

THE DRAMA OF THE COMMONS

Committee on the Human Dimensions of Global Change

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Common Property, Regulatory Property, and Environmental Protection: Comparing Community-Based Management to Tradable Environmental Allowances

Carol M. Rose

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The days are long gone in which environmentalists have believed that there is a “nature” or “natural world” separable from human activity. Our newspapers are full of stories of the human impact on what might be otherwise fondly thought of as pure “nature,” from the ocean depths through the remotest forests to the skies above; the consequences of human agriculture, transportation, manufacture, and resource extraction affect even the most seemingly inaccessible corners of the globe.

Because no part of the world’s environment is untouched by human activity, environmental protection must be seen in large measure as a matter of human social organization. But what social organization is possible for dealing with environmental resources? The pessimistic views of Hardin, and his successor Ophuls, have been well-known for decades: On Hardin’s analysis, as elaborated by Ophuls, environmental resources are the locus of the “tragedy of the commons,” a multiple-person prisoners’ dilemma (PD) (Hardin, 1968; Ophuls, 1977; Ullmann-Margalit, 1977). Here it is in the interest of each resource user, taken individually, to exploit the resource *à outrance* while doing nothing to conserve, with the result that otherwise renewable resources instead become wasting assets. In the Hardin/Ophuls view, environmental degradation—overfishing, deforestation, overgrazing, pollution, whatever—is only a bleak set of repetitions of the “tragedy,” and only two solutions are possible to stave off the tragic decimation: individual property on the one hand, which internalizes the externalities of common pool exploitation, or “Leviathan” on the other, where governmental directives force individuals to perform in ways that promote the common good (Hardin, 1968; Ophuls, 1977).

The great service of Ostrom and her colleagues has been to contest this unattractive view, and to offer a powerful set of counterexamples of conservationist social institutions. Ostrom and others have pointed out that the problem that Hardin called “the commons” was really a problem of “open access,” whereas a common resource that is limited to a particular group of users may suffer no such decimation. Indeed, Hardin’s dominating example of the medieval common fields was not tragic at all, but was rather an example of a set of community-based sustainable agricultural practices that lasted for centuries, if not millennia (Cox, 1985; Dahlman, 1980; Ostrom, 1990; Rieser, 1999; Smith, 2000).

As the first chapter of this book notes, there has been considerable variety in the nomenclature that refers to such limited common resources and the community governance processes that manage them,¹ but for purposes of this chapter, I will refer to community-based management regimes for common property resources as “CBMRs.” I use this term to convey what I hope is a subtly greater attention to governance institutions and practices, rather than to the common-pool resources that underlie them; obviously, however, the physical and the institutional are intertwined—no doubt giving rise to the difficulties in nomenclature.

Whatever the names and emphases, institutions for managing common resources have become the subject of a growing and rather affectionate literature. This literature includes descriptions and analyses of un-tragic community resource management practices all over the world—Turkish fisheries, Japanese and Swiss grazing communities, ancient and modern Spanish irrigation systems, communal forestry in India and Indonesia, wetlands management by medieval English “fen people,” fishing and hunting practices among northern Canadian clan

groups, lobster fishing communities in Maine (Berkes, 1995; Bosselman, 1996; Ostrom, 1990).

Obviously, there is a great deal to be said simply for setting the record straight about what the "commons" really mean and have meant over time. But there are larger lessons implicit or explicit in the CBMR literature as well, and they are lessons of a somewhat more political nature. First is the lesson that voluntary social action is possible, and in particular that it is possible as a means to solve resource-related problems. That is to say, contrary to some of the more pessimistic presentations of the dismal science, human beings are not always individual maximizers, getting themselves stuck in the endless repetition of n-person PDs. Instead, quite ordinary people have the psychological, social, and moral wherewithal to arrive at cooperative arrangements on matters of common interest. A second lesson is that bigger is not always better. More particularly, the CBMR literature offers numerous examples in which larger governmental forays into resource management are distinctly inferior to community-based solutions, and in which governmental intervention has badly damaged perfectly workable community systems (Higgs, 1996; Ostrom, 1990; Pinkerton, 1987). In short, the ever-expanding CBMR scholarship argues strongly that nongovernmental, community-based resource management can offer models for efficient and sustainable resource use.

Given the surge of interest in community-based resource regimes, it is curious that their institutional structures do not appear more frequently in legal proposals for the improvement of environmental regulation. This is not because legal scholars are unaware of the literature on community-based common property. Although CBMR scholars for the most part appear to be untouched by legal scholarship, the reverse is not true; legal scholars regularly cite the major studies in a number of contexts, from intellectual property (Merges, 1996) to the burgeoning literature on informal norms (Ellickson, 1991). The legal scholarship on the Internet in particular has drawn analogies to the bottom-up community self-organization that has emerged in much older common resource regimes (Rose, 1998). Nevertheless, aside from a handful of scholars (Bosselman, 1996; Rieser, 1997; Rose, 2000), few in the legal academy have paid much attention to community-based management institutions as potential engines to drive improved *environmental* regulation.

Instead, among legal scholars, the poster children of proposed environmental improvement are a new version of individual entitlements that I will call tradable environmental allowances (TEAs). In TEA regimes, governmental regulators in effect place an upper limit or cap on the total quantity of a given resource that is to be available for use, whether the "use" is extractive or polluting. The regulators then divide the capped total into individual allowances. Henceforth they require all resource users to purchase or trade for whatever allowances they use.

TEAs along this model already have been deployed, to great applause, for the regulation of sulfur dioxide pollution in the United States; they have been used to manage fisheries in Australia, New Zealand, and elsewhere; and they are under much discussion as an element of future international regimes to control greenhouse gases (Rieser, 1997; Stavins, 1998; Tietenberg, 1985; Tietenberg, this volume: [Chapter 6](#)).

At least in theory, each TEA regime transforms access to the resource in question into a divisible but finite total quantity, and each individual resource user must pay for every pound of pollution released into the atmosphere or every pound of fish landed; resource use thus becomes in effect a kind of private property that must be acquired through purchase and trade. The property-like characteristics of TEAs are at the heart of their attractiveness. As has been so often argued about more conventional private property, the underlying idea is that if resource users are confronted with the need to purchase TEAs, they will husband resources carefully and will undertake conservation or innovation to substitute for their now expensive resource use (Ackerman and Stewart, 1988; Kriz, 1998; Rose, 1994; Tipton, 1995).

Although TEAs do not entirely vindicate the Hardin/Ophuls view that the choice for governing structures lies *either* with private property *or* with Leviathan, TEAs—much more than the self-organized CBMRs—do have a Hardin/Ophuls ring about them. TEAs in effect *combine* Leviathan with private property; they are state-created private rights, tradable in a market along with other commodities.

Despite the differences between TEA and community-based institutions, however, these two types of resource management regimes share a basic underlying structure. Neither takes a “hands off” approach to environmental protection. Quite the contrary, both types of regime contemplate some human use or consumption of renewable resources, whether those resources are wildlife, fish, grasses, trees, the air mantle, underground aquifers, surface water stocks, or whole ecosystems. Moreover, although both types of regime contemplate some human inroads into the resources they regulate, for both regimes the critical issue is to limit those inroads to moderate “fringe” amounts that are compatible with the renewal of the underlying cores of the resource stocks. And finally, both types of regime are fundamentally *property* regimes—individual property in the case of TEAs, common property in the case of CBMRs; in neither case are resources open to the world at large, but are rather treated as the domain of their respective individual or common owners.

