Tradition and Globalization
Common Property in Theory and Practice

The Example of Biodiversity Protection in Fisheries

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Introduction

World fisheries are good examples of the magnitude of the changes affecting common property resources. They illustrate the pressures exerted on tradition in an age of globalization that is characterized by the expansion of markets and the integration of environmental policies. Globalization of environmental policy is affecting fisheries in the recovery of overfished stocks, the vesting of use rights, the protection of biodiversity and the advancement toward ecosystem management. This manuscript focuses on biodiversity protection as an example of the challenges associated with finding an effective blend of tradition and change in an era of globalization and in moving from theory to practice.

Marine ecosystems are forms of natural capital that provide value in stocks and flows of goods and services. Goods are used directly as seafood, pharmaceuticals, oils and additives. Services are used indirectly through their contribution to ecosystem resilience, genetic diversity, and aesthetic appreciation. Biodiversity can be viewed in a number of dimensions, including the diversity of species, genetic material and functional roles. The capital properties of ecosystems means that biodiversity can be sustained only through maintaining a balance of stocks and flows and ensuring healthy ecosystem functions.

Restoring marine ecosystem biodiversity is an internationally recognized need. This restoration will require increased biological knowledge, but it will also require a much better understanding of human behavior, particularly in fisheries, the main extractive use. Restoring and maintaining biodiversity is ultimately a problem of controlling human use, and is therefore a problem of common property resource management. It is also an area in which tradition and globalization are in tension.

Status of Marine Biodiversity

The need to maintain healthy ecosystem function is well understood in theory but often poorly achieved in practice. The history of post-World War II fishery management illustrates the problem. Worldwide, fisheries and their management have contributed to marine biodiversity loss and have resulted in large losses in the economic productivity of ecosystems.

The current state of world fisheries is both a cause and an effect of the biodiversity problem. Fisheries are a fundamental cause of the biodiversity problem because of the general focus on single-species management, slow response to environmental signals, and the patterns of sequential harvesting, overcapacity and failure to control access (Hanna 1996). Fisheries bear the effect of biodiversity loss through declining biological and economic productivity, loss of aesthetic and recreational values, a diminished range of harvested species, regulations implemented to protect endangered species, and increasing costs of management designed to protect further biodiversity loss (National Research Council, 1995).

World fisheries developed rapidly after World War II under national policies to promote expanded economic opportunities and control of ocean territory. Access remained open to all, subsidies were provided for the construction of vessels, and seafood markets expanded. As a result, fisheries were transformed from being 60% underexploited in the early 1950s to 60% overexploited by the early 1990s (FAO 1997). FAO reports that of the fish stocks accounting for the majority of the world's marine landings, 60% are in urgent need of management (FAO 1997). The degree of overfishing varies widely by geographic area, but where it exists, species abundance is reduced and ecological resilience is compromised (Botsford et al. 1997). Ecosystem productivity in coastal areas is also suffering from habitat degradation and fragmentation (Gray 1997), and these declines in biological productivity translate directly into economic losses.

Biological and economic stresses on marine ecosystems also affect marine fishery management at all levels. Increasing conflicts, complicated regulations, expanding information requirements and declining legitimacy of management all contribute to increasing fishery management costs. The 1990s have seen a number of publications describing fishery management as in crisis (McGoodwin 1990; Crean and Symes 1996; Hannesson 1996).

Problems in maintaining the biodiversity of marine ecosystems also affects equity and fairness, issues that are especially relevant for food security and employment. Globally, fish are 16% of the animal protein content of human diets. Regionally, fish are a more important protein source for poor countries in Africa (21%) and centrally planned Asian economies (22%) than for rich countries in Western Europe (10%) and North America (7%) (FAO 1993). When biological

productivity of marine ecosystems falls, small-scale artisanal fisheries in poor countries suffer loss of subsistence and markets, often without available substitutes (Williams 1996).

