymmetry between the government and vessel owners (Latacz-Lohmann). Economic theory may suggest that auctions will be more efficient than fixed-rate payments in all but the omniscient government case, but it also suggests that efficient auctions only occur if they are carefully designed (Klemperer). The previous discussion of "auctions" involved programs where eligible participants stated their willingness-to-accept (WTA) compensation for the forfeiture of fishing privileges (identified with permits and/or vessels). Generally, past research has shown that WTA values are greater than willingness-to-pay (WTP) values. If so, a cost-minimization requirement might favor a "buy-in" system whereby eligible participants (e.g., those with active limited entry permits) would state their WTP for a permit to remain in the fishery for a specified duration of time (e.g., 10 years or forever). The funds raised from the payments would then be used to compensate those without permits that were eligible to bid. In addition, a double auction format could be considered whereby both permit sellers and buyers submit bids which are then ranked highest to lowest to generate demand and supply profiles. From the profiles, the maximum quantity exchanged can be determined by matching selling offers (starting with lowest price and moving up) with demand bids (starting with highest price and moving down). The decision as to which format to use, noting that there are many types of auctions, would depend on whether latent permit holders would be eligible to accept payment and/or sell their permits.

Regardless of whether fixed-rate payments or auctions are used, experience suggests that buyback programs need to carefully consider the measures that are used to both attract participants and to prioritize buyout offers. Isé and Sunding examined the variables that affect buyout bids for water rights in the United States and found that, in addition to the present value of future net earnings, personal characteristics (including financial condition and access to credit markets) were significant in participation and bid price. This situation would presumably hold for fishery buyouts as well. Anecdotal evidence from the West Coast groundfish buyout (Young, pers. comm.) suggests that (1) beliefs regarding the future effects of the reductions and (2) demographics of the bidder (especially age) are the two most important factors affecting bids. In addition, a recent study by Kitts, Thunberg, and Robertson found that total annual revenues, vessel power, and fishing days all positively affected bid amounts, which were assumed to equal the net present value of future net earnings plus the difference between the cost to scrap the vessel and its salvage value.

Buyout Funding

Financing of buyback programs can take the form of federal or state appropriations, private funds, or some amalgam. Most previous U.S. buyback programs have relied principally on public expenditures, because they were simply a component of a larger assistance program (e.g., Interjurisdictional Fisheries Act). However, increased emphasis was given to privately funded buyback programs with the passage of the 1996 Sustainable Fisheries Act amendments to the Magnuson-Stevens Act and the creation of the Fishing Capacity Reduction Program (FCRP). Private funding sources include loans and donations. Statutory loans for buybacks are paid with assessments on landings of the postbuyback fishery participants. These loans involve no promissory notes, mortgages, or other conventional loan documentation, and, beyond repayment fees, no one has any other liability for loan repayment.

To date, loans have been used to fund the most expensive vessel-based programs, and donations have been used to purchase permits. Conservation-based donations can, however, play a significant role in effort reduction. For example, the Texas Parks and Recreation Department has received donations from the National Fish and Wildlife Foundation and the Coastal Conservation Association to purchase shrimp permits. The National Fish and Wildlife Foundation also supported the purchase of latent permits in the New England groundfish fishery (Read and Buck). Also, an independent nonprofit organization supported by the sport angling industry (i.e., the North Atlantic Salmon Fund) purchased all of the permits associated with the salmon fishery around the Faroe Islands and all quotas from fishermen in Greenland (Read and Buck).

If a loan is the sole source of funding of the program, the total amount of money available for the program can be determined *a priori* and used to assess whether an alternative program would be able to remove the fishing capacity necessary to improve the fishery. To convey the importance of this factor, consider that the 79 permits purchased in the New England groundfish buyback program represented less than 5% of the 1,763 permits that were issued in 1996, and 62 previously inactive permits were reactivated with larger-capacity vessels after the program (U.S. General Accounting Office). Although this program clearly did little to reduce fishing capacity and effort, it did provide economic aid.

Summary statistics associated with U.S. government-sponsored vessel and permit buybacks, including the total level of funding, from 1995 to 2004 are presented in Table 2. The cost of the buyback programs totaled about $285 million by 2004, with the federal share equaling $74 million. The two most recent buyout programs are the largest in terms of dollars and both are industry financed through assessments on future landings.

