CREATING MARINE ASSETS
PROPERTY RIGHTS IN OCEAN FISHERIES

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To the Reader

A thousand years ago Basque fishermen were engaged in international fishing, reports Mark Kurlansky in his book Cod. And they were not the first to exploit the cod stocks off the coasts of Greenland and Canada; the Vikings had been involved in the race to fish before that.

Regardless of their diligence, the Basques, with their small boats, had little impact on fish stocks. But modern technology—floating fish factories—allows the first to find a school of fish the chance to vacuum the ocean. Decades of exploitation of fish and other marine life has caused the collapse of some fisheries.

To prevent destruction of sustainable stocks of marine life, there must be limits on the thousands of boats vying for the harvest. Governments have imposed a host of regulations. Such controls have had little or no success. The race has often become one of ever-fancier technology that lets the swiftest capture the fish. The race is wasteful and the results are hazardous to the environment and those involved in the catch.

In this PERC Policy Series, Robert Deacon considers how economic incentives can solve this problem. Marine life can become an asset to be nourished over time, not consumed in a wasteful race. Deacon draws on a large literature on the subject, but focuses on a novel management experiment in Alaska and one developing along the California coast. He makes the case that economic theory can provide guidance for getting people who fish for a livelihood to agree on how best to protect fish stocks and reduce environmental damage.

This essay is part of the Policy Series of papers on timely environmental topics. This issue was edited by Roger Meiners with Mandy-Scott Bachelier supervising production and design.

Introduction

Marine scientists are sounding alarms over the collapse of commercially valuable fish stocks and the destruction of marine habitats by bottom trawling and other harvesting practices. The fact that these trends persist in fisheries that have been managed for decades indicates that traditional management approaches do not hold the key to reversing these trends.

An alternative approach that bases fisheries management on property rights, or "limited access privileges" in the ocean, can shift the incentives of resource users away from destruction and toward stewardship.[1] As explained in what follows, a broad application of this approach holds promise as a solution to the problems of sustaining fish stocks and minimizing damage from commercial fishing.

Rights-based management regimes were initially instituted to improve the economic performance of fisheries. While currently applied only to a small fraction of the world's fisheries, these systems have been successful where adopted. Under traditional approaches, the harvests of individual fishing firms are based on the rule of capture, which leads to a race to fish and, thereby, depletion of fish stocks. Regardless of whether industry harvests are constrained by limits on total allowable catch, by limitations on entry, or only by licensing requirements, the success of the fisher is determined by the ability to catch fish before one's rivals. As case studies have amply documented, this has led to overinvestment in fishing vessels, shortened fishing seasons,

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excessive catch, high processing costs due to the pulse nature of harvests, unnecessarily dangerous fishing conditions, and low product quality. The response has been an almost universal focus on conserving stocks that has led to depressed economic conditions in fishing communities. Economists and fisheries scientists generally agree that traditional management strategies have failed both to protect stocks of marine life and to generate the highest rate of return.

The most prominent property rights approach is the individual catch share. Depending on how they are administered, these may be called individual transferrable quotas (ITQs), individual fishing quotas, or individual vessel quotas. Catch share systems are designed to end the race by establishing individual ownership to portions of the allowed catch, giving each shareholder a secure harvest right. Experience with these regimes has been positive; enhanced fishery profits are directly evident in positive prices for quota allocations and indirectly evident in higher unit values for fishery products, longer and safer fishing seasons, and improved catch per vessel. Many studies indicate that markets for catch shares are both competitive and efficient in regimes where they are tradable. Additionally, fishers vested with secure harvest rights have incentives for stewardship of the resource and more efficient management, neither of which exists in the traditional race to fish. While clearly producing gains, however, the application of property rights principles in the catch share systems has been incomplete.

This essay explores the potential for further gains by a more complete application of the property rights approach. As we will

see, allowing individual rights holders to combine their harvest rights into harvesters' associations, or to cede certain aspects of individual rights to centralized coordinators, can be advantageous—as illustrated by the Chignik Salmon Cooperative in Alaska, which operated between 2002 and 2004. This innovative association coordinated the deployment of its members' efforts across space and time, cooperated in the provision of shared inputs, and shared information on stock locations. It achieved efficiencies unheard of in traditionally managed salmon fisheries. The fact that the Chignik co-op came under attack by nonmembers, and was eventually declared illegal by the courts, is grim evidence that gaining the support of all fishery participants can be difficult to achieve.

We will also see how a more complete treatment of fishing rights as "property," with a potential for encumbering these rights, can achieve conservation objectives. Although marine environments generally are not owned, existing institutions grant fishers' rights to use these environments in specified ways. If these rights can be placed under easement, now a common strategy on land, then a new avenue is opened for conservation groups or government decision makers to use a market approach to achieve conservation objectives.

A vehicle for exploring this possibility is an initiative by the Nature Conservancy (TNC) and the Environmental Defense Fund (EDF) to purchase federal trawling permits and trawling vessels from commercial fishers in Morro Bay, California. This purchase, completed in 2007, is intended to reduce bycatch[2] and seafloor damage from bottom trawling. While TNC retired some of these vessels and permits, others were

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leased back to the fishers who owned them originally, but with lease restrictions requiring them to use lighter gear and constrain fishing to avoid environmentally sensitive areas. The Nature Conservancy's action involved purchase and ownership of vessels and permits and, in this sense, was not a true conservation easement. Nevertheless, it points to the potential for applying a powerful tool for terrestrial conservation to a marine setting.