Implementing Biodiversity Protection for Common Property Fisheries

New institutional approaches to biodiversity protection will be done, if at all, within the hierarchy of the existing institutional environment that includes international agreements, national policies, government agencies, decision bodies, regulations and enforcement.

International Agreements

At the top levels there are many international agreements and national laws that support or promote biodiversity protection in fisheries. These include the Rome Consensus on World Fisheries adopted by the FAO Ministerial Meeting in March 1995, the Code of Conduct On Responsible Fisheries, adopted by the Rome Conference of FAO in October 1995, and most recently and most specifically, the Kyoto Declaration adopted at the Conference on the Sustainable Contribution of Fisheries to Food Security (FAO, 1997). The Rome Consensus includes agreement on the need to eliminate overfishing, reduce fishing capacity, reduce bycatch and discards and strengthen governance. The Code of Conduct contains guidelines on fishery management and operations, aquaculture, coastal zone management, trade and research. The Kyoto Declaration, concerned with food security, includes agreements on the need to reduce fishing capacity, strengthen the scientific basis for multispecies and ecosystem management, reduce incidental catch and strengthen institutional coordination. These international agreements reflect the environment of globalization. In several cases they are leading to national efforts to define and implement the various actions (FAO, 1997).

National Policies

Moving down to the level of national policies, the performance of fishery management nationally is critically important to the performance of fisheries management globally, because the majority of world fishery production comes from the continental shelves. In addition, nations bring their histories and expectations about common property resource governance to international agreements which are the basis for the control of fishing practices and the protection of habitat quality. An example of a recent national law strengthening biodiversity protection is the U.S. Sustainable Fisheries Act of 1996, which contains much stronger conservation protection measures related to essential fish habitat and overfishing. These measures are still new and largely untested. The specifics of implementation are still being worked out.

Operating within the framework of national laws are national and regional resource agencies, decisionmaking bodies, regulations and enforcement. All of these comprise institutional implementation. As one moves down the nested hierarchical structure the difficulties of institutional redesign increase at each successive level because actions increase in specificity and in the number of unresolved implementation issues. It is in this institutional implementation environment, at the agency level and below, that the real challenge of institutional design for common pool resources lies.

Agencies

Worldwide, fishery agencies range in level of authority from international intergovernmental, to national governmental, regional and local. At all levels these agencies, as a result of the heavy use of marine ecosystems, are struggling to adjust to a new institutional environment that involves redefined authorities, expanded responsibilities, continued fragmentation between agencies, expanded information requirements, and the complexities of new management directions. To implement biodiveristy protection, these agencies must develop new mechanisms to coordinate ecosystem-level management across fragmented authorities, implement data collection on the status and health of previously unmonitored species, and find methods to finance their new and broader ecosystem responsibilities.

Decision Bodies

Decision bodies range in structure from authoritarian, in which decisions flow from the top down, to participatory, in which users contribute to decisionmaking as advisors or as co-managers. Regardless of structure, decision bodies in fisheries are coping with similar problems in the implementation of biodiversity protection. Such bodies tend to have developed a narrow and shifting management scope does not account for biodiversity. They also tend to be operating within a cumbersome management structure that makes flexibility and adaptation difficult. As a result, many of the decisionmaking bodies are under strain at a time when they must accommodate a broader range of responsibilities and interests. The scope of management is often narrowly defined for single species, and vacillates from goals of conservation to maximizing employment to protection of historical fishing shares (Hanna, 1998). Interests within fishery management - gear groups, operations of different scales, fishing communities, scientists, environmental organizations - are increasingly polarized, with ensuing conflicts that are costly and often intractable. Questions are being raised about the appropriate level of decisionmaking authority, with many recommendations for devolving control to as low a level as possible (Costanza et al., 1998). The complex decision structures designed to maintain procedural transparency and protect against special interest capture often work against decision flexibility to changing environmental conditions, and promote slow adaptation to changing

institutional conditions. It is at this level that the implementation of theory into practice is most sorely tested.

