Fishery Cooperatives as a Management Institution

Robert T. Deacon
Department of Economics, UCSB
Resources for the Future
University of California, Santa Barbara, CA 93106
Ph: 805 729 4351
Email: deacon@econ.ucsb.edu

Daniel A. Ovando
Sustainable Fisheries Group
Bren School of Environmental Science & Management
University of California Santa Barbara, CA 93106-5131, USA
Ph: 805.284.6864
Email: dovando@bren.ucsb.edu

Keywords: cooperatives, fisheries management, incentives, rights based management

Table of Contents

1. **Overview**
2. **The Economics of Fishery Cooperatives**
3. **Experiences with Cooperative Fishery Management**
4. **Conclusions and Research Directions**

Abstract

Cooperative fishery management assigns management rights, formally or informally, to a group of users. Assigning rights to groups rather than individuals can be advantageous, given the shared, common-pool nature of fish stocks. Efficiency can potentially be improved by coordinating harvests over space and time, providing public good inputs, sharing information and setting quality standards. Management by groups rather than individuals can also enhance stewardship incentives. In countries that suffer from ineffective governance, user-based management can fill voids governments might otherwise occupy. Case studies from around the globe demonstrate that these advantages can be important in practice and indicate that fishery cooperatives deserve increased attention from researchers and policy makers as a management option.

Abbreviations:

CPUE – catch per unit effort, a common indicator of stock abundance
TAC – total allowable catch
MPA – marine protected area
ITQ – individual transferable quota
RBM – rights based management
PMPA – private marine protected area
QMS - quota management system
FCMA – fishermen collective marketing act
FEDECOOP – Baja California regional federation of the fishing cooperative societies
CBFM – community based fisheries management
MEABR – management and exploitation areas for benthic resources
CBMRM – community-based marine resource management
OECD - organization for economic cooperation and development

Glossary:

Cooperative: A group of fishers or stakeholders with collective exclusive access to some aspect of a fishery's resources

Common pool resource: A resource such as a fishery or a forest that is available to and usable by a wide array of people

Effort: Actions taken to actively capture fish. Often expressed as a numerical mortality rate applied to a fish stock representing the sum total of all fishing effort

Fish stock: A broad concept defining the functional unit of a fish species population, large enough to be self-reproducing and connected by shared genetics and life-history characteristics

Individual transferable quota: A rights based management instrument that assigns quantitative, tradable catch rights in a fishery to an individual fisher

Marine protected area: An area of the ocean protected against certain uses, such as fishing

Rights based management: Fisheries management strategy in which dedicated access to an aspect of a fishery's resources is assigned to fishers

Territorial use rights fishery: A rights based management approach in which fishers are provided dedicated access to a spatial portion of a fishery

Total allowable catch: A fixed total amount of catch that fishers are allowed to take during a fishing season

Fishery Cooperatives as a Management Institution

1. Overview

A stock of fish is the iconic example of a common pool resource. The economic literature on fisheries rightly emphasizes problems caused by the rule of capture and each individual's incentive to outcompete rivals for the unowned resource. Far less attention has been placed on the fact that all members share the use of this key factor of production, the stock of fish, and may therefore benefit from coordinating how they use it. Looking more closely at this second problem, coordination, can shift the spotlight to policies that the research literature often overlooks.

Recent innovations in managing fisheries are largely based on assigning dedicated access privileges of some form to fishery users. Two rights-based management (RBM) strategies have been the focus of attention in the economics literature, individual transferable quotas (ITQs), a system that assigns quantitative harvest rights to individuals, and territorial use rights fisheries (TURFs), which assign rights on a spatial basis. Management based on assigning management rights to well-defined user groups has received less attention, despite having antecedents in forms of customary marine tenure utilized for centuries by many island cultures. This article summarizes the economic literature on fishery cooperatives, the incentives behind their formation and evidence on how well they work. Deacon (2011) covers many of these topics in greater detail.

Assigning exclusive access rights to groups as a specific RBM strategy can have advantages over other policy approaches if the effect is to facilitate collective action. Collective action gains can take two forms. First, in situations where governments do not function effectively, collective action by harvester coops can fill roles that government regulators would otherwise occupy. Coops can implement and enforce limits on gear or fishing seasons, monitor who fishes, and take stewardship actions such as delineating protected (no-take) areas. In these situations, common in the developing world, fishery coops can have advantages over

RMB approaches that require active government participation. Second, harvest efficiency often can be enhanced by coordinating the actions of individual fishing inputs, much as a firm's manager enhances the organization's profit by coordinating the inputs under its control. In a fishery these gains can result from sharing information on stock locations, providing public good inputs and coordinating effort deployment over space and time.

