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Property-Rights Regimes and Natural Resources: A Conceptual Analysis

Edella Schlager and Elinor Ostrom

ABSTRACT. *The term "common-property resource" is an example of a term repeatedly used to refer to property owned by a government or by no one. It is also used for property owned by a community of resource users. Such usage leads to confusion in scientific study and policy analysis. In this paper we develop a conceptual schema for arraying property-rights regimes that distinguishes among diverse bundles of rights ranging from authorized user, to claimant, to proprietor, and to owner. We apply this conceptual schema to analyze findings from a variety of empirical settings including the Maine lobster industry.*

I. INTRODUCTION

Political economists' understanding of property rights and the rules used to create and enforce property rights shape perceptions of resource degradation problems and the prescriptions recommended to solve such problems. Ambiguous terms blur analytical and prescriptive clarity. The term "common-property resource" is a glaring example of a term that is repeatedly used by political economists to refer to varying empirical situations including: (1) property owned by a government, (2) property owned by no one, and (3) property owned and defended by a community of resource users.¹ The term is also used to refer to any common-pool resource used by multiple individuals regardless of the type of property rights involved. The purpose of this paper is to develop a conceptual schema for arraying property-rights regimes that distinguishes among diverse bundles of rights that may be held by the users of a resource system. We define a property-rights schema ranging from authorized user, to claimant, to proprietor, and to owner. We do *not* find that "owners" are the only resource users who make long-term investments in the improvement of resource systems. Proprietors face incentives that are

frequently substantial enough to encourage similar long-term investments. Even claimants may manage use patterns to an extent not predicted by a simpler property-rights dichotomy. We apply this conceptual schema to analyze findings from a variety of empirical settings but focus in particular on the Maine lobster industry.

II. RULES, RIGHTS, AND PROPERTY REGIMES

As individuals conduct day-to-day activities and as they organize these activities, they engage in both operational and collective-choice levels of action (Kiser and

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¹The confusion in the use of the term "common property" has been addressed frequently in the past (Ciriacy-Wantrup and Bishop 1975; Bromley 1982, 1986, 1989; Runge 1981) without much impact on its careless usage. Even scholars, who are meticulous theorists and observers of behavior related to natural resource systems, use the terms "open access" and "common property systems" interchangeably (see Johnson and Libecap 1982, 1005; for other examples, see Agnello and Donnelly 1975; Bell 1972; Christy 1975; Gordon 1954; Scott 1955; Scott and Christy 1965; Smith, Weber, and Wiesmeth 1991; Sinn 1988).

Ostrom 1982).² Operational activities are constrained and made predictable by operational-level rules regardless of the source of these rules. By the term "rules" we refer to generally agreed-upon and enforced prescriptions that require, forbid, or permit specific actions for more than a single individual (E. Ostrom 1986).³ Examples of operational rules are those used by fishers to specify the types of fishing equipment authorized or forbidden at particular locations within a fishing ground.

Operational rules are changed by collective-choice actions. Such actions are undertaken within a set of collective-choice rules that specify who may participate in changing operational rules and the level of agreement required for their change. Changing the types of fishing equipment authorized or forbidden at different locations within a resource is an example of a collective-choice action. The particular set of operational rules that are actually in use and enforced may have been devised in multiple arenas. Operational rules related to inshore fisheries are as apt to be devised in a local meeting place, even a tavern, as they are in a court, a legislature, or a governmental bureau.⁴

The terms "rights" and "rules" are frequently used interchangeably in referring to uses made of natural resources. Clarity in analysis is enhanced by recognizing that "rights" are the product of "rules" and thus not equivalent to rules. "Rights" refer to particular actions that are authorized (V. Ostrom 1976). "Rules" refer to the prescriptions that create authorizations. A property right is the authority to undertake particular actions related to a specific domain (Commons 1968). For every right an individual holds, rules exist that authorize or require particular actions in exercising that property right. In this paper we focus entirely on rights, but we need to stress from the beginning that all rights have complementary duties. To possess a right implies that someone else has a commensurate duty to observe this right (*ibid.*). Thus rules specify both rights and duties.

In regard to common-pool resources, the most relevant operational-level property

rights are "access" and "withdrawal" rights. These are defined as:

- Access: The right to enter a defined physical property.
- Withdrawal: The right to obtain the "products" of a resource (e.g., catch fish, appropriate water, etc.).⁵

If a group of fishers hold rights of access, they have the authority to enter a resource. Rules specify the requirements the fishers must meet in order to exercise this right. For instance, fishers may be required to reside in a specified jurisdiction and to purchase a license before entering a fishing ground. In addition, fishers, through a lottery, may be assigned particular fishing spots (Faris 1972; Martin 1973). The assignment of fishing spots is an operational-level

²A third level of action is also available and that is the constitutional level. Constitutional-choice actions entail devising collective-choice rules. In establishing an organization or changing the process by which operational rules are to be devised within an existing organization, individuals engage in constitutional-choice actions. Fishers creating a marketing cooperative is an example of a constitutional-choice action.