Beyond those basics, however, CBMR and TEA regimes often diverge dramatically, so much so that one can see them as alternative ideal types for very different approaches to property-based environmental management. For example, in TEA regimes, as in all modern legislative programs, legislators and the public may discuss explicitly the appropriate permissible “fringe” usage of the resource in question, that is, the total allowable take or total cap placed on resource use (Ackerman and Stewart, 1988). In CBMRs, on the other hand, explicit discussions of this sort are less likely to occur, and the total take is more likely to emerge from established practices—practices that themselves may originate in efforts to manage interpersonal conflict rather than to engage in explicit management of the larger resource (Bardhan and Dayton-Johnson, this volume: [Chapter 3](#); McCay, this volume: [Chapter 11](#); Seabright, 1993). Even more noticeable are the very different ways in which individual entitlements are allocated and enforced in the two types of regime. In TEA regimes, regulatory bodies split up the allowable total take into individual allowances and allocate these allowances; thereafter the allowance holders may trade among themselves as they wish, subject to monitoring and enforcement by the regulators. In community-based regimes, on the other hand, the user groups’ own practices set individual entitlements. These entitlements generally depend on longstanding residence, reputation, and adherence to community norms—norms that are often very elaborate, and that are enforced by the community members themselves—and trading is often quite restricted. I will return shortly to both these subjects, that is, the questions of setting the total take on the one hand, and the structures of entitlements on the other hand. I will do so because both subjects have some bearing on the series of comparisons to which I now turn.

In the comparisons that follow, I treat CBMR and TEA regimes as ideal types of property-based environmental management. One caveat: It is important to bear in mind that the community-based common property regimes that are best known are often of long duration, which means that they are apt to be quite traditional, whereas TEA regimes tend to be quite new; this is a factor that can in itself accentuate differences between these regimes. A second caveat runs in the opposite direction: Real life being a more blurred affair than are any “ideal types,” one finds in practice that more-or-less community-based regimes sometimes share characteristics with more-or-less tradable allowance regimes. Indeed, as I will illustrate later, some quite promising ideas for modern environmental management try to combine these different approaches. But in setting out CBMR and TEA regimes as more or less “pure” types, I hope to illuminate some of their typical characteristics. More important, I hope to show how these differing typical characteristics map onto different dimensions of current environmental problems, and how they result in quite different strengths and weaknesses as modes of property-based environmental management.

CBMR AND TEA REGIMES AS MANAGEMENT INSTITUTIONS: VARYING SOLUTIONS UNDER VARYING CONDITIONS

Resource Size

One important dimension of any environmental issue is simply the *size* of the resource in question. Environmental resources are generally too large for individual ownership. In fact, that is what creates environmental problems: Individual resource uses have spillover or common-pool effects on other persons and resources. Individual landholdings generally lie adjacent to environmental resources such as air, surface water, groundwater, and wildlife. But the landowner who burns trash affects the neighbors' air. Similarly, the landowner who removes trees on his or her own land may diminish nesting bird populations and contribute to an insect explosion throughout the vicinity. Similarly again, the landowner who spills toxins on the ground may pollute an aquifer or a stream that carries the deadly materials miles into the distance. In all these instances, individual uses of individual property spill out into a larger environmental arena. Global environmental issues implicate activities in vastly larger spaces; the most everyday form of combustion anywhere in the world—a motor scooter, a backyard barbecue—may contribute to greenhouse gases that raise global temperatures, lift the levels of the oceans, and contribute to melting tundra (Wiener, 1999).

CBMRs and Resource Size

The sheer size of many environmental problems may be one reason why community-based institutions have been relatively little noticed as social management regimes for the environmental resources that are typically the candidates for legal regulation. With some limited exceptions, CBMRs tend to encompass activities only on a fairly small scale.

Many CBMRs have been studied in the context of a burgeoning "new institutional economics," a line of scholarship concerning nongovernmental social problem solving of all sorts, and this scholarship suggests some reasons for the generally small scale of community management institutions. An emerging consensus suggests that human beings can overcome PD problems, including the *n*-person PDs in the form of the "tragedy of the commons"; indeed, this is one of the chief lessons of new common property scholarship. But certain group factors are very helpful in overcoming such problems—especially relatively small numbers in a group, kinship or other intense relationships such as religion, and/or interactions among group members on wide numbers of fronts. Such factors make it possible for group members to monitor one another closely and with relatively low costs, and therewith to form mutually trusting relationships and shared behavioral norms; trust and norms in turn allow people to overcome commons problems, of which environmental problems are one example (Ellickson, 1991; Greif, 1989; Ullmann-Margalit, 1977).

But where environmental problems have large or even global dimensions, as they often do, the small size of many or most community management institutions would appear at first blush to render them irrelevant. The usual range of social interactions around CBMRs seem simply too limited to contain larger environmental damage. Indeed, the coordinated activities involved in such group practices may exacerbate that larger damage. Nineteenth-century whalers, for example, often came from the same towns even though they navigated the globe; at home they enjoyed thick familial and associative relationships. Perhaps not surprisingly, when they were at sea these neighbors generated group customary practices that assisted in the cooperative capture of their large and dangerous prey. But no overarching intergroup social norms ever developed among the far-flung groups of whalers to regulate the total catch of the various types of whales, with the well-known result that a number of the most valuable species were decimated (Ellickson, 1991).

"Nested" CBMRs

The small-size pattern does not hold across the board for all community-based management institutions. Ostrom (1990, 1992) gives examples of venerable irrigation networks that have spread over entire watersheds, “nesting” smaller community institutions into larger cooperative entities. For this reason, as Snidal (1995:57) notes, Ostrom regards size as an overrated factor—secondary to institutional structure—in the success or failure of community-based resource governance. Nevertheless as Snidal (1995:59, n.20) also suggests, a number of Ostrom’s

criteria for successful CBMR institutions do implicitly limit size. Moreover, although communities may enlist (or be enlisted by) wider scale governments for aid in management, in such cases the larger enforcing and/or coordinating entity becomes governmental rather than self-organized (Oye and Maxwell, 1995; Snidal, 1995).

In any event, the primary example of nested CBMRs is irrigation, but irrigation, with its intensive human intervention into natural systems, presents at best an ambiguous case of environmental conservation. Putting that problem to one side, irrigation also may be something of a special case among community management institutions, indeed an exception that suggests why the smaller CBMRs are more generally prevalent. The key probably lies in monitoring. Although the origins of most community-based natural resource management regimes are unknown, if they do emerge from efforts to contain resource competition and dispute, as McCay suggests (this volume: [Chapter 11](#)), it is plausible that the activities giving rise to management institutions are generally those in which the members of a community can observe one another’s behaviors and their impact on a shared common resource. Resource-related activities involved in irrigating— taking water from ditches, laboring on infrastructure development and upkeep— are especially open to mutual monitoring. Not only can one farmer observe another farmer along the same ditch, but upstream and downstream communities can observe what other communities are doing with respect to water use and infrastructure maintenance (Maass and Anderson, 1978; Ostrom, 1990).