Relevance for Fisheries Policy

A highly publicized article in Science projected the global collapse by the year 2048 of all groups of marine organisms now commercially fished, due primarily to overfishing (Worm et al. 2006).[3] The authors recommended implementation of marine reserves, fishery closures, and restrictions on catch, effort, and gear to stave off the catastrophe. Such recommendations have long been mainstays of traditional fisheries management, leaving little reason to hope that the authors' gloomy forecast will be avoided. Traditional (or no) management is still the norm for most of the world's fisheries, which has proven unable to either conserve fish stocks or allow fishers to capture profits.

The Newfoundland cod stock is a sad example of a resource that was decimated, despite active management. Basque fishers harvested this stock well before Columbus's famous voyage, and sustainable harvests continued until the latter half of the 20th century. Hilborn et al. (2003) succinctly describe how the stock fared beyond that point, under traditional management:

> The destruction [that] began with large foreign fleets moving onto the Grand Banks, was temporarily stopped in 1977 when Canada declared a 200-mile limit that excluded most foreign fishing, and then continued with the building

> of Canada's own offshore fleet, a fleet that was much too large based on overly optimistic scientific assessments of long-term sustainable yield. Ultimately, it was the Canadian fleet, with Canadian scientists providing advice and Canadian managers in charge that led to the demise of this fishery. In theory, it was a management system the world could admire . . . [but] it failed totally. (2003, 360)

Despite the depressing forecasts of fishery collapse and evidence of mismanagement, there is a glimmer of hope. A re-analysis of the data that indicated the global demise of fisheries by 2048 found that trends in the 121 fisheries managed with property rights institutions (catch shares) are strikingly different than the 11,000-plus commercial fisheries operating under traditional or no management (Costello, Gaines, and Lynham 2008). Prior to the advent of catch shares, the fisheries now operating under some form of property rights all followed the same downward trends that led to the dismal forecast. Once catch shares were introduced, the rate of decline in the stocks halted, and actually reversed by some estimates.

Under catch share management, fishers acquire secure property rights to specific harvests. As owners, they acquire stewardship incentives that are missing in the traditional race to fish. In New Zealand, Iceland, and Canada the introduction of such regimes has motivated commercial fishers to lobby for reduced catch targets to allow stock rebuilding, to promote improved catch monitoring, and to cooperate on research.[4] In New Zealand and elsewhere, associations of catch share holders have promoted more stringent size regulations, instituted

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training programs to reduce incidental mortality, and directly invested in replenishing stocks.

Catch share regimes perform well in eliminating waste and creating value. When implemented in the British Columbia and Alaska halibut fisheries, seasons were extended from a few days to most of the year, reducing the size of the fleet needed for the harvest, and allowing most of the catch to be sold fresh rather than frozen.[5] Financial returns in fisheries adopting these systems improve dramatically due to elimination of redundant effort, removal of restrictions on fishing methods, and enhanced product value (higher quality fish for market) due to longer, slower-paced fishing seasons (Leal 2002; Wilen 2004).[6] Where quota rights are tradable (ITQs), the evidence indicates that quota markets are efficient and competitive (Newell, Sanchirico, and Kerr 2005). By the same token, failure to fully define harvest rights, e.g., by restricting transferability or permanency of rights, has been shown to dilute the gains achieved (Grafton, Squires, and Fox 2000).

Shifting from traditional management to a property rights approach can benefit marine environments. A key environmental concern is bycatch. According to a recent survey, 26 percent of the world's catch is discarded each year; in the shrimp and prawn trawl fisheries, discards are estimated at five times the amount actually landed.[7] A study of 10 fisheries in the United States and Canada found that bycatch declined an average of 40 percent following the implementation of catch shares, partly due to a slower pace of fishing.[8] Leal, De Alessi, and Baker, (2005) point out that shortened seasons in the traditionally managed Gulf of Mexico red snapper fishery led to large out-of-season catches, which are discarded. This fishery recently transitioned to catch shares, giving reason to hope for longer seasons and reduced discards, as occurred in the Alaska halibut fishery after catch shares were introduced.[9] Another environmental concern is seafloor degradation, coral destruction,

and other damage caused by bottom trawling, dredging, and trapping. While avoiding sensitive habitats or using different gear can minimize this damage, appropriate incentives typically are missing, even in catch share systems.

Nearly 99 percent of the world's commercial fisheries and roughly 85 percent of worldwide catch are not managed with catch shares.

Catch share systems have achieved impressive gains, but the pace of implementation has been disappointing; as of 2008, nearly 99 percent of the world's commercial fisheries and roughly 85 percent of worldwide catch are not managed with catch shares.[10] To a degree, this is due to contention overallocation of initial shares and resistance by "highliners" who generally oppose constraints on their traditional rights to fish.[11] Paying attention to these issues when deciding how rights are assigned could lead to more widespread adoption of property rights regimes that enhance catch and protect the environment.

The central premise elaborated below is that the standard way of administering catch share systems may fail to capture efficiency gains for two reasons. First, relying solely on individual catch rights, and transactions in these rights as a management tool, may miss gains from coordinating the actions of individual fishers and from providing shared inputs. These gains can be enhanced by allowing individuals to combine their catch rights, or to assign some rights to centralized managers. Second, truly treating commercial fishing rights as "property" suggests using private agreements, negotiated among conservation groups and fishers, to achieve conservation goals. Such agreements would offer compensation to fishers who agree to avoid fishing practices that harm the marine environment—conservation easements in the oceans. Examples of both property rights extensions are elaborated in what follows.

Gains from Coordination: The Chignik Experience

A group of commercial fishers successfully petitioned the Alaska Board of Fisheries in 2001 to allocate a portion of the 2002 sockeye salmon catch from the Chignik fishery to them collectively, with the intent of fishing this allocation as a voluntary cooperative. The Chignik commercial salmon fishery is one of Alaska's oldest, dating to the 1880s, and the catch is almost entirely sockeye. The fishing grounds are located on the Alaska Peninsula (see Figure 1). Sockeye salmon migrate toward spawning grounds drained by the Chignik River and become more concentrated as the migration proceeds. Since 1974, the fishery has operated under limited entry, with approximately 100 permits in force in 2005. The management regime specifies a biologically determined escapement goal and monitors the returning stock to make sure the overall catch is consistent with this goal.[12] The harvest is controlled by closing the fishery during parts of the migration season, thereby encouraging a race to fish during the open season.

