



Property in Land and Other Resources

EDITED BY DANIEL H. COLE
AND ELINOR OSTROM



Foreword by Douglass C. North

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Edited by

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Enclosing the Fishery Commons

From Individuals to Communities

BONNIE J. MCCAY

The oceans and their fish and shellfish are classic instances of “open access” (places and goods with essentially no protection at all), “common property” governance arrangements (places and goods subject to legal and customary protections of shared use rights), and “common-pool” resources (resources that are hard to draw defensible boundaries around and are subject to overexploitation). Depending on the extent of effective regulatory constraint, demand for resource flows, and conditions of the resource systems, marine fisheries are so vulnerable to “tragedies of the unmanaged commons” (Hardin 1994) that one scholar argues that the tragedy of the commons can be thought of as “the fisherman’s problem” (A. F. McEvoy 1986).

The long history and widely distributed occurrence of small or large and modest or grandiose efforts to create exclusive places and rights at sea constitute a historical geography of marine environments and resources that are subject to various forms of enclosure, rather than open access. The great diversity of tenurial systems in the world’s fisheries, past and present, lends credence to the notion that, at least on local and smaller scales and under certain conditions (Ostrom 1990), people who fish are capable of coordinating and restraining their activities to avert tragedies of the commons (Cordell 1989; Dyer and McGoodwin 1994; McCay and Acheson 1987; McGoodwin 1990; Pinkerton 1989; 1994; Pinkerton and Weinstein 1995; Ruddle 1989). But exploration, colonization, modernizing technologies, and institutions contributed to the marginalization or disappearance of such community-oriented, common-property-based systems of marine resource management throughout the world (Johannes 1978; McCay 1987), even though important dimensions of community affiliation persist and newly emerge even in the most technologically sophisticated fisheries (St. Martin 2006).

Consequently, marine geographies can be characterized very simply in most regions of the world’s oceans. In oceans outside territorial waters, there are open-access fisheries that are beyond national limits of jurisdiction and are limited by international institutions of very modest effectiveness. Within national limits, there are broadly defined public rights of access subject to national and local regulatory institutions with similarly modest effectiveness. The thesis that open access creates conditions for overexploitation and economic loss was developed by resource economists and is a well-known justification for enclosing the fisheries commons (H. S.

Gordon 1954; Scott 1955). Open access has been construed as the fundamental component of the incentive structure for overexploiting a shared resource. Open access makes it difficult to formulate collective agreements on management; for instance, there is nothing to prevent newcomers from reaping the benefits of the efforts or sacrifices of present users. Free-rider problems are rampant.

The resultant “tragedy of the commons” scenarios contribute to disappointing performance of fisheries worldwide. The latest global statistics show a leveling off of wild fish catches and increased dependence on farmed production (FAO 2009). Data are even more dismal for many coastal fisheries, as well as some open-sea fisheries; from the perspective of biodiversity, the situation is grave indeed (Worm et al. 2006; but see Branch 2008). The lack of alternatives to fishing in many poorer regions, the difficulties of controlling fisheries beyond national zones of extended jurisdiction because of the weaknesses of international institutions, and the underdevelopment of knowledge about fish and fisheries are major barriers to restoration and sustainable exploitation of fish stocks. However, it is also widely agreed that combinations of closed areas, gear modification, and catch restrictions can and do make a difference, depending on local context (Worm et al. 2009), and that key conditions include restricting access and reducing effort. Controlling access, especially by granting exclusive property rights to individuals or other social units, reduces free-rider and overcapitalization incentives and is also said to improve incentives for stewardship by giving resource users a clear-cut and defensible stake in the resource, present and future, and hence, the motivation to follow the rules and also to participate in developing them.

Spatial Enclosure of the Fisheries Commons

A major step toward enclosure that reshaped fisheries policy and, to some extent, fisheries science was taken in the mid-1970s during a series of United Nations Law of the Sea conferences, when nations agreed to claim two hundred miles of extended jurisdiction over seas and fish stocks that formerly had been treated as part of the international “freedom of the seas” regime. This agreement encouraged the development of new domestic and international institutions for fisheries research and management while restricting access to rich coastal fishing grounds. However, the trend within many nations was to encourage fuller domestic exploitation of fish stocks in adjacent waters, which resulted in expansion of domestic fisheries. In the United States and Canada, many coastal fish stocks had been overfished before implementation of the two-hundred-mile limit; the pattern was for domestic fisheries to continue what foreign fishing had begun (Hennessey and Healey 2000; Ludwig, Hilborn, and Walters 1993). Tragedies of the fisheries commons continued, but within, rather than outside, national boundaries.

In this context and in response to multiple signals of trouble at sea, other forms of enclosure began to take shape in policy planning. A major one is the use of marine protected areas (MPAs), spatially bounded places that are managed to protect marine organisms and habitats from human activities. Establishing MPAs may involve closing areas during spawning seasons or making some fish habitats out of bounds in general or for specific types of fishing gear, but they may also be set aside

as “no-take” zones. MPAs have been heavily promoted by environmental groups (Agardy 2000) and are part of national marine resource policies throughout the developed world and in poorer countries as well. They are advocated as measures to complement other management tools and particularly as precautionary measures where scientific knowledge is scarce and highly uncertain (Clark 1996). Also, when resources are not harvested, they have tourist and other values. From a fisheries perspective, MPAs may be thought of as “exclosures,” and much research effort has been devoted to exploring the complex parks and people issues involved (Brechin et al. 2003; Christie et al. 2003). MPAs are increasingly subsumed into the topic of marine spatial planning, which is an important thrust of the most recent U.S. ocean policy and central to policy in Canada, the European Union, and other developed countries (Crowder et al. 2006).

Spatial enclosures are also used to provide privileges and assign some management responsibilities to fishing groups. They may be set aside, for example, for those who use certain types of fishing gear, but not others. Of particular interest are territorial use-rights fisheries (TURFs), which grant community groups exclusive fishing rights to certain fishing grounds, or certain species within those grounds. For example, in Chile and Mexico, local fishing syndicates or cooperatives have exclusive concessions for mollusks and crustaceans in marked territories that are usually adjacent to the coastal communities involved (Castilla and Defeo 2001; Ponce-Díaz et al. 1998; Ponce-Díaz, Weisman, and McCay 2009). The TURF model affords an important alternative to individual and marketable fishing rights, which will be discussed later.

Enclosure of the Marine Commons: Commodifying the Right to Fish

A major trend since the 1980s has been to treat fishing rights as commodities that can be parceled out and are subject to negotiation and exchange. Not long after nations claimed two-hundred-mile limits, the view of fishing rights began to change in many countries from the notion of the freedom of citizens to fish, with or without permits and rules, to that of more exclusive and individualized rights (Huppert 2005). The ultimate step, in the eyes of economists and other advocates, is individual transferable quotas (ITQs).

The ITQ management system, also known as individual vessel quota (IVQ) or individual fishery quota (IFQ), has become a popular, but controversial, innovation in fisheries management. The ITQ system for the Atlantic surf clam (*Spisula solidissima*), combined with one for ocean quahogs, another species in the fishery, closely followed examples created earlier in Canada, Iceland, The Netherlands, and New Zealand (National Research Council 1999b). Its design reflected some experiences from work of Lee Anderson, a university professor who had advised the New Zealand fisheries agency on ITQs before working with the Mid-Atlantic Fishery Management Council (Anderson 1989a; 1989b; 2000). Portions of an overall allowable catch are granted to participants in a fishery, who use them as marketable commodities and can buy, lease, and sell them. In the surf-clam fishery, each ITQ owner or lessee receives a percentage of the annual quota and is given tags for the steel cages

for clams after dredging. The ITQ system is analogous to cap-and-trade programs for the control of air pollutants in that the government retains the critical rights and responsibilities of setting and enforcing the caps and other rules of the game. Within those constraints, enterprises can make many other critical decisions. The goal is a win-win outcome where private entities are profitable while the goal of environmental protection or resource conservation is achieved.

The process of changing property rights is often incremental and historically specific although general in outcome (North 1990). Measures to address management issues can lead to new or intensified problems that call for new measures, some of which, like ITQs, result in privatizing the right to harvest fish or shellfish, that is, make them exclusive to the holder and potentially divisible and tradeable. This is evident in the case of the Atlantic surf-clam fishery of the eastern seaboard of the United States, the first in U.S. federal waters to become managed by ITQs. Surf clams are large mollusks found in sandy and muddy bottoms on the continental shelf. They are harvested by hydraulic dredges and are used in processed products, such as frozen or canned clam meats that are sold to consumers as breaded clam strips, spaghetti with clam sauce, or clam chowder (Jacobson and Weinberg 2006). In the 1970s clear signs of stock decline and increased effort led to a diagnosis of a tragedy of the commons, but until the United States created its fisheries act, the Magnuson-Stevens Act, in 1976, little could be done to address the issue of open access in federal waters, outside the states' three-mile limits. The Magnuson-Stevens Act provided for a two-hundred-mile limit of extended federal jurisdiction, as well as regional fishery management councils with the power of enacting fishery regulations. In 1978 the Atlantic surf-clam fishery outside the three-mile limit of state jurisdiction became the first fishery in the United States to be managed by limited entry. The Mid-Atlantic Fishery Management Council imposed a moratorium on new vessels in the fishery, as well as a minimum size limit, a closed area to protect juvenile clams, and an overall catch quota. About 120 vessels were allowed to continue fishing for surf clams.

Programs that cap the number of permitted users create smaller groups of commons users, but they can also replicate the commons dilemma on a smaller scale as users continue to compete freely for limited resources, and management continues to depend heavily on efforts to restrict how people harvest (effort controls) or how much they harvest (output controls). In the surf-clam case, catches were controlled through an overall competitive quota that replicated open-access incentives to invest in better technology to race for the resource before the quota was reached and the fishery would have to close. Managers countered the race somewhat by restrictions on vessel and dredge size but also by restrictions on the amount of fishing time allowed per week. The latter were imposed to help spread out production over the year to fit the capacity of clam processing plants.

Such systems create their own inefficiencies, congestion problems, and enforcement challenges, which can lead to demands for further management innovations. In the Atlantic surf-clam case, as clam abundance increased through the growth of two successful year-classes, that is, unusually large populations of clams born in 1977 and 1978 and controls on harvests, it became easier to catch huge amounts of

clams in a short period of time. The overall quota remained the same because of management concern given evidence that there were no more large year-classes to follow those of 1977 and 1978, and the consequence was a reduction in allowable fishing time. By 1984 the surf-clam vessels were allowed to work the clam beds no more than six hours per week. Because participation in the fishery required using a vessel that had been in it before limited entry was imposed, the trip limits were attached to specific vessels, and people with multiple vessels were not allowed to combine their trip-limits on one vessel, a clear-cut case of overcapitalization emerged. Management meetings focused on the question of allowing vessel owners to combine the allowable times of two or more vessels into that of one vessel in order to economize. That proposal was a major step toward privatization because access rights (allowable fishing time) came to be thought of as units that could be moved around independently of the boats.

Meanwhile, unknown to many of the actors in this scenario, the key unit being restricted through management began to shift from fishing time to amounts of clams that could be caught. The Atlantic surf-clam fishery was on the verge of becoming a program that “stinted” the limited access rights by attaching some quantified allocation to these rights, the “stinting” practice of the archetypal village commons (Christy 1973; Moloney and Pearse 1979). Talk of combining allowable fishing days or hours into one vessel, which was resisted by those who owned only one vessel because they feared the competitive advantage of large fleet owners, was transformed over time into talk of assigning portions of the overall quota to individual vessels. Economists had long seen the prospect of privatization for this fishery; as early as 1979, some form of stock certificates for this fishery had been discussed, and in the mid-1980s the overcapitalization caused by management through limited entry offered an opportunity for economists to insert the notion of tradable vessel quotas into management debates. Assigning shares of a quota to individual vessels made little sense in this case without the ability to consolidate them into fewer vessels because each of the 120 original vessels would have far too low a share to make economic sense. Hence, the discussion quickly moved past the notion of attaching shares to vessels and cast them as separate from the boats, making them far more fungible commodities.