³A plan adopted by an individual for how that individual wishes to undertake future actions is better thought of as a "strategy" rather than as a "rule." The concept of "rule" relates to shared understandings about prescriptions that apply to more than a single individual. A marriage contract can be viewed as a set of rules authorizing and forbidding future actions for the two individuals involved. A court decision outlawing some types of agreements among fishers using inshore fisheries is a set of rules affecting future actions for all individuals using the coastal fisheries under that court's jurisdiction. Rules, be they operational, collective choice, or constitutional choice, instruct individuals to take actions that are required or permitted, or to avoid taking action that is forbidden (Gardner and Ostrom 1991; E. Ostrom 1986; see Buck [1989] for an analysis of the rules creating property rights in the American southwest).

⁴Not all actions taken in collective-choice arenas affect rules in use. Passing a new law or writing a new regulation is not the equivalent of establishing a new rule. Laws and regulations must be enforced to become rules (see V. Ostrom 1991). To be effective they must be accepted as legitimate by resource users.

⁵Rules defining the rights of access and withdrawal may or may not permit those rights to be transferred.

withdrawal right authorizing harvesting from a particular area.⁶

Individuals who have access and withdrawal rights may or may not have more extensive rights authorizing participation in collective-choice actions. The distinction between rights at an operational-level and rights at a collective-choice level is crucial. It is the difference between exercising a right and participating in the definition of future rights to be exercised. The authority to devise future operational-level rights is what makes collective-choice rights so powerful. In regard to common-pool resources, collective-choice property rights include management, exclusion, and alienation. They are defined as follows:

- Management: The right to regulate internal use patterns and transform the resource by making improvements.
- Exclusion: The right to determine who will have an access right, and how that right may be transferred.
- Alienation: The right to sell or lease either or both of the above collective-choice rights.

The right of management is a collective-choice right authorizing its holders to devise operational-level withdrawal rights governing the use of a resource. Individuals who hold rights of management have the authority to determine how, when, and where harvesting from a resource may occur, and whether and how the structure of a resource may be changed. For instance, a group of fishers who devise a zoning plan that limits various types of harvesting activities to distinct areas of a fishing ground are exercising rights of management for their resource (see, e.g., Davis 1984; Cordell 1972).

The right of exclusion is a collective-choice right authorizing its holders to devise operational-level rights of access. Individuals who hold rights of exclusion have the authority to define the qualifications

that individuals must meet in order to access a resource. For instance, fishers who limit access to their fishing grounds to males above a certain age who live in a particular community and who utilize particular types of gear are exercising a right of exclusion.⁷

The right of alienation is a collective-choice right permitting its holder to transfer part or all of the collective-choice rights to another individual or group. Exercising a right of alienation means that an individual sells or leases the rights of management, exclusion, or both.⁸ Having alienated those rights, the former rights-holder can no longer exercise these authorities in relation to a resource or a part thereof.

Arraying these rights, as shown in Table

⁶See Copes (1986) for an analysis of quota systems in relation to fisheries. See Wilson (1982) for an effective critique of standard economic theory's limited view of institutional alternatives in relation to fisheries.

⁷If these same fishers revise the conditions that constitute the right of access by expanding the number of fishers who can enter their fishery, they have not exercised a right of alienation. They have not transferred rights to additional individuals. Rather, they have exercised their right of exclusion to redefine who may or may not enter. The right of alienation refers only to the authority to alienate collective-choice rights, that is, to sell or lease such rights.

⁸By alienation we specifically mean the authority to sell or lease collective-choice rights. We do not include the ability to bequeath. In most common-property regimes, users have the ability to bequeath their rights in a resource. Rights rarely die with an individual. In many situations, however, resource users do not have the right to sell or lease their rights to others. Limiting alienation to sale or lease also brings it closer to its economic usage. The importance of a right of alienation for many economists is that it provides the possibility that resources will be transferred to their highest valued use. While being able to sell or lease collective-choice rights provides that potential, the right to bequeath these rights is usually presumed by economists to be an insufficient property right to achieve full efficiency. Larson and Bromley (1990) effectively challenge this commonly held view and argue that much more needs to be known about the specific values of a large number of parameters in a particular setting before analysts can make careful judgments whether the right of alienation leads to higher levels of efficiency than the right to bequeath. See also Anderson and Hill (1990) for an analysis of three different alienation rules that the U.S. government used in transferring public lands to individuals.