Regulation

The depleted condition of many fisheries has led to new regulations concerning the protection of essential fish habitat, overfishing, and the ecosystem effects of fishing. In the United States, regulations derived from measures in the 1996 Sustainable Fisheries Act are for the most part new and untested, are layered onto old systems of regulations, and carry system-wide effects. New measures for biodiversity protection are fundamentally different from existing regulations in several ways. They integrate commodity use and noncommodity existence of fish species. They introduce requirements for protection that are based on boundaries that are ecological rather than political or geographic. They require scientific information on species that are not directly exploited. They require protection of a wider range of species about which there is significant scientific uncertainty about critical functions and thresholds. And, perhaps most importantly for institutional redesign, they explicitly require accounting for interactive effects within marine ecosystems and, by implication, require more regulatory flexibility at a time when the overexploited state of many fisheries has led to regulatory rigidity.

Enforcement

Many of the regulations designed to protect biodiversity are enforceable only at sea. Such measures include restrictions on fishing technology and the deployment of gear, the prohibition of fishing in protected areas, temporary area closures, bycatch limits, prohibited species restrictions, and requirements for full retention (zero discards). At-sea enforcement, while ideal for monitoring behavior within these types of regulations, is expensive. Fishery authorities currently rely heavily on onshore enforcement of regulations, most of which control access, gear use, and landings. Given the extent to which fishery agency budgets are already stretched and the low probability of budget expansions, effective at-sea enforcement of biodiversity protection measures becomes a serious challenge. It is in the enforcement arena that it becomes most important to have users vested in the goals and objectives of management.

Property Rights and Marine Biodiversity

The current status of world fisheries has lent urgency to the goals of ecosystem restoration. Learning how to repair damage and maintain marine biodiversity, while providing access to ecosystem use, has become an important goal of fishery management. Achieving this goal requires understanding the properties of ecosystems, the human uses of ecosystems, and the way those human uses are controlled.

Ecosystem use is controlled through rules and responsibilities of property rights, under the umbrella of the larger institutional setting of national laws and international agreements. Property rights define privileges and responsibilities in the use of environmental goods and services. They specify the way people are to behave toward one another as they use environmental resources (Bromley 1991). Property rights define the conditions that guide and control the human use of the natural environment. They establish the terms under which people use and sustain the capacity of the environment to generate a continuing flow of goods and services. Property rights are a means by which people interact with their environment and control their behavior toward one another. They embody the expectations people have about natural resources and influence the way people make resource use decisions. Property rights are the intersection of marine ecosystems, people and fishery management (Hanna 1996b).

Property rights have several functions. They delineate the population of legitimate owners. They specify the allowable actions of these owners and their associated responsibilities so that expectations are consistent and enforcement of rules is possible. And by setting consistent expectations they reduce uncertainty about others' behavior. In the larger sense, they connect the pieces of the natural system to the pieces of the human system.

The basic functions of managing common pool resources - coordinating users, enforcing rules, and adapting to changing environmental conditions - cannot be met without a system of property rights. The way that property rights function in any particular context determines whether the natural and human system will interact in compatible or conflicting ways.

Property rights in marine ecosystems can control both use and conservation. Their scope may be either individual species or areas of water in which species live. They may also include different types of use. At present, most systems of property rights are designed for direct uses, such as catching fish for food, but they may also include indirect uses, such as the right of the public to enjoy marine birds or to protect endangered species of sea turtles.

The fundamental problem for marine biodiversity protection is that many of the biodiversity values fall outside the realm of direct use, whereas most traditional control rules affect direct use. Direct uses are easiest to monitor and measure, control and trade. Property rights are frequently left undefined for unused species or to communities of species, leaving them unprotected by ownership. Indirect uses such as genetic information and aesthetic appreciation are less visible because their contribution is more diffuse over space and time. Because these resource values are seldom owned, bought or sold, they are often at a competitive disadvantage in a market economy, leaving them undervalued and overused. This leads to the common approach of protecting biodiversity not through property rights but by removing them from human influence in sanctuaries, refuges or reserves.