Marketable shares provide incentives and mechanisms to adjust investments to resources in theory and practice (Grafton et al. 2006; Hannesson 2004). Despite much opposition, particularly from the smaller-scale fishers who felt that their initial allocations would be too small to allow them to continue profitably, the regional fishery management council agreed in 1988 to allow the Atlantic surf-clam fishery to be managed with ITQs (McCay and Creed 1988). The new system began in 1990 and resulted in a very rapid decline in the number of vessels and the amount of vessel capacity (McCay and Brandt 2001a). Today there are fewer than 35 vessels. Thus, in little more than a decade, that fishery shifted from open access to limited entry with complex, costly, and inefficient controls on effort and then to a privatized system of marketable extraction rights embedded within a government-run management system.

Economics and ITQs

The economic performance of ITQs is well known and amply depicted in the literature (Grafton, Squires, and Fox 2000). The intent and theory of an ITQ program are that it will cause a reduction in the overcapitalization and regulated inefficiencies that occur in many common-pool resource systems by downsizing the fishery as the more efficient and/or better-capitalized firms buy out the others. A case study review reports, “Improving transferability of quota is likely to be the only feasible solution to reduce overcapacity and generating resource rents in the fishery . . . The incentives inherent in a tradable [ITQ] scheme provide Adam Smith’s ‘invisible hand’ to direct the fishery in the right direction” (Asche et al. 2008, 926–927). Those who remain in the fishery as quota holders tend to make more money than they did before, countering the tendency in open-access fisheries for the resource rent from nature to be dissipated through competition and overharvesting.

ITQ programs often replace fisheries that were organized with competitive quotas that led to “derby fishing,” or races to catch fish before the quota was reached. As in the Atlantic surf-clam case, they may also replace fisheries management regimes that developed extraordinarily complex and costly regulatory measures. ITQs guarantee to their owners that they will be able to catch a certain amount of fish during the year. Because fishing can take place at different paces, the dangers and other costs of races to fish are reduced, and fishers can time their work according to markets, weather, and personal life choices. ITQs can also transform markets, as shown for halibut in the Pacific Northwest, where the gluts created by competitive quotas had necessitated a frozen-fish product. The implementation of ITQs allowed fishermen to time their harvests according to markets, no longer fearing an early closure, and they were able to sell the fish for higher prices on fresh fish markets (Casey et al. 1995; Pinkerton and Edwards 2009).

Conservation and ITQs

Recently, much attention has been devoted to the conservation outcomes of ITQs, following the notion central to bioeconomic theory that privatized ownership—expressed also as owning a secure asset—may provide stronger incentives for ecological stewardship than are found in conventional fisheries management (Costello, Gaines, and Lynham 2008). This notion is controversial; many scientists and social scientists argue for it, but others deny or cast doubt on the argument (Beddington, Agnew, and Clark 2007; Copes 1986; Grafton et al. 2006; Hilborn, Orensanz, and Parma 2005; Macinko and Bromley 2002; McCay 1995b).

Empirical research on the question is now possible because ITQ programs have a three-decade history, are numerous in developed nations, and can be studied within the framework of large databases on fisheries and fish stocks that enable large comparative studies. Costello, Gaines, and Lynham (2008) revived the question and used a database of more than 11,000 commercial fisheries plus a database that had been used to assess trends in fisheries collapse, defined as less than 10 percent of the maximum recorded harvest. They claimed that ITQ-managed fisheries

were much less likely to show signs of biological collapse and, when ITQs were implemented, they did much to avert or reverse collapse.

Other scholars found less convincing results that underscore the fact that ITQs are only parts of complex fisheries institutions. They are usually accompanied by more restrictive and/or better-enforced fishing rules, a factor not included in Costello, Gaines, and Lynham's study. Two studies found that whether stock biomass continued to decline after the introduction of ITQs had less to do with ITQs per se than with other changes in management, such as more effective total allowable catch levels and better enforcement and monitoring (Branch 2009; Chu 2009). In addition, Branch found that "ITQs have largely positive effects on target species but mixed or unknown effects on nontarget fisheries and the overall ecosystem" (2009, 39). This result highlights the challenge of melding market-based and ecosystem-based approaches to marine resource management.

Essington (2010) used more refined measures of behavior and ecological outcomes, as well as efforts at controlled comparison. He found that ITQ-managed fisheries differed from non-ITQ fisheries in his study only by markedly reduced variability in year-to-year levels of indicators such as exploitation rate and landings. Essington speculated on the causes and implications of this finding. The end of a race to fish, improved catch reporting (necessitated when individual catches must be monitored), and changes in incentives when individuals must stay within their own quotas and can trade within a fishing season all make it possible both to catch the entire quota and not to exceed the quota. The next result is that resource managers can be more certain about whether a given strategy for management will have a desired outcome in an ITQ fishery. However, the use of ITQs to distribute access to a resource is still dependent on the overall quota and other measures to protect the resource.

The findings about the importance of other management measures in the success of ITQ fisheries are further supported by the biomathematician Colin Clark. In 1973 he raised a warning to those who cast the problem of the commons as defined by the lack of private property. He presented a formal mathematical argument that a private owner could be motivated to harvest a resource to extinction if the growth or replenishment rate was low and the discount rate was high; whaling was the compelling example (Clark 1973). This observation has been treated as either wrong or merely a theoretical possibility in several analyses of the economics of marine fisheries examining the benefits of privatized fishing rights such as ITQs (e.g., Grafton et al. 2006). In response, Clark and colleagues revisited, extended, and broadened the 1973 analysis and concluded that the result "cannot be safely dismissed as being no more than a theoretical possibility. There is a nontrivial number of resources that cannot be safely entrusted to complete private control and management. There are indeed limits to private resource ownership" (Clark, Munro, and Sumaila 2010, 216).

Social and Power Relations and ITQs

There are other reasons that a society cannot and should not rely on privatized property rights alone in managing a public trust and common-pool resource (Bromley 2003; 2009; Macinko and Bromley 2002; Rose 1994; 2002). These reasons support the

need to look not only at improving government management of common-pool resources, but also at the roles of user-based institutions, such as communities, in resource management.

In the initial phases of a privatized resource system, processes of downsizing and consolidation tend to result in fewer owners, more leaseholders, and fewer crew members. The leaseholders and crew members, who in some fisheries, as shares decline, become more transient and less skilled than before, may believe that they have little stake or at least little power in the fishery (Pinkerton and Edwards 2009). This perception can work against the dynamic of ownership and stewardship. Lessees and crew are less likely to be in a position to share knowledge about and interest in the fate of the resource with owners and managers. More generally, they have little incentive to follow sustainable fishing practices (Olson 2011). ITQ holders do have strong incentives for engagement in management decision making, and these incentives increase the odds of effective collaboration and even comanagement. However, ITQ holders also may be powerful enough to influence the management agencies and raise the “foxes in the henhouse” problem (McCay 1995a). Such industry control over management decision making can reduce the capacity for adaptation to environmental, institutional, or climate change. Essington’s (2010) finding of greater stability in ITQ fisheries was mentioned earlier; rights-holding businesses may be inclined to emphasize maintaining stability not only in performance, but also in the conditions of management affecting the value of their capitalized rights. This emphasis on stability can result in disincentives to adapt to environmental or other changes that might otherwise call for adjustments of the annual quota, as noted in a study of United Kingdom fisheries (Christensen et al. 2009).

More generally, ITQs have been criticized for their socially inequitable outcomes. In an extensive review of the literature on ITQs and similar catch-share programs involving privatized fishing rights, Julia Olson (2011) identifies evidence of significant negative effects of ITQs on crew employment, small-scale boat owners, fishing practices, households and communities, and culture. For instance and quite obviously, the downsizing of the fishing fleet that usually occurs results in fewer boats and fewer people working in them and has direct social consequences for fishery-dependent communities. Equally significant is the fact that trades in quota shares can result in major redistribution of access to fishing and fish-processing opportunities, favoring some enterprises and communities and hurting others (Copes and Charles 2004; McCay 2004; McCay et al. 1995). An important and widely discussed social issue is the difference between the first generation of rights holders, who in all historic cases received a windfall allocation (rather than one that was purchased), and future generations who eventually must pay for access to the fishing rights, taking on major debts and obligations (Copes 1986). Taxation policies often intensify barriers to entry; for example, capital gains taxes lead many initial rights holders to resist selling out in favor of leasing, creating a class of “sea lords,” or people who no longer fish but continue to gain wealth from the sea, contrary to deeply embedded notions about rightful relationships with the sea and work.

The social equity implications of privatization were immediately evident in the Atlantic surf-clam fishery (Apostle, McCay, and Mikalsen 2003; Brandt 2005a; 2005b;

Creed and McCay 1996; GAO 2004; Hicks, Kirkley, and Strand 2004; McCay and Brandt 2001b; McCay and Creed 1987; 1990; 1994; D. McEvoy et al. 2009). They were of even greater consequence in other parts of North America, where communities were more heavily dependent on fisheries (McCay 1995b; McCay et al. 1995). In the United States the concerns led to a nationwide moratorium on the use of ITQs in fishing between 1995 and 2006. One of the troubled outcomes that led to such measures was the creation of a generation of people who lost access to fishing as a livelihood, as reported for small Alaskan native communities left behind as a result of ITQ trading (Langdon 2008; Lowe and Carothers 2008). In New Zealand the claims of the indigenous Maori population led to a costly reorganization and settlement (Boyd and Dewees 1992; Crothers 1988). In Iceland there have been several major legal cases on the matter, and today efforts are under way to dismantle the country's ITQ system (Copes and Pálsson 2000). As Huppert observes, privatizing fishing rights can initiate radical changes in how fisheries are organized, "ultimately changing who fishes, where and when they fish, the products sold, the balance of power among industry sectors, incentives to support conservation, the size of incomes from fishing, and the location of shore-side economic activity. Changes of this sort are bound to provoke controversy" (2005, 201). These social dimensions of ITQs have sparked resistance and calls for reform, including calls for greater involvement of communities in management.

Reclaiming "Rights" for Communities

In fisheries policy, the language of "rights" or "property rights" has become shorthand or a euphemism for privatized property rights; the phrase "rights-based management" almost always means systems that use individualized assignments of rights to fishing quotas or related measures (Neher, Arnason, and Mollett 1989). Resistance to ITQs has led to efforts to represent the needs and claims of poorer groups and resource-dependent communities as driven by "rights" as well, as in this report on a workshop in Brazil in 2006: "The tendency to privatize fish resources [goes] . . . against the rights of fishing communities and represents a direct consequence of the neoliberal model aiming to transfer to the private bank the property of fish resources that in most countries are considered as national goods for public use. By this means those who control the fishing capital become the owners of the fishing wealth of nations" (Avendaño 2006, 7). From the perspective of small-scale fisheries and the communities that depend on them, the absence of rights over fisheries resources is a problem quite different from what Hardin (1968) meant in his analysis of the conditions for tragedies of the commons. One recent and thoughtful review of the situation in the developing world concludes that a major impediment to resilient small-scale fisheries "is the inability of fishers to secure and exercise rights and responsibilities over fisheries resources" (Andrew et al. 2007, 228). Rights regimes are contested or are inappropriately assigned, given the scales at which power is exercised versus the scales over which social and ecological systems function.

The refusal to equate "rights" with "private property rights" raises the idea that fishing rights are human rights, as in a statement from a 2008 workshop in

Zanzibar:¹ “The fishing rights should not be treated as a tradable commodity and they should be seen as an integral part of human rights. A rights-based approach to fisheries should not lead to the privatization of fisheries resources” (Kumar 2008). This statement goes on to define a “rights-based” approach to fisheries as one that recognizes “the customary rights, local knowledge, traditional systems and practices, and the rights to access marine and inland resources of small-scale, artisanal and indigenous fishing communities, as well as the right to land for homestead, fishery-related, and other livelihood-related activities. Furthermore, such an approach should enhance collective, community-based access and management regimes” (Kumar 2008). The workshop statement, signed by 45 participants from eastern and southern African nations, also called for gender equality: “All the rights and freedoms that are agreed to as relevant for rights-based approach to fisheries, should apply equally to all men and women of fishing communities” (Kumar 2008). This complicated claim incorporates both a notion of universal and hence “human” rights to access the wherewithal for a livelihood and more specific and somewhat contradictory notions of rights linked to specific cultures, communities, and experiences. Both notions gain rhetorical strength, however, from their opposition to what is viewed as a neoliberal instrument (Mansfield 2004a; 2004b) that threatens the welfare of poor and fishery-dependent communities.