To succeed, of course, a cooperative must solve a collective action problem. It must find a way to gain some control over its members' actions and devise a CPR management policy that they find acceptable. These tasks are by no means trivial, especially if the organization does not have the state's power to coerce. Nevertheless, cooperatives are now a common institution in fisheries and, as the examples described later demonstrate, many are enjoying remarkable success. Fishery coops deserve careful consideration as a management institution, to bring them into the fold of modern fisheries policy and expand the management tools available for solving specific problems.

In legal terms a cooperative is a business organization formed and operated for the benefit of its members. We use the term "fishery cooperative" more broadly to include any association of fishers that holds collective rights to manage its members' effort. This definition allows us to consider diverse management structures, from the *de facto* management practices of many cooperatives in Oceania to the contractually formalized activities of industrial cooperatives in New Zealand. We avoid including organizations defined only on a spatial basis, called territorial use rights fisheries (TURFs), because they are covered in a separate encyclopedia entry. The line between these two management structures is not distinct, however, so some overlap is unavoidable.

The number of fishery cooperatives active in the world is vast. At least 400 operate in Bangladesh, close to 2000 are reported in Japan and thousands are claimed to be active in India. Case studies have documented their presence in every major fishing region of the world and demonstrated that they exhibit a broad array of forms and activities. Case study evidence compiled by Ovando, *et al* (2011) gives insights on what fishery coops do and how they are organized. Table 1 provides summary information and a breakdown for developed (OECD) and developing (non-OECD) countries. The first two rows report on actions and organizational attributes not directly linked to resource management. Coops in the developed world often formed for the purpose of enhancing market power. Surveys of these groups reveal that many engage in collective marketing, coordinate to ensure catch quality and collectively organize provision of shared inputs. A large proportion of fishing coops practice some form of profit sharing.

The remaining actions in Table 1 are linked to resource management. The most common of these is coordination of members' fishing. Typical coordination actions include assigning the timing or location of members' fishing and division of fishing labor among cooperative members. An emphasis on collective actions in resource management functions is evident. Coops commonly adopt restrictions on gear and fishing seasons and impose and enforce codified penalties for violations, particularly in developing countries. Coops sometimes adopt direct limits on catch quantity or size, but these actions are fairly rare. Actions motivated by the goal resource conservation or stewardship are striking, and include by-catch avoidance, coordinated gear switching and support for research. Spatial restrictions, also common, often take the form of private marine protected areas (PMPAs) or fish sanctuaries intended to protect breeding stocks.

2 The Economics of Fishery Cooperatives

A resource management structure assigns authority to decide how and by whom a resource is used and how its returns are distributed. A property rights regime accomplishes the same tasks, so the two concepts are closely related. Property rights generally specify who has rights to use a resource, and by implication who is excluded. Rights may be quantitative, e.g., an assigned catch, or simply temporal, defining a period of allowed fishing. Property rights have additional dimensions as well and different rights dimensions may be controlled by different parties. Management structures generally follow the same pattern: in a fishery a government regulator may control the total catch, a fishermen's coop may decide what gear will be used to harvest it, and individual coop members may decide how and where effort is deployed. The range of possible management structures is therefore very broad.

In general, the incentive to manage a resource to maximize its return is strongest when the return accrues to the party who makes management decisions. This principle gives guidance for the choice of management systems in diverse circumstances. It also gives an economic rationale for the way firms are organized: the firm's owner decides how resources hired by the firm are used and claims any profit the firm generates. This principle can also guide the choice of management structure in a fishery. Consider the task of task of policing how and by whom a fishery is used to illustrate. Assigning this task to government can be advantageous due to government's monopoly on sanctioned coercion, but only if government is oriented toward providing public goods and upholding the rule of law. If government is corrupt and oriented toward channeling rents to political elites, assigning these duties to government may result in bribery and little effective enforcement. In this case monitoring and enforcement may be more effective if assigned to a group of users.

This clearly has implications for the role of coops in fishery management. Other things equal, the scope for management by cooperatives (and other kinds of user associations) is greater in circumstances where government is corrupt or otherwise unable to manage resources in the public interest.