Buyback Program Development for the U.S. Atlantic Shark Fishery

U.S. Regulatory Environment

The 1996 Sustainable Fisheries Act amendments to the Magnuson-Stevens Act added an FCRP, section 312(b)–(e) that authorized buybacks of vessels and permits funded from several sources (Public Law 104–297). In addition, amendments to the Capacity Reduction and Financing Authority (Title XI of the Merchant Marine Act, 1936), section 303(a), dictated specific requirements related to the amount, duration, and interest rate of the loan if privately funded. The key provisions of the laws, as summarized in Table 3, are used to discuss each aspect of the development of a potential buyback program for the shark fishery in the Atlantic Ocean and Gulf of Mexico.

Objectives and Analysis

Provisions I–IV in Table 3 specify the conditions under which a FCRP can be conducted and the objectives and guidelines for developing the program. Provision I requires that the program helps conserve the resource in a measurable way. Given that the shark fishery includes approximately 70 species, specific management units (i.e., LCS, pelagic sharks, and SCS) would have to be addressed. It is

Table 2. Characteristics of Vessel/Permit "Buyback" Programs for U.S. Fisheries, 1995–2004

Year: Fishery (No.)[a]	Value ($ mil)	Vessels (No.)	Permits (No.)	Avg price ($ thous)	Funding ($ mil) States	Industry[b]	Federal	Total
1995: TX Inshore shrimp	?	0	310	4.5	0	0	1.4	1.4
1995–1998: WA salmon	9.6	0	829	16.8	1.2	0	12.7	13.9
1995–1999: NE multispecies (13)	101.0	79	787	43.0	0	0	34.5	34.5
1999: AK pollock[c]	175.7	9	17	10,000.0	0	75.0	15.0	90.0
2003: WC groundfish (7)[d]	50.0	92	240	497.3	0	35.8	10.0	45.8
2004: AK BSAI crab (7)[e]	240.0	?	?/335	?	0	100.0	0	100.0
Total (if known)	NA	180	2,183	NA	1.2	210.8	73.6	285.6

Sources: U.S. Department of Commerce (1999, 2003a); Leipzig; U.S. General Accounting Office.

[a] Only the Alaska crab and West Coast groundfish are pure buyback programs. The remainder, those primarily federally funded, were not directed buyback programs. Instead, the fisheries received federal funds for disaster assistance that were later used for buybacks.

[b] Loan proceeds are dispersed as buyback payments. Postbuyback harvesters repay the loans with assessments on landings.

[c] Bering Sea. The nine vessels were large factory trawler/processors (250–300 feet).

[d] In addition to federal groundfish trawl permits, the program removed state-licensed Dungeness crab and/or pink shrimp permits held by the same owner. The 30-year loan referendum passed with 86% of the votes weighted by permitted fishery.

[e] Bidding under this program is complete, but the loan repayment referendum is ongoing. This table assumes the referendum will pass.

likely that this provision could be satisfied by focusing on the three primary management units, because each has been subject to a recent stock assessment and each has been considered as overcapitalized using at least one of seven qualitative measures (U.S. Department of Commerce 2003b). Furthermore, because specific gears have been shown to target specific shark management units (U.S. Department of Commerce 2001), this information can be used to link fishing capacity with the stock condition of each management unit.

Provision II identifies the FCRP objective as obtaining the maximum sustained reduction in fishing capacity at the least cost and within the shortest time period. A sustained reduction requires restrictions on "leakages," which could apply to both the vessel and vessel owner (and other human capital such as the captain and crew). Previous programs have restricted the title of the vessel such that it can never fish again, and other programs have required that the vessel be scrapped. The European decommissioning programs detail the salvaging process and costs that owners should factor into their bids. Other programs have accepted title to the vessel for the purpose of auctioning to raise funds to offset administrative costs. In the case of the shark fishery, the age and condition of the fleet would determine the most appropriate approach.