For many resource-dependent coastal communities, a big question now is how such a rights-based approach can be created, given a history of privatized access rights and a context of economic difficulties worldwide, government downsizing, and pressures to reduce participation in the fisheries altogether. How can residents of coastal communities in rural areas or even the fishing communities of urbanized coasts maintain access to the livelihoods, infrastructure, and culture they need to participate viably in the fisheries of the future and, perhaps, to be stewards of the resources of the sea? Is there some way they can benefit from a fisheries management system that depends on control of how many fish are taken and allocates that amount to participants in the fishery? Are there alternatives to criteria such as historical participation and vessel ownership, the most common bases for assignment of ITQ rights? Is there an argument for communities or community-related organizations as “rightful” entities that should participate in such an allocation? Although these questions seem most pertinent to poor communities in the developing world, they are highly relevant to fishery-dependent communities in the developed world as well. The remainder of this chapter addresses these questions through the lens of recent shifts in fisheries policy and practice in the United States, Canada, and western Europe, with a focus on catch shares.

¹ The workshop in Zanzibar, Tanzania, was titled “Asserting Rights, Defining Responsibilities: Perspectives from Small-Scale Fishing Communities on Coastal and Fisheries Management.” It was organized by the International Collective for Support of Fishworkers (ICSF), headquartered in Chennai, Tamil Nadu, India, together with the World Forum of Fisheries Peoples, the Western Indian Ocean Marine Science Association, and the Masifundise Development Trust (an independent, nongovernmental organization working with small-scale and traditional fishing and coastal communities in the west and south coasts of the Western Cape, South Africa). The ICSF has been active over the past two decades in defining such positions.

Catch Shares and the Commons

On 4 November 2010, the U.S. agency responsible for the nation's fisheries beyond state jurisdiction, the National Oceanic and Atmospheric Administration (NOAA), published a policy statement on "catch shares" (NOAA Office of Sustainable Fisheries 2010). Earlier, while the policy was still in draft form, the agency provided funding to facilitate the adoption of catch shares in commercial fisheries on both the west and the east coasts of the United States. The term "catch share" follows on other terms—including "limited access privileges" and "individual fishery quotas" (IFQs)—used in the United States to indicate the privatization approach to fisheries management, assigning exclusive extraction rights to individuals or groups. The difference in terms also seems to indicate a progressive semantic widening. IFQ was a synonym for ITQ, the market-based tool for allocating fishing rights long promoted by resource economists. Controversy over the use of ITQs led to a congressional moratorium on their use in 1995, a major national study of ITQs (National Research Council 1999b), and a broadening of the concept in the nation's fisheries law under the term "limited access privilege" (LAP). The language of LAPs asserted and supported the national policy that allocating exclusive fishing rights from a public resource was better construed as granting revocable privileges rather than enduring property rights. It also avoided controversy about giving away public resources, a salient issue in the context of the U.S. public trust doctrine (McCay 1993; Turnipseed et al. 2009).

The broadened notion of LAPs also opened up the possibility of allocation of shares of a quota to units other than individuals. The most recent catch-share policy is more explicit about the range of units that can be involved in the allocation of exclusive fishing privileges or property rights:

"Catch share" is a general term for several fishery management strategies that allocate a specific portion of the total allowable fishery catch to individuals, cooperatives, communities, or other entities. Each recipient of a catch share is directly accountable to stop fishing when its specific quota is reached. The term includes specific programs defined in law such as "limited access privilege" (LAP) and "individual fishing quota" (IFQ) programs, and other exclusive allocative measures such as Territorial Use Rights Fisheries (TURFs) that grant an exclusive privilege to fish in a geographically designated fishing ground. (NOAA 2010, i)

Changing the vocabulary and broadening the scope of the catch-share policy have not done away with controversy because the policy is about enclosing the fisheries commons, restricting access to formerly open or publicly available places and resources. Catch shares have been subject to vigorous debate and public protest just as their predecessors, particularly IFQs, have been, largely because most of the programs understood to be covered by this rubric are, to date, mainly based on the allocation of exclusive and usually tradable fishing rights to individuals or individual firms. Implementation also coincides with a tightening of fishery limits, which intensifies criticism of the policy. But the new catch-share policy does create opportunities for fisheries management programs that better reflect and support the needs of a wider range of fisheries and fishing communities.

Defining Community

One difficult question is that of defining “community” in the context of fisheries management. U.S. fisheries law and popular culture view communities as defined by place, but anthropological theory and social science research in fisheries point to more fluid notions of community that are marked less by physical or political boundaries than by broadly conceived interactions on multiple scales (Clay and Olson 2007; 2008). Geographic towns, ports, and municipalities serve as place-based fishing communities because of their significant dependence on and/or heritage of fish harvesting or processing. Examples are Dutch Harbor, Alaska, and Gloucester, Massachusetts. There are also enclaves and occupational subcultures within urban areas, such as the commercial fishermen of San Francisco. However, given the mobility of fish and fishermen, significant social interactions can take place away from land locations and can create virtual communities of people who pursue the same prey with similar technologies and in similar places, such as the long-liner fishermen who specialize in large pelagic species, for example, swordfish and tuna, and might be working the Grand Banks off Newfoundland one year and the deep waters off the Hawaiian Islands another.

Each of these cases has dimensions of community, as expressed by the capacity to act collectively on the basis of some degree of shared history, values, and interests and some chance of interaction in the future. One can also find instances of enduring social ties in management arenas as something approximating either an “epistemic community” of expertise and shared concerns and values (Haas 1992) or, in science-policy discourse, extended peer communities (Funtowicz and Ravetz 1993). These types of communities are significant for the development of post-normal science, based on both lay and professional expertise, which is very important in fisheries (St. Martin et al. 2007). However, the discussion that follows refers mainly to place-based fishery-dependent communities and to more or less discrete and localized groups of people with similar fishing technologies or interests, the kinds of communities that have been the focus of studies of small-scale fisheries and irrigation, forest, and other commons management.

Roles of Communities in Fisheries Management

Apart from social impact assessments, there has been little explicit acknowledgment of the fishing rights of communities in the United States and Canada. However, in Japan, Mexico, and some other nations, community-based management has a strong foothold and is particularly connected with fisheries cooperatives and their exclusive concessions. Fishing communities are engaged in fisheries management through political processes (the power of the vote; advisory, consultative, and other participatory institutions), as well as public and private acts of compliance, resistance, and subterfuge. Moreover, community interests are recognized in the U.S. federal law for marine fisheries, the Magnuson-Stevens Act (MSA),² which as of 1996 included a provision that fisheries management plans should promote the

² Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. §§ 1801 et seq.).

sustained participation of fishery-dependent communities and minimize economic hardships for such communities. Community-related provisions occur throughout the MSA. For example, in a section in the part of the MSA that requires the rebuilding of overfished stocks, the needs of fishing communities are mentioned, as is the requirement that both restrictions and recovery benefits be allocated fairly and equitably among sectors of the fishery (Clay and Olson 2008). However, it is understood from court cases that requirements for biological conservation and recovery trump the concerns of fishing communities when fishery management choices must be made (Heinz Center 2002).

The topic of community-based management intersects with the movement toward decentralized and industry-based management or “comanagement,” with implications for communities. In the northeastern United States, for instance, decentralized, industry-based management has long been practiced in both formal and informal institutions for the region’s highly territorial lobster fisheries, and today both the federal waters lobster fishery management regime and a zonal system developed in the state of Maine bear testimony to the capacity for delegating much management authority to industry groups (Acheson 2003). Marketing and dock cooperatives have long existed in the area (Pollnac and Poggie 1988). To a limited extent, they have been involved in managing local fisheries mainly for market purposes (McCay 1987), taking advantage of a Depression-era law that protects cooperatives from antitrust allegations (Sullivan 2000).

Strong industry involvement in management occurs in some of the region’s small, specialized fisheries, particularly for tilefish, red crabs, and, as noted earlier, surf clams and ocean quahogs (Kitts, Pinto da Silva, and Rountree 2007; McCay and Brandt 2001a; Pinto da Silva and Kitts 2006). In those cases, fisheries industry associations or small networks of industry leaders play key roles together with management councils to craft regulations that suit industry and community needs and provide considerable flexibility to members. Some have also been particularly active in cooperative research to supplement government scientific research (Johnson 2007).

The notion of providing exclusive quota shares to communities or other groups that are associated with communities is more radical and innovative than previous efforts to reflect the needs and values of communities in fisheries management. Some such programs have evolved parallel with, as reforms of, or in reaction to ITQ management. A recent trend toward sector management offers the potential for greater community engagement in fisheries management.

Community Quotas in Alaska

In the United States the first major instance of assigning quota shares to communities came about through the creation of community development quotas (CDQs) in western Alaska in 1992. The goal was to give remote and mostly native communities bordering the Bering Sea a financial stake in fisheries that were heavily industrialized and often distant (Tryon 1993). Percentages of the overall quota for commercially valuable species, particularly groundfish like pollock, halibut, and, more recently, crabs, have been granted to six corporations. These corporations were

created to represent the interests of 65 local communities for the purpose of community development. In most cases, the corporations lease their shares of the quota to commercial fishing businesses rather than operate their own vessels, but the system is characterized by great diversity and dynamism (National Research Council 1999a). CDQs may be exchanged among the six corporations, but they do not have the right to sell their CDQs or accumulate more by purchase from other groups, and they do not have a seat at the table for fisheries management, although they are active politically. Their performance as vehicles for community development has been criticized and is highly variable (Langdon 2008).

More recently, in Alaska the individual fishery quota (IFQ) program for halibut, sablefish, and other species was modified to help redress the movement of quotas away from many small communities because of transfers among quota holders. In 2004 the North Pacific Fishery Management Council enacted a provision allowing 42 small, isolated, and fishery-dependent communities in the Gulf of Alaska to organize as nonprofit community quota entities (CQEs) with the right to purchase quotas on behalf of community members.³ Each year the CQE then leases its quota to one or more persons deemed to be permanent members of the community. This provision was in response to an unexpected consequence of another provision of the IFQ program intended to promote community values: quota ownership is supposed to be restricted to bona fide fishers, that is, individuals with experience in fishing. Moreover, to preserve the owner-operator nature of the fishery, the owner of the quota being used for a fishing trip should be on board the boat (there are numerous grandfathered exceptions). Both provisions made it difficult for larger businesses to purchase quotas, the intent of the program, but they also made it impossible for entities like communities or cooperatives to do so. However, the CQE program was very narrowly designed, with neither an allocation of quotas to CQEs nor a program to support financing purchase of IFQs on the open market. As of 2010, only one community has been able to get financing to purchase a quota, and it purchased the quota from one of its own retiring members (Ed Backus, personal communication, 1 June 2010).

The nonprofit group Ecotrust has created the North Pacific Fisheries Trust as a potential financing mechanism to help the CQE program realize its goals.⁴ Trusts are emerging as important vehicles for development of community-related fisheries in the context of privatized rights, reflecting their use more generally for environmental, housing, and other purposes. Another trust, the Cape Cod Fisheries Trust, was formed in 2009 and is playing a major role in community-based management in New England.

Community Management Boards in Atlantic Canada

A less well-known innovation in North America is the community management board program created in the 1990s for small-scale fisheries in the Scotian Shelf region of Atlantic Canada (Kearney 2005; Kearney et al. 1998). In 1990 ITQs were

³ Community Quota Program Final Rule, 69 Fed. Reg. 23,861, 30 April 2004; effective 1 June 2004. NOAA Fisheries: Restricted Access Management: Community Quota Program, <http://www.fakr.noaa.gov/ram/cqp.htm>.