Cooperatives and community management

Many economists have noted that common property is not synonymous with open access, but this point has been made most forcefully by Elinor Ostrom and her colleagues at the Workshop on Political Theory and Policy Analysis at Indiana University. Their goal has been to understand how groups exploiting small scale common pool resources (CPRs) can self-organize to overcome or diminish the free rider problem and thereby avoid the wastes of open access. Many of the user-based systems this group has studied are not formally organized as cooperatives, but the results reported still are relevant for this review because each represents a user-based approach to the key collective choice problem that every cooperative faces: restraining the actions of individual members in order to achieve outcomes that are superior for the group.

As an initial step, Ostrom and her colleagues demonstrated that self-organized, user-based management systems are common around the world and are often successful. This implicitly challenged economists to explain how CPR outcomes other than the Prisoner's Dilemma dominant strategy equilibrium could persist, and led to focused attention on the steps these groups take to solve collective action problems. Case study evidence was compiled from developed countries, including Switzerland, Japan, the U.S. and Canada and from numerous developing nations, including Sri Lanka, India, Turkey and Brazil. The CPRs studied include communal pasture land, communal forests, coastal fisheries and groundwater basins.

The case study evidence revealed regularities in the specific management tasks user organizations either succeed or fail to accomplish. For example, setting and enforcing quantitative limits on fish catches, or CPR appropriations more generally, is rare in the developing world. A survey of 30 developing nation coastal fisheries found no examples of user groups controlling catch quantities. User groups do set catch limits in developed country fisheries, however, with prominent examples in Norway, New Zealand and Japan. A well known study of Turkish fishery cooperatives found that some succeeded in enforcing exclusion and monitoring, while others failed. In this case, a key factor for success was support from a third party authority, possibly by a local government, that legitimizes exclusion. Evidence from other CPRs indicates that enforcement of rules and sanctioning of violators often is more effective when performed by user groups rather than government agencies. This has been reported in a study of 47 coop-managed irrigation systems and in case studies of communally managed forests in India.

According to case study evidence, cooperative solutions work particularly well in assigning the catch among users and solving coordination problems. Disputes among fishers can arise over access to favored sites and conflict can arise over interference between gear types. A fishery in Valenca, Brazil has become well known for a rotational system for assigning individual users access to the best fishing opportunities and the case study literature contains other similar examples. Additionally, coordinating effort deployment often can enhance harvest efficiency.

Understanding why communal management succeeds in some cases and not in others clearly is a central question. Searching for answers, researchers have compiled qualitative and quantitative case study information and looked for patterns in the attributes of user-based systems judged to be successes versus failures. This led to the promulgation eight well known "design principles", attributes which if present help to account for success in user-based CPR managment. Three of these principles figure prominently in the ensuing discussion: (i) Exclusion, clearly defined boundaries for which individuals have rights to appropriate the resource, as well as the resource's physical boundaries; (ii) Legitimization, at least minimal recognition by relevant governments of the group's right to organize for CPR management; and (iii) Monitoring, those who actively audit use of the CPR are accountable to the appropriators, or are the appropriators.

Game theory and experimental methods have also been employed in the search for attributes that lead to success. Experimental economists have placed subjects in CPR appropriation games and given opportunities to develop appropriation rules and sanctioning mechanisms. The outcome is generally more efficient (a greater portion of CPR rent is captured) when users develop the rules and sanctions when an external authority imposes them. Allowing subjects to communicate with one another enhances the advantage of user-based rules and sanctions, even when the experimental design prevents participants from reaching binding agreements. Allowing non-binding communication also enhances coordination among participants in designs where coordination can enhance rent capture. Another experimental regularity is that CPR management regimes are most effective at capturing rent when sanctions for rule breaking are gauged to the severity of the violation, rather than 'all or nothing' in nature.