Least-cost considerations, in terms of administration, would point to the use of fixed price accept/reject programs. This is because the research needed to determine the appropriate fixed price would only involve an aggregate analysis of permit value as revealed in past transactions prices, average vessel gross revenue, or average vessel value. This is in contrast to auction-based programs that require NMFS to summarize data on each vessel/permit over time, which is complicated in the case of sharks because landings entail a portfolio of species. In terms of the total payments to be made, the purchase of vessels would be the most costly approach. The cost issue in terms of program payments, however, would depend on the funding mechanism. If privately (industry) funded, then the payments by the government are zero, which would be the least cost (excluding recurring costs to monitor loan payments). For the shark fishery, a reasonable approach would be to conduct the buyback in multiple phases, first offering a

Table 3. Key Buyback-Related Provisions in the 1996 Sustainable Fisheries Act Amendments

No.	Section, Description
I.	312(b)(1)(A) A FCRP may be conducted in a fishery if the program "is necessary to prevent or end overfishing, rebuild stocks of fish, or achieve measurable and significant improvements in the conservation and management of the fishery"
II.	312(b)(2) "The objective of the program shall be to obtain the maximum sustained reduction in fishing capacity at the least cost and in a minimum period of time"
III.	312(e)(1)(A) The buyback program implementation plan shall "define criteria for determining types and numbers of vessels which are eligible for participation in the program taking into account characteristics of the fishery, the requirements of applicable fishery management plans, the needs of fishing communities, and the need to minimize program costs"
IV.	312(e)(1)(B) The buyback program implementation plan shall "establish procedures for program participation (such as submission of owner bid under an auction system or fair market value assessment)"
V.	312(b)(1)(B)(i) A FCRP may be conducted in a fishery if the program is consistent with the relevant FMP and the FMP "will prevent the replacement of fishing capacity removed by the program through a moratorium on new entrants, restrictions on vessel upgrades, and other effort control measures, taking into account the full potential fishing capacity of the fleet"
VI.	312(b)(1)(B)(ii) A FCRP may be conducted in a fishery if the program is consistent with the relevant FMP and the FMP "establishes a specified or target total allowable catch or other measures that trigger closure of the fishery or adjustments to reduce catch"
VII.	312(b)(1)(C) A FCRP may be conducted in a fishery if the program "is cost-effective and capable of repaying any debt obligation"
VIII.	312(d)(2)(B) The fees for a program shall "not exceed 5 percent of the ex-vessel value of all fish harvested from the fishery for which the program is established"
IX.	303(a)Sec.1111(b)(3) Any debt obligation shall "not exceed $100,000,000 in an unpaid principal amount outstanding at any one time for a program"
X.	303(a)Sec.1111(b)(4) Any debt obligation shall "have such maturity (not to exceed 20 years)"
XI.	303(a)Sec.1112(b) "the annual rate of interest . . . shall be fixed at two percent of the principal amount . . . plus . . . the interest cost of borrowing from the United States Treasury"
XII.	312(d)(1)(B) "The industry fee system shall be considered approved if the referendum votes which are cast in favor of the proposed system constitute a two-thirds majority"

fixed price to reduce latent permits then proceeding with a bid score system for vessels.

In terms of minimizing time, the use of a fixed valuation approach avoids the need to examine individual effort and landings levels and their comparison with the actual bids received (Hogarth). In addition, if privately funded by the industry with a loan, then an "auction" would involve numerous steps, including the creation of individual bid scores, selection, calculation of individual capacity by fishery, and release of results for referendum, then the referendum and weighting of results. Studies of the Texas shrimp fishery have suggested, however, that simple fixed-price permit buybacks may take a long time to reduce effort to target levels, primarily because of the large amounts of latent effort in the fishery (Funk et al.). This is true of all passive-reduction approaches whereby permits are revoked via a voluntary forfeiture.

Provisions III and IV state that participant selection must account for the characteristics of the fishery, whereas the program goals, objectives, and selection procedures must be outlined. These provisions require a significant amount of analysis, although some of this has already been conducted at the aggregate level for the shark fishery. The numbers of active and latent directed permits are known, and the landings by management unit are controlled by quota. This information can be used to determine the annual average revenue associated with each permitted vessel. This approach has been used as a rule of thumb in previous analyses and has been found to correspond with

the bid levels observed in buyback programs (Kirkley et al.). The critical element in the shark fishery case would be defining the scope of species to include in the revenue calculation and, thus, the relevant permits. Other than directed shark permits, there are also incidental shark permits that would be held by other vessels. The primary gear used for certain management units, namely the LCS and SCS, will differ by geographic region and species mix. This is important, because gear is often nonselective. As a result, all pelagic longline vessels must have permits for swordfish, tunas, and sharks. If vessels own directed shark permits, they will also have swordfish and tuna permits, which could substantially increase the scope of the program. Congressional testimony in 2001 regarding a capacity reduction program contained in the Atlantic Highly Migratory Species (HMS) Conservation Act stated that "NOAA Fisheries also recommends that the legislation clarify that pelagic longline fishing for HMS is authorized only for vessels with all three permits (swordfish/shark/tuna) and that the permits be surrendered as a package."