The impetus to form the co-op arose in part from a decline in salmon prices, largely attributed to competition from farmed salmon, and a consequent decline in the value of Chignik fishing licenses. Between 1990 and 2001, license values fell from $417,000 to $186,000. In addition, many saw the fleet's overcapitalized state and the wastes inherent in competitive fishing as a cause of depressed economic conditions. Competitive fishing also made it difficult to enhance quality by handling the catch more carefully, which would differentiate the Chignik catch from farmed salmon. Finally, the formation of cooperatives in the North Pacific

The Chignik commercial salmon fishery is one of Alaska's oldest, dating to the 1880s.

Figure 1:
Map of Chignik Management Area

The co-op was allocated 69.3 percent of the 2002 sockeye salmon harvest.

pollock and Pacific whiting fisheries in the late 1990s provided precedents.

Of the 100 active permit holders, 77 joined the co-op for the 2002 season and by 2004 that number increased to 84 (Knapp 2008). In accordance with a management plan, the co-op was allocated 69.3 percent of the 2002 sockeye salmon harvest and the Alaska Department of Fish and Game (ADF&G) managed this allocation by specifying different open dates for the co-op and independent fleets.[13]

The co-op was incorporated as the Chignik Seafood Producers Cooperative and adopted bylaws that specified equal distribution of the net proceeds from fishing.[14] License holders could opt into the co-op, but had to do so by a specified date prior to the start of the season. Once joined, a member could not opt out until after the season ended. Governance was by an elected board of directors. The board selected members to fish on the co-op's behalf. The selection criteria were experience, skill, vessel condition, expected cost, and intent to give preference to local laborers as crew. The board was also authorized to negotiate contracts with processors.

Different incentives for different fleets

The incentives of the cooperative and independent fleets differed in three important ways. First, because the independent fleet's capacity far exceeded what was needed to harvest the allowed catch, the regulator was forced to shorten the season to a fraction of the time the stock is available. This leads to a race to fish while the season is open, followed by periods of unproductive idleness.[15] A cooperative seeking to maximize the profit of its entire membership can do better by slowing the rate of fishing and extending the season. This also allows it to concentrate effort

among its most efficient members; nonfishing members can apply their inputs to other valuable activities in or out of fishing.[16]

Second, because salmon migrate in a predictable direction over the season and generally become more concentrated in the process, an independent fisher must decide between intercepting the stock where it is closest or most concentrated, or intercepting it further out at sea. Fishing can be "better" on the outside because others have not yet fished the stock, but transportation cost is higher. Acting independently, some fishers will travel the extra distance even though this behavior is collectively wasteful. A co-op managed to maximize its members' profits will wait until the stock is at its closest or densest, to minimize harvest cost.

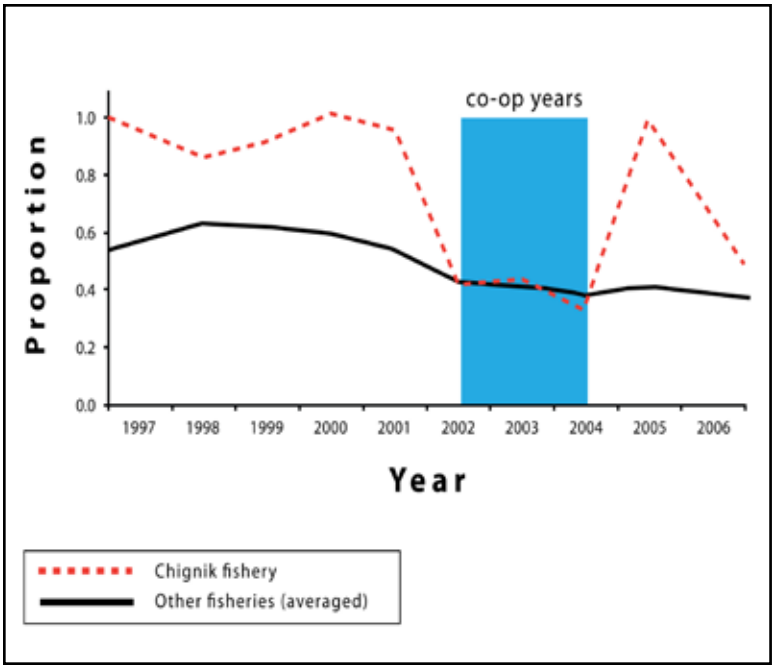
Third, independent fishers have no incentive to share in the provision of information and other public goods or to coordinate their actions. They are notorious for concealing the locations of fish concentrations and it is not uncommon for fishers to jockey for an advantageous position on the fishing grounds. This can be beneficial for members of a fleet fishing independently, but is wasteful for the fleet as a whole. A cooperative can increase its members' profits by sharing information on stock locations, coordinating members' actions to reduce conflicts and capitalizing on opportunities to complement one another.

How the fleets operated

On the first point—slowing the rate of fishing and lengthening the season—evidence shows that the proportion of permits fished in the Chignik fishery was substantially below historical levels during the three years that the co-op operated (2002–2004), as shown in Figure 2.[17] The comparison to

A cooperative can increase its members' profits by sharing information on stock locations.