TABLE 1
BUNDLES OF RIGHTS ASSOCIATED WITH POSITIONS

	Owner	Proprietor	Claimant	Authorized User
Access and Withdrawal	X	X	X	X
Management	X	X	X	
Exclusion	X	X		
Alienation	X			

1, enables us to make meaningful distinctions among four classes of property-rights holders related to fisheries. The five property rights are independent of one another but, in relation to fisheries, are frequently held in the cumulative manner arrayed in Table 1. It is possible to have entry rights without withdrawal rights, to have withdrawal rights without management rights, to have management rights without exclusion rights, and to have exclusion rights without the rights of alienation.⁹ In other words, individuals or collectivities may, and frequently do, hold well-defined property rights that do not include the full set of rights defined above. On the other hand, to hold some of these rights implies the possession of others. The exercise of withdrawal rights is not meaningful without the right of access; alienation rights depend upon having rights to be transferred.

We call individuals holding operational-level rights of access and withdrawal "authorized users."¹⁰ If specified in operational rules, access and withdrawal rights can be transferred to others either temporarily, as in a lease arrangement, or permanently when these rights are assigned or sold to others. Transfer of these rights, however, is not equivalent to alienation of management and exclusion rights as we discuss below.

The rights of authorized users are defined by others who hold collective-choice rights of management and exclusion. Authorized users lack the authority to devise their own harvesting rules or to exclude others from gaining access to fishing grounds. Even though authorized users may be able to sell their harvesting rights, nevertheless, they lack the authority to par-

ticipate in collective action to change operational rules.

An example of authorized users are the salmon and herring fishers of Alaska. In 1972, the Governor's Study Group on Limited Entry was created to research and develop limited entry legislation, which the Alaskan legislature adopted in 1973 (Adasiak 1978, 771). The Alaskan limited entry system divides Alaskan salmon and herring fisheries into a number of different fisheries. An Entry Commission determines the number of permits available for each fishery. The Commission can make adjustments in the numbers as circumstances change, either by issuing additional permits or by buying back existing permits. Fishers cannot hold more than one permit per fishery. The permits are freely transferable, but cannot be used as collateral. The Alaskan fishers who hold permits are authorized users. The Alaskan legislature in conjunction with a study group devised the fishers' rights of access and withdrawal, which

⁹While theoretically it is possible to hold entry rights without withdrawal rights, in practice this rarely occurs. The distinction between access and withdrawal becomes crucial at a collective-choice level. Oftentimes individuals who hold rights of management and thereby define withdrawal rights are not the same individuals who hold rights of exclusion and thereby define access rights. We provide a number of examples throughout the remainder of the paper.

¹⁰One could also define a position called "squatter" to consist of individuals who possess no rights at any level in relation to a common-pool resource. Squatters use natural resources, such as fisheries, but they do so at their own risk. If challenged by a person who holds collective-choice or operational rights, squatters lack authority to enforce their claims. Squatters stand entirely exposed to the actions of others as concerns the use of a resource.

fishers can transfer. The fishers do not directly participate in making collective choices and thus cannot devise their own operational-level rules concerning the use of their fisheries.

We define as “claimants” individuals who possess the same rights as authorized users plus the collective-choice right of management.¹¹ With the right of management, claimants have the collective-choice authority to devise operational-level rights of withdrawal. They cannot, however, specify who may or may not have access to resources, nor can they alienate their right of management. For instance, the net fishers of Jambudwip, India, are claimants (Raychaudhuri 1972). Jambudwip is an island in the Bay of Bengal which is only occupied during fishing seasons when fishers establish camps and fish off its southwestern shore. The Jambudwip fishers, exercising management rights, have devised a set of withdrawal rules that permit them to coordinate their use of the fishing grounds. At the beginning of a fishing season each crew chooses a spot on which to set their net. A large bag net is suspended between two posts which are then driven into the ocean floor. Rules, as well as environmental conditions, govern the placing of nets. As Raychaudhuri explains:

According to the convention of the fisherfolk, one is not allowed to set his net in a line, either in front or behind another's net. But there is no bar to set on any side of it If one net is set in front of another, both lose the catch, either of the tide or of the ebb. (Raychaudhuri 1972, 174)

In addition, a spot once claimed by a fishing crew belongs to that crew for the remainder of the fishing season. Even if the crew removes its net from the spot and moves to another spot, no other crew can fish the abandoned spot unless first gaining permission from the original crew (*ibid.*, 167–68). While the Jambudwip fishers have exercised management rights by devising rules that define withdrawal rights, they do not exercise the authority to decide who can

that they utilize. Consequently, the Jambudwip fishers are claimants and not “proprietors.”