⁴ Ecotrust: North Pacific Fisheries Trust, <http://www.ecotrust.org/npft/>.

put in place for the mobile-gear (otter-trawl or dragger) groundfish fishery in the region (Apostle, McKay, and Mikalsen 2003; McCay, Apostle, and Creed 1998). Very strong and even violent opposition to the expansion of ITQs to other fleets or the possibility that owners of vessels with ITQs could buy up quotas held by smaller-scale fishers contributed to efforts by fishery leaders, community workers, and others to find a more community-oriented alternative. These efforts were focused on the small-scale fixed-gear fleet (mostly hand-line and gill-net fishers) (Kearney et al. 1998). The Canadian government's Department of Fisheries and Oceans (DFO) was supportive, apparently seeing the community program as a way to reduce the allocational conflict that occurred every season among the numerous small associations that had emerged over the years to represent the interests of hand-liners and other small-scale fishers and their communities (Peacock and Annand 2008). A pilot program began in 1995, and by 1997 DFO had worked with community development representatives and local fishing associations to create eight community management boards (CMBs) that covered all the small-scale fixed-gear fisheries of the region.

"Community" was defined in terms of both geography and "like-minded" fisheries, that is, "groups of fisheries who have common management objectives" (Peacock and Annand 2008, 102), but in all but one case, geography sufficed for like-mindedness. In that one exception, the geographic community was divided into two boards, one mindful of the benefits of ITQ-like ways of allocating the catch share among board members, the other preferring a competitive fishery modified by trip limits. The CMBs received portions of the overall quotas for cod, haddock, and other species that were based on historic landings of individuals in the areas (as well as records from processors, given the difficulty of getting documentation for all individual landings). All registered fishers in an area within the vessel categories involved become members of the CMBs, although they have the right to opt out and fish in a competitive fishery (the size and limitations of which have discouraged most fishers) (Peacock and Annand 2008). Each CMB must put together a "conservation harvesting plan" that has to be approved by the DFO and becomes the contractual agreement with the agency.

This example shows the importance of using community-based programs to reduce conflict, enable diversity and experimentation in management, and improve compliance. Government participants have emphasized the last factor. The CMB has the obligation to ensure that the rules are obeyed, in accordance with standards developed over time between government and industry. It uses a dockside monitoring program that evolved with ITQs in the region. The CMBs are said to have been effective in using peer pressure to enforce compliance. In some communities, they have instituted more draconian penalties than would be issued by courts, typically reductions in quotas and/or time that can be spent at sea (Peacock and Annand 2008).

The communities, on the other hand, have been behind efforts to limit transferability, in sharp contrast with the local ITQ fishery management regime. The CMBs have been able to trade quotas with other communities (but not with the ITQ fleet, with one exception), and fishers are able to move between communities, but these movements require agreement from both communities (Peacock and Annand 2008).

The CMB system is a genuine comanagement system. The government plays a significant role in enhancing the capacity of the CMBs and in quality control. The DFO has responsibility for licensing, through which many conditions of the fishery are established and enforced (e.g., vessel and gear features and fishing areas). It also has the function of auditing to ensure that the sharing works as planned and that conservation approaches are adopted. It further helps the CMBs manage the limits they have imposed, as well as those dictated by the DFO for conservation purposes, by providing data on individual vessel landings (Peacock and Annand 2008). The CMBs have the responsibility to determine how the assigned allocations are to be harvested. The options range from competitive fishing by gear type (hand-liners have one competitive quota; gill-net fishers have another competitive quota), trip limits, or time limits at sea to an industry-developed ITQ system. The CMBs can be divided into smaller groups with different approaches to the fishery. In the Shelburne area, the largest, there are two CMBs. One of the Shelburne CMBs has five different associations, each with its own harvesting plan; the other has three.

A major benefit of the CMB system has been reduced conflict among the small-scale fishing communities. Examples of enhanced cooperation include some trading of quotas and the creation of the Bay of Fundy Council, made up of two CMBs and other groups, which seeks to develop an ecosystem-management approach (Kearney et al. 1998; Peacock and Annand 2008). This council was a significant institutional shift toward more explicit industry-based stewardship over ecologically defined areas, but reports suggest that standard fisheries conservation benefits have been mixed. There has been a marked improvement in the science-advisory process, and the fishers are more meaningfully involved in participatory research (Peacock and Annand 2008; Wiber et al. 2008). On the other hand, fish stocks in the region, particularly cod, have been in poor shape. One assessment notes the continued problem of discarding and high grading, that is, given strict quota limits, bringing in only the fish that are more valuable and throwing away much else that is actually caught, dead or alive (Peacock and Annand 2008).

Assessment of conservation and economic outcomes is complicated by the fact that community-based management in the Scotian Shelf region has taken place in a context of severe and continuing resource decline. Participation in these fisheries has dropped dramatically in the area as people have left fishing altogether or have focused more on lobsters.⁵ It is remarkable that community-based management evolved as it did, given the high transaction costs, observer fees, and other costs of this form of fisheries management (Peacock and Annand 2008), but those costs may have contributed to movement out of the groundfish fisheries.

Greg Peacock and Chris Annand, who were both deeply involved in the government side of the program, believe that the CMBs enabled a “more business-like” way of managing fisheries and facilitated the readjustment of efforts to be more in line with the resource; that is, they helped downsize the fishery (2008, 107). However, they also point out that the CMBs are strongly divided about the use of “business-like” methods, particularly the assignment of individual quotas to members of the CMBs.

⁵ The number of active vessels in all communities fishing in the region decreased from 1,274 in 1996 to 384 in 2005 (Peacock and Annand 2008).

Consequently, there are no formal or official ITQ programs in this fishery even though some groups have informal means of assigning and managing quotas that are functionally equivalent to ITQs. For example, they may allow some degree of “license stacking,” where one boat uses two license-attached quotas (Peacock and Annand 2008, 108).⁶ Nonetheless, all groups resisted “self-rationalization” schemes allowing the buyout of members by others, and the fishery was still in economic trouble, with incentives that worked against conservation, including incentives to discard less valuable fishes (Peacock and Annand 2008, 109).

The system was run without legally binding arrangements between the DFO and the fishing groups; such arrangements were not allowed for in Canada’s Fisheries Act. The DFO agreed to the measure informally, without specific legislative basis, and the boards used contracts for their internal organization (Kearney 2005; Kearney et al. 1998). Several of the CMBs persist as institutions to represent local interests vis-à-vis the government, but the fisheries have changed greatly, with further problems in groundfish populations and economics, such that the traditional hand-line fishery is virtually gone. One longtime proponent and participant in the system from the community development side, Arthur Bull, believes that the major limitation was that the CMBs were not granted exclusive rights to fishing areas (TURFs) and instead had to share fish stocks with the larger-scale, industrialized fishing fleets. Representing what were always seen as marginal fishers, the CMBs were ill equipped to compete for sizable shares of overall quotas and had little incentive to cooperate for tighter management (Arthur Bull, personal communication, 2 June 2010).

Sector Allocations in The Netherlands and the United Kingdom

The Producer Organisation (PO) quota management programs in the United Kingdom and the Biesheuvel groups in The Netherlands involve the allocation of shares of overall quotas to organized groups of fishers (Christensen et al. 2009). The Biesheuvel system began as an ITQ-based fishery, but it evolved into a system whereby smaller, geographically distinct groups of fishers in the large-scale cutter fleet belong to organizations that have responsibility for managing a share of the overall quota, within which ITQs are used (Dubbink and van Vliet 1996).⁷ The PO system in the United Kingdom is similar but has developed within a policy framework that is generally opposed to ITQs, allowing individual vessel allocations but no trading of quotas independent of transfers of the vessels. POs are artifacts of the European Community that were intended originally for marketing purposes, but in the 1980s they became vehicles for allocating shares of overall quotas to groups of fishermen within which decisions about more detailed allocations are made. The POs have responsibilities to the larger fishery management system for ensuring that the quotas are not exceeded and that other conservation measures are met, and they are involved in purchasing or leasing quotas from other groups.

⁶ Peacock and Annand refer to the license permits as “quasi-property rights” and note that there has been controversy in the larger fishing industry about them because the more informal ITQ fishers pay much lower fees than do those involved in formal ITQ fisheries (2008, 108).

⁷ The Dutch Biesheuvel system is named after a minister of food and fisheries of the 1960s who not only promoted methods for improving fish quality but also presided over a group which was mandated to find ways to make the fisheries sector take more responsibility for its activities.

Some of the POs operate like ITQs, allowing some accumulation of purchased or leased quotas on individual boats. Others remain wholly or in part committed to a more egalitarian mode of allocating quotas among boats (Christensen et al. 2009; Goodlad 2005; Philippson 1999). The POs can trade quotas with one another and obtain quotas from other sources. They provide many of the advantages of both ITQs and comanagement. By allowing fishers to make many crucial decisions about allocation through the democratic processes of the POs, they give them a sense of ownership, as well as responsibility.

From a management perspective, it appears that the value of such community-oriented management that matters most to the larger system is the use of group responsibility and peer pressure to ensure better compliance with a management regime, as well as getting government out of the sticky business of deciding how to distribute allocations. In contrast with the Canadian case, in the Dutch and U.K. systems, there may be little relationship to specific fishing communities or to larger objectives of community development, including maintaining opportunities for fishing as a livelihood. Indeed, the U.K. system has evolved into a full-fledged quota-trading system, despite an anti-ITQ policy. Nonetheless, the system is a strong co-management one, where the POs and fishers function as interacting social beings who play important roles in the management of quotas. Government manages the POs, but POs manage the fishers (Goodlad 2005).

Within this setting, one true community-owned fish quota has been instituted, in the Shetland Islands (Goodlad 2005). In the United Kingdom it has been possible since 1993 to purchase fish quotas through fleet-decommissioning schemes, where vessel owners sell their quota entitlements (which come from the records of their fishing performance) to their PO, relinquish their licenses, and thereby separate entitlements from the vessels. By entitlement is meant that share of the quota assigned by a given vessel. The Shetlands PO purchased such quota entitlements with the intent of retaining them as a whole to secure future fishing opportunities for members. Through that and another quota investment scheme, the Shetlands community held two pools of demersal (groundfish) fish quotas, more than the quotas owned privately by the individuals and companies within the Shetland fleet (Goodlad 2005). The part held by the PO was never to be sold and was to be used only to augment the quota allocations of member vessels. The other part, held by an islands development fund, was used to help new entrants get started in the industry, to counter the problem common in remote regions where people surrounded by fish and dependent on the fish industry see access to marine resources and livelihoods being eroded through quota trading.

Sector Management in New England

On 1 May 2010, the groundfish fisheries of New England under the auspices of the New England Fishery Management Council came under a management system very similar to what is found in the systems in Canada, The Netherlands, and the United Kingdom described earlier. The system is called “sector management” and can be viewed as an example of a more collective form of a catch-share policy. The

groundfish fleet from Maine to New Jersey is organized into cooperative-like sectors, each of which is allocated a portion of the overall catch for each stock of fish in the management unit on the basis of the historic performance of members of the sectors from certain years, as in the PO system in the United Kingdom. In this system, too, it is up to the organization that receives the allocation to decide how the sector's share is to be allocated among members of the sector. Fishers who are not able or willing to join a sector remain in a common-pool fishery subject to strict controls on days at sea and other measures (*Federal Register* 2010). Fishers are apparently free to move from one sector to another from year to year, taking their historic catch records with them.

The current system of sector management owes much to the example set by a group of fishers and others based in Cape Cod, Massachusetts, which had an explicit community orientation. As controls on fishing effort in the demersal fisheries tightened through limited days at sea, and cod were reduced to a bycatch for most fishers, the Cape Cod Commercial Hook Fishermen's Association (CCCHFA) came up with a proposal for a special allocation to a "sector" of the fishing industry that would be awarded a share of an allowable catch quota for cod. In 2004 an amendment to the multispecies groundfish plan included a provision for the Georges Bank Cod Hook Sector, and in 2006 a second sector was authorized by a framework of the plan, the Georges Bank Fixed Gear Sector. Both sectors were based largely on vessels from two Cape Cod ports, Harwich and Chatham. As sectors, they were responsible for keeping catches under a certain limit, but they also were exempt from some of the rules that the small-scale hook-and-line and gill-net fishers felt would end their participation in fishing. Each sector decided to distribute its allocations in the form of monthly quotas fished competitively by members (K. Gordon 2010).