When considering the implementation plan, participant eligibility will be crucial. For example, if a landing-dependent bid score is used, latent permits/vessels will not be eligible for participation. Instead, the fair market value of these permits should be determined, perhaps by examining the characteristics of the associated vessel and whether the owner holds other permits. Because latent effort can become active and undermine program objectives, this segment must also be considered.[2] Provision IV specifically provides for an auction system, and such an approach could result in the lowest payments if repeat bidding were allowed and bidding information was made available. Of course, the initiation of any of the required preliminary analyses could trigger potential participants to capital stuff, thereby increasing the biological and economic damage to the fishery and negating potential benefits from an anticipated buyout program (Clark, Munro, and Sumaila).

FMP Requirements

Provisions V and VI pertain to elements of the corresponding Fishery Management Plan (FMPs). In the case of sharks, a limited access system for the commercial fishery (directed and incidental) was established in 1999. The FMP also contains biannual quotas on each of the three management units. Additional information on the "full potential fishing capacity of the fleet" would have to be investigated. The primary decision involves defining what the fleet is, which could be determined by examining the gear types for each fishery. One definition could be bottom longliners with directed shark permits. This would require identifying all vessels using bottom longline gear and their landing portfolios.

Funding

The last six provisions, VII–XII, concern loan funding for a buyback program. The first provision (VII) addresses the need for the fishery to be capable of repaying the debt. To assess this capability, the total cost of the buyback program must be estimated in advance. This implies that, within the preliminary fishery analysis, the total effort reduction needed to cause a measurable improvement in stock size (and, thus, support a sustainable stock, fishery, and fishing-dependent community) must be estimated and then valued. Once the FCRP target is established and individual units are valued, the total cost of the program can be determined. Whether a 5% assessment on ex-vessel landings over 20 years, discounted at the Treasury rate plus 2%, will be large enough to cover the estimated costs will determine whether the fishery is capable of pay-

[2] Note that the recreational sector remains an open-access fishery. Although the commercial shark fishery began a permit management program in 1999, recreational permits were not required until March 2003. As of September 30, 2003, a total of 22,290 permits have been issued, with the majority (82%) going to recreational anglers and the remainder to charter boats. Because recreational effort has grown substantially and this effort contributes to total fishing mortality, any program aimed at reducing fishing capacity to improve the sustainability of the stock should consider the recreational sector.

ing the debt. Given that the total ex-vessel gross revenues of Atlantic shark fisheries was valued at approximately $3 million in 2001 (U.S. Department of Commerce 2003b),[3] an assessment on shark-only landings alone would support a loan of just $1.87 million under the assumption of a 4% U.S. Treasury annual interest rate. Thus, a buyback based on this level of funding is likely to be only capable of targeting permits. The fishery may not be able to generate the funds necessary to purchase enough vessels.

There are several methods for assessing permit/vessel value. One such approach is to use the insurance/book value. It is unlikely that this approach would be favored by the industry, because the majority of vessels are old and of relatively low value. The industry has proposed that $5,000 per linear foot be paid for each vessel. Given that these vessels run 40–60 feet in length, the average cost per boat would be $250,000. At that valuation, the industry could afford to buyback just seven vessels (8% of active vessels) with the $1.87 million generated from the loan scenario described previously. Note also that such a valuation greatly exceeds a reasonable estimate of 1 year's gross shark revenue for active directed shark permit holders, which equals just $32,000 (i.e., total dockside value for sharks divided by the number of active permits, which is 85) (U.S. Department of Commerce 2003b, p. 6-2). If we assume that owners of directed shark permits receive 50% of their gross revenues from shark, which is a conservative effort for targeting behavior, the rule-of-thumb value would equal $64,000. This higher annual gross revenue estimate would, in turn, double the loan amount and the effort that could be bought out, but it would require that the other fisheries be included in the program. On the basis of a previous analysis of the Atlantic commercial shark fishery (U.S. Department of Commerce 2003b), assembling data on all shark permit owners would require the use of the federal permit database and logbooks for the Northeast multispecies, longline, and reef fish fisheries. In addition, these data would be needed for multiple years, usually 2–5 years.