Figure 2:
Proportion of permits fished in Alaska's Purse Seine Fisheries



Source: Deacon, Parker, and Costello (2008)

trends in neighboring fisheries demonstrates that this change was not driven by unusual market, weather or regulatory conditions. Within the co-op, less than 30 percent of the members actually fished in any year; by comparison, nearly all independents fished in all years.[18] The co-op paid the members who actually fished between $47,000 and $60,000 per season, plus the cost of fuel and insurance (Knapp 2008). All co-op members received equal shares of the co-op's net revenue, amounting to $15,000 to $28,000 per season (Knapp 2008). Consistent with the slower pace of fishing, the season was lengthened. The fishery had operated roughly 80 days per year prior to the co-op, but the season lengthened by roughly 32 days during 2002–2004.

Slowing the pace of fishing allowed the co-op to handle the catch more carefully, resulting in higher quality fish and higher prices. During the co-op years, the average price paid for Chignik salmon was 17 cents per pound above average prices paid in other years and in other fisheries.[19] The slower pace of fishing, and special fish-handling equipment, enabled the co-op to deliver live fish to the processing facility.

Data on daily catch locations are consistent with the second point. The co-op coordinated its members' actions to avoid fishing outside and focused its effort where the stock is most concentrated. The cooperative fleet made 100 percent of its catches "inside"—in the management zone nearest the stock's ultimate destination—in the years it operated. Combining data from the co-op and independent fleets, the proportion of fish caught inside was 27 percent higher during 2002–2004 than in earlier years.[20] The following account from a co-op founder makes clear that this was a conscious operating policy:

> We had originally planned to employ a couple of large seiners to fish out on the capes [outside], but we realized that the extra running time would increase costs and reduce product quality. Harvesting in the close proximity and concentrated harvest area of the Chignik Lagoon was simply the most efficient and quality conscious method to pursue.[21]

Anecdotal accounts of the cooperative's strategy for exploiting the stock at locations and times of maximal concentration are more impressive than the numbers. The same co-op member gave the following description:

Instead of [a co-op member] making four or five sets

> during the flood [high tide] for 200–300 [fish] a haul, he now could wait till the Lagoon drained out. At low tide [the channel] became a slow, meandering river of concentrated sockeye. And now, fishing for the entire co-op, he could make one giant drag for 3,000 to 5,000 fish.[22]

An additional coordination benefit was an ability to precisely control a day's catch, something independent fishers cannot accomplish. With independent fishing, the fishery manager must forecast the rate of catch and announce a closing time calculated to meet the escapement target, an imprecise process at best. On days the co-op fished, the manager could hit the escapement target precisely, simply by requesting that the co-op cease fishing when the desired number of fish was caught (Pappas and Clark 2003).

The third incentive difference related to cooperation on shared information and infrastructure. A description of the co-op's operating methods for information sharing is enlightening:

> Around Chignik [prior to the co-op] a few fathers and sons shared info on the radio, but essentially no one else had a formal group that shared strategy and information. [Once the co-op began fishing] it took about three days to get with the new program. Then the guys had it pegged. I was amazed how these competitive, individualistic fishers could figure out how to work so well together so fast.[23]

The co-op also deployed public infrastructure in the form of "fixed leads," essentially stationary nets placed along the fish migration route to funnel the stock toward waiting purse seiners.[24] The leads altered the style of fishing and dramatically reduced the number of vessels required to achieve a given catch.

The Co-op and the Alaska Supreme Court

In 2002, two of the more successful Chignik fishers, both independents, filed suit in Alaska Superior Court against the Alaska Board of Fisheries. The plaintiffs argued that the board exceeded its authority in allocating a quota of salmon to the cooperative and that the regulation promulgating the co-op was inconsistent with the Alaska Limited Entry Act. The plaintiffs initially lost on summary judgment but won on appeal before the Alaska Supreme Court (Deacon, Parker, and Costello 2008). The Supreme Court recognized and approved of the co-op's efficiency, but found that the board, while authorized to allocate fish "between" fisheries, had no authority to allocate "within" a given fishery.[25] This eliminated exclusivity, the foundation of the co-op's success. The Court also disallowed the co-op's practice of concentrating all fishing activity among its most efficient members. The Court ruled that a permit holder must be "an individual who will fish," and disallowed "corporations, companies, partnerships, firms, associations, organizations, joint ventures, trusts, societies, or any other legal entity other than a natural person" from exercising permits.[26] The co-op attempted to modify its practices during 2005 to be consistent with the Court's ruling, but was unsuccessful and ceased operation.

There is evidence that the co-op's participants regarded it as a success. A survey conducted after the first year of operation found that 55 percent of co-op members who fished and 73 percent who didn't fish believed the co-op made them better off financially (Knapp, Siver, DeRoche, and Hill 2003).[27]

A survey conducted after the first year of operation found that 55 percent of co-op members who fished and 73 percent who didn't fish believed the co-op made them better off financially.

Independents, however, believed they were disadvantaged by the co-

op's formation. In the same survey, 83 percent said they were made worse off by the co-op, with the remaining 17 percent expressing mixed feelings (Knapp, Siver, DeRoche, and Hill 2003). One of the plaintiffs in the court case, a highliner who fished independently, explained his negative reaction (Anderson 2002). While clearly recognizing the wastes of competitive fishing and appreciating the co-op's efficiencies, he thought the state's division of catch between fleets and the co-op's equal division of profits was unfair to highliners. This opponent favored individual fishing allocations that, ironically, could be exercised only through harvesters' associations that coordinate their members' actions; as in the Chignik case, nonjoiners would default into an independent fishery (Anderson, 2002). How does this differ from the ill-fated co-op? Critically, individual catch allocations would be proportional to historic catch. While the co-op's aggregate allocation roughly equaled the membership's aggregate historic catch share, the co-op's members shared profits equally. At least to this one highliner, an equal division of profits was unacceptable.[28]

Coordination in Other Fisheries

The most compelling evidence that coordination can produce gains beyond what ITQs achieve comes from fisheries that are under ITQ management. The best example is the Challenger Scallop Enhancement Company (CSEC), which was formed from 38 individual quota holders under New Zealand's ITQ system.[29] CSEC has invested extensively in stock enhancement and research on stock abundance and condition. This company provides information on the spatial distribution of stocks to its quota-holder members and

The company is now responsible for enforcing individual catch quotas and for setting annual catch quotas.

coordinates the harvest across areas, reseeding each area after harvesting. Remarkably, the company is now responsible for enforcing individual catch quotas and for setting annual catch quotas. Its operations are financed by fees the quota holders levy on themselves by majority vote.