These programs have been described by their designers, participants, and others as exemplars of community-based fisheries management. They have received a great deal of media attention, as well as foundation and public support. Their Web site (<http://www.cchfa.org>) reads: "The sector system, pioneered by the Hook Association, allows fishermen to work collectively to harvest a combined quota of fish. These fishing cooperatives work for our community by increasing flexibility and profit for fishing businesses, encouraging sustainable fishing methods, and making it easier for fishermen to stay within annual limits."

The amendments to the fishery management plan that resulted in the Georges Bank Cod Hook and Fixed Gear sectors were written generically, enabling other sectors to form, but it was not until 2009 that the New England Fishery Management Council agreed on a full-fledged sector program, to begin in May 2010. This program was strongly supported by the Environmental Defense Fund (EDF), a representative of which was appointed to the New England Fishery Management Council, along with an employee of the CCCHFA. The EDF was among several environmental groups that promoted catch-share management in New England and nationally (Environmental Defense Fund 2009). The context was a long period of continuous decline in allowable fishing days, attrition in fisheries participation, and deep economic and social distress for individuals, enterprises, families, and communities that threatened to worsen because of a management shift from indirect controls

on fishing mortality, such as days at sea and closed areas, to strict caps or quotas (NOAA Northeast Fisheries Science Center 2010). The effect on fishing communities was mitigated somewhat by the fact that some shifted to other fisheries, particularly lobsters, scallops, and monkfish, but many people left fishing altogether, and the infrastructure of the fisheries in some areas was in peril. The direness of the situation was compounded by a new provision in the 2006 revision by the U.S. Congress of the Magnuson-Stevens Act that required precautionary lowering of allowable catches where there was significant scientific and/or implementation uncertainty, even for fish stocks thought to be in fairly good shape, no longer overfished, or on their way to restoration.

Anticipating even further cuts in allowable fishing time, the New England Fishery Management Council combined its mandate to impose caps on catches with sector management in 2009, to start in May 2010. Extremely hard choices are required, and these are being delegated to industry groups, which have to decide how limited fish quotas are to be parceled out among their members, as well as what the criteria for membership should be. By January 2010, the deadline for sector organization, the Northeast Seafood Coalition, an industry group, had established 12 of its eventual 13 sectors, representing more than 500 fishing vessels, and the coalition expected allocations of about two-thirds of all the fish authorized to be caught under the new program for the new fishing year, to begin in May 2010 (Gaines 2010). Another industry trade association, Associated Fisheries of Maine, organized a large sector, the Sustainable Harvest Sector, which then had 93 permitted vessels enrolled and expected a few more. This group represented the larger, mobile trawlers of Maine and nearby states and had a large portion of the haddock quota for the region (Gaines 2010). The common pool varied greatly in size and share of fish-stock quotas as owners of fishing vessels vacillated between sectors and the common pool, but ultimately it had very low allocation and, as expected, was on the verge of being closed within a month of the opening of the fishery, exemplifying the “derby” dynamic that sectors were intended to help people avoid.

Although the official language of the national catch-share policy emphasizes that catch shares can be allocated to communities, as well as individuals, and the sectors are good examples, leaders of the New England Fishery Management Council publicly stated their intent that sector management would usher in ITQs (personal observation, Gulf of Maine meeting, October 2009). The size of a sector’s allocation is a function of the historic performance of its members, the same condition that applies to the U.K. POs. Some of the U.K. POs have long awarded their members equal fishing rights despite what they bring to the PO from their historic records as entitlements attached to their vessels, and other allocations have been devised. It appears that the New England sectors are not moving into such terrains. By and large, they are choosing instead to share the sector allocations according to what each member brings in and to allow trades among members, coming close to ITQ systems despite a long history of resistance to ITQs. Therefore, the sectors may prove to have little “community” significance beyond their roles in comanagement. This is recognized in the fervor of opposition to the system, exemplified by a recent movement called *Who Fishes Matters*, led by a small advocacy group, the Northwest

Atlantic Marine Alliance (<http://www.namanet.org>), although most opposition has focused on the size of the catch limits.

Sector management does provide a structure that could enhance community interests, as might have been expected, given the strong community orientation of the Georges Bank Cod Hook and Fixed Gear sectors. There was a semblance of like-minded community in the early composition of many of the sectors, but by and large, the larger ones emerged as business enterprises that had little identity linked to place or even technology and gave early indications, as mentioned earlier, of moving toward ITQs. However, several very small sectors also signed up by May 2010 with the intention of protecting and enhancing opportunities for fishing communities. These were the Georges Bank Cod Fixed Gear Sector, the Port Clyde Community Groundfish Sector, and the Northeast Coastal Communities Sector, each of which is organized around themes of social equity and community survival.

Sectors and Communities

Community-oriented sector management in New England has emerged mainly within the three very small sectors and in conjunction with other innovations designed to help keep small-boat, local, and family-based fishing businesses alive at a time of severe cutbacks in fishing opportunities. Financial trusts and a system known as permit banking have been introduced to help local groups obtain financing to acquire increasingly scarce and costly permits. The Cape Cod group combined its former sectors into one, the Georges Bank Fixed Gear Sector, and as of January 2010 was set up to receive a large portion, 28 percent, of the Georges Bank cod allocation (Gaines 2010). Furthermore, in order to realize the group's commitment to the goal of helping keep fishing as a livelihood in Chatham and other Cape Cod communities, the CCCHFA obtained help from environmental groups and foundations to fund the Cape Cod Fisheries Trust through which it can purchase limited licenses in other fisheries, particularly scallops, to enable its members to participate in more diversified fisheries.

Similar innovations are taking place in the two other small sectors. Although its membership went beyond the Port Clyde fleet, the Port Clyde Community Groundfish Sector is based on a local fishing cooperative that had already begun community-based initiatives, including its Community Supported Fishery program (<http://www.portclydefreshcatch.com>), the first in the United States, with the goal of enabling fishermen to make adequate incomes from smaller catches. A similar strong commitment to local fisheries and community development was demonstrated by the organization that became the Northeast Coastal Communities Sector, led by the Penobscot East Resource Center of Stonington, Maine, but combined with a small group of fishers from Martha's Vineyard, Massachusetts. Together they were able to muster 19 permit holders as members for the 2010 fishing year (Schreiber 2010b). Their allocations were very small. It was a challenge to find people with groundfish permits from Maine because many had given up groundfishing for lobstering. That difficulty played a role in Penobscot East's decision to work with Martha's Vineyard, even though the two places are in separate states and many miles apart.

The mission of the Northeast Coastal Communities Sector is explicitly community oriented: “To rebuild a sustainable groundfishery and ensure access for traditional fishing communities” that have come to have very limited access to groundfish (Garrett-Reed 2010). The sector system reopens possibilities for participation in the cod and other groundfish fisheries as the fish populations recover. A Maine fisherman from Swans Island explained: “In my case, coming from a small-boat community that traditionally fished groundfish seasonally, this is my only opportunity to fish” (Jason Joyce, quoted in Schreiber [2010b]). His father had lost his groundfish permit many years ago, and he had purchased one about 15 years ago, keeping up the paperwork but never able to use it for want of allocated days at sea. Now, as a member of the sector, he is able to participate according to how many groundfish the sector is allocated, given the combined landings history of the members. The situation on Martha’s Vineyard is similar. Its fishing community sees the sector program as a way to revive and preserve its fishing heritage for coming generations. Only five groundfish permit holders are left; they fish for other species during the summer and fall and hope that access to groundfish allocations will enable them to revive a winter cod season.

However, allocations have been very small for the Port Clyde and Northeast Communities sectors, and survival in fishing for the fishermen and communities involved is increasingly dependent on trusts and permit banking. In 2009 the Penobscot East Resource Center partnered with The Nature Conservancy to purchase groundfish permits, up to now from local fishermen, which are being banked for future use or leased at relatively low cost to local fishers who can use the days at sea or annual catch shares involved, as well as being made available to local fishermen for research into more sustainable fisheries (Cartwright 2009). Similarly, the Port Clyde sector has access to quotas from a permit bank created by The Nature Conservancy and the Island Institute. The Penobscot East sector is using the groundfish permits to establish a “sentinel fishery” research program. Days at sea, which are attached to permits, are leased from the bank so that a vessel can participate in cooperative research projects. “This is a really important project for the future of the groundfish fishery here,” said the Penobscot East Resource Center’s director, Robin Alden. “Even this small start has taken getting past almost insurmountable obstacles. Without the permit bank, the sentinel fishery would not be possible. Without the sentinel fishery research, we couldn’t find out what’s happened to the fish. On top of that, we are restarting the shoreside infrastructure—ice, offloading, and marketing. The door is no longer closed on groundfishing in eastern Maine” (Schreiber 2010a).

In the winter of 2009–2010, the NOAA announced an expansion of permit banking as part of an appropriation to help with the transition to catch shares and sector-based management. About \$5 million was announced for funding permit banks in the New England states of Maine, New Hampshire, Massachusetts, and Rhode Island. The State of Maine had received \$1 million as seed funding in 2009 and will receive \$2 million more. Notable is the existence of regulations that “indicate a new commitment in Washington to community-based fisheries” (Hayden and Conkling 2010). Recognizing that limited-access programs and the consolidation that follows them tend to squeeze out small boats and hence hurt fishery-dependent coastal com-

munities, the new permit-banking program restricts participation in the permit banks to fishermen whose vessels are 45 feet or less in length and who either reside in or operate from communities with 30,000 or fewer residents. For organized sectors to obtain permits from the bank, at least 65 percent of the member fishermen must meet those requirements (Hayden and Conkling 2010).

The Northeast Coastal Communities sector exemplifies one of the potential contributions of sector management that makes it close to the Shetlands example. The sector uses collective access to a share of a resource as the basis for reaching agreements on conservation and allocation measures beyond the catch limits established by the regional fisheries management council, that is, to create locally devised resource management. Thus, Northeast Coastal Communities sector management not only seeks to restore traditional fishing patterns, as in the case of the Swans Island fisherman quoted earlier, but also sets constraints on technology to encourage methods that are deemed to be more selective and protective even though they are more labor intensive. At least for the first year, the vessels in the sector are allowed to use only longline, tub-trawl, or pots/traps gear. A Martha's Vineyard small otter trawler is the only exception (Schreiber 2010b).

Permit banking and sector management are closely intertwined, and both depend on a far more decentralized and potentially community-oriented system of fisheries management than before in this region. They require the existence of legitimate organizations representing subgroups in the fisheries and the capacity of people in those organizations to devise and work out viable systems for allocating and using scarce resources, as well as support from the outside, in this case from political representatives and administration officials who have included line items in federal budgets. But most of all, permit banking has emerged as a tool for sector management to enable communities to ensure future and viable participation in the fisheries.

If decision making and monitoring are devolved to smaller units of fishers, the sector management system of New England, which has many similarities to cases described from Canada and the United Kingdom, may become more participatory, which should increase the legitimacy of practices and rules that evolve and strengthen the sense of ownership that seems critical to stewardship in the longer term. At the same time, participants in the fishery are rewarded according to their past performance (catch histories determining catch shares) and are granted the option of trading or purchasing shares, at least within their sectors, to counterbalance constraints created by the initial allocations. Following the logic of exclusive fisheries based on tradable rights, this incentive structure could allow for the exercise of individual choice, investment, and skill and increase efficiencies of production within a system, the sector, that provides some security for future participation (the catch shares) within a more or less collective framework.

The extent to which the sector institution of New England will become a transition to full-fledged ITQs or remain an instrument for comanagement is uncertain. Whether and where sectors will be managed on behalf of small-scale fishers and fishery-dependent communities is also an open question. At this point, the use of sectors for fishery-dependent communities is happening on very small scales and is heavily dependent on subsidies from interested foundations and nongovernment

organizations, as well as leadership from strongly motivated and highly principled individuals. More generally, fisheries management in the northeastern United States is moving toward the ITQ end of the spectrum, while enclosure itself, in its many forms, is fully under way through the events and processes of “creeping enclosure” that have affected individual fisheries, fishery by fishery and region by region (Murray et al. 2010). But these small-scale experiments keep alive the possibility and practice of community in fisheries, as do current laws and policy statements (St. Martin 2001; 2005).