A recent trend is the use of field experiments to study CPR systems. Evidence from this work has found that societies that are *generally* are more likely to manage CPRs effectively. Community members from 49 communally managed forests in Ethiopia participated in laboratory experiments designed to gauge each individual's inclination toward 'conditional cooperation', a willingness to cooperate if others do. Communities in which communal forest management was judged to be successful had relatively high proportions of conditional cooperators, as opposed to free riders. A field experiment in community fishery management in northeastern Brazil agrees with these findings. Laboratory experiments placed individuals in games designed to assess each participant's level of trust and willingness to cooperate. These results were then compared to the individual's aggressiveness in exploiting a communal fish stock, where aggressiveness was judged by the gear used. The most trusting individuals systematically practiced moderation in exploiting the stock, specifically by using gear that allows small, pre-fertile fish to escape and enhance the community's future harvests. Another field experiment tested the common claim that allowing fishers to participate in developing a communal management policy, rather than imposing it from the outside, enhances prospects for success. This claim was not supported by the evidence. However, the importance of individual trust and beliefs about the trustworthiness of other community members was confirmed.

Cooperatives as firms

Fishers who join a cooperative cede rights over how their effort will be deployed in return for benefits the cooperative can provide by taking collective actions. To a large degree these collective action benefits stem from the coop's ability to manage fishing effort in a coordinated way to achieve the group's collective goals. This relationship between the coop and its members, and the benefits that result, resemble the relationship and benefits that exist within a firm between workers and the firm's management. Workers in a firm allow the manager broad rights to allocate their labor hierarchically in order to achieve gains from coordination. The theory of the firm is therefore a natural focal point for considering the economic function of cooperatives.

The firm as a collection of contracts between inputs and a manager, structured hierarchically so the manager can organize inputs without excessive transactions costs. This structure allows the firm to capture gains from collective actions such as providing public good inputs, coordinating activities of workers with complementary skills and organizing of workers into non-competitive teams. Organizing workers in teams can enhance productivity in certain instances, even though team production allows individual workers to free ride on the effort of others.

The potential efficiency gains from coordination are arguably pronounced in fish harvesting due to the fact that all harvesters share in the use of a single key input, the stock of fish. The profitability of each fish harvester depends on the availability and condition of this input and on the actions other harvesters take when exploiting it. The gains from coordination are most obvious when the alternative is open access, i.e., unconstrained fishing by anyone who chooses to enter the fishery, in which case the predictable outcome is stock depletion and rent dissipation. Coordination gains are more nuanced when a management structure such as limited entry or ITQs is in place, but they may can be important. ITQs can achieve efficiency without coordination if all units of the stock are homogeneous in economic value. If there are heterogeneities, however, the result can be wasteful races to catch the most profitable fish. Heterogeneity can arise from variations in the spatial density of stocks, variations in their proximity to ports or processing facilities and temporal variations in value due to market conditions or cost-affecting weather patterns. Alaska's wild salmon fisheries exemplify this. Because fish are naturally concentrated and easily accessible at the mouths of spawning streams, it is efficient to delay fishing until they arrive there. With uncoordinated fishing, however, individuals are tempted to intercept the migrating stock earlier in order to harvest from it before rival fishers do, which raises costs.

Collective action can facilitate provision of public good inputs. Information on the density, size and quality of fish stocks is an important example. These factors can vary across space, resulting in redundant search if individuals do not share information with one another. Abalone, which exist as distinct populations among scattered reefs, show important variation in both density and size of individuals. Without coordination the individual diver who finds a desirable patch has no incentive to share that information with others. 'Physical' public good inputs, including as fish aggregating devices such as floating structures or lights deployed at night, can also lower costs. Stretching the concept only slightly, a collectively observed quality standard for catch can also be regarded as a public good. Catch quality generally can be raised by slower fishing and more careful handling. An individual harvester embedded in a large fishery may find it impossible to differentiate his or her catch from that of hundreds of others, however, eliminating the individual's incentive to take the necessary steps. If numerous harvesters band together for the expressed purpose of enforcing a quality standard, their 'brand' may benefit all simultaneously by commanding a price premium.

Actions taken to conserve or steward the resource itself are also public goods. While other RBM institutions such as ITQs arguably enhance the individual's interest in long term sustainability, they do not overcome the free rider problem; no individual rights holder has an incentive to make a sacrifice today that will enhance the stock's abundance in the future. Well-functioning cooperatives can solve these problems in principle, much as a local government solves the free rider problem when providing public goods. Potential stewardship actions extend far beyond simply constraining catch. As the case studies summarized later demonstrate, fishery coops often establish "no take" zones to protect breeding stocks, invest in habitat enhancement and fund research on stock conservation.