Fishery governance by harvester-based organizations represents a logical next step beyond ITQ regulation.

New Zealand's paua (abalone) fishery, managed under an ITQ system since 1986, is another example. Since 2004, a group of harvesters operating near Christchurch has managed to direct activity away from overfished areas and shared information on stock locations and diving conditions. It has also adopted more restrictive size limits than regulators require, proposed diver accreditation to reduce incidental mortality, and invested in reseeding of depleted fishing grounds.[30]

The following three cases illustrate how coordination can emerge in other regulatory contexts.[31] In 1986, the Canadian government assigned the overall quota for offshore scallop harvests to nine firms, in the form of enterprise allocations. While this led to an expected consolidation of effort, it also resulted in an extensive industry-funded research program and industry efforts to control the harvest of undersized scallops. In British Columbia's geoduck fishery, limited entry permit owners petitioned for an ITQ system and formed an association with responsibilities for monitoring and enforcement of quota limits, for research on stock enhancement, and for spatial management of effort to avoid local depletions.[32] Finally, limited entry permit holders in the Yaquina Bay herring roe fishery in Oregon privately agreed to divide the allowed catch equally, essentially forming a privately negotiated ITQ system, and jointly funded research on stock assessment (Leal 2008).

Property rights and coordination

Fisheries expert, Anthony Scott (2000) argues that fishery governance by harvester-based organizations represents a logical next step beyond ITQ regulation. He regards these organizations as vehicles for coordination to overcome the free rider aspects of enforcing property rights, to capture the public good benefit of sharing information on fish stocks, and to eliminate wasteful races to catch the best fish. The Chignik case illustrates the last two of these benefits, and adds to these the gains from providing nonenforcement public goods such as shared equipment and a highly refined allocation of effort. Significantly, the Chignik co-op captured these gains without navigating the cumbersome process of shifting from independent fishing to individual catch shares for 100 individual permit holders.

Instead, the Chignik co-op achieved gains by augmenting the weak property rights that existed under the traditional management system, first by securing a catch share for the entire association, and second by centrally managing the actions of its members. Business enterprises in a modern economy follow much the same practice: they allocate labor and capital in a coordinated, centralized way rather than across markets, because this mode of allocation economizes on transactions costs. We will return to this point—that harvesters' associations and business firms face very similar resource allocation problems, and similar organizational solutions may be appropriate for both—toward the end of this report. The following section explores how a different revision of property rights in the fishery can accomplish environmental goals via voluntary exchanges rather than by regulatory fiat.

The goals are to reduce bycatch of depleted seafloor species, such as canary rockfish and cow cod, and to reduce seafloor habitat damage from bottom trawling.

Markets Protecting Marine Environments

In 2006, the Nature Conservancy purchased seven federal trawling permits and four trawling vessels from commercial fishers based in Morro Bay, a coastal town in central California.[33] This deal represented the first private buyout of permits and vessels for conservation purposes in the U.S. Pacific. The permits are for commercial trawling, which targets groundfish such as petrale sole, sand dabs, and sablefish. The goals are to reduce bycatch of depleted seafloor species, such as canary rockfish and cow cod, and to reduce seafloor habitat damage from bottom trawling. The Nature Conservancy could have simply retired the permits and scrapped or sold the vessels. This would have been unnecessarily costly, however, because the economic value of fishing in less damaging ways would have been lost. Instead, TNC adapted a market tool for protecting terrestrial habitats, the conservation easement, to a marine setting.

Conservation easements

Legal scholars often describe conservation easements by comparing landownership to a bundle of sticks, with each stick representing a right to use land, or exclude others from using it in a certain manner. A conservation easement is a transaction in which a landowner cedes some sticks from his or her bundle for a specified duration, usually perpetuity, in exchange for compensation. Rights ceded by conservation easements can be "negative," such as prohibitions on residential development or farming near streams, or "positive," such as providing recreational access to property. The rights conveyed in easements bind future owners and therefore "run with the land."

Parties to conservation easements in the United States typically

are private landowners and conservation organizations known as land trusts.[34] Easements to conserve scenery, wildlife habitat, and other amenities usually prohibit residential and commercial development; they may also restrict farming and logging practices. The acreage under conservation easements in the United States stood at 6.2 million acres in 2005, plus an additional 1.6 million acres held by the nation's largest land trust, TNC.[35] Land use regulations, an alternative approach to conservation, suffer from two disadvantages: They typically apply equally to all landowners and generally work against the owner's interest. By contrast, conservation easements can be customized on a case-by-case basis and can be written to motivate voluntary conservation. Using easements can be more advantageous than outright land purchase when land has valuable soil, timber, or minerals that are better managed by a specialized landowner. Using easements to prohibit unwanted land use, while keeping production decisions with the specialized landowner, helps reduce the cost of conservation.

A novel approach

The obvious challenge for writing conservation easements to protect the marine environment is the absence of property rights to the target resource. Existing commercial fishing permits actually do, however, delineate property rights to use the resource in specified ways. This opens the possibility of negotiating a conservation easement *on the permit*, a transaction in which a permit holder cedes rights to some actions that are legal but are an environmental concern to others, in return for compensation. The same logic implies that the scope for using marine easements to achieve

Conservation easements can be customized on a case-by-case basis and can be written to motivate voluntary conservation.

conservation depends on how the existing regulatory instrument—such as a commercial fishing permit in the Morro Bay case—delineates the right to use the resource.