But in the case of many environmental resources—for example, wide-ranging fish or animals, or widely dispersed or invisible pollution—community members are unlikely to observe the impacts of behaviors even within the community, much less the environmental impacts of others on an intercommunity basis. Hence communities may not generate resource-related norms with respect to the entire resource, but at most with respect to some aspect of its use (McCay, this volume: [Chapter 11](#)). Perhaps it is for this reason that aside from irrigation, there are few examples of wider scale, nested community management institutions, at least on a self-organizing basis. This is not to say, of course, that larger governmental institutions might not intervene to organize “nested” CBMRs, as Agrawal and Ribot (1999) argue in the case of community forestry in the Kumaon District of India. Insofar as formal governments act as overall managers, CBMRs share an important feature with TEA regimes.

TEAs and Resource Size

Turning to TEAs and their relation to resource size, TEA regimes are quite different from typical community-based institutions in that they seem particularly attuned to larger resource size. TEA systems are formally structured by governments, and they generally rely on impersonal governmental enforcement rather than social norms. Thus in principle these institutions can encompass environmental problems that coincide with the scope of governments themselves, or even with larger areas subject to intergovernmental agreements.

Quite aside from their governmental origins, there are other important structural reasons why TEAs operate best at larger scales, and rather more poorly at a local level. One of the positive features of TEAs is precisely that they can be traded, so that the allowances tend to flow to those who value them most. But trading works best in large, thick markets. That is why TEAs are feasible for far-ranging gases like sulfur dioxide, where many market participants can participate in trades, but are less easily established for more localized pollutants (Schmalensee et al., 1998).

One intriguing possibility, explored particularly by Rieser in the context of fisheries, again blurs certain aspects of TEAs and CBMRs: She suggests that a TEA regime might allocate at least some quota to communities rather than to individuals (Rieser, 1997). This is an approach that would open the door for community-based institutions under the auspices of TEA regimes, and that could combine the large scale of TEAs with community-based institutions' more nuanced approaches to resource complexity, a subject discussed later in this chapter. If, as Ostrom argues, the key to larger scale community resource management is institutional structure, and if, as Snidal argues and as Berkes (this volume: [Chapter 9](#)) describes, community regimes have already relied on larger governments for coordination and enforcement, then TEAs might offer an interesting institutional structure for that coordination, a kind of "nesting" of CBMRs through market-organized institutions.

One final note on resource size: Even when they remain uncoordinated and un-"nested," an enclave community's resource regimes still may be relevant to some important environmental problems, including global ones. Some seemingly large-scale environmental issues are in large part an additive sum of intensely local ones. "Biodiversity loss," for example, is in some measure an umbrella term for a whole series of local losses, from golden-cheeked warblers in Austin, Texas, to radiated tortoises and lemurs in Madagascar (Webster, 1997). In the United States, the most serious threat of species loss is in isolated Hawaii. This pattern is typical; it is precisely the isolated areas that are most likely to have the unique plants and animals that come under siege in a modern economy (Dobson et al., 1997). Moreover, global problems may have at least some localized solutions; greenhouse gases, for example, may be sequestered in local forests, and local forests may be managed through community institutions. Insofar as environmental problems can be subdivided into more local ones, then, even the typically small CBMRs still may be players in the environmental game.

Resource Complexity

The statement that everything is connected to everything else is a truism in environmentalism. Pull one thread, it is often said, and the entire skein unravels.

If true, this complex interconnectedness would create problems for either TEA regimes or CBMRs, because both contemplate some use of resources. To be environmentally friendly, both TEA regimes and CBMRs must contemplate some constriction on allowable use, that is, constriction to a level that is compatible with renewability of a whole complex network of resources in which the target resource is embedded. Thus the complexity and interactiveness of environmental resources brings us back to an subject mentioned earlier: What is the appropriate level of use, the total "take" or cap on any given environmental resource? I discuss this question briefly before coming back to CBMRs and TEAs.

The fishing industry may have been the first to attempt to answer this question in a disciplined way (Scheiber and Carr, 1997). Toward the end of the 19th century, fishing industry experts hit on the concept of "maximum sustainable yield," an amount that related fishing effort to its effect on the underlying stock; in this analysis, the appropriate limit on total fishing effort was one that could maintain a consistent maximum catch level. Similar ideas soon pervaded forestry practices, as reflected in the U.S. Forest Service's mantra of MUSY (maximum use, sustainable yield). By the 1950s, the great resource economist Gordon refined the model, observing that the appropriate *economic* goal should be not to maximize the yield but rather the "rents," the difference between revenues and the costs of extraction. Gordon's work suggests that instead of the goal of maximum yield, the object of resource management should be "maximum *economic* yield" (MEY), a total take level that is rather more conservationist, and that has become the new conventional wisdom in resource economics (Gordon, 1954; Townsend and Wilson, 1987; Brown, 2000).

But more recent scholarship has cast doubt even on the MEY goal in the environmental context. Once again, fishing gives an example. Although human catch levels clearly influence fish populations, many other things do as well: weather patterns, shifts in water temperature

and currents, alterations in food sources and predators, to name just some factors. All these fluctuating elements undermine not only the concept of an ideal climax equilibrium state for any given resource, but also the idea of a smoothly curved relationship between human activity (e.g., fishing or pollution) and resource stock levels (e.g., bountiful fish or clean air). The new "nonequilibrium" thinking suggests that complex and interrelated resources fluctuate in much spikier patterns, and that the best management method may be what is called "adaptive management"—basically, intense use followed by rapid shifts away from the resource at early signs of trouble, allowing the resource to recover (Tarlock, 1994; Townsend and Wilson, 1987).

Now we return to TEAs and CBMRs, beginning with TEAs.

TEAs and Resource Complexity

The rhetoric of the total take or cap in TEA regimes often sounds rather close to the resource economists' conventional models. In analyzing "optimal pollution," for example, the goal is often said to be to equate prevention costs and

environmental damage at the margin, as illustrated by curves on the conventional charts (e.g., Kaplow and Shavell, 1996). In fact, however, current TEA regimes have set total caps in a manner that departs from economic models and instead generally have taken historic practice as the benchmark. That is, they generally roll back previous use levels by some agreed-on percentage (Heinzerling, 1995; Stavins, 1998; Tipton, 1995).

It is hardly surprising that rollback should be the method of setting the allowable totals for TEA regimes. The introduction of any new environmental regulatory practice generates intense political pressures; this is particularly the case for a regulatory change in which resource users have to pay for something that they previously took "for free" (Libecap, 1989). Rollback is an easy concept to grasp, and it seems to distribute costs with some rough justice. Moreover, rollback can be quite effective to reduce total use; for example, the United States' acid rain control legislation, which instituted TEAs in sulfur dioxide, cut total sulfur dioxide production by quite substantial amounts (Schmalensee et al., 1998). All the same, rollback can hardly be called adaptive management. Although rollback amounts can be rolled back even further in the future, political inertia creates "stickiness" for rapid adaptation once rollback levels are set.

Moreover, another factor also impedes rapid adaption in TEA regimes, bringing us again to a second subject mentioned earlier: the methods of allocating individual entitlements. If TEAs are to bring the usual advantages of property rights—encouraging care and investment by rights holders—then individual allotments must be relatively secure, so that the holders of these rights can rely on them and plan accordingly. Moreover, if TEAs are also to bring the standard benefits of trading and marketability, allowing the entitlements to flow to those who value them most, then these allowances must be relatively simple; simplicity is necessary to allow that these rights to be more or less fungible, and to enable future holders to know what they have. Thus if regulation hedges TEAs with qualifications and conditions, it will undermine both their security and their marketability (Rose, 2000).