As discussed earlier, coops often perform ordinary resource management functions, essentially filling in where government fails to function. Cooperatives can also provide 'fixes' for inefficiencies resulting from well-established but poorly designed government regulation. Developed country fisheries often are managed in a top-down fashion by dictating fine details of how fisheries are prosecuted. The result can be wasteful races for fish, use of inefficient, antiquated fishing gear and investment in excessive capital. Some developed world cooperatives have formed to eliminate these inefficiencies while accomplishing conservation objectives.

Importantly, cooperatives can be layered onto other regulatory systems. Coops have formed among ITQ holders to achieve coordination gains without sacrificing the efficiencies that an ITQ market can bring. Coops have also formed among license holders in limited entry fisheries and eliminated some of the worst inefficiencies associated with a race to fish and excess capacity. The following descriptions include examples of such hybrid systems.

3 Experiences with Cooperative Fishery Management

The motives, behavior, successes and failures of fishery cooperatives are best delineated by describing how prominent fishery cooperatives function. The following cases are grouped into developed and developing country examples, on the hypothesis that the functions performed will differ between these two contexts. They range from modern, multi-million dollar industries to subsistence level community organizations. This existing case study literature may well be biased toward successes over failures. Successful coops are likely to persist longer, making it more likely they will be noticed and studied, whereas failures may come and go too quickly to attract focused attention. We discuss this further in the conclusions.

Prominent developed country cooperatives

New Zealand has managed its fisheries under an ITQ framework called the Quota Management System (QMS) since 1986. While this system has performed well, quota holders in several fisheries have formed associations, effectively combining cooperative management with an ITQ system. The Challenger Scallop Enhancement Company (CSEC) is a prominent example. The southern scallop population targeted by this fishery collapsed in the 1970s. Government responded with strict regulations and an aggressive reseeding program, and eventually included the fishery in New Zealand's QMS program. A group of 38 quota holders subsequently formed a cooperative, Challenger, which now carries out most management functions in the fishery. CSEC generally has held catches to levels below government mandates. It also coordinates effort spatially and reseeds depleted areas following harvests. CSEC routinely invests members' contributions in stock enhancement and biological research. Over time government has devolved management responsibility to Challenger and limited its role to oversight.

New Zealand's *paua* (abalone) fishery provides a second example. ITQ quota owners have formed management action committees (MACs) in order to coordinate the spatial deployment of effort. *Paua* stocks are spatially distributed and local concentrations are heterogeneous in densities and growth rates. ITQs are not so finely differentiated, however. Absent coordination the MACs facilitate, individuals would compete to harvest concentrations that yield the highest short term profit. In addition, MACs share information among members on stock locations and diving conditions. The *paua* MACs observe privately adopted size limits more stringent than regulators require, have instituted diver training programs to minimize incidental mortality, and regularly invest in stock replenishment.

In the U.S. the Pollock Conservation Cooperative (PCC) targets spawning aggregations of Bering Sea pollock stock, largely for it's highly valuable roe. This fishery has become North America's largest by volume. Before PCC formed, the offshore pollock fishery was governed by a TAC and a season closure, which predictably lead to a wasteful derby fishery. During the open season processors faced gluts of quickly caught and poorly quality catch, raising costs and lowering final product quality. Effort to form a cooperative in this fishery eventually led to passage of the American Fisheries Act, which specifically sanctioned formation of PCC with an assigned portion of the TAC. PCC divided its overall quota among its members, effectively eliminating the historic race to fish, and reduced excess fishing capacity. These actions slowed the rate of fishing and increased product recovery rates.

The Chiknik Sockeye Salmon Cooperative (CSSC) operated from 2002 to 2004 in Alaska. As is common in U.S. fisheries, the Chiknik salmon run was managed by limited entry and season closures, leading to excess fishing capacity and rushed fishing. The coop formed on a voluntary basis and was granted a dedicated period of fishing and a portion of the allowed catch based on the number of permit holders who joined. Non-joiners fished at separate times and competed for the remainder of the allowed catch. CSSC apparently enhanced profitability. License values were systematically higher than in comparison fisheries and exceeded values in Chignik before or after the coop period. Enhanced value evidently resulted from coordinated harvest efficiencies as well as higher prices. The coop enhanced efficiency by centralizing information on fish locations. It also coordinated effort spatially and temporally to reduce transportation costs and to target dense concentrations. CSSC installed barriers along the migration route to concentrate the run and enhance effort efficiency. Non-coop license holders who felt disadvantaged by the way the State divided the TAC filed suit and prevailed, ending the CSSC's operation after the 2004 season.