Are There "Best" Forms of Property Rights for Biodiversity?

Which forms of property rights are best for the protection of biodiversity? People often promote a particular form of property right because of its ability to contribute to achieving larger goals such as community stability, equity or economic efficiency. In fact, the goal of sustaining marine biodiversity can be achieved with a variety of forms of property rights. The key requirement is that the system of property rights fit into the ecological, economic and social context in a way that contributes to maintaining ecological function and diversity.

Property rights take many forms. Differences in form derive from the scope of the rights, the type of rights owner and the privileges and responsibilities of the rights owner. The most common categories are private, public, state and common. The types of property rights are ordered loosely along a spectrum, where the owner ranges from an individual person to no one (Hanna et al. 1996).

Open Access

Open access, *res nullius*, is the absence of property rights and has no ownership assigned. It is open to all, with resources becoming owned only at the point of capture. The absence of rights is often, but mistakenly, referred to as "common property." The "tragedy of the commons" metaphor is a description of the outcome of open access. It describes the use of a common-pool resource for which it is too costly to exclude people from use.

In the tragedy of the commons, individuals make choices about resource use based on their own private costs and benefits. And while the benefits of their actions accrue to them alone, the costs, in terms of the effect on the resource, are social costs spread among all users. Eventually and inevitably without some control over access, the failure to account for social costs locks people into behavior that leads to resource degradation and overuse.

Common Property

Common property, *res communes*, is owned by an identified group of people who have the right to exclude non-owners, the duty to participate in decisions about use, and the responsibility to act as resource stewards. For example, near-shore fishing territories may be owned and managed by the residents of the adjoining coastal community. Community members as owners decide how many people have rights to use the resource, what kind of rights these may be, and what objectives they have for resource productivity. Although the "tragedy of the commons" is a metaphor that is widely used, it does not really describe common property.

State Property

State property, *res publicae*, is owned by citizens who assign management authority and stewardship responsibility to an agency of the state. For example U.S. fish and wildlife resources are the property of the citizens of individual states or of the country as a whole. The citizens designate the fish and wildlife agencies of individual states and the federal government to manage these resources in their name. The agencies may grant rights of use to individual users or communities of users, but the resources remain owned by the citizens at large.

Private Property

Private property, *res privatae*, assigns ownership to named individuals including legal individuals, such as corporations, guaranteeing to those owners a bundle of rights about access and use. Although individuals have the greatest autonomy under private property, this form of property rights is also stinted by prohibitions against unacceptable uses, such as activities that pollute. For example, individuals may own land and the fish and wildlife on that land, but the types of use to which they can put either the land or the wildlife may be constrained by law.

Property Rights Over Goods

Property rights have one attribute in common: they have, in practice, been applied almost exclusively to environmental goods. When resources are thought of as natural capital, it is easy to see that they create value through the size of standing stock and through the flow of resources from that stock. We are familiar with property rights over the stock and flow of natural capital goods. For example, in marine ecosystems rights can be assigned to the resource only on capture (competitive fishing), to the standing stock itself (territories for sedentary species), to the flow of goods from the standing stock (individual fishing quotas). Property rights to goods from marine ecosystems vary from private/community/state in near-shore areas, to state property in offshore zones, to open access in international waters. These are the tangible components of ecosystems.

Property Rights Over Services

The idea of owning ecosystem services is, in contrast, less familiar and therefore more challenging. These are the intangible components of ecosystems that do not fall easily under definitions of rights. For example, species provide services to the ecosystem and to humans through genetic information, reproduction and contribution to critical ecosystem functions through roles such as predator or prey. Species and groups of species provide additional services to humans through the information they contain and the pleasure they provide.

The idea of intellectual property rights over discoveries leading from information and ideas is a familiar one. Nations have patent and copyright systems that protect rights of ownership over goods and services that flow from the application of intellectual capital; these include designs, published works and medicines. But the focus of intellectual property rights is on the discovery or creation that results from information, not on the information itself. Property rights are poorly defined for ecosystem services such as genetic information.