“Proprietors” are defined as individuals who possess collective-choice rights to participate in management and exclusion. Proprietors authorize who may access resources and how resources may be utilized, however, they do not have the right to alienate either of these collective-choice rights. Scholars who have recently undertaken theoretical and empirical research on “common-property regimes” focus primarily on those regimes organized by proprietors (National Research Council 1986; Berkes 1989; McCay and Acheson 1987; E. Ostrom 1990). To use the same term for regimes composed of proprietors, who possess four bundles of property rights, and regimes composed of individuals who possess no property rights, clearly confounds the capacity to communicate about important scientific and policy issues.

The fishers who participate in the cod trap fisheries of Newfoundland are proprietors. Cod trap berths are allocated by lottery. To gain access to a berth, a fisher must participate in a lottery. “Only fishermen from the local community are allowed to participate in the lottery” and to sit on the local cod trap berth committee that operates the lottery (Martin 1979, 282). The lottery system is significant in that “the organization of cod trap committees since 1919 has legally codified the boundaries of the fishing space over which a community has political jurisdiction” (Martin 1973, 15).

Turkish fishers who harvest from coastal lagoons are also proprietors. The Turkish government leases lagoons to fishers' co-operatives. For instance, it leases the Ayvalik-Haylazli lagoon to a fishers' co-op of the same name. To access and harvest fish from the lagoon, a fisher must belong to the co-op. In order to belong to the co-op a fisher must reside in one of the three adjacent villages for at least six months and not

¹¹ Alchian and Demsetz refer to the possession of the right of management, but not exclusion or alien-

have wage employment income (Berkes 1986, 72). The fishers of Ayvalik-Haylazli lagoon

have exclusive and legal rights to the fish of the lagoon and the lagoon's adjacent waters. All fishermen are cooperative members, and all cooperative members are active fishermen. They protect their rights by patrolling the boundary of their fishing area and chasing off or apprehending intruders. (Three outside fishing boats were apprehended in 1983.) (*ibid.*)

Neither the fishers of Ayvalik-Haylazli lagoon nor the cod fishers of Newfoundland, however, can sell or lease their rights of management and exclusion.

If in addition to collective-choice rights of management and exclusion, individuals also hold the right of alienation, that is, they can sell or lease their collective-choice rights, then they are defined as "owners."¹² For instance, fishers of Ascension Bay, located in Quintana Roo State, Mexico, are members of the Vigia Chico cooperative. Co-op members have divided Ascension Bay into "individually held capture areas ('parcelas' or 'campos') ranging from 0.5 to more than 3 km²" from which they harvest lobster (Miller 1989, 190). Each co-op member holds complete sets of rights over specific areas. The fishers may transfer their rights of management and exclusion over their particular spot to other fishers of Ascension Bay. "Several campos are sold or bartered each season and such transactions are common knowledge. On occasion, sales are registered with the co-op" (*ibid.*, 192). Once having sold their campos, however, fishers no longer can exercise rights of exclusion or management in relation to Ascension Bay lobstergrounds.

III. DE FACTO AND DE JURE PROPERTY RIGHTS

The sources of the rights of access, withdrawal, management, exclusion, and transfer are varied. They may be enforced by a government whose officials explicitly grant such rights to resource users. If so, such rights are de jure rights in that they are

given lawful recognition by formal, legal instrumentalities. Rights-holders who have de jure rights can presume that if their rights were challenged in an administrative or judicial setting, their rights would most likely be sustained.

Property rights may also originate among resource users. In some situations resource users cooperate to define and enforce rights among themselves. Such rights are de facto as long as they are not recognized by government authorities. Users of a resource who have developed de facto rights act as if they have de jure rights by enforcing these rights among themselves. In some settings de facto rights may eventually be given recognition in courts of law if challenged, but until so recognized they are less secure than de jure rights.¹³

Within a single common-pool resource situation a conglomeration of de jure and de facto property rights may exist which overlap, complement, or even conflict with one another. A government may grant fishers de jure rights of access and withdrawal, retaining the formal rights of management, exclusion, and alienation for itself. Fishers, in turn, may cooperate and exercise rights of management and exclusion, defining among themselves how harvesting must take place, and who may engage in harvesting from their fishing

¹²The rights of alienation can be exercised in total or to a limited set of rights for a limited duration. Given the latter capability, "hybrid" legal arrangements related to the same resource are possible and occur frequently. Alchian and Demsetz (1973, 18) point out that some of the "ambiguity in the notion of state or private ownership of a resource" occurs "because the bundle of property rights associated with a resource is divisible." In fact, all coastal fisheries in the U.S. are apt to be hybrid legal arrangements of one or another variety since the ownership rights to the coastal waters are vested in states. Each state decides whether to assign claimant status to all residents, to all residents who obtain licenses, or to allow various forms of proprietorship to come about through self-organization or through formal lease-hold arrangements.