This pattern creates something of a flexibility dilemma for TEA regimes. In New Zealand, for example, TEAs for fishing were first set in absolute quantities, but fishery managers quickly realized that if they had to scale back the total allowable catch for the health of the larger fishery, they would face claims for compensation by TEA holders. Noticing this issue, and noticing the reluctance that buy-back programs elicit among politicians, many proponents of TEAs propose that the TEA be set at a given *percentage* of the resource rather than at some fixed *amount*—the solution, incidentally, that New Zealand now has adopted (Clark et al., 1989; Tipton, 1995). But of course this solution entails an unavoidable tradeoff: a percentage-based right, like a short-term right, offers less security and marketability to the holders.

These are not insuperable problems for TEA regimes, and some ingenuity can no doubt help to create a practical balance between flexibility and security, as is the case with other property regimes—even landed property, which is relatively secure but still subject to eminent domain and regulation. But the problems do suggest that TEA regimes may be insufficiently responsive where environmental resources are most densely interactive, complex, and fluctuating; recent commentators, for example, note the difficulties of applying TEAs to the densely interactive resources of wetlands (Salzman and Ruhl, 2000).

Related enforcement problems also derive from the necessarily relatively simple rights structures of TEAs. Because TEAs are designed to be traded, their rights structures must be fairly simple; otherwise they could not be marketed easily. In the air pollution area, TEAs focus on a single pollutant such as sulfur dioxide for the existing regulations for acid rain precursors; perhaps future regulation of greenhouse gases will focus on carbon dioxide. In fisheries too, TEAs also may be defined in some measure of weight for particular species; for example, each TEA corresponds to some number of pounds of quahogs or surf clams. But these relatively simple measures can lead to problems when applied to complex and interactive resources. For example, in fishing, the gross weight of the landed catch may correspond only very inexactly with species conservation. Holders of fishing TEAs know that the larger fish are more profitable than the small ones, and “highgrading” fishermen may actually catch far more fish than their allowances suggest, throwing out the small specimens and keeping the large fish. Just as serious in a complex ecosystem, TEAs in a target species may make fishermen careful about that species, but they may kill with abandon other unmarketable species as “bycatch” (Tipton, 1995; Rieser, 1997; Rose, 2000).

These problems of highgrading and bycatch have been noticed in the literature on fishing TEAs, and although bycatch problems may be less severe under TEA regimes than under some alternative regulations (Tietenberg, this volume: [Chapter 6](#)), even strong TEA proponents have suggested that supplemental command-and-control regulation may be required to control these problems (Hsu and Wilen, 1997). As I have noted elsewhere, these problems are examples of a phenomenon that might be classed as “too much property”: Creating property rights in one resource may create an imbalance, drawing care and attention to the propertized resources, but crowding out nonpropertized resources (Rose, 1998). Imbalances of this sort are apt to be most serious where resources interact in complex ways. Unless hedged with other regulations or supplementary property regimes, property rights in a single segment of this web could undermine the larger ecosystem. But regulatory hedges complicate the TEA property rights, making them less secure for the holders and less tradable to others.

If TEAs raise questions with respect to their suitability for complex resources, CBMRs, interestingly enough, fare rather better on this dimension.

CBMRs and Resource Complexity

Even though traditional community resource institutions are far less organized around rational planning, and far more driven by custom and norms, some of their management practices may have certain advantages with respect to adapt ability to complex resources. The new, dynamic understanding of environmental resources suggests that intensive use and prompt switching are appropriate adaptive management techniques for complex resource bases (Townsend and Wilson, 1987). Even if not planned to do so, certain traditional resource practices follow this pattern, insofar as hunting, fishing, planting and gathering are undertaken in “pulse” patterns, moving from resource to resource over the course of time (Berkes, 1987; McEvoy, 1986).

This pulse pattern sometimes follows no set of conscious calculations about the whole stock. Indeed, a common traditional belief in hunting and fishing communities is that human activity does *not* affect the stocks of wild animals. Some apparently think it disrespectful to the hunted animals or fish to suggest that they are influenced by human action; instead, the resource stocks are thought to be controlled by the animals themselves, or by God (Berkes, 1987;

Brightman, 1987; Carrier, 1987). It would be overly romantic to think that such beliefs constitute a general "respect for nature," or that "respect" for given wildlife resources necessarily entails conservation. Quite the contrary, the idea that the animals control their own numbers may impede any effort to restrain hunting or fishing, and concepts of "respect" may cause opposition to modern resource management techniques such as counting the fish or other wildlife (Berkes, 1987). For this reason, traditional beliefs in some circumstances could contribute to the decimation of particular resources; this may be most likely to happen when traditional practices are confronted with sudden shifts in commercial demand from outsiders, a subject to which I will return shortly. This is not to deny the evidence that some traditional groups have indeed incorporated conservation into their concepts of "respect," perhaps as a result of experiencing and learning from resource depletion shocks (Berkes, 1987; Brightman, 1987). Quite aside from conscious consideration of overall resource stocks, however, traditional hunting, fishing, and gathering practices often rely on diversified resource bases, where pulse patterns of exploitation and relatively low technological methods often leave behind sufficient stocks to regenerate, corresponding in a rough way to more formal adaptive management practices (Berkes, 1987; McEvoy, 1986).

In more settled CBMRs, such as grazing or irrigation regimes, the participants are more likely to be explicit in adjusting their own impacts on underlying resources. This may be because agricultural resources and water levels are more visible than wildlife stocks, and hence the human impact can be monitored and more easily subjected to group discipline. Here, too, some communities' traditional practices respond adaptively to overall resource levels, perhaps more so than in communities dependent on wildlife. For example, Swiss grazing villages limit the right of any resident to "common" more sheep than the resident can feed over the winter; this is a rule that limits individual usage of the common fields and roughly calibrates consumption to the forage available (Netting, 1981). Irrigation communities also carefully adjust individual water appropriation to seasonal water levels (Ostrom, 1990, 1992; Maass and Anderson, 1978).

These adjustments are possible for CBMRs because the individual entitlements in such regimes often are defined in complex ways that incorporate seasonal or resource-related variations—unlike the more fixed TEA entitlements. There is a tradeoff here, as there is in TEAs, but it is made in the opposite direction. Community management practices often show considerable flexibility and responsiveness to dynamic natural change, but at the cost of the security and tradability that promotes investment and innovation; TEAs, on the other hand, promote investment and trade but at the cost of some responsiveness to complex natural change.

Extraction vs. Pollution

Environmental problems may be grossly divided into two classes: the pollution or "putting-in" issues, and the "taking-out" or extractive issues, such as fishing or hunting or even farming. Curiously enough, in a very rough way, this distinction maps onto TEA regimes and CBMRs. Although there are currently some extractive TEAs in the form of individual fishing quotas, the best known TEAs were created to regulate pollution—that is, the sulfur dioxide TEAs in the U.S. acid rain program (Stavins, 1998). Proposed new applications of TEAs also tend to focus on pollution control, particularly the effort to cut back on global greenhouse gas emissions. In contrast, community-based institutions are generally organized around "taking out" or extractive issues—fishing, hunting, irrigation, agriculture, grazing, and the like.