The lack of systems of property rights for genetic information is a critical issue for its protection. The information stored in biodiversity could lead to discoveries and patented products, but for the potential investor, the necessary protections to encourage investment are not in place. Since rights to the use of genetic information are unspecified, incentives for its protection are also absent. Biodiversity is treated as an open access resource, with the familiar "tragedy of the commons" result.

Biodiversity is a public good—providing benefits to all—at both national and international scales. Developing means to protect its value is a critical challenge, particularly within common property. Some of the same conclusions that apply to property rights and the protection of single resources apply as well to multiple resources and to biodiversity. The evidence of the applied property rights literature indicates that no single type of property rights can be a remedy for all needs of resource protection. It depends on the resource management objectives and on the context.

The Malawi Principles and Property Rights

The Third Trondheim Conference on Biodiversity, held in Trondheim, Norway in September 1999, expanded on principles for an ecosystem approach to biodiversity management developed in Lilongwe, Malawi in the previous year.

The "Malawi Principles" offer insights into the connections between people and marine ecosystems. Five of the twelve Principles relate to the design elements of property rights necessary to sustain marine ecosystems. The principles, describing the desired properties of ecosystem management, carry implications for the way human use of those ecosystems is controlled and so carry corresponding implications for common property.

- Management objectives are a matter of social choice (Principle 1)
- Ecosystems should be understood within the economic context (Principle 4)
- The ecosystem approach should be undertaken at the appropriate scale (Principle 7)
- Change is inevitable, and an appropriate balance between conservation and use should be maintained (Principles 9 and 10)

Managing resources according to the Malawi Principles requires the cooperation of people, and cooperation in turn depends on having incentives in place to encourage the desired behavior. The findings of both theoretical and applied property rights research support the principles listed above.

The challenge for marine biodiversity protection is to integrate the Malawi Principles and property rights into standard marine resource management practice. This integration will take place within the institutional environment of several international agreements developed for the protection of biodiversity.

Despite recognition and support for the legitimacy of the Malawi Principles in theory, in practice, they are difficult to implement in marine ecosystems. One reason is that the existing systems of property rights over marine resources are often serving as barriers to their protection. They are property rights that apply to single species and focus on direct commodity use. Overcoming these barriers will require redesign. To be compatible with long-term biodiversity protection, systems of property rights must function in a way that deals with uncertainty, externalities, transactions costs and scale (Hanna 1996a). The question is what is the role for traditional uses and users as property rights are redesigned to accommodate international agreements?

Uncertainty

Uncertainty is endemic to natural systems. There are large gaps in basic knowledge about biodiversity; about threshold levels of protection, the measurement of ecosystem function, and the definition of goals for biodiversity. In marine ecosystems, relatively little is known about ecosystem composition, links between species, food and reproductive requirements, critical ecological processes and tradeoffs among species.

Inadequate understanding of ecosystem structure may limit the ability to fully specify rights to all ecosystem components. Uncertainty about the future will shorten the time horizons over which decisions are made, removing the incentive to invest in long-term protection. These uncertainties affect how well property rights perform and work against the protection of biodiversity.

Property rights must be flexible to adapt to changing ecosystem conditions to maintain the balance between conservation and use. This research finding complies with Principles 9 and 10, which recognize the central role of change and response to change in maintaining the balance between conservation and use. The need for flexibility in adapting to change can often conflict with the need to provide security of ownership In an uncertain environment, decisionmaking takes place through trial and error. Changing rules create a tension between people and long-term goals that pose a difficult design challenge for property rights developed to protect biodiversity.

Property rights address some, but not all, of the components of uncertainty. They define and sanction ownership, resolving the question of future access. They provide assurance about the behavior of others, because they define appropriate types of use. They do not in themselves increase knowledge about the ecosystem, although they may provide an incentive for owners of property rights to produce this information.