The New England groundfish fishery suffered for years from chronic overfishing. Regulatory attempts at recovery were largely ineffective, but the new regulations combined with the poor state of the stock decimated the region's small-scale fishing industries. In an attempt to both reverse the historic decline of groundfish stocks and provide support to local fishing communities, the government enacted the New England Sector Allocation (NESA) program. Under the NESA, a voluntary group of groundfish permit holders can form a cooperative and apply for a dedicated catch allocation and access rights, in exchange for binding agreements on fishing conduct and management support. Early performance was variable as the sectors became familiar with the new program. Subsequent analysis indicates that NESA's results are largely positive. Revenues in one sector have increased by seventy-five percent, while catches have been maintained below the quota allocated to the cooperative. There are also signs of positive ecological effects; by-catch has fallen sharply due to the adoption of more selective gear by sector cooperatives. NESA has also helped protect the historic industry of many New England fishing communities.

In the U.S., anti-trust law has inhibited the formation of fishery cooperatives whenever the effect is to reduce catch. Clearly, unrestrained competitive harvesting is the crux of the common pool problem. Given the way anti-trust law is structured in the U.S. the goal of protecting consumers from monopolized supply is squarely at odds with the goal of resource conservation. To date U.S. courts have not recognized the conservation role fishery cooperatives can play. Prominent fishing cooperatives have been struck down by the Sherman Act, including the Gulf Coast Shrimper's and Oystermen's Association and Monterey Sardine Industries. The Fishermen's Collective Marketing Act (FCMA) provides some statutory anti-trust protection, but its application is limited. Overall, U.S. law has not reconciled the desire to protect consumers from monopolies with the need to protect for common pool resources.

Prominent developing country cooperatives

Nine fishing cooperatives, organized under an umbrella organization known as FEDECOOP, target spiny lobster, abalone, and other species on the west coast of Baja California, Mexico. Each has exclusive rights to fish along specific stretches of coastline under government concessions granted in the 1930s, so they are actually TURFs. While the coops submit annual management plans to government authorities, the government's main role is to legitimize restricting entry. The coops effectively manage effort and catch and are responsible for most enforcement. The FEDECOOP cooperatives appear economically successful, with the lobster fishery alone generating multi-million dollar annual revenues. The lobster fishery has also demonstrated sufficient ecological sustainability to achieve certification by the Marine Stewardship Council (MSC), a rarity in the developing world.

A group of freshwater fisheries in Bangladesh were the subjects of an ambitious experiment in cooperative fishery management. Thousands of these fisheries exist, made up of open water bodies such as seasonal ponds, stretches of river and oxbow lakes. They are critical in supplying protein to the country's population. Traditionally, government granted control of individual fisheries to wealthy landowners, politicians, and other elites under short term leases. Those in control allowed local fishers access, in return for a share of the catch or other payment. Incentives for stock enhancement and other stewardship actions were reportedly minimal. Two phases of a Community Based Fishery Management (CBFM) experiment were carried out during 1994-2005. During the last 5 years, local harvester associations were granted dedicated access and management authority to roughly 100 water bodies for an extended period. When compared to control fisheries managed under business as usual, CBFM sites performed significantly better in catch per unit effort and fishery yields. CBFM communities also routinely took such stewardship actions as establishing fish sanctuaries (no-take zones), restoring habitats, instituting season closures and setting restrictions on gear. These actions were uncommon or nonexistent in control fisheries.

Artisanal fishers in Chile historically have targeted *loco*, a relatively sedentary, shallow water mollusk similar in appearance to abalone. Increasing demand and ineffective management combined to reduce stocks severely, prompting in a complete closure of the fishery during 1989-1992. Together with local researchers, the Chilean government sought to implement an incentive-based management system. This led to a program known as Management and Exploitation Areas for Benthic Resources (MEABRs). Under MEABR, *loco* can only be harvested by cooperatives. Local communities may propose cooperatives formed of local fishers, provided that they agree to a legal contract of responsibilities and benchmarks. If all parties agree the coop is granted exclusive access to the region's *loco* and other marine species, i.e., a TURF. Numerous studies have analyzed the effects of MEABR. Population densities of *loco* are far higher within cooperatively managed waters than elsewhere. Other ecosystem indicators such as diversity and abundance of non-target species show similar patterns. Landings and CPUE in participating coops have generally increased over historic levels. The coops commonly coordinate members' harvesting activities, carry out enforcement and aid in ecological research and restoration. They also facilitate collective marketing of members' catch. Predictably, MEABR cooperatives often fail to effectively manage species whose range extends beyond their borders. Outside the physical jurisdiction of waters governed by MEABR cooperatives, illegal fishing remains problematic.