Using more comprehensive valuation methods, such as those defined in Kitts, Thunberg, and Robertson, could result in higher calculated fair market values based on net present value of annual net returns (i.e., annual net revenue from multiple years discounted back to current dollars) and the salvage costs less scrap value of the vessel. Another way of determining vessel value would be to hire independent appraisers. The Washington salmon buyback program during the late 1970s determined fixed price buyback offers on the basis of two independent appraisals and the market price of the permits.

If a buyback is funded by an industry loan, fishermen vote on whether to proceed in a final referendum that identifies the buyback participants and their past harvest levels. For example, fishermen would vote on whether they would be willing to pay a 5% assessment on their landings for the next 20 years. Using the aggregate average shark price of $1.90 pound dw (note 3), the "garnishment" would total approximately $0.095 pound dw, which would reduce the net price to fishermen to $1.80 pound dw. By comparison, the pollock fishers are assessed a fee of just $0.006 per pound landed. The relatively low level of the pollock fee brings out two important points. First, the level of fee assessment is directly related to the loan amount and indirectly related to the total value of the fishery. Second, the provisions of the Magnuson-Stevens Act may be too constraining. In the case of the Alaska pollock buyback, the loan is over 30 years, not the Magnuson-Stevens Act's mandated 20 years. And, in the case of the two most recent

[3] These data were obtained from Table 6.3; however, Table 9.1 lists total landings by state and reports a total commercial value of nearly $5.0 million (U.S. Department of Commerce 2003b). Because Table 9.1 does not identify whether the values are at the ex-vessel level, we use the data from Table 6.3, which contain more conservative estimates. The $3.0 million valuation was based on average prices of $0.91, $1.11, and $0.79 per pound dw for LCS, pelagic sharks, and SCS, respectively. In addition, the value of shark fins was calculated under the assumption that the fins weighed 5% of landings and received a price of $19.67 per pound. In sum, landings totaled 1.58 million pound dw for an average price of $1.90 per pound dw.

buybacks (West Coast groundfish and Alaska crab), the buyback covered multiple fisheries (defined as the number of distinct permits included). These revisions are possible if the loan program is created with special legislation that supercedes provisions in the Magnuson-Stevens Act. If directed shark permit holders are required to have swordfish and tuna permits, or if a majority do, the program would have to be funded under special legislation. Although not addressed in the legislation, subsequent monitoring and assessment of the success of the program in terms of meeting the specified objectives is necessary (U.S. General Accounting Office). This would also include management of the fee collection mechanism.

Discussion

Declining fishery stocks, increasing fishing effort, and poor market conditions have produced difficult financial situations for fishermen worldwide. In several high-value fisheries, especially those that are considered to be overcapitalized, the total value of landings averaged across the current fleet suggests that revenues are insufficient to cover production costs. This overcapitalization is becoming a fisheries pandemic.

Although allowing the market to solve overcapacity problems would be the simplest policy to adopt, there are several reasons why continuing government intervention may be needed. First, many stocks need to begin rebuilding immediately and may not be able to withstand the transitory increases in fishing pressure that might result from a rapid transition to market-based policies. Second, coastal communities are heavily dependent on an active fishing fleet, and rapid movements to a market-rationalized fleet would certainly cause economic dislocations. Third, entry and exit from the fishing industry is not unhindered, given that vessels are a significant capital investment and that there are moratoriums on the issuance of new permits in many fisheries. Last, there is much evidence to suggest that fishermen are optimistic regarding stock rebuilding, financial assistance, and potential changes in fisheries regulations and management—all factors that dissuade fishermen from exiting the industry.

The purchase and permanent retirement of fishing vessels and/or permits in a buyback program is one of the approaches for managing capacity that was identified in the recent U.S. National Plan of Action for the Management of Fishing Capacity. Evidence from previous programs, however, suggests that buybacks are not a panacea for solving overcapacity problems in fisheries. "Although the issue is complex, NOAA Fisheries believes that overcapacity is linked to overfishing, and we have a legal mandate to remedy the latter" (Fishing Capacity Reduction Program Fact Sheet, NOAA Fisheries, National Marine Fisheries Service). In addition, as the *de facto* trustee of many of the nation's natural resources, the government may have a responsibility to protect those resources. According to the recent Federal Fisheries Investment Task Force Report to Congress, when there is a mismatch between stock abundance and fishing capacity and the cause of this mismatch is outside the fishery (e.g., institutional failure resulting in inadequate protection of the resource base), "the government has a fundamental governance responsibility to assist people in an industry reshape the fishery in the public interest" (U.S. Department of Commerce, 1999, p. 119). Thus, "[a]lthough not every fishery will profit from a buyback program, arguments in favor of such programs are sufficiently strong that the industry should be encouraged to explore the full potential of this mechanism as set forth in the Sustainable Fisheries Act" (U.S. Department of Commerce, 1999, p. 105).