What are the reasons for this pattern? Any answer is necessarily speculative, but there are some possible reasons for this rough division of labor, some of them harking back to subjects touched on earlier.

First is the factor of regime size, as compared to the size of the common-pool problem it addresses. Pollution problems are typically externalized onto outsiders, in part or in whole. Although community management practices undoubtedly control the ill effects of pollution within the community, participants are unlikely to have much motivation or ability to contain

pollution that primarily affects outsiders, except insofar as they are required to do so by interactions with “downstream” communities. Indeed, the very activities that clean up pollution within a community could exacerbate pollution elsewhere, as in pouring wastes into a river or stream. TEAs, on the other hand, are typically organized by larger governmental bodies, and they are aimed precisely at controlling external effects of the use of environmental resources (Esty, 1996). Thus where the environmental issue is pollution, and particularly pollutants that flow far from their source, TEA regimes would seem to be more practicable than CBMRs as property approaches to environmental issues. Some extractive issues may have common-pool effects over large areas (e.g., whale hunting), but many are more localized, as in reef fishing or grazing in particular mountain meadows, and hence they may be managed by the smaller CBMRs.

A second factor is monitoring. Both CBMRs and TEA regimes depend on monitoring; indeed, every property-based regime must have the ability to ascertain whether rights holders stay within their allotments or the entire regime will unravel. But in general, extractive activities are much easier to monitor than are polluting ones. Harvested logs can be observed, the catch from fishing or hunting can be seen, and overuse of grazing fields is noticeable. Pollution, on the other hand, may be entirely invisible. Although some extractive activities may be undertaken surreptitiously (e.g., cheating in taking water from irrigation ditches), CBMRs generally structure rights so that community members can monitor and control one another with respect to this type of overreaching (Ostrom, 1990; Smith, 2000).

Whatever difficulties there may be in monitoring extractive activities, they generally pale by comparison to the problems of monitoring the introduction of pollutants into the air or water or groundwater. Not only does the receiving medium disperse the polluting elements, but insofar as pollutants are invisible and intangible, even polluters themselves may not know what they are doing. Then too, where CBMRs involve relatively small and scientifically unsophisticated communities, as they often do, the participants may lack the technical ability to monitor many forms of pollution. For TEA regimes, monitoring pollutants is also a critical and extremely difficult issue, but larger governments enjoy economies of scale with respect to scientific research (Esty, 1996). Indeed, TEAs have become feasible only as governments have acquired the technical skills to monitor and model pollutants, such as with remote sensing satellites or with sophisticated chemical tags (Rose, 1998; Schmalensee et al., 1998; Tietenberg, this volume: [Chapter 6](#)).

A third factor may relate the different feedback effects of “putting in” and “taking out” activities, a point that relates to the new dynamic model of the environment discussed earlier. When certain resources—such as fruits or shellfish—are extracted from a larger ecosystem, deleterious effects may ripple in unexpected feedback loops throughout the entire ecosystem. But here the practical “adaptive management” of CBMRs may be advantageous; their adaptive practices can respond to particular resource shortages by moving on to others before the ill effects of overextraction cause resource crashes, with all the attendant disruptions to the larger ecosystem.

Like extractions, pollutants have ripple effects throughout an ecosystem. For that reason, the *removal* of any given pollutant also can have ripple effects. But in the case of pollution removal, unlike extraction, the ripple effects generally are considered an unalloyed good. For this reason, the simple and single-element focus of TEAs is generally unproblematic with respect to pollution control; the removal of, say, SO₂ undoubtedly does have synergistic effects that are not taken into account by TEA holders, but those effects are all positive. But by the same token, the more flexible and multidimensional responses of community management practices may give no particular advantage with respect to pollution removal. Even if the TEA regime reduces pollution in a way that is entirely simple and focused on a single resource, that diminution in pollution is still likely to represent an advance over a more polluted condition. Flexible and multidimensional responses—where CBMRs may have an advantage—are not necessary to create this benefit.

For these various reasons, one might expect CBMRs to be most effective with respect to environmental issues involving “taking out” or resource extraction, whereas TEA regimes are probably at their most effective with “putting in” or pollution problems. No doubt there are exceptions, but in the end, it may not be coincidental that we are more likely to find TEA regimes associated with pollution control, and community-based regimes associated with issues of resource extraction.

Commerce in Resources

In Western legal regimes, commercially available resources tend to be discussed by reference to a finite and relatively limited number of rights categories. Thus in countries on the European continent, property of rights must be among the “*numerus clausus*,” a defined and closed set of cognizable types of property rights; somewhat similarly, Anglo-American property regimes also provide a number of off-the-rack forms of property, and they sharply discourage efforts to create more complicated forms of property. Recent scholarship suggests that this pattern stems from the fact that in Western legal regimes, a property right—as distinguished from a contractual right—is traded commercially from one person to the next, and then on to the next and the next. Because property is traded to strangers, property rights need to be relatively simple, so that strangers will know what they are getting. (By contrast, contracts can create far more complex forms of rights and duties because these obligations generally affect only the immediate parties, who know the “deal.”) Thus for the sake of trades that may take place over many years among complete strangers, Western property rights pare back property rights to a limited number of relatively simple forms (Merrill and Smith, 2000; Rose, 1999).

TEAs, because they are tradable, are subject to these same pressures for simplification. Simplification in TEAs is well known to cause imperfections, however. For example, because of prevailing west-to-east wind patterns, sulfur dioxide TEAs, measured simply in tons, are more damaging if traded toward and exercised in the Midwestern United States than they would be if exercised on the Atlantic coast. This is because a ton of pollutants originating in the Midwest falls in New England, whereas a ton originating on the east coast blows harmlessly out to sea (Revesz, 1996; Salzman and Ruhl, 2000; Stavins, 1998). TEAs could be “vintaged” to take account of locational effects, but if TEAs were hedged with such qualifications, they could split into numerous different markets, creating the usual problems of thin markets (such as holdouts or strategic bargaining) and also creating problems for monitoring (“Did Factory X purchase enough of the right kind of rights for its location?”).

Nevertheless, in an imperfect but relatively simple form (e.g., allowances measured simply in tons of emissions), TEAs can be effective devices for dealing with commerce and for incorporating strangers into that commerce. In the larger market made possible by these gross and simple rights definitions, strangers and innovators can purchase and sell TEAs, and officials can monitor and police their use, no matter who the users are. If demand rises and a given environmental resource becomes scarce, the market-based TEA regime responds automatically through a rise in prices. In turn, a price rise may well encourage innovation through conservation or through the introduction of nonpolluting substitutes or more effective and cheaper pollution prevention devices. In these ways, TEA regimes insulate environmental resources from changes in commercial demand.

Once again, it is to be noted that TEAs illustrate the tradeoff between different desirable factors. Like functioning commercial markets in other goods, TEA regimes can accommodate demand shifts through price changes, and they encourage innovation as well as the movement of rights to those who value them most. But the cost of these good things is that TEAs must be relatively simple, and thus they may be adjusted only inexactly to natural environmental conditions.