In 2007 a 3.8 million acre area (a little smaller than Connecticut) was closed to trawl fishing.

A minimal requirement is exclusivity—that anyone using the resource must have a permit and that the number of permits is limited. The Morro Bay trawl fishery was managed by limited entry, so there were a fixed number of permits to harvest groundfish off the coast of central California. The easements TNC negotiated required a change in fishing methods, from bottom trawling to less damaging trap and hook-and-line gear. Individual transferable quota systems and other regimes that delineate quantitative fishing rights provide an even broader scope for achieving conservation goals with marine easements.[36]

The Nature Conservancy and EDF targeted the central California trawl fishery in part because the industry was damaging marine habitats. In a bottom trawl fishery, large, weighted nets are dragged across the seafloor. Nontarget species, some of which are depleted, often get caught in the process, and corals and seafloor can be damaged. Depressed economic conditions presumably made Morro Bay trawl fishers more receptive to an offer to sell, providing another reason for TNC and EDF to target this fishery. While catch volume is high, it is relatively low in value. This factor, combined with an overcapitalized fleet and depleted resource stock, made the economic situation bleak. Between 1987 and 2003, gross revenues from Pacific groundfish trawling fell from $110 million to $35 million.[37]

As part of an overall plan for marine conservation on the central California coast, TNC and EDF sought to exclude commercial trawling from sensitive habitats (Nature Conservancy 2008). They worked with the fishing industry to identify critical habitat areas

and, with industry support, lobbied the Pacific Fishery Management Council to close these areas to trawling. In exchange for the industry's support, TNC promised to buy back trawl permits and vessels from any who wished to sell if the no-trawl zone was adopted.[38] The policy gained approval and, when implemented in 2007, a 3.8 million acre area (a little smaller than Connecticut) was closed to trawl fishing. The final step in implementing marine easements—more environmentally friendly trawl fishing—required regulatory permission with less damaging traps and hook-and-line gear.[39]

A key advantage of the easement approach to environmental protection—the flexibility to tailor individual contracts to specific circumstances and to experiment with different contracting approaches—was evident in a novel "conservation fishing agreement" that TNC negotiated with Morro Bay fisherman, Ed Ewing. Using one of the vessels it purchased in 2006, TNC and Mr. Ewing signed a private lease agreement that specifies using gear with a foot rope design that is smaller and lighter than traditional deep water trawl nets. This design constrains the user to trawling on soft bottom surfaces because the gear is too light to be deployed on rocky, ecologically sensitive areas, thereby limiting seafloor habitat damage.[40]

The Nature Conservancy, participating fishers, and the local community are pursuing the possibility of a new, high-value market for groundfish harvested sustainably under these marine conservation easements.

Comparing marine conservation policies

Trawl fishing is the only way to harvest certain commercially valuable flat fish, but it is nonselective and results in bycatch. Fishers can control bycatch to a degree, by avoiding critical areas, by taking care when deploying gear, and by using more selective

trawl equipment, but no individual has an incentive to do so. To deal with bycatch, the prior regulation specified strict catch limits for each species that trawls might capture and closed the entire fishery when the target for a single species was reached. Catch limits for cow cod and canary and yelloweye rockfish were particularly restrictive. Because these limits were applied to the entire fishery rather than to specific fishers, no individual was motivated to minimize bycatch to keep the fishery open. Consequently, the fishery often closed before allowed catches for commercial species were reached.[41]

In the Morro Bay case, the conservation easement approach is superior because it reduces bycatch without unnecessarily sacrificing commercial harvests. Also, because it involves only voluntary contracts between private parties, it obviates the torturous (or impossible) task of making regulatory change. Additionally, the conservation fishing agreement negotiated with a single fisher, in part to experiment with a new conservation tool, illustrates the flexibility of this approach over one-size-fits-all government regulation.

Notwithstanding the advantages of easements, the process of negotiating the contracts described here was anything but costless. Purchasing fishing permits and vessels required lengthy negotiations with individual owners. Both the fishing industry and the local community were suspicious of outsiders—particularly a conservation agency bent on limiting commercial fishing to protect environmental amenities. Any attempt to use marine easements more extensively elsewhere may encounter both suspicion and active resistance

Advantages of the easement is the flexibility to tailor individual contracts to specific circumstances and to experiment with different contracting approaches.

Allowing rights to be transferable can lead to significant improvements in efficiency, even when exclusivity is missing or incomplete.

from large commercial fishing interests, some of whom have been sued by environmental advocates over bycatch and other issues.

The use of marine easements could also be limited by some fishery regulations that restrict the property rights of permit holders. The reauthorized Magnuson-Stevens Act stipulates that those holding federal permits must actively participate in the fishery. Clearly, requiring TNC to enter the fishing business would serve no environmental goal and would raise the cost of any conservation achieved. This stipulation, in combination with limits on the number of permits a single entity can own, could make it impossible to accomplish large-scale environmental protection via easements. In effect, it might be illegal for any one conservation group to acquire enough permits to protect an entire habitat or species.

These limitations could be overcome by treating existing fishing rights more consistently as property rights. One key change would be to allow fishers to agree to limitations on the gear used and areas fished with active permits, making it unnecessary for a conservation group to purchase permits and lease them back with restrictions. Absent this change, the current situation could be improved by getting rid of limits on consolidation in the industry. While possibly offending those who admire the rugged, small-scale fisher, or frown at the thought of conservationists participating in fishery profits, this could enhance the economic welfare of fishers while allowing conservation interests to pursue broad-scale marine conservation.