The communities of Oceania, especially those concentrated among the Pacific Islands, contain perhaps the oldest traditions of cooperative fisheries management known to exist. These cooperatives trace their roots to practices of community-based marine resource management (CBMRM), in which a clan, village, family, or other group of individuals assume responsibility and ownership over the waters surrounding its community. Traditionally, CBMRM practices included the creation of fishing seasons and protected areas, size limits, gear restrictions and assignment of harvesting rights. These practices are reported among nations as diverse as Palau, the Cook Islands, Solomon Islands, Fij, Samoa, Vanuatu, the Philippines, Papua New Guinea and Sri Lanka. While CBMRM in many of theses communities declined dramatically following colonization, independence often led to their resurgence. Despite their ancient origins, widespread ongoing use, and intensive study by sociologists, anthropologists and ecologists, the CBMRM practices of Oceania have received little attention from natural resource economists.

4 Conclusions and Research Directions

There is now robust evidence that groups of fishermen can perform many of the management tasks often considered to be the exclusive purview government. The evidence suggests that government's essential role lies in assigning enforceable access rights and in providing a legal system for adjudicating disputes. In a wide variety of circumstances, associations of users, often organized as cooperatives, can carry out day to day management tasks if government legitimizes their exclusive access rights. These management tasks include monitoring and enforcing rules on how and by whom fisheries are exploited and apportioning the catch among individual group members; in some cases users' management responsibilities extend to setting the allowed catch. Extensive evidence also confirms that user groups empowered to manage can enhance rent capture by coordinating effort, providing shared inputs and investing in stock enhancement. Admittedly, a cooperative cannot succeed unless it solves the key collective action of getting members to agree to limits on their actions and to make contributions necessary to cover the cooperative's expenses. While the difficulty of these tasks should not be minimized, the fact that thousands of fishery cooperative are now operating and have operated for long periods indicates that these obstacles are not insurmountable.

We organize conclusions on likely directions for future research by posing and commenting on three questions that bear on the role and efficacy of cooperatives. First, when cooperatives are judged to be successful in CPR management, what forms do the efficiency gains take? This question has received the most attention in the literature. Although research on this question will no doubt continue, the body of evidence from case studies, laboratory and field experiments and econometric analysis is already extensive.

Second, what factors contribute to, or enable, the success of cooperative CPR management? Researchers have addressed this question in several ways. One approach compiles case study results linking coop attributes to judgments about the degrees of success attained. The influential design principles referenced earlier emerged from this approach. Demonstrating causation obviously is problematic, however. One must demonstrate that the attributes identified as drivers are not consequences of success rather than causal factors. One must also demonstrate that an empirical association does not just reflect a correlation between a falsely identified attribute and an unobserved true causal factor. Empirical designs that include control groups and account for the confounding possibilities of reverse causation and endogeneity of attributes are one avenue forward. Laboratory and field experiments, where treatments representing potential drivers of success can be randomly assigned and compared to controls are another. The literature includes examples of both approaches, but there clearly is room for more work along these lines.

Third, how successful are *actual* cooperative regimes in capturing CPR rents in comparison to other management strategies? The answer would help determine how forcefully cooperative CPR management should be pushed in a given circumstance, relative to other rights-based approaches. The case study evidence is not decisive here. It is unlikely that the set of existing case studies is a representative sample of the entire population of coops; successes seem to be favored over failures and developed country cases over developing country cases. Laboratory experiments can be downplayed as a source of credible answers to this question due to their artificial setting. A compelling strategy for answering this question would randomly assign cooperative management to a set of fisheries, paired with non-cooperative control fisheries, and then track fishery performance for both groups over time. Field experiments involving cooperative management treatments applied to *actual* fisheries, though clearly ambitious, should not be dismissed as impossible. A large scale experiment of this nature is slated for Bangladesh and a preliminary study in the same area has already yielded encouraging results.