Externalities

Another function of property rights is to resolve the problem of externalities, in which one action affects another. When property rights to resources do not exist or are incomplete, people do not take full account of the costs of their actions because there is no corresponding owner to defend against harm. Development and pollution of estuaries harms habitat important to the production of marine ecosystems, but because ownership over the early production stages of populations is not clearly specified, these ecosystem functions often remain unprotected. In open access fisheries people compete for resource benefits by fishing as fast as they can and catching as much as they can, so one person's catch affects the amount of fish available to others.

In some cases property rights may be defined but unenforceable, and the lack of enforcement then becomes equivalent to removing the right. For example, if dumpint silt into estuaries is prohibited but the rules are unenforced, the right of spawning areas to protection is invalid. If fishing rights are expressed in terms of areas, and others are not excluded from those areas, their encroachment will render the right meaningless.

Externalities involve choice, and the choice about what uses to protect through ownership is a social choice. Systems of property rights must create incentives consistent with the long-term management objectives and social goals. These are social choices, as Principle 1 states, and so will differ among regions and countries. Some may opt for maintaining opportunities for subsistence fishing, or employing many small-scale fishermen. Others may opt for industrial development in estuarine areas, sacrificing the protection of biodiversity to other commercial goals.

The outcome of missing or unenforceable property rights in marine ecosystems is biodiversity loss, as only some components of the ecosystem are protected, leaving others vulnerable to external effects.

Transaction Costs

How well a system of property rights functions both affects and is affected by transactions costs. Transactions costs include costs of gathering information, coordinating users, organizing decisionmaking and enforcing rules. Some transactions costs remain fixed regardless of the type of process used to make

decisions. Others vary with the way decisions are made - the amount of data collected, analyses done, and the process used to make decisions.

Transactions costs are also influenced by the condition of the ecological system. As resources become depleted a system of property rights must account for more and more externalities that increase the costs of management program design and enforcement. It is possible to create a system so costly to design or enforce that potential benefits are outweighed by the costs. This cost effect, particularly in consideration of actions to change property rights, is a particularly important factor in the consideration of the transition to property rights for protecting biodiversity.

To contain transactions costs, systems of property rights must reflect the properties of both the ecosystem and the economic systems within which ecosystems are used. This finding, consistent with Principle 4, is an expression of the linking function of property rights in tying people and their decisions to the biophysical systems they live in and use. People are embedded in the larger social and economic systems. In using marine ecosystems, people respond to economic signals from local, national and international markets, and in doing so, take actions that affect and also reflect changes in the marine environment. To create the right incentives, the assignment of property rights must appropriately track these connections.

Scale

The functioning of property rights is also affected by the scale of the area over which they apply. Just as the ecosystem approach must be taken at the appropriate scale (Principle 7), that is a scale that incorporates the natural structure of the ecosystem, so too should property rights be tailored to ecosystem scale. In practice, rights to use marine resources are generally developed along single species, rather than ecosystem, lines. Property rights to goods are relatively easy to define and enforce because they are associated with geographic space and their value is embodied in the goods themselves. But property rights to services are much more elusive. For example, rights to the information value of species would involve several owners, even nations, over wide geographic space.

A fundamental contributor to the biodiversity problem in marine ecosystems is fisheries management that focuses on single-species, responds slowly to environmental signals, and allows sequential overharvesting of stocks without recognition of community effects (Hanna 1996). This is a reflection of an incomplete assignment of property rights throughout the range of the ecosystem. Nonfishing actions also affect marine biodiversity when all components are left unprotected by property rights. In addition to reflecting ecosystem scale, property rights must also apply over a scale that has meaning to political organization.

For rights to resources to have meaning in terms of providing incentives for their conservation, those rights must have value to the owners. The value rests in part on their uniqueness and exclusivity. When the resource is the genetic information encoded in a plant and the plant species is distributed over a range larger than that areas encompassed by the property right, the information embodied in that plant is also available to others, leaving the rights owner without the power to exclude or to capture the potential financial value from the information. This scale mismatch limits the potential for property rights to provide the appropriate incentives for investing in conserving the genetic information.