Since TNC and EDF's experiment with marine easements is only now getting underway, it is too early to assess the outcome. It is

clear, however, that the approach has the support of the participating fishers, the local community, and the environmental interests involved, which in itself is a notable achievement.

Property Rights and Efficiency in Fishery Management

The benefits from creating property rights to a shared resource depend on how fully those rights are defined. This is obvious for exclusivity, the aspect of property rights emphasized most by economists and legal scholars. Assigning a measurable catch target to an entire industry, rather than individual decision makers, creates only the weakest form of exclusivity. While outsiders are prevented from poaching on the rights of permit holders, nothing restrains the permit holders from stampeding to capture the scarce resource to the point of extinction. Catch share systems end this race by eliminating the rule of capture, and putting in its place a secure, quantitative harvest right for the individual fisher.

A second important aspect of fully defined property rights is transferability, the right to transfer one's ownership claims to others. When property rights are transferrable, ordinary market exchange causes them to flow toward efficient users. Incorporating transferability in ITQ systems clearly means allowing individual fishers to exchange quotas with one another. When rights are fully defined, transferability has a richer meaning. It means allowing ‚rights holders to cede specific aspects of their property rights—certain sticks in the bundle—to other parties. Allowing rights to be transferable can lead to significant improvements in efficiency, even when exclusivity is missing or incomplete.

In the two case studies presented, the fishery management regime was limited entry, so none of the fishers involved had exclusive, quantitative catch rights. Nevertheless, allowing

The Pacific Whiting Conservation Cooperative negotiated participants' catch shares and other details of a harvesting agreement in less than a day.

existing, limited entry rights to be transferred resulted in important efficiency gains.

Dividing the allowed catch between cooperative and independent fleets—a weak form of exclusivity—was a necessary ingredient for success in Chignik. Equally important, however, was the right of co-op members to transfer, to the co-op's manager, control over where, when, and by whom their limited entry permits would be fished. Existing law denied them the "by whom" dimension of transferability, which led to the co-op's demise.

In the Morro Bay case, the simplest way to implement marine conservation easements would have been for individual fishers to transfer to TNC control over where and with what gear they fish. Such agreements would be analogous to conservation easements on land. Instead, TNC felt obliged to purchase and own federal trawl permits, and then lease them back to their original owners with restrictions on use. Evidently, the option of negotiating legally binding encumbrances on limited entry trawl permits was not available, necessitating a more roundabout transaction.[42]

More than 70 years ago, Nobel laureate Ronald Coase (1937) observed that a distinguishing feature of any market economy is the "firm"—an organization that relies on centralized resource allocation within an organization by an "entrepreneur-coordinator."[43] To accomplish this task, the entrepreneur-coordinator's reward must be correlated with the enterprise's net profit. Coase realized that transactions across a market are costly, particularly when inputs interact with one another in complex ways.

Building on this observation, economists Armen Alchian and Harold Demsetz (1972) explained that the advantage of centralized

coordination over market transactions is greatest when managers bring together inputs, such as labor, to work in teams or share infrastructure and equipment. When many inputs are used together in an enterprise, it becomes difficult to measure the value created by a specific input, such as one worker, to the value of the output. The conditions favoring centralized resource allocation by an entrepreneur-coordinator, instead of transactions across a market, are present in many or all commercial fisheries. All fishers share in the use of the most important input, the stock and the gains from deploying effort as a coordinated team can be substantial, as exemplified in the Chignik cooperative. It is worth emphasizing that these coordination gains could not have been achieved solely by trading catch shares across a market. As Scott (1993, 2000) has suggested, fishery governance by harvester-based organizations may well be the logical next step, beyond catch shares, in the evolution of fishery management.

While the efficiency advantages of property rights management regimes are now evident, the individuals most adept at racing may resist moving away from a rule of capture system. Indeed, negotiating the initial allocation of individual catch shares often is the key obstacle in moving from limited entry to a catch share regime (Sullivan 2000). If so, alternative property rights approaches, involving weaker forms of exclusivity but greater transferability, may be easier to implement. The success of harvester associations and cooperatives exemplify this possibility. In some of these cases, the regulator makes broad initial allocations between groups, but leaves detailed within-group allocations to private negotiations.

According to Sullivan (2000), the four companies that eventually formed the Pacific Whiting Conservation Cooperative negotiated participants' catch shares and other details of a harvesting agreement in less than a day. The Bering Sea pollock negotiations, which were more complex and resulted in separate cooperatives

with separate suballocations, still achieved within-group catch divisions in less than two months (Sullivan 2000). The Chignik Salmon Cooperative solved an apparently more difficult initial allocation problem in an entirely different fashion. The sheer number of individuals involved, 77–87 during the years it operated, and the diversity of their skill levels, would have made negotiations on individual catch shares difficult at best. The Chignik co-op's solution was simple and effective: The catch was divided equally among members, and those who found this unsatisfactory could opt into an independent fleet with its own aggregate catch share. Evidently, this scheme produced an outcome that the vast majority of permit holders could accept.[44]

Conclusion

The case studies described here illustrate the advantages of greater private sector involvement in fisheries and marine habitat management by firms, harvesters' cooperatives, and conservation organizations. A key ingredient for achieving these gains is to treat existing harvest rights more completely as property—bundles of sticks that include individual exclusivity—but also allow rights holders to cede individual sticks to other parties. One valuable consequence of such change would be to harness the private sector's creativity and entrepreneurship in finding new approaches to fishery management, as exemplified by the novel harvest methods developed in Chignik and in TNC and EDF's innovation with marine conservation easements. Another benefit of extending the property rights approach is that it allows environmental conservation and economic efficiency goals to be pursued via voluntary transactions and negotiated agreements, rather than by regulations imposed from above. When resource users' incentives are aligned with these goals, the users them-

selves are motivated to carry out the monitoring, enforcement, and management activities needed to maximize the value of these marine assets.