Communities, Places, and the Future of Fisheries

There are many ways in which communities and their needs are involved in marine fisheries management. Even in many ITQ programs, there are provisions to protect community-oriented values, such as owner-operated fishing enterprises (McCay 2004). However, if community participation in catch-share-managed fisheries is to be taken seriously, communities must be included in the initial allocations of catch-share programs. A major barrier for many communities is financing, particularly when catch-share programs take place during downturns in the fisheries. Permit banking and fishery trusts are significant innovations, but they are heavily dependent on government subsidies and grants from private charities, neither of which is reliable or even desirable on a permanent basis. Efforts are currently under way, through the NOAA, the Pacific Fisheries Management Council, and groups such as Ecotrust, to adapt enabling legislation on “fishing communities” and “regional fishery associations” to establish the administrative framework for allocations to community-based organizations or “community fishing associations.”

Whether communities will have a genuine role as recipients of catch shares will depend on the politics of specific fisheries management efforts, as well as regional and national organizing by advocacy groups. In the United States, when a catch-share program is implemented, granting initial windfall allocations to community-based groups is highly unlikely in most circumstances, given political pressures to recognize the claims and interests of individual vessel owners and fishery companies. It is more likely, as in Alaska’s CQE program and the New England sectors, that community groups will have to struggle to obtain financing in order to purchase catch-share allocations after they have been granted. Consequently, effort is being directed toward finding capital from public and private sources or creative mixtures, as in the development of innovative financing mechanisms through trusts or the fisheries equivalent of community development corporations, for example, Coastal Enterprises of Maine (<http://www.ceimaine.org>).

In this context, it is also worthwhile to consider the development of TURFs, which provide exclusive access or governance rights to coastal communities over the resources found in adjacent waters, a version of the marine protected area rather than the catch-share system of management. In TURF systems, local communities or user groups claim or are granted exclusive fishing rights to certain fishing grounds or certain species within those grounds. The best-known examples are in Japan (Barrett and Okudaira 1995; Lim, Matsuda, and Shigemi 1995; Makino and Matsuda

2005; Ruddle 1989; Takahashi, McCay, and Baba 2006; Weinstein 2000), Chile (Castilla and Defeo 2001; 2005; Defeo and Castilla 2005), and Mexico (Ponce-Díaz et al. 1998; Ponce-Díaz, Weisman, and McCay 2009), where local fishing syndicates or cooperatives have exclusive concessions for benthic resources in marked territories usually adjacent to the coastal communities involved.

In some regions, such as the Gulf of California, Mexico, such exclusive claims may be associated with marine protected areas, where the local fishers forbid harvesting in an area and claim the exclusive right to harvest once it has recovered (Cudney-Bueno et al. 2009). Research in Mexico and the Philippines shows that where communities are able and willing to defend their territories and to develop high levels of compliance, local, community-oriented management through exclusive fishing territories can be successful in achieving economic, social, and conservation goals. However, defense of territories requires getting recognition and some enforcement support from the larger government, which is often difficult (Cudney-Bueno et al. 2009). Furthermore, enforcing compliance is a complex matter involving process legitimacy, well-defined boundaries, and other factors (Pollnac et al. 2010).

Considerable effort has been directed toward understanding these systems, including recent research on a federation of fishing cooperatives on the Pacific coast of Baja California, Mexico (Ponce-Díaz, Weisman, and McCay 2009). The concession system used for lobsters, abalones, turban snails, and a few other benthic and sedentary species has an impressive history of community-based sustainable fishing, especially for lobsters, whose system received ecocertification from the Marine Stewardship Council in 2004. The ability of fishing cooperatives to fish sustainably is closely tied to the property-rights incentives afforded by the exclusive concessions (Costello and Kaffine 2008). It is also due to conditions well known in the common property literature, including well-defined social and geographic boundaries, high dependence of the local community on the fisheries at stake, high value of the concession species, good comanagement and cooperative research relationships with government agencies, and wide involvement of resource users in monitoring, research, and policy through their cooperatives (McCay et al. 2008).

The TURF model affords a noteworthy alternative to individual and marketable fishing rights. In the best-known cases, the resources at stake are benthic and relatively sedentary, mainly shellfish and crustaceans, or are found mainly on discrete coral reef or lagoon structures. Territorial solutions may be easier to create and enforce for these kinds of resources than for mobile and migratory finfish, a fact that has contributed to much stronger policy and academic interest in enclosure through privatization of access rights and a long delay in addressing whether and how privatized rights might be used in ways that protect and benefit coastal communities. However, in the future, fisheries management may see increased interest in more spatially discrete and place-based management controls even for finfish.

During the past decade, more place-based management of finfish has been a topic of discussion in marine fisheries management, particularly for the Gulf of Maine region. Academic scientists, industry leaders, community development specialists, and The Nature Conservancy have discussed ways to develop more place-

based appreciations of both human behavior and fish-stock biology in the Gulf of Maine. For example, they have recognized the earlier history of discrete inshore spawning events and likely subpopulations and have posed the notion of complex metapopulations (Ames 2004). The metaphor of “roving bandits” has been used to depict the incentive-driven and predatory behavior of fishers in New England, as elsewhere, which poses challenges to effective management (Berkes et al. 2006). Discussions have taken place about ways to change institutions in order to provide the incentives and wherewithal for improved knowledge and harvest management in highly uncertain, complex, and multiscaled natural systems (Wilson 2007). One outcome of these discussions was a set of efforts by the Island Institute, a regional nonprofit organization, and The Nature Conservancy to create permit banking with the explicit intent of increasing fishers’ participation in improving the knowledge base for fisheries management in local areas and protecting the future of small-scale fisheries, which are dependent on local fishing grounds.

Whether exclusive use rights and other property rights will be claimed and defended over local fishing territories in the United States is doubtful, given public trust and constitutional legal constraints. But the history of lobster territoriality in the region suggests that it is premature to ignore TURFs as possible outcomes, particularly where maintaining local control can be a prerequisite for year-round community survival, as in the case of some of the more remote fishing communities (Acheson 1988; 2003; Princen 2005). The larger point of this overview of trends in fisheries enclosure is that greater attention should be given to alternative property rights systems, including community-oriented ones. The current catch-share policy has room for a broader construction. Giving support to communities and small-scale fisheries through permit banking and other measures may help slow trends toward consolidated control and ownership of the right to fish and provide opportunities to experiment with socially and ecologically sensitive, as well as economical, ways to manage fisheries.

REFERENCES

- Acheson, James M. 1988. *The lobster gangs of Maine*. Hanover, NH: University Press of New England.
- . 2003. *Capturing the commons: Devising institutions to manage the Maine lobster industry*. Hanover, NH: University Press of New England.
- Agardy, Tundi. 2000. Information needs for marine protected areas: Scientific and societal. *Bulletin of Marine Science* 66:875–888.
- Agrawal, Arun. 2002. Common resources and institutional sustainability. In *The drama of the commons*, eds. Elinor Ostrom, Thomas Dietz, Nives Dolšak, Paul C. Stern, Susan Stonich, and Elke U. Weber, 41–85. Washington, DC: National Academy Press.
- Ames, Edward P., 2004. Atlantic cod stock structure in the Gulf of Maine. *Fisheries* 29:10–28.
- Anderson, Lee G. 1989a. Conceptual constructs for practical ITQ management policies. In *Rights based fishing*, eds. Philip A. Neher, Ragnar Arnason, and Nina Mollett, 191–209. Dordrecht: Kluwer Academic Publishing.
- . 1989b. Property rights in fisheries: Lessons from the New Zealand experience. Working Paper 89–22. Bozeman, MT: Political Economy Research Center.

- . 2000. The effects of ITQ implementation: A dynamic approach. *Natural Resource Modeling* 13:435–470.
- Andrew, Neil L., Christophe Béné, Stephen J. Hall, Edward H. Allison, Simon Heck, and Blake D. Ratner. 2007. Diagnosis and management of small-scale fisheries in developing countries. *Fish and Fisheries* 8:227–240.
- Apostle, Richard, Bonnie McCay, and Knut Mikalsen. 2003. *Enclosing the commons: Individual transferable quotas in a Nova Scotia fishery*. St. John's, Newfoundland: Memorial University of Newfoundland, Institute of Social and Economic Research.
- Asche, Frank, Håkan Eggert, Eyjulfur Gudmundsson, Ayoe Hoff, and Sean Pascoe. 2008. Fisher's behaviour with individual vessel quotas—Over-capacity and potential rent; Five case studies. *Marine Policy* 32:920–927.
- Avendaño, Pedro. 2006. *Proceedings of Workshop on Land, Territory and Dignity Forum and Artisanal Fisheries, Porto Alegre, Brazil (6–10 March)*. World Forum of Fish Harvesters and Workers. <http://www.foodsovereignty.org/new/documenti/pescafoeroen.pdf>.
- Barrett, Gene, and Tadahiko Okudaira. 1995. The limits of fishery cooperatives? Community development and rural depopulation in Hokkaido, Japan. *Economic and Industrial Democracy* 16:201–232.
- Beddington, J. R., D. J. Agnew, and C. W. Clark. 2007. Current problems in the management of marine fisheries. *Science* 316:1713–1716.
- Berkes, F., T. P. Hughes, R. S. Steneck, J. A. Wilson, D. R. Bellwood, B. Crona, C. Folke, L. H. Gunderson, H. M. Leslie, J. Norberg, M. Nyström, P. Olsson, H. Österblom, M. Scheffer, and B. Worm. 2006. Globalization, roving bandits, and marine resources. *Science* 311: 1557–1558.
- Boyd, Rick O., and Christopher M. Dewees. 1992. Putting theory into practice: Individual transferable quotas in New Zealand's fisheries. *Society and Natural Resources* 5:179–198.
- Branch, Trevor A. 2008. Not all fisheries will be collapsed in 2048. *Marine Policy* 32:38–39.
- . 2009. How do individual transferable quotas affect marine ecosystems? *Fish and Fisheries* 10:39–57.
- Brandt, Sylvia. 2005a. The equity debate: Distributional impacts of individual transferable quotas. *Ocean and Coastal Management* 48:15–30.
- . 2005b. A tale of two clams: Policy anticipation and industry productivity. *Regulation* 28:18–21.
- Brechin, Steven R., Peter R. Wilshusen, Crystal L. Fortwangler, and Patrick C. West. 2003. *Contested nature: Promoting international biodiversity with social justice in the twenty-first century*. Albany: State University of New York Press.
- Bromley, Daniel W. 2003. Rights-based fishing: The wrong concept and the wrong solution for the wrong problem. In *Managing marine fisheries in the United States: Pew Oceans Commission Workshop on Marine Fishery Management*, 35–39. <http://www.pewoceans.org/reports/pew-managing-fisheries.pdf>.
- . 2009. Abdicating responsibility: The deceptions of fisheries policy. *Fisheries* 34:280–290.
- Cartwright, Steve. 2009. Permit banking could help save fishery. *Working Waterfront*, August. <http://www.workingwaterfront.org>.
- Casey, Keith E., Christopher M. Dewees, Bruce R. Turriss, and James E. Wilen. 1995. The effects of individual vessel quotas in the British Columbia halibut fishery. *Marine Resource Economics* 10:211–230.
- Castilla, Juan Carlos, and Omar Defeo. 2001. Latin American benthic shellfisheries: Emphasis on co-management and experimental practices. *Reviews in Fish Biology and Fisheries* 11:1–30.
- . 2005. Paradigm shifts needed for world fisheries. [Letter to the editor]. *Science* 309:1324–1325.
- Christensen, Anne-Sophie, Martin Aranda, Bonnie McCay, H. Anne McLay, Carl Rova, Andrea Leme da Silva, and Franziska Wolff. 2009. Understanding social robustness in selected European fisheries management systems. In *Comparative evaluations of innovative fisheries management*, eds. K. H. Hauge and Douglas C. Wilson, 163–189. Dordrecht: Springer.