The scale question also means that biodiversity protection is often an international issue. There are global benefits to biodiversity that are unaccounted for in national systems of property rights. Species distributions are independent of national boundaries. In addition, the loss of biodiversity is often an international externality, where the impact of one nation's actions are felt by another.

Conclusion

Common pool resource management and the property rights on which it is based tend to evolve over time in response to changing scarcities. The current impetus for considering property rights for the protection of biodiversity is the scarcity resulting from declines in the number, range and diversity of species that enhances biodiversity's value. The evoutionary path to this point, marked by a gradual expansion of property rights over ecological goods and services, is one that has reflected the relative changes in the benefits and costs of property rights as conditions of resource use change.

Designing property rights to protect marine biodiversity faces several challenges. One challenge is how to provide appropriate incentives so that people find it in their interest to promote and maintain biodiversity. A second challenge is how the rights, rules and responsibilities that constrain resource use can be expanded from single species or physical areas to multiple species that may be distributed over wide areas. A third challenge is how to make the transition from traditional single-species use rights to ecosystem services rights that restore and maintain biodiversity.

The institutional transition from single-species management to biodiversity protection is additionally challenged by forces that are both internal and external to fisheries. Internally, the increasing scarcity brought on by fully or overexploited fisheries means that the range of options for both users and managers has declined. Fewer adaptations are possible. Information needs for fishery management are increasing not only because of new biodiversity protection requirements but also because political pressures of high levels of capitalization demand maximum levels of production. In addition, fishing effects on multiple

species require closer monitoring when stocks are fully exploited and overfishing regulations are in effect.

The general trend to greater participation in management through co-management or community-based arrangements offers promise for better regulatory design and compliance. At the same time participation creates its own difficulties. Participatory management requires that user groups have knowledge of the scientific principles underlying management as well as skills in articulation and group negotiations. All of these internal forces create higher levels of transactions costs as agencies and decision bodies coordinate over larger number of people, respond to a broader array of interests, collect more data, analyze more alternatives, and enforce more regulations.

Externally, pressures are also mounting on fishery management. As economies grow and expand away from resource dependence, fisheries represent a smaller proportion of economic activity and thus must face a declining political base. Declining political support is often expressed in lower budgets and a diminished willingness to accept government support of fisheries. In addition, changing public values are placing more importance on nonconsumptive use of fisheries. Finally, the globalization of seafood markets means that many of the drivers of fishing effort are far removed from the control points of fishery management. Points of influence are more diffuse and difficult to control.

Both internally and externally, forces are competing to shape the time horizon of fishery management. Biodiversity protection and notions of sustainable use - external values held by the public at large - are long-term concepts, requiring a long time horizon for management decisionmaking. At the same time, the overexploited levels of many fisheries combined with uncertainty about their sustainability leads to internal fishery pressures to shorten the time horizon and make decisions for the short-run.

As these external and internal pressures illustrate, the very conditions in fisheries that require biodiversity protection are also those which are causing difficulties in its implementation. In order to make headway, we need not only to increase our knowledge of marine ecosystems and decrease the level of human pressure, we need most importantly to attend to innovative institutional design. Without serious and fresh attention, the institutional environment of fisheries is likely to be completely inadequate to the task of protecting biodiversity.

The key design requirement for marine ecosystem property rights is that they fit into the ecological, economic and social context in a way that contributes to maintaining ecological function and diversity. These contributions will be made through the ability of property rights to address the fundamental questions of uncertainty, externalities, transactions costs and scale. Property rights will need to be consistent with long-term social goals, fit into the scale of management and the ecosystem, maintain legitimacy of the management systems, and promote

adaptability. Protecting biodiversity in marine ecosystems will depend on the redesign of traditional property rights to address these fundamental requirements; failure to do this will result in continued biodiversity loss.

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