¹³Note that unchallenged de facto rights are as much a factor affecting action as are de jure rights. Only if de facto rights are challenged do the differences between the two classes of rights become apparent.

grounds. In many situations where local fishers possess *de jure* authorized user or claimant rights, field researchers have found *de facto* proprietor arrangements that are commonly understood, followed, and perceived as legitimate within the local community (Cordell and McKean 1987; Berkes 1986, 1989; Davis 1984; Acheson 1975).

In many instances government officials simply pay little attention to inshore fisheries, leaving fishers with sufficient autonomy to design workable arrangements. For many years this was the case for fishers of Valenca, Brazil, who fished from the adjacent estuary (Cordell 1972). These fishers held *de jure* rights of access and withdrawal when they first developed the fishery at the beginning of this century. Initially, they experienced a number of problems due to the diverse technologies in use. Gear became entangled and was destroyed, leading to violence among the fishers. In addition, fishers fought over the choicest fishing spots (*ibid.*, 105). Over a period of time fishers designed harvesting arrangements that addressed many of the problems they had experienced. The fishers divided the estuary among different technologies so that diverse gears were not utilized within the same area (*ibid.*, 42). In addition, fishers allocated fishing spots by drawing lots to determine the order of use of a particular spot. The Valenca fishers did not initially experience exclusion problems. No other fishers exhibited interest in fishing the estuary. While the Valenca fishers were *de jure* authorized users, they were *de facto* claimants.

The Brazilian government, in an attempt to "modernize" fisheries, made nylon nets available to anyone who qualified for a bank loan arranged by the government through the Banco do Brasil. The Valenca fishers did not qualify for bank loans and could not purchase nets. A number of wealthy individuals around Valenca did qualify, and purchased nets. These individuals hired men to fish with the nets, men who had no prior fishing experience. The men invaded the Valenca estuary. Conflict erupted between the established fishers and

the new entrants. Fishers were shot and equipment destroyed. The *de facto* property rights crumbled as fishers fought for whatever fishing spots they could gain. The fishery was overharvested and eventually was abandoned (Cordell 1978).¹⁴

De facto property systems are important for several reasons. First, the resource economics literature examining property rights and fishery regulation is generally pessimistic about the likelihood of fishers undertaking self-regulation so as to avoid inefficient economic outcomes, such as rent dissipation and the extinction of valuable species. And yet, an extensive empirical literature exists that documents a diversity of indigenous institutions devised by fishers without reference to governmental authorities (Alexander 1977; Berkes 1986, 1989; Cordell 1972; Davis 1984; Faris 1972; Forman 1970; Martin 1979; McCay and Acheson 1987; Pinkerton 1989). Many of these *de facto* arrangements substantially reduce the incentives to overinvest in harvesting effort and to dissipate rent that fishers face in an open access fishery. Understanding the *de facto* arrangements that have enabled some fishers to reduce inefficient use of resources permits the development of better explanations of the conditions that inhibit or enhance effective self-organized collective solutions.

Second, self-organized collective-choice arrangements can produce operational rules closely matched to the physical and economic conditions of a particular site. Within the context of *de facto* proprietor regimes fishers have devised maps of their fishing territories that could not be generated by central authorities. The maps reflect local knowledge of where fish spawn, their habits in particular waters, and where technologies can be used without the efforts of one boat adversely affecting the success of another boat (see, e.g., Cordell 1972 or Berkes 1986). The knowledge needed to establish agreement concerning

¹⁴ See Matthews (1988) and Matthews and Phyne (1988) for discussions of the impact Canadian fishing policies are having on the institutional arrangements devised by fishers in Newfoundland.

a set of productive fishing spots is achieved by a community of fishers who learn from their accumulated daily experience on a particular fishing ground. The cost of assigning a government official to devise a similar arrangement would be prohibitive. Nor is such an arrangement enforceable without the commitment of the fishers to the legitimacy of their self-imposed constraints (see, e.g., McGuire and Langworth 1991).

Third, since the professional literature is so pessimistic about fishers adopting effective self-regulation, this literature is used by policy analysts to recommend sweeping reforms. These reforms, however, may "sweep away" successful human efforts to solve extremely difficult problems (see, e.g., Berkes 1989; Davis 1984). Fourth, since the regulation of these *de facto* proprietor regimes is undertaken by local fishers who benefit from these regimes, the costs of regulation are largely borne by these same beneficiaries. Institutional arrangements that internalize the costs of monitoring and exclusion among beneficiaries reduce inefficiencies.