Notes

The author benefitted from conversations with and comments from Don Leal, Terry Anderson, and participants at a PERC seminar in 2008.

1. The term "limited access privilege" is in the language of the reauthorized Magnuson-Stevens Act, a key federal statute governing U.S. fishery management.
2. Bycatch refers to species caught inadvertently or to immature fish that are caught. These fish or crustaceans may be discarded or sold.
3. Several fisheries scientists took issue with the methods used to reach this conclusion. A somewhat earlier review of the world's fisheries took a more tempered view, but still concluded that the world's catch had probably peaked, that few significant resources remained to be developed, and that many stocks were severely depleted or headed in that direction (Hilborn, et al. 2003).
4. Grafton, Squires, and Fox (2006).
5. Grafton, Squires, and Fox (2000); Leal (2002).
6. According to Newell, Sanchirico, and Kerr (2005), the market value of New Zealand's quota shares in the mid-1990s was NZ$3 billion.
7. Hilborn et al. (2003).
8. Hilborn et al. (2003).
9. Some are concerned that catch shares would encourage high-grading, the practice of retaining the most valuable fish caught

to credit against one's quota allocation and discarding the rest. Leal, De Alessi, and Baker (2005) note that this is a monitoring and enforcement issue and is present in all management systems.

10. The information on number of implemented systems and share of catch is from Costello, Gaines, and, Lynham (2008) and Arnason (1996), respectively.
11. A highliner is a particularly successful fisherman.
12. Escapement refers to the fish that escape commercial or recreational fishing to remain in the river to spawn. Goals are set in many spawning grounds for this to ensure viable populations.
13. See Leal (2002) and Sullivan (2000).
14. See Appendix D and E, of Pappas and Clark (2003).
15. Under limited entry and independent fishing, the seasons for Alaska and British Columbia halibut were only three to six days per year (Leal 2002). Subsequent experience revealed that an efficient season length is on the order of eight months per year.
16. In other fisheries, lengthening the season can also make more fresh fish available and reduce risks from weather hazards.
17. The source of these data is provided in Deacon, Parker, and Costello (2008).
18. A detailed statistical analysis shows that the lower proportion of Chignik permits fished from 2002 through 2004 is statistically significant and was not due to variations in the total allowed catch or time-related factors that affected all fisheries generally. See Deacon, Parker, and Costello (2008).
19. Deacon, Parker, and Costello (2008). Because this is an average price for fish landed by the co-op and independent fleets combined, it understates the premium for the co-op's product.

20. This comparison also adjusted for the possible effect of variations in total catches and other trends.
21. Ross (November 2002).
22. Ross (December 2002).
23. Ross (December 2002).
24. See Pappas and Clark (2003).
25. Grunert v. State, 109 P.3d 924, 930 (2005).
26. Grunert v. State, 109 P.3d 931 (2005).
27. The numbers believing they were made worse off were 10 percent and 6 percent, respectively, with the remainder giving no opinion.
28. There was also opposition to the profit shares paid to nonfishing co-op members. According to one member "… many had a hard time accepting that 'people were getting something for nothing' and didn't have to work to earn a share of the co-op's revenue." Others objected to the co-op "because what we were doing was somehow 'communistic' or un-American" (Ross 2002).
29. See Arbuckle and Drummond (2000) and Townsend (2005).
30. This description is from http://seafoodindustry.co.nz/paua. Costello and Deacon (2007) provide further discussion.
31. The following examples are described in Townsend (2005).
32. Leal's (2008) description of the Yaquina Bay herring roe fishery is another instance of industry initiated management. In this case, limited entry permit holders agreed to an assignment of equal individual shares of the allowed catch, essentially forming an industry initiated ITQ system. On the issue of coordination, the group jointly owns one fishing permit and uses the revenue it generates to fund stock assessment.
33. The following description draws on the Nature Conservancy (2006).
34. Conservation easements are also held by various government

agencies.

35. In total, an area about the size of Maryland.
36. See Deacon and Parker (2009). This logic becomes clearer if we compare open access, where exclusivity is entirely absent, to a hypothetical sole ownership regime, where such rights are completely delineated. With open access, TNC could pay a fisher to refrain from unwanted actions, but another harvester not so encumbered would be motivated to enter and outcompete the fisher under easement. Consequently, nothing would be achieved. Under sole ownership, where one agent holds rights to make coordinated decisions on all aspects of the resource's use, TNC could proceed the same way it does with conservation easement on land, by negotiating a single agreement covering many aspects of the resources' use.
37. The poor economic condition of the fishery also led to community support for TNC's initiative, which was seen as a potential route to revitalization.
38. Purchase prices were negotiated ahead of time and any fisher selling a permit to the Conservancy agreed not re-enter the trawl ground fishery.
39. Ironically, the trawl technology itself replaced a preexisting trap and hook-and-line fishery.
40. This information is from the Nature Conservancy (2007) and from personal communication with Michael Bell of TNC.
41. In other fisheries, regulators attempt to control bycatch by limiting the kind of gear that can be deployed. Deacon and Parker (2009) discuss other proposals for controlling bycatch.
42. There are, of course, differences in the marine and terrestrial cases. Unlike land, the marine resource is shared, so its condition depends on how all users treat it and makes it important to negotiate agreements with all users. Also, as

with land, the condition of a marine resource may matter to third parties, e.g., recreationists or those fishing commercially with different gear, and reaching an efficient outcome requires incorporating the interests of these parties as well.

43. The term 'entrepreneur-coordinator' is Coase's.
44. For other examples of privately negotiated catch shares, see Leal (2008) and Townsend (2005).

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