CBMRs, though sometimes highly adaptive to *natural* change, are much less adaptive to *commercial* changes, and in some ways they may leave environmental resources much more

vulnerable to commercial pressure from outsiders. Commerce can open up resources to vastly larger numbers of users outside the community, but unfortunately, community management institutions sometimes seem ill equipped to deal with this phenomenon. A particularly sad example of environmental decimation is now occurring in Madagascar, where endangered radiated tortoises are being hunted out by local gatherers. These animals were once hunted only for occasional feastday meals, but they are now the object of an illegal but seemingly insatiable trade to collectors throughout the world. Local peoples have responded to this leap in commercial demand by hunting as many tortoises as they can today, shrugging off tomorrow's almost certain dearth (Webster, 1997). Because of the suddenness and unexpectedness of this demand—perhaps reminiscent of the European demand for beaver furs several centuries ago in Northern Canada—local peoples seem to have had insufficient time to develop customs or norms that might withstand the onslaught, or that might contain their own contribution to it (Brightman, 1987).

Having said all this, there are certain ways in which the customary practices of community management regimes sometimes do buffer the onslaughts of commerce, precisely because of the impediments that community norms raise to commerce. Whereas TEAs are driven toward relatively simple forms, like most Western property entitlements, entitlements in CBMRs seem to be driven toward complexity. The rights structures in community-based regimes may be fabulously

complicated; Papuan fishermen, for example, own overlapping rights to fish in certain places as well as other rights to fish with certain equipment (Carrier, 1987); precontact Maori families owned overlapping rights in objects as small as individual bushes (some had fowling rights, others berrying rights) (Banner, 1999); in medieval Europe as in present-day Swiss villages, villagers owned scattered strips in the fields (Dahlman, 1980; Netting, 1981; Smith, 2000). Even in the more modern irrigation communities of the Philippines, water rights holders also scatter their fields (Ostrom, 1990). Long residence, kinship, extended practice, and the respect of one's fellows are necessary for the full enjoyment of many of these entitlements. Even where an occasional outsider may enter, for example, by buying land or through marriage, he or she is subject to a seasoning process (e.g., Acheson, 1975, 1987; Netting, 1981; Ostrom, 1990).

In short, quite the opposite of TEA regimes, in community-based institutions outsiders find it difficult to enter and insiders cannot sell out easily. What this means, however, is that the participants in the CBMR are stuck with one another because of the very complexity of entitlement structures (Bardhan and Dayton-Johnson, this volume: [Chapter 3](#)). Because they are stuck with one another, they are more likely to interact on multiple fronts. In turn, because of those dense interactions, they are more likely to generate the normative structures that help to moderate their own uses of resources (Ostrom, 1990, 2000; Rose, 2000; Ullmann-Margalit, 1977). In that sense, the complexity of CBMRs' entitlement structures is part of a social pattern that may protect environmental resources from depredations not only from insiders, but also from outsiders. Insofar as complex entitlements baffle and thwart outsiders, they also may discourage outsiders from getting their hands on common resources; hence the very anticommercial character of community-based entitlements may protect these resources from commercial shifts.

Historical and contemporary examples suggest, however, that although CBMR practices may impede outside access to the resources that the community considers most central to its well-being, these same practices are not capable of containing unexpected waves of commercial demand for resources not previously considered important or scarce to the community members. The terrible over-hunting of Madagascar tortoises is one example, the decimation of sandalwood in early postcontact Hawaii is another, the historic overtrapping of beaver in the Canadian North is perhaps a third. In all these cases and in others as well, outside commercial demand devastated environmental resources that were nominally in control of a community; indeed, community members were recruited to participate in the decimation (Berkes, this volume: [Chapter 9](#)). Perhaps because CBMR regimes are so often governed by norms that

emerge over time, a number of these regimes have proved unable to adapt rapidly enough to save some resources from sudden spurts in human demand.

Such failures suggest that between TEAs and CBMRs, TEAs are vastly better prepared to cope with shifts in *human* demand for natural resources. Notice the contrast to resource scarcity coming from *natural* shifts. With respect to the latter, as was discussed earlier, community-based practices may be preferable and may show more of the characteristics of “adaptive management,” whether so planned or not. But with respect to commerce, matters are different. TEAs are creatures of a thoroughly commercial understanding of property, and for all its reductionist faults and oversimplifications, this is an understanding that is centrally aimed at accommodating, monitoring, and controlling economic relationships among strangers.

All this suggests that if community-based structures are to be deployed to manage environmental resources that have become commercially valuable in the modern world—such as wildlife in reserve areas—the communities in question may need assistance and possibly restraints from the state in order to shield these communities and their resources from direct contact with that commercial demand.

Adding It All Up

Putting together all these factors, one is struck by the degree to which TEAs and CBMRs are mirror images, having the opposite strengths and weaknesses. In a table format, and discounting for the extremes of “ideal type” presentation, their respective situational advantages might be laid out as shown in [Table 7-1](#).

Taken together, these contrasting characteristics suggest that, although TEAs have been the flagship for modern property rights schemes in environmental resources, CBMR institutions also have a number of positive features for property-based environmental governance. Indeed, the most positive features of CBMRs

TABLE 7-1 Characteristics and Advantages of Tradable Environmental Allowances (TEA) and Community-Based Management Regimes (CBMR)

	TEA Characteristic/Advantage	CBMR Characteristic/Advantage
Scale	Larger	Smaller (unless “nested” or coordinated)
Resource complexity	Simple, single focus	Complex, interactive
Practices encouraged	Security of investment, innovation	Adaptation, long-term stability, risk sharing
Social structure	Loose, stranger relations	Close knit
Adaptation to shifts in natural environment	Less adaptive	More adaptive
Adaptation to shifts in human demand	More adaptive	Less adaptive
Typical resource application	Pollution (putting in)	Extraction (taking out)
Relation to commerce	Accommodates commerce	Vulnerable to commerce

emerge precisely at the points where TEAs tend to be least effective as environmental protectors, that is, in coping with locally dense, complex natural systems like forests or wetlands (Salzman and Ruhl, 2000).

It is perhaps for such reasons, among others, that modern environmentalists are now experimenting with ways to provide state assistance and control to community-based resource management. One well-known experiment is Zimbabwe’s CAMPFIRE (Communal Areas Management Programme for Indigenous Resources), where, under the auspices of state conservation efforts, communities may be treated as wildlife “owners.” The expectation, to

some degree already fulfilled, is that these communities' members will have an incentive to use their knowledge and skills to save the animals rather than deliver them to poachers, because the community will receive revenues from tourism and sport hunting permits (Anderson and Grewell, 1999). In its general outlines, this program is quite similar to an idea mentioned earlier, allocating fishing TEAs to communities rather than to individuals. It is also similar to the Indian forestry programs mentioned, in which larger government agencies coordinate and "nest" community forestry practices.

A problematic feature of such programs is the degree to which central authorities actually do allow revenues—and hence conservationist incentives—to devolve down to local communities (Agrawal and Ribot, 1999). Such problems illustrate a very important larger point: that success in such mixed regimes depends heavily on the probity and administrative capacities of the larger government. Nevertheless, although rent seeking and frictions undoubtedly occur when state agencies become involved in community-based institutions, wider governmental control over decentralized management has the capacity in principle to take advantage of community institutions' fine-grained resource management practices while helping to overcome their typical weaknesses. Governments can coordinate various communities' efforts and mediate disputes; they can set overall quotas to channel total demand of all the communities; and they can defend community institutions against outsiders. Indeed, even the ancient Spanish CBMRs for irrigation intertwined state officialdom into their community practices, apparently to serve some of these very functions (Glick, 1979; Maass and Anderson, 1978).