IV. PROPERTY RIGHTS, INCENTIVES, AND OUTCOMES

Different bundles of property rights, whether they are *de facto* or *de jure*, affect the incentives individuals face, the types of actions they take, and the outcomes they achieve. An important difference often discussed in economics is that between owners, who hold a complete set of rights, and all other users who do not hold complete rights. In particular, the right of alienation is believed crucial for the efficient use of resources.¹⁵ Alienation rights, combined with rights of exclusion, produce incentives for owners to undertake long-term investments in a resource. Through the sale or lease of all or part of the property rights owners hold, they can capture the benefits produced by long-term investments. In addition, alienation permits a resource to be shifted from a less productive to a more productive use (Posner 1975). Ownership, however, does not guarantee the survival of

a resource. If owners use a relatively high discount rate, they may still destroy a resource (Clark 1973, 1974) or engage in activities leading to substantial "overexploitation, resource abuse, and overcapitalization" (van Ginkel 1989, 102; see also Larson and Bromley 1990).

Owners of natural resources often invest in the physical structure of resources that maintain or increase the productivity of the resource. For instance, the fishers of Ascension Bay, discussed earlier, place artificial habitats, called *casitas*, on the sea floor in each of their *campos*, which attract lobsters (Miller 1989). Lobsters are attracted because they "are gregarious; because they remain in dens during the day; and because they do not modify existing habitat or build new habitat" (*ibid.*, 190). In addition, *casitas* may enhance the productivity of the *campos* because they provide "refuge sites from predators," and those located near feeding grounds of lobsters "have the potential to reduce predation risk" (*ibid.*). Fishers of Ascension Bay regularly make long-term investments in their fishing grounds.

Rights of alienation, however, are not the only important distinction among rights-holders. Another important difference is that between claimants and authorized users on the one hand, and proprietors and owners on the other hand, based on the right of exclusion. The right of exclusion produces strong incentives for owners and proprietors to make current investments in resources. Because proprietors and owners can decide who can and cannot enter a resource, they can capture for themselves and for their offspring the benefits from investments they undertake in a re-

¹⁵ By efficiency, we focus in this article on the level of resource rents that are obtained by fishers and not dissipated through overinvestment or other inefficient practices. Copes (1972) points out that in relation to fisheries, however, not only can resource rent be dissipated but producer and consumer surplus can be lost, depending upon the institutional arrangements that govern the use of a fishery. We have not attempted to expand our analysis of efficiency to that of total social surplus, as we are not examining property rights to resource units in commodity markets.

source.¹⁶ Owners and proprietors are reasonably assured of being rewarded for incurring the costs of investment (Posner 1975). Such investments are likely to take the form of devising withdrawal rights that coordinate the harvesting activities of groups of owners or proprietors so as to avoid or resolve common-pool resource dilemmas. In addition, owners and proprietors devise access rights that allow them to capture the benefits produced by the withdrawal rights (Dahlman 1980).

Claimants, because of their rights of management, face stronger incentives than do authorized users to invest in governance structures for their resources even though their incentives are weaker than proprietors or owners. Claimants can devise operational-level rights of withdrawal for their situation. Without collective-choice rights of exclusion, however, they can no longer be assured of being rewarded for investing in withdrawal rights. Consequently, whether claimants exercise their rights of management depends upon whether they act within a set of circumstances that allows them to capture the benefits of coordinating their activities even without rights of exclusion.

For instance, claimants may utilize resources that no other groups are interested in using, or claimants may be physically isolated from other populations so that exclusion is not problematic. In such situations, claimants are likely to be able to capture the benefits from exercising their rights of management. The fishers of Valenca, Brazil, discussed earlier, even though claimants, utilized fishing grounds of no interest to other potential users. Over a period of time the fishers devised a number of withdrawal rights that resolved the common-pool resource dilemmas that they faced. For several decades the Valenca fishers enjoyed the benefits produced from coordinating their use of the Valenca estuary. Of course, such arrangements are vulnerable to external invasion as the Valenca fishery attests.

Finally, authorized users possess no authority to devise their own rules of access and withdrawal. Their outcomes are depen-

dent primarily upon the operational-level rights that others define for them. Whether the incentives they face induce them to act so as to achieve efficient outcomes depends upon the institutional design skills of those who hold the collective-choice rights. Since authorized users do not design the rules they are expected to follow, they are less likely to agree to the necessity and legitimacy of the rules. Authorized users may engage in a game with rule enforcers, seeking to gain as much as possible. This leads to an overinvestment in the fishery and inefficient outcomes.