- Christie, Patrick, Bonnie J. McCay, Marc L. Miller, Celia Lowe, Alan T. White, Richard Stoffle, David L. Fluharty, Liana Talaue McManus, Ratana Chuenpagdee, Caroline Pomeroy, Daniel O. Suman, Ben G. Blount, Daniel Huppert, Rose-Liza Villahermosa Eisma, Enrique Oracion, Kem Lowry, and Richard B. Pollnac. 2003. Toward developing a complete understanding: A social science research agenda for marine protected areas. *Fisheries* 28:22–26.
- Christy, Frances T., Jr. 1973. Fishermen's quotas: A tentative suggestion for domestic management. In *Occasional Papers 19*. Kingston, RI: Law of the Sea Institute, University of Rhode Island.
- Chu, Cindy. 2009. Thirty years later: The global growth of ITQs and their influence on stock status in marine fisheries. *Fish and Fisheries* 10:217–230.
- Clark, Colin W. 1973. The economics of over-exploitation. *Science* 181:630–634.
- . 1996. Marine reserves and the precautionary management of fisheries. *Ecological Applications* 6:369–370.
- Clark, Colin W., Gordon R. Munro, and U. Rashid Sumaila. 2010. Limits to the privatization of fishery resources. *Land Economics* 86:209–218.
- Clay, Patricia M., and Julia Olson. 2007. Defining fishing communities: Issues in theory and practice. *NAPA (National Association of Practicing Anthropologists) Bulletin* 28:27–42.
- . 2008. Defining “fishing communities”: Vulnerability and the Magnuson-Stevens Fishery Conservation and Management Act. *Human Ecology Review* 15:143–160.
- Copes, Parcival. 1986. A critical review of the individual quota as a device in fisheries management. *Land Economics* 62:278–291.
- Copes, Parcival, and Anthony T. Charles. 2004. Socioeconomics of individual transferable quotas and community-based fishery management. *Agricultural and Resource Economics Review* 33:171–181.
- Copes, Parcival, and Gísli Pálsson. 2000. Challenging ITQs: Legal and political action in Iceland, Canada and Latin America; A preliminary overview. *IIFET Proceedings 2000*, 1–6.
- Cordell, John, ed. 1989. *A sea of small boats*. Cambridge, MA: Cultural Survival.
- Costello, Christopher J., Steven D. Gaines, and John Lynham. 2008. Can catch shares prevent fisheries collapse? *Science* 321:1678–1681.
- Costello, Christopher J., and Daniel Kaffine. 2008. Natural resource use with limited-tenure property rights. *Journal of Environmental Economics and Management* 55:20–36.
- Creed, Carolyn F., and Bonnie J. McCay. 1996. Property rights, conservation, and institutional authority: Policy implications of the Magnuson Act reauthorization for the mid-Atlantic region. *Tulane Environmental Law Journal* 9:245–256.
- Crothers, Stan. 1988. Individual transferable quotas: The New Zealand experience. *Fisheries* 13:10–12.
- Crowder, L. B., G. Osherenko, O. R. Young, S. Airame, E. A. Norse, N. Baron, J. C. Day, F. Douvère, C. N. Ehler, B. S. Halpern, S. J. Langdon, K. L. McLeod, J. C. Ogden, R. E. Peach, A. A. Rosenberg, and J. A. Wilson. 2006. Resolving mismatches in U.S. ocean governance. *Science* 313:617–618.
- Cudney-Bueno, Richard, Luis Bourillon, Andrea Saenz-Arroyo, J. Torre-Cosi, P. Turk-Boyer, and W. W. Shaw. 2009. Governance and effects of marine reserves in the Gulf of California, Mexico. *Ocean and Coastal Management* 52:207–218.
- Defeo, Omar, and Juan Carlos Castilla. 2005. More than one bag for the world fishery crisis and keys for co-management successes in selected artisanal Latin American shellfisheries. *Reviews in Fish Biology and Fisheries* 15:265–283.
- Dubbink, Wim, and Martijn van Vliet. 1996. Market regulation versus co-management: Two perspectives on regulating fisheries compared. *Marine Policy* 20:499–516.
- Dyer, Christopher, and James McGoodwin. 1994. *Folk management in the world's fisheries: Lessons for modern fisheries management*. Boulder: University Press of Colorado.
- Environmental Defense Fund. 2009. Catch shares design manual: A guide for fishermen and managers. Draft. http://www.environmentaldefensefund.org/documents/10400_catch_shares_design_manual_09.09.09.pdf.
- Essington, Timothy E. 2010. Ecological indicators display reduced variation in North American catch share fisheries. *Proceedings of the National Academies of Science* 107:754–759.

- FAO (Food and Agriculture Organization). 2009. *FAO yearbook: Fisheries and aquaculture statistics, 2007*. Rome, Italy: Food and Agriculture Organization of the United Nations. <ftp://ftp.fao.org/docrep/fao/012/i1013t/i1013t.pdf>.
- Federal Register*. 2010. 50 CFR Part 648. Fisheries of the Northeastern United States; Northeast Multispecies Fishery; Framework Adjustment 44; Final Rule. Page 18356. <http://edocket.access.gpo.gov/2010/2010-7235.htm>.
- Funtowicz, Silvio O., and Jerome R. Ravetz. 1993. Science for the post-normal age. *Futures* 25:739–755.
- Gaines, Richard. 2010. NMFS extends sector deadline. *Gloucester Times*, January 4. <http://www.gloucestertimes.com/local/x546183983/NMFS-extends-sector-deadline>.
- GAO (U.S. General Accounting Office). 2004. Individual fishing quotas: Methods for community protection and new entry require periodic evaluation. Report to congressional requesters. GAO-04-277. Washington, DC: U.S. General Accounting Office.
- Goodlad, John. 2005. Co-management and community-based fisheries management initiatives in Shetland. In *Successful fisheries management: Issues, case studies and perspectives*, eds. Stephen Cunningham and T. Bostock, 91–110. Delft: Eburon.
- Gordon, H. Scott. 1954. The economic theory of a common property resource: The fishery. *Journal of Political Economy* 62:124–142.
- Gordon, Kimberly. 2010. Catch share management in New England: Groundfish sectors. Master's thesis. Duke University.
- Grafton, R. Quentin, Ragnar Arnason, T. Bjørndal, D. Campbell, H. F. Campbell, Colin W. Clark, Robin Connor, Diane P. Dupont, Rágnvaldur Hannesson, Ray Hilborn, James E. Kirkley, Tom Kompas, Daniel E. Lane, Gordon R. Munro, Sean Pascoe, Dale Squires, Stein I. Steinsamm, Bruce Turriss, and Quinn Weninger. 2006. Incentive-based approaches to sustainable fisheries. *Canadian Journal of Fisheries and Aquatic Sciences* 63:699–710.
- Grafton, R. Quentin, Dale Squires, and K. J. Fox. 2000. Private property and economic efficiency: A study of a common-pool resource. *Journal of Law and Economics* 43:679–713.
- Haas, Peter M. 1992. Epistemic communities and international policy coordination: Introduction. *International Organization* 46:1–35.
- Hannesson, Rágnvaldur. 2004. *The privatization of the oceans*. Cambridge, MA: MIT Press.
- Hardin, Garrett. 1968. The tragedy of the commons. *Science* 162:1243–1248.
- . 1994. The tragedy of the unmanaged commons. *Trends in Ecology and Evolution* 9:199.
- Heinz Center. 2002. *Managing summer flounder: A Heinz Center dialogue on marine fisheries initiative*. Washington, DC: H. John Heinz III Center for Science, Economics, and the Environment.
- Hennessey, Timothy M., and M. C. Healey. 2000. Ludwig's ratchet and the collapse of New England groundfish stocks. *Coastal Management* 28:187–213.
- Hicks, Robert L., James E. Kirkley, and Ivar E. Strand, Jr. 2004. Short-run welfare losses from Essential Fish Habitat designations for the surf clam and ocean quahog fisheries. *Marine Resource Economics* 19:113–129.
- Hilborn, Ray, J. M. Orensanz, and Ana Parma. 2005. Institutions, incentives and the future of fisheries. *Philosophical Transactions of the Royal Society B* 360:47–57.
- Huppert, Daniel D. 2005. An overview of fishing rights. *Reviews in Fish Biology and Fisheries* 15:201–215.
- Jacobson, Larry, and James Weinberg. 2006. Atlantic surfclam (*Spisula solidissima*). In *Status of Fishery Resources of the Northeastern US, 2006*. NOAA/NEFSC, Resource Evaluation and Assessment Division. Revised December 2006. <http://www.nefsc.noaa.gov/sos/spsyn/iv/surfclam/index.html>.
- Johannes, Robert E. 1978. Traditional marine conservation methods in Oceania and their demise. *Annual Review of Ecology and Systematics* 9:349–364.
- Johnson, Teresa. 2007. Integrating fishermen and their knowledge in the science policy process: Case studies of cooperative research in the northeastern U.S. Ph.D. diss., Rutgers University.
- Kearney, John. 2005. Communities-based fisheries management in the Bay of Fundy: Sustaining communities through resistance and hope. In *Natural resources as community assets*, eds.

- M. W. Lyman and B. Child, 83–100. Washington, DC: Aspen Institute and Sand County Foundation.
- Kearney, John, Arthur Bull, Maria Recchia, Mary Desroches, L. Langille, and G. Cunningham. 1998. Resistance to privatisation: Community-based fisheries management in an industrialised nation. Paper presented to International Workshop on Community-Based Natural Resource Management, the World Bank, May 10–14. Washington, DC.
- Kitts, Andrew, Patricia Pinto da Silva, and Barbara Rountree. 2007. The evolution of collaborative management in the Northeast USA tilefish fishery. *Marine Policy* 31:192–200.
- Kumar, K. G. 2008. Workshop on perspectives from small-scale fishing communities on coastal and fisheries management in eastern and southern Africa, Zanzibar, Tanzania, 24–27 June 2008. Chennai, India: International Collective in Support of Fishworkers. http://www.icsf.net/icsf2006/uploads/publications/proceeding/pdf/english/issue_100/ALL.pdf
- Langdon, Steve J. 2008. The community quota program in the Gulf of Alaska: A vehicle for Alaska native village sustainability? In *Enclosing the fisheries: People, places, and power*, eds. Marie E. Lowe and Courtney Carothers, 155–194. Bethesda, MD: American Fisheries Society.
- Lim, Christina P., Yoshiaki Matsuda, and Yukio Shigemi. 1995. Co-management in marine fisheries: The Japanese experience. *Coastal Management* 23:195–221.
- Lowe, Marie, and Courtney Carothers, eds. 2008. *Enclosing the fisheries: People, places, and power*. AFS Symposium 68. Bethesda, MD: American Fisheries Society.
- Ludwig, Donald, Ray Hilborn, and Carl Walters. 1993. Uncertainty, resource exploitation, and conservation: Lessons from history. *Science* 260:17–18.
- Macinko, Seth, and Daniel W. Bromley. 2002. *Who owns America's fisheries?* Covelo, CA: Center for Resource Economics and Island Press.
- Makino, Mitsutaka, and Kiroyuki Matsuda. 2005. Co-management in Japanese coastal fisheries: Institutional features and transaction costs. *Marine Policy* 29:441–450.
- Mansfield, Becky. 2004a. Neoliberalism in the oceans: “Rationalization,” property rights, and the commons question. *Geoforum* 35:313–326.
- . 2004b. Rules of privatization: Contradictions in neoliberal regulation of North Pacific fisheries. *Annals of the Association of American Geographers* 94:565–584.
- McCay, Bonnie J. 1987. The culture of the commoners: Historical observations on Old World and East Coast U.S. fisheries. In *The question of the commons: The culture and ecology of communal resources*, eds. Bonnie J. McCay and James M. Acheson, 195–216. Tucson: University of Arizona Press.
- . 1993. The making of an environmental doctrine: Public trust and American shellfishermen. In *Environmentalism: The view from anthropology*, ed. Kay Milton, 85–96. London: Routledge.
- . 1995a. Foxes and others in the henhouse? Environmentalists and the fishing industry in the U.S. regional council system. In *Fisheries resource utilization and policy: Proceedings of the World Fisheries Congress, Theme 2*, eds. R. M. Meyer, Chang Zhang, Malcolm L. Windsor, Bonnie McCay, Leroy Hushak, and Robert Muth, 380–390. New Delhi: Oxford and IBH Publishing Co.
- . 1995b. Social and ecological implications of ITQs: An overview. *Ocean and Coastal Management* 28:3–22.
- . 2004. ITQs and community: An essay on environmental governance. *Review of Agricultural and Resource Economics* 33:162–170.
- McCay, Bonnie J., and James M. Acheson, eds. 1987. *The question of the commons: The culture and ecology of communal resources*. Tucson: University of Arizona Press.
- McCay, Bonnie, Richard Apostle, and Carolyn Creed. 1998. ITQs, comanagement, and community: Reflections from Nova Scotia. *Fisheries* 23:20–23.
- McCay, Bonnie J., Richard Apostle, Carolyn Creed, Alan C. Finlayson, and Knut Mikalsen. 1995. Individual transferable quotas (ITQs) in Canadian and U.S. fisheries. *Ocean and Coastal Management* 28:85–116.
- McCay, Bonnie J., and Sylvia Brandt. 2001a. Changes in fleet capacity and ownership of harvesting rights in the United States surf clam and ocean quahog fishery. In *Case studies on the*