Among institutional economists, it is not news that community-based environmental management has some virtues; CBMRs have acquired something of a cheering section among those who study them. There is some reason to be cautious about joining this cheering section unqualifiedly, however. It might be wise to keep in mind a set of critiques that came from past experience, particularly from American legal institutions. In the past, American courts for the most part were implacably hostile to "customary law" and to any efforts to claim a legal place for customary practice. There were some notable exceptions, such as the acceptance of newly-formed customary norms in certain new industries, as among gold miners and whalers. But unlike British courts, American courts refused to accept the claim that longstanding practice, without more, could create legal rights that would govern communities (Rose, 1994).

The reasons were instructive: American courts thought that customary rights were feudal remnants, smacking of the hierarchy of manorial life, at once sclerotic and antidemocratic. They thought that communities should be governed not by the accidents of hoary custom, but rather according to the open constitutional practices of a democratic republic, in which legislation was openly discussed, determined, and changed by elective representatives (Rose, 1994).

An unjaundiced view of modern CBMRs should give rise to some of the same concerns that track through the very inhospitable 19th century American jurisprudence of "customary law." Take, for example, Acheson's attractive, picturesque, and much-cited portrait of the lobster fishermen of Maine's Monhegan Island. The islanders effectively manage the lobster stock as a common property, controlling depredation of nearby lobstering grounds by following customary norms; they allocate fishing rights among themselves and use informal punishment to defend the "perimeter" of their fishing grounds from outsiders (Acheson, 1975, 1987). In a somewhat flintier light, however, these same lobster fishermen appear to be much less attractive: They look xenophobic, hierarchical, thuggish, and thoroughly misogynist. Feminist writers on international human rights echo such concerns in discussing demands for the devolution of governing authority onto fundamentalist religious communities (Shachar, 1998): These communities too seem xenophobic, hierarchical, thuggish, and thoroughly misogynist. This is not to say that all CBMRs should be viewed with suspicion. But some of them should, on democratic grounds, however environmentally friendly they may be.

One of the strongest cases for the recognition and promotion of CBMRs is actually a feature of international human rights: Recognition of community management practices can help to protect traditional peoples who otherwise would be deprived of their longstanding homes and livelihoods altogether. Indeed, much of this deprivation has come through the operation of conventional European-model property regimes, in which traditional community management practices are simply invisible as property (Rose, 1998). As Breckenridge (1992) has pointed out, there are a number of areas in which conservationist concerns overlap with such human rights concerns, and it is in those areas that the recognition of community resource management is most compelling as a basis for the allocation of property rights to the participants.

Even aside from that set of issues, as this article and others have pointed out, there is an environmentalist case to be made for learning from traditional CBMRs. Indeed, there is even a political case to be made for some CBMRs; as Ostrom (1990) stresses, the most long-lived community regimes are likely to have attractive features of member participation, dispute resolution, and intergroup cooperation. But this political case may be strengthened by attempting to devise modern CBMRs in which participation is more egalitarian and potentially more inclusive. Dagan and Heller (2001) argue that we have models of common “liberal prop

erty” regimes in cooperatives, condominiums, and even corporations; all these models entail a mix of self-government with the supervision of larger legal institutions. Meanwhile, recent proposals for allocating TEA quotas to communities also incorporate liberalizing reforms for these common property institutions (Rieser, 1997; Rose, 2000).

It may be that the future of CBMRs, with their many environmental strengths, indeed lies in this more liberal direction. What remains to be seen is whether greater liberalization and openness is compatible with the very social practices that give rise to CBMRs’ environmental strengths.

NOTE

- 1 P. Seabright (1993:114) also has discussed the various designations given to common property institutions and resources.

REFERENCES

- Acheson, M. 1975 *The Lobster Gangs of Maine*. Hanover, NH.: University Press of New England
- 1987 The lobster fiefs revisited: Economic and ecological effects of territoriality in the Maine lobster industry. Pp. 37-68 in *The Question of the Commons: The Culture and Ecology of Communal Resources*, B.J. McCay and J.M. Acheson, eds. Tucson: University of Arizona Press .
- Ackerman, B.A., and R.B. Stewart 1988 Reforming environmental law: The democratic case for market incentives. *Columbia Journal of Environmental Law* 13:171-199.
- Agrawal, A., and J. Ribot 1999 Accountability in decentralization: A framework with South Asian and West African Cases. *The Journal of Developing Areas* 33:473-502.
- Anderson, T.L., and J.B. Grewell 1999 Property rights solutions for the global commons: Bottom up or top down? *Duke Environmental Law and Policy Forum* 10:73-101.

Banner, S. 1999 Two properties, one land: Law and space in nineteenth-century New Zealand. *Law and Social Inquiry* 24:807-852.

Berkes, F. 1987 Common-property resource management and Cree Indian fisheries in subarctic Canada. Pp. 66-91 in *The Question of the Commons: The Culture and Ecology of Communal Resources*, B.J. McCay and J.M. Acheson, eds. Tucson: University of Arizona Press.

1995 Indigenous knowledge and resource management systems: A native Canadian case study from James Bay. Pp. 99-109 in *Property Rights in a Social and Ecological Context: Case Studies and Design Application*, S. Hanna and M. Munasinghe, eds., Washington, DC: World Bank.

Bosselman, F.P. 1996 Limitations inherent in the title to wetlands at common law. *Stanford Environmental Law Journal* 15:247-337.

Breckenridge, L. 1992 Protection of biological and cultural diversity: Emerging recognition of local community rights in ecosystems under international environmental law. *Tennessee Law Review* 59:735-785.

Brightman, R.A. 1987 Conservation and resource depletion: The case of the boreal forest Algonquians. Pp. 121-141 in *The Question of the Commons: The Culture and Ecology of Communal Resources*, B.J. McCay and J.M. Acheson, eds. Tucson: University of Arizona Press.

Brown, G.M. 2000 Renewable natural resource management and use without markets. *Journal of Economic Literature* 38:875-914.

Carrier, J.G. 1987 Marine tenure and conservation in Papua New Guinea. Pp. 142-167 in *The Question of the Commons: The Culture and Ecology of Communal Resources*, B.J. McCay and J.M. Acheson, eds. Tucson: University of Arizona Press.

Clark, I.N., P.J. Major, and N. Mollett 1989 The development and implementation of New Zealand's ITQ Management System. Pp. 117-145 in *Rights Based Fishing*, P.A. Neher, R. Arnason, and N. Mollett, eds. Dordrecht Boston: Kluwer Academic Publishers.

Cox, S.J.B. 1985 No tragedy of the commons. *Environmental Ethics* 7:49-61.

Dagan, H., and M.A. Heller 2001 The liberal commons. *Yale Law Journal* 110:549-623.

Dahlman, C.J. 1980 *The Open Field System and Beyond: A Property Rights Analysis of an Economic Institution*. Cambridge, Eng.: Cambridge University Press.