IV. A CONSIDERATION OF THE MAINE LOBSTER FISHERY

The state of Maine has owned the lobster grounds off its coast since its founding. The most general property-rights regime is one of government ownership with *de jure* authorized users status extended to all who obtain licenses (Acheson 1975). In addition to *de jure* authorized user rights, lobstermen in many harbors have developed *de facto* proprietor rights among themselves (Acheson 1975; Grossinger 1975). Prior to 1920, the entire coast was divided into a series of lobster "fiefs" with the men from each harbor or island fishing only the grounds associated with their own harbors. The lobstermen in each fishing village determined who could enter "their" grounds. Further, they decided how these grounds would be used—what production techniques would be allowed, etc. Since the lobstermen could not sell, lease, or bequeath their rights of management and exclusion, they would be classified as *de facto* proprietors.

The enforcement of the *de facto* proprietor rights was borne entirely by the lobstermen of each village. The sanction that

¹⁶See Larson and Bromley (1990) for an important analysis of the "bequest motives" that exist under common property versus the "market incentives that exist under private property." They conclude: "There is no scientific knowledge that can rank the relative magnitudes of the terminal value under private property . . . and common property . . . even assuming a perfect land market" (1990, 254).

they used against anyone who violated communal rules was gear destruction. Lobstermen use large wooden traps, set on the ocean floor, to catch lobsters. These traps are attached by rope to buoys. The easiest means of destroying traps is to cut the rope by which the traps are attached to buoys. Prior to 1920, lobstermen used this enforcement mechanism primarily to enforce exclusion. They cut any traps set in their territory by intruding lobstermen from other areas.

The period of time during which *de facto* proprietor rights existed along the entire coast and remained stable is uncertain, but Acheson reports that they began to change after 1920. He attributes the change to the interaction of two factors—new technology and the shape of the coastline (Acheson 1975, 192). After 1920, lobstermen installed motors on their boats. The motors extended both the range and the type of weather in which the men could fish. No longer did the lobstermen have to fish only during the calm waters of summer. This technological change had its greatest impact in southern Maine where the coast is convoluted and forms deep bays. Men who fished in these bays prior to 1920, “inland” men, did so only during the summer months when lobsters were active in the warm waters of the bays. The “inland” lobstermen had much to gain by invading and gaining access to open water grounds. Being able to fish for more than three months out of the year translated into higher incomes and the ability to pay for expensive motors. The alternative for the inland lobstermen, Acheson argues, was “to be bottled up in small traditional territories near their home harbors” (*ibid.*, 193).

The initial response of the open water lobstermen to these incursions was to retaliate by cutting traps. The open water lobstermen were, however, unwilling to incur these enforcement costs permanently in order to exclude the baymen from their open ocean territories. The change in technological capabilities that allowed fishers to access larger territories meant that stemming the incursions permanently would require the escalation of trap cutting into a full-

scale lobster war. In addition, the open water lobstermen knew that while they might temporarily protect the boundaries of their grounds, future incursions would be a certainty. As a result, “men from open-ocean harbor gangs feel it is better to mix than fight” (*ibid.*). Thus, in the southern part of Maine, boundaries of the former lobster fiefs have slowly become more permeable. Mixed fishing, *i.e.*, groups of men from different harbors fishing the same territories, has become more common. The *de facto* system has slowly evolved to be much closer to the *de jure* system than it was previously.

In general, lobstermen in northern Maine have been more successful in maintaining their *de facto* proprietor rights. The physical environment that these men face is quite different from that faced by the southern lobstermen. The coastline is generally not as convoluted as in the south. There are fewer bays, and harbors tend to face the open seas. Therefore, communally defined territories have tended to include the open seas. Some of the northern fishing villages have quite effectively defended their territories, when challenged, and have further controlled “the total number of men engaged in the fishery in a particular area over a period of time” (Wilson 1977, 101). Wilson argues that the voluntary agreements among lobstermen in these territories “confer on the group the potential benefits of ownership and control” (*ibid.*). Some of the island men have even gained legal recognition by the state of Maine of their proprietor rights.

Acheson reports, for example, that the lobstermen of Monhegan Island persuaded the Maine legislature to forbid fishing in Monhegan waters from June 25 to January 1, providing support for their *de facto* right of exclusion (Acheson 1975, 191). By taking this action, the legislature recognized the existence of a territory called “Monhegan waters.” The State takes on the role of the traditional police officer patrolling waters to enforce proprietor property rights during six months of the year. From January 1 to June 25, the Monhegan lobstermen patrol their own territory. They choose to fish

during this period because most other lobstermen do not fish during these months and the price of lobster is at its highest level.