- effects of transferable fishing rights on fleet capacity and concentration of quota ownership*, ed. Ross Shotton, 44–60. Rome: Food and Agriculture Organization of the United Nations.
- . 2001b. *Initial allocation in the Mid-Atlantic surf clam and ocean quahog individual transferable quota fisheries: Report*. Rome: Food and Agricultural Organization of the United Nations.
- McCay, Bonnie J., and Carolyn F. Creed. 1987. *Crews and labor in the surf clam and ocean quahog fleet of the mid-Atlantic region*. Dover, DE: Mid-Atlantic Fisheries Management Council.
- . 1988. Dividing up the commons: Management of the U.S. surf clam fishery. In *Marine resource utilization: A conference on social science issues*. Mobile: University of South Alabama.
- . 1990. Social structure and debates on fisheries management in the mid-Atlantic surf clam fishery. *Ocean and Shoreline Management* 13:199–229.
- . 1994. *Social impacts of ITQs in the sea clam fishery: Final report to the New Jersey Sea Grant College Program*. Fort Hancock, NJ: New Jersey Marine Sciences Consortium.
- McCay, Bonnie J., Wendy Weisman, German Ponce-Díaz, Geoff Shester, and Saudiel Ramírez-Sánchez. 2008. Conditions that enable self-governance in managing common-pool resources: A view from the Pacific Coast of central Baja California. Unpublished paper, revised 10 October.
- McEvoy, Arthur F. 1986. *The fisherman's problem: Ecology and law in the California fisheries, 1850–1980*. Cambridge, U.K.: Cambridge University Press.
- McEvoy, David, Sylvia Brandt, Nathalie Lavoie and Sven Anders. 2009. Effects of ITQ management on fishermen's welfare in the presence of an imperfectly competitive processing sector. *Land Economics* 85:470–484.
- McGoodwin, James R. 1990. *Crisis in the world's fisheries: People, problems, and policies*. Stanford, CA: Stanford University Press.
- McKean, Margaret. 1996. Common-property regimes as a solution to problems of scale and linkage. In *Rights to nature: Ecological, economic, cultural, and political principles of institutions for the environment*, eds. Susan S. Hanna, Carl Folke, and Karl-Göran Mäler, 223–243. Washington, DC: Island Press.
- Moloney, David G., and Peter H. Pearse. 1979. Quantitative rights as an instrument for regulating commercial fisheries. *Journal of the Fisheries Research Board of Canada* 36:859–866.
- Murray, Grant, Teresa Johnson, Bonnie J. McCay, Satsuki Takahashi, and Kevin St. Martin. 2010. Cumulative effects, creeping enclosure, and the marine commons of New Jersey. *International Journal of the Commons* 4:367–389.
- National Research Council. 1999a. *The Community Development Quota Program in Alaska*. Washington, DC: National Academy Press.
- . 1999b. *Sharing the fish: Toward a national policy on individual fishing quotas*. Washington, DC: National Academy Press.
- Neher, Philip A., Ragnar Arnason, and Nina Mollett. 1989. *Rights-based fishing*. Dordrecht: Kluwer Academic Publishing.
- NOAA (National Oceanic and Atmospheric Administration) Northeast Fisheries Science Center. 2010. NOAA announces new northeast groundfish management measures. March 31. http://www.nefsc.noaa.gov/press_release/2010/News/NR1008/index.html.
- NOAA (National Oceanic and Atmospheric Administration) Office of Sustainable Fisheries. 2010. Catch share policy. November 4. http://www.nmfs.noaa.gov/sfa/domes_fish/catch-share/docs/noaa_cs_policy.pdf.
- North, Douglas C. 1990. *Institutions, institutional change, and economic performance*. Cambridge, U.K.: Cambridge University Press.
- Olson, Julia. 2011. Understanding and contextualizing social impacts from the privatization of fisheries: An overview. *Ocean and Coastal Management* 54:353–363.
- Ostrom, Elinor. 1990. *Governing the commons: The evolution of institutions for collective action*. Cambridge, U.K.: Cambridge University Press.
- Peacock, F. G., and Christina Annand. 2008. Community management in the inshore groundfish fishery on the Canadian Scotian Shelf. In *Case studies on fisheries self-governance*, eds. Ralph E. Townsend, Ross Shotton, and H. Uchida, 101–110. FAO Fisheries Technical Paper 504. Rome: Food and Agriculture Organization.

- Philippon, Jeremy. 1999. The fish producers' organisations in the U.K.—A strategic analysis. In *Alternative management systems for fisheries*, ed. D. Symes, 79–92. Oxford: Blackwell Science.
- Pinkerton, Evelyn W. 1989. *Cooperative management of local fisheries*. Vancouver: University of British Columbia Press.
- . 1994. Local fisheries co-management: A review of international experiences and their implications for salmon management in British Columbia. *Canadian Journal of Fisheries and Aquatic Sciences* 51:1–17.
- Pinkerton, Evelyn, and D. N. Edwards. 2009. The elephant in the room: The hidden costs of leasing individual transferable fishing quotas. *Marine Policy* 33:707–713.
- Pinkerton, Evelyn, and M. Weinstein. 1995. *Fisheries that work: Sustainability through community-based management*. Vancouver, BC: David Suzuki Foundation.
- Pinto da Silva, Patricia, and Andrew Kitts. 2006. Collaborative fisheries management in the Northeast U.S.: Emerging initiatives and future directions. *Marine Policy* 30:832–841.
- Pollnac, Richard B., Patrick Christie, Joshua E. Cinner, Tracey Dalton, Tim M. Daw, Graham E. Forrester, Nicholas A. Graham, and Timothy R. McClanahan. 2010. Marine reserves as linked social-ecological systems. *Proceedings of the National Academy of Sciences* 107(43):18282–18265.
- Pollnac, Richard B., and John J. J. Poggie. 1988. The structure of job satisfaction among New England fishermen and its application to fisheries management policy. *American Anthropologist* 90:888–901.
- Ponce-Díaz, German, A. Vega-Velázquez, Mario Ramade-Villaneuva, G. León-Carballo, and R. Franco-Santiago. 1998. Socioeconomic characteristics of the abalone fishery along the west coast of the Baja California peninsula, Mexico. *Journal of Shellfish Research* 17:853–857.
- Ponce-Díaz, German, Wendy Weisman, and Bonnie J. McCay. 2009. Co-responsabilidad y participación en el manejo de pesquerías en México: Lecciones de Baja California Sur. *Pesca y Conservación* 1:1–9.
- Princen, Thomas. 2005. *The logic of sufficiency*. Cambridge, MA: MIT Press.
- Rose, Carol M. 1994. The comedy of the commons: Custom, commerce, and inherently public property. In *Property and persuasion: Essays on the history, theory, and rhetoric of ownership*, ed. Carol M. Rose, 105–162. Boulder, CO: Westview Press.
- . 2002. Common property, regulatory property, and environmental protection: Comparing community-based management to tradable environmental allowances. In *The drama of the commons*, eds. Elinor Ostrom, Thomas Dietz, Nives Dolšák, Paul C. Stern, Susan Stonich, and Elke U. Weber, 233–257. Washington, DC: National Academy Press.
- Ruddle, Kenneth. 1989. Solving the common-property dilemma: Village fisheries rights in Japanese coastal waters. In *Common property resources*, ed. Fikret Berkes, 168–198. London: Belhaven Press.
- Schreiber, Laurie. 2010a. Shrinking the fleet, A16, banks and buyouts. *Fishermen's Voice: News and Comment for and by the Fishermen of Maine* 15. <http://www.fishermensvoice.com/0510ShrinkingTheFleet.html> 15.
- . 2010b. Swans Island fisherman inaugurates sector fishing. *Bar Harbor Times*, May 22. <http://mdi.villagesoup.com/news/story/swans-island-fisherman-inaugurates-sector-fishing/327117>.
- Scott, Anthony. 1955. The fishery: The objectives of sole ownership. *Journal of Political Economy* 63:116–124.
- St. Martin, Kevin. 2001. Making space for community resource management in fisheries. *Annals of the Association of American Geographers* 91:122–142.
- . 2005. Disrupting enclosure in New England fisheries. *Capitalism Nature Socialism* 16:63–80.
- . 2006. The impact of “community” on fisheries management in the U.S. Northeast. *Geoforum* 37:169–184.
- St. Martin, Kevin, Bonnie J. McCay, Grant Murray, Teresa Johnson, and Bryan Oles. 2007. Communities, knowledge, and fisheries of the future. *International Journal of Global Environmental Issues* 7:221–239.

- Sullivan, Joe. 2000. Harvesting cooperatives and antitrust law—Recent developments and implications. Paper presented at the annual meeting of the International Institute of Fisheries Economics and Trade, Corvallis, Oregon, July 10–15. <http://oregonstate.edu/dept/IIFET/2000/papers/sullivan.pdf>.
- Takahashi, Satsuki, Bonnie J. McCay, and Osamu Baba. 2006. The good, the bad, or the ugly? Advantages and challenges of Japanese coastal fisheries management. *Bulletin of Marine Science* 78:575–591.
- Tryon, Luanne E. 1993. An overview of the CDQ fishery program for western Alaskan native communities. *Coastal Management* 21:315–325.
- Turnipseed, Mary, Larry B. Crowder, Rafael D. Sagarin, and Stephen E. Roady. 2009. Legal bedrock for rebuilding America's ocean ecosystems. *Science* 324:183–184.
- Weinstein, Martin S. 2000. Pieces of the puzzle: Solutions for community-based fisheries management from native Canadians, Japanese cooperatives, and common property researchers. *Georgetown International Environmental Law Review* 12:375–412.
- Wiber, Melanie, Anthony T. Charles, John Kearney, and Fikret Berkes. 2008. Enhancing community empowerment through participatory fisheries research. *Marine Policy* 33:172–179.
- Wilson, James. 2007. Scale and costs of fishery conservation. *International Journal of the Commons* 1:29–41.
- Worm, Boris, Edward B. Barbier, Nicola Beaumont, J. Emmett Duffy, Carl Folke, Benjamin S. Halpern, Jeremy B. C. Jackson, Heike K. Lotze, Fiorenza Micheli, Stephen R. Palumbi, Enric Sala, Kimberley A. Selkoe, John J. Stachowicz, and Reg Watson. 2006. Impacts of biodiversity loss on ocean ecosystem services. *Science* 314:787–790.
- Worm, Boris, Ray Hilborn, Julia K. Baum, Trevor A. Branch, Jeremy S. Collie, Christopher Costello, Michael Fogarty, Elizabeth A. Fulton, Jeffrey A. Hutchings, Simon Jennings, Olaf P. Jensen, Heike I. Lotze, Pamela M. Mace, Tim R. McClanahan, Colin Minto, Stephen R. Palumbi, Ana M. Parma, Daniel Ricard, Andrew A. Rosenberg, Reg Watson, and Dirk Zeller. 2009. Rebuilding global fisheries. *Science* 325:578–585.