The recent emphasis on fishing capacity management affords the opportunity to address the problem in an efficient and effective manner. This is particularly the case for loan-financed buybacks where the benefactors of the reduced capacity (fishermen) compensate those who voluntarily elect to give up their fishing privileges. If, however, there are additional benefits from the capacity reduction (such as bycatch reduction and improved habitat from the use of less gear, which are issues

pertaining to bottom longline gear that targets sharks; Morgan and Chuenpagdee), then the program provides a positive externality. In such cases, government funding could be pursued to alleviate some of the repayment burden. Alternatively, donations could be solicited from conservation groups that value the improvements.

The concern as to whether buyback programs lead to any long-term reduction in effort extends well beyond the issue of latent capacity becoming active after the initial buyback. Specifically, it has been argued that prebuyback active participants will increase effort after the buyback program in response to increasing industry profits. As stated by Holland, Gudmundsson, and Gates, "[for a] buyback program to improve long-run resource stability and profitability, the growth in effort must be constrained (or the reduction in effort must be very large). This requires restricting not only new entry, but increases in effective fishing effort due to various forms of input stuffing by existing fishermen. Otherwise, an ever-widening gap between real and nominal effort will develop, and the ratio of fishing mortality to nominal effort will drift up over time. Conservation goals will be frustrated and the economic cost of fish will increase needlessly." (Holland, Gudmundsson, and Gates, p. 68).

Although such a conclusion is supported by economic theory in those instances where the buyback is government funded, empirical evidence of such findings is relatively limited. This partially reflects the short history of most programs in relation to the time frame required to observe and assess long-term technical changes in response to changing economic conditions. Furthermore, industry funding of a buyback program through assessments would tend to suppress the generation of profits associated with postbuyback stock improvements and reduce the incentive to capital stuff.

Finally, concern regarding "moral hazard" tends to arise in most economic reviews of buyback programs. For example, anticipation of compensation via an expected buyback program (or a higher level of compensation if delayed participation provided a control date is not established) has resulted in some participants, who would otherwise exit a fishery because of low economic returns, remaining active in the fishery while buyback discussions are ongoing (U.S. Department of Commerce 2003a). Holland, Gudmundsson, and Gates expressed concern that buyback compensation tied to historical catches can lead to the perverse incentives of accelerating overfishing of stocks already declining and, in anticipation of additional public intervention, capital stuffing in less regulated fisheries. Actions of this type can have strong negative effects, both in terms of economic efficiency and stock conservation.

The Magnuson-Stevens Act requires that a limited entry permit system be in place before a buyback can be conducted. However, the removal of effort does not remove the capital-stuffing incentive. Remaining vessels still must compete at sea for landings. Transferable exclusive output quota schemes, on the other hand, can provide the "rationalization" necessary to increase efficiency and profitability of the fleet. For example, the Bering Sea pollock buyback removed 9 of 30 vessels, but the subsequent creation of a fishing cooperative resulted in the voluntary withdrawal of an additional 4 vessels. Thus, additional efficiency was achieved at no additional cost to the remaining fleet, whereas benefits will accrue to those 21 vessels that are members of the cooperative.

To date, the management of commercial fishing capacity in the United States has been predicated on an institutional structure that has considered previous participation (permit ownership and/or past landings) tantamount to partial rights to the underlying resource. Buyback programs have solicited WTA bids for the relinquishment of rights to participate in a given fishery with specific assets (e.g., permit and/or vessel numbers). Exclusive quota programs have allocated shares on the basis of previous landings. An alternative is to consider "buy-in" programs that would solicit WTP bids for continued participation and auction programs that would allow participants to bid for quota shares (Macinko and Bromley). In either case, the funds raised could be used to

offset losses of those no longer allowed to fish. Although these solutions are outside the current provisions of the Magnuson Act, they raise important issues regarding property rights that can affect the degree of rent capture associated with sustainable fisheries management.

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