The fact that *different* property-rights systems exist side-by-side along the Maine coast permits a comparative institutional analysis.¹⁷ Wilson and Acheson collected data from three lobstergrounds whose boundaries were well defended (de facto proprietors) and from three adjoining lobstergrounds whose boundaries were permeable (de jure authorized users). Wilson and Acheson collected data on crowding effects, seasonality of catches, the age and size of the lobsters caught, stock density, and income. They found that defended grounds were not as crowded as undefended grounds. There were fewer boats per square mile in defended areas, and the average catch as measured by the number of lobsters per trap hauled was 60 percent greater in these areas (Acheson 1975, 196; Wilson 1977, 104).

In relation to the seasonality of the two types of fisheries, the average catch remained relatively stable throughout the year in defended grounds. Lobstermen with de facto proprietor rights spread their fishing effort more evenly throughout the year. In undefended grounds, the average catch is quite high from August 1 to December 31, declining dramatically over the remaining several months (Wilson 1977, 106). Average catches are high during this time period because lobsters molt into legal size and there is a rush to harvest such lobsters quickly. Lobstermen without de facto proprietor rights expend much of their fishing effort during five months of the year.

The relatively uncrowded conditions and the stable fishing effort that characterizes defended grounds translate into greater stock densities in those grounds than in undefended areas. Acheson reports that depending on the time of year, stock densities of defended grounds are from 22 percent to 50 percent greater than those of undefended grounds (1975, 202).

In light of the above data, it is not surprising that the incomes of lobstermen who have de facto proprietor rights are, on aver-

age, greater than the incomes of de jure authorized users. As Wilson tentatively reports ($N = 27$), lobstermen from controlled areas average \$22,929 per year as opposed to \$16,449 for lobstermen from uncontrolled areas (Wilson 1977, 108). The work of Acheson and Wilson suggests that de facto proprietors experience greater benefits when compared to de jure authorized users. In addition, their work reveals the importance of holding a right of exclusion. Having a right of exclusion encouraged lobstermen to invest in institutional arrangements to govern their grounds.

The major purpose of this article is to propose a property-rights scale ranging from authorized user, to claimant, to proprietor, and to owner, that provides a better analytical scheme for beginning to explain outcomes achieved by joint users of a common-pool resource, particularly inshore fisheries.¹⁸ By examining the evidence concerning the institutions that govern Maine lobster fisheries and the outcomes lobstermen have achieved, we are calling attention to the importance of discriminating among a range of incentives.

VI. CONCLUSION

The development of effective property-rights systems to manage inshore fisheries is extraordinarily difficult no matter what type of property-rights regime is adopted (Johnson and Libecap 1982; Buck 1988). Assigning full ownership rights does not guarantee an avoidance of resource degradation and overinvestment (Larson and

¹⁷It is this capacity to do comparative institutional analysis that is missed when scholars presume that any regime that is not "private property" must be the equivalent of open access (Bell 1972).

¹⁸The concepts defined in this article would be useful in the analysis of outcomes in other common-pool resources such as grazing lands, irrigation systems, groundwater basins. See Blomquist (1992); Gardner, Ostrom, and Walker (1990); McCay and Acheson (1987); E. Ostrom, Gardner, and Walker (forthcoming); E. Ostrom (1987); National Research Council (1986); Tang (1992).

Bromley 1990; Clark 1973, 1974; van Ginkel 1989). Nor can we simply presume that, if state and Federal governments changed their policies of opposition to locally developed proprietor-rights systems, new and effective property arrangements would emerge in most inshore fisheries. The number of proprietor fisheries in Maine has steadily diminished and may now be only about 10 percent of the territory (Wilson 1977, 109). Other proprietor systems have been shown to be relatively unstable when large exogenous changes occur through technology or the expansion of markets (Cordell and McKean 1987; Andersen 1979; Johannes 1978).

None of the governmental policy interventions that are frequently recommended clearly produce net benefits in all situations either. Quota systems ignore the great differences in the fishing skills of participants and protect the inefficient (Pearse 1980; Johnson and Libecap 1982). Taxes imposed by a larger government raise substantial questions as to how the tax will be used and whether the transfer of funds from the fishers to a government bureaucracy will enhance overall efficiency. Implementing fishery regulations is frequently fraught with unexpected problems and failures (Dewar 1990).

Instead of blind faith in private ownership, common-property institutions, or government intervention, scholars need a better understanding of: (1) the conditions that enhance or detract from the emergence of more efficient property-rights regimes related to diverse resources, (2) the stability or instability of these systems when challenged by various types of exogenous or endogenous changes, and (3) the costs of enforcing regulations that are not agreed upon by those involved. Further, the performance of property-rights regimes in field settings needs to be compared to other regimes in field settings. No real-world institution can win in a contest against idealized institutions. The valid question is how various types of institutional arrangements perform comparatively when confronted with similarly difficult environments.

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