Further Reading

Adler, Jonathan H., 2004. Conservation through Collusion: Antitrust as an Obstacle to Marine Resource Conservation. *Washington and Lee Law Review 61*(3) 3-78.

Arbuckle, Michael, and K. Drummond, 2000. Evolution of Self-Governance within a Harvesting System Governed by Individual Transferable Quota. In R. Shotton, ed., *Use of Property Rights in Fisheries Management,* FAO Fisheries Technical Paper 404/2, 370-382.

Berkes, Fikret, 1986. Local-level Management and the Commons Problem. *Marine Policy* (July).

Cancino, Jose P., Hirotsugu Uchida and James E. Wilen, 2006. Turfs and ITQs: Coordinated vs. Decentralized Decision Making. *Marine Resource Economics* Vol. 22, 391-406.

Costello, Christopher and Robert T. Deacon. 2007. The Efficiency Gains from *Fully* Delineating Rights in an ITQ Fishery, *Marine Resource Economics* Vol. 22: 347-361.Deacon, Robert T., 2011. "Managing Fisheries by Assigning Rights to Harvester Cooperatives," Department of Economics, University of California, Santa Barbara.

Deacon, Robert T. 2010. Pathways to Fishery Reform: Accounting for Political Economy. In Donald R. Leal, ed., *Political Economy of Natural Resource Use: Lessons for Fishery Reform*, World Bank, 2010.

Deacon, Robert T., Dominic P. Parker and Christopher Costello, 2010. Overcoming the Common Pool Problem through Voluntary Cooperation: The Rise and Fall of a Fishery Cooperative, NBER Working paper No. 16339 (September 2010), Cambridge, MA.

Fehr, Ernst, and Andreas Leibbrandt, 2010. A field study on cooperativeness and impatience in the tragedy of the commons. Unpublished manuscript: Department of Economics, University of Chicago.

Grafton, R. Quentin, R. Arnason, T Bjorndal, D. Campbell, H. F. Campbell, C. W. Clark, R. Connor, D. P. Dupont, R. Hannesson, R. Hilborn, J. E. Kirkley, T. Kompas, D. E. Lane, G. R. Munro, S. Pascoe, D. Squires, S. I. Steinshamn, B. R. Turris and Q. Weninger, 2006. "Incnetive-based approaches to Sustainable Fisheries." *Canadian Journal of Fisheries and Aquatic Science* Vol. 63: 699-710.

Holmstrom, Bengt R., and Jean Tirole, 1989. The Theory of the Firm. In R. Schmalenses and R. D. Willig, eds., *Handbook of Industrial Organization: Volume I*, Elsevier Science Publishers, B. V. 1989.

Johannes, R.E., 2002. "The Renaissance of Community-Based Marine Resource Management in Oceania", *Annual Review of Ecologycal Systems*, 33: 317-340.

Kitts, A. W., and S. F. Edwards, forthcoming. Cooperatives in US Fisheries: Realizing the Potential of the Fishermen's Collective Marketing Act. *Marine Policy*.

Knapp, Gunnar, 2008. The Chignik Salmon Cooperative. In R. Townsend, R. Shotton and H. Uchida, eds., *Case Studies in Fisheries Self-Governance*, Rome: Food and Agriculture Organization of the United Nations, 2008.

Matulich, Scott C., Murat Sever and Fred Inaba, 2001. Fishery Cooperatives as an Alternative to ITQs: Implications of the American Fisheries Act. *Marine Resource Economics* (*16*) 1-16.

Ostrom, E. 1990. *Governing the Commons*. Cambridge University Press.

Ostrom, Elinor, Roy Gardner and James Walker, 1994. *Rules, Games, and Common Pool Resources*, Ann Arbor: University of Michigan Press.

Ostrom, Elinor, Thomas Dietz, Nives Dolšak, Paul C. Stern, Susan Stonich and Elke U. Weber, Eds., 2002. *The Drama of the Commons*. Washington DC: National Academy Press.

Ovando, Daniel, Robert Deacon, Christopher Costello, Sarah E. Lester, Tonya Van Leuvan, Karlynn McIlwain, Kent Strauss, Rod Fujita, Stefan Gelcich, Hirotsugu Uchida, Michael Arbuckle. 2011. "Conservation Incentives and Collective Action in Cooperative Fisheries." Unpublished manuscript, Bren School of Environmental Science and Management, (in review).