Dobson, A.P., J.P. Rodriguez, W.M. Roberts, and D.S. Wilcove 1997 Graphic distribution of endangered species in the United States. *Science* 275:550-553.

Ellickson, R.C. 1991 *Order Without Law: How Neighbors Settle Disputes*. Cambridge, MA: Harvard University Press.

Esty, D.C. 1996 Revitalizing environmental federalism. *Michigan Law Review* 95:570-653.

Glick, T.F. 1979 *Irrigation and Society in Medieval Valencia*. Cambridge, MA: Harvard University Press.

- Gordon, H.S. 1954 The economic theory of a common-property resource: The fishery. *Journal of Political Economy* 62:124-142.
- Greif, A. 1989 Reputation and coalitions in medieval trade: evidence on the Maghribi traders. *Journal of Economic History* 49:857-882.
- Hardin, G. 1968 The tragedy of the commons. *Science* 162:1243-1248.
- Heinzerling, L. 1995 Selling pollution, forcing democracy. *Stanford Environmental Law Journal* 14:300-344.
- Higgs, R. 1996 Legally induced technical regress in the Washington salmon fishery. Pp. 247-277 in *Empirical Studies in Institutional Change*, L.J. Alston, T. Eggerstsson, and D.C. North, eds. Cambridge, Eng.: Cambridge University Press.
- Hsu, S.L., and J.E. Wilen 1997 Ecosystem management and the 1996 Sustainable Fisheries Act. *Ecology Law Quarterly* 24:799-811.
- Kaplow, L., and S. Shavell 1996 Property rules versus liability rules: An economic analysis. *Harvard Law Review* 109:713-790.
- Kriz, M. 1998 After Argentina. *National Journal* 30(49):2848-2853.
- Libecap, G.D. 1989 *Contracting for Property Rights*. Cambridge, Eng.: Cambridge University Press.
- Maass, A., and R.L. Anderson 1978 *...And the Desert Shall Rejoice: Conflict, Growth, and Justice in Arid Environments*. Cambridge, MA: MIT Press.
- McEvoy, A.F. 1986 *The Fisherman's Problem: Ecology and Law in the California Fisheries 1850-1980*. Cambridge, Eng.: Cambridge University Press.
- Merges, R.P. 1996 Contracting into liability rules: Intellectual property rights and collective rights organizations. *California Law Review* 84:1293-1393.
- Merrill, T.W., and H.E. Smith 2000 Optimal standardization in the law of property: The *numerus clausus* principle. *Yale Law Journal* 110:1-70.
- Netting, R.M. 1981 *Balancing on an Alp: Ecological Change and Continuity in a Swiss Mountain Village*. Cambridge, Eng.: Cambridge University Press.
- Ophuls, W. 1977 *Ecology and the Politics of Scarcity*. San Francisco: Freeman.
- Ostrom, E. 1990 *Governing the Commons*. Cambridge, Eng: Cambridge University Press
- 1992 *Crafting Institutions for Self-Governing Irrigation Systems*. San Francisco: Institute for Contemporary Studies Press.
- 2000 Collective action and the evolution of social norms. *Journal of Economic Perspectives* 14:137-158.

Oye, K.A., and J.H. Maxwell 1995 Self-interest and environmental management. Pp. 191-221 in *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains*, R.O. Keohane, and E. Ostrom, eds. London: Sage Publications.

Pinkerton, E. 1987 Intercepting the state: Dramatic processes in the assertion of local comanagement rights. Pp. 344-369 in *The Question of the Commons: The Culture and Ecology of Communal Resources*, B.J. McCay and J.M. Acheson, eds., Tucson: University of Arizona Press.

Revesz, R.L. 1996 Federalism and interstate environmental externalities. *University of Pennsylvania Law Review* 144:2341-2416.

Rieser, A. 1997 Property rights and ecosystem management in U.S. fisheries: Contracting for the commons? *Ecology Law Quarterly* 24:813-832.

1999 Prescriptions for the commons: Environmental scholarship and the fishing quotas debate. *Harvard Environmental Law Review* 23:393-421.

Rose, C.M. 1994 *Property and Persuasion: Essays on the History, Theory and Rhetoric of Ownership*. Boulder, CO: Westview Press.

1998 The several futures of property: Of cyberspace and folk tales, emission trades and ecosystems. *Minnesota Law Review* 83:129-182.

1999 What government can do for property (and vice versa). Pp. 209-222 in *The Fundamental Interrelationships Between Government and Property*, N. Mercuro and W.J. Samuels., eds. Stamford, CT: JAI Press.

2000 Expanding the choices for the global commons: Comparing newfangled tradable emission allowance schemes to oldfashioned common property regimes. *Duke Environmental Law and Policy Review* 10:45-72.

Salzman, J., and J.B. Ruhl 2000 Currencies and the commodification of environmental law. *Stanford Law Review* 53:607-694.

Scheiber, H.N., and C. Carr 1997 The limited entry concept and the pre-history of the ITQ movement in fisheries management. Pp. 235-260 in *Social Implications of Quota Systems in Fisheries*, G. Palsson and G. Petursdottir, eds. Copenhagen: Nordic Council of Ministers.

Schmalensee, R., P.L. Joskow, A.D. Ellerman, J.P. Montero, and E.M. Bailey 1998 An interim evaluation of sulfur dioxide emissions trading. *Journal of Economic Perspectives* 12:58-68.

Seabright, P. 1993 Managing local commons: Theoretical issues in incentive design. *Journal of Economic Perspectives* 7:113-134.

Shachar, A. 1998 Group identity and women's rights in family law: The perils of multicultural accommodation. *Journal of Political Philosophy* 6:285-306.

Smith, H.E. 2000 Semicommon property rights and scattering in the open fields. *Journal of Legal Studies* 29:131-169.

Snidal, D. 1995 The politics of scope: endogenous actors, heterogeneity and institutions. Pp. 47-70 in *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains*, R.O. Keohane and E. Ostrom, eds. London: Sage Publications.

Stavins, R.N. 1998 What can we learn from the grand policy experiment? Lessons from SO₂ allowance trading. *Journal of Economic Perspectives* 12:69-88.

Tarlock, A.D. 1994 The nonequilibrium paradigm in ecology and the partial unraveling of environmental law. *Loyola of Los Angeles Law Review* 27:1121-1144.

Tietenberg, T.H. 1985 *Emissions Trading: An Exercise in Reforming Pollution Policy*. Washington, DC: Resources for the Future.

Tipton, C.A. 1995 Protecting tomorrow's harvest: Developing a national system of individual transferable quotas to conserve ocean resources. *Virginia Environmental Law Journal* 14:381-421.

Townsend, R., and J.A. Wilson 1987 An economic view of the tragedy of the commons. Pp. 311-326 in *The Question of the Commons: The Culture and Ecology of Communal Resources*, B.J. McCay and J.M. Acheson, eds. Tucson: University of Arizona Press.

Ullmann-Margalit, E. 1977 *The Emergence of Norms*. Oxford, Eng.: Oxford University Press.

Webster, D. 1997 The animal smugglers: The looting and smuggling and fencing and hoarding of impossibly precious, feathered and scaly wild things. *The New York Times Magazine*, 16 February.

Wiener, J.B. 1999 Global environmental regulation: Instrument choice in legal context. *Yale Law Journal* 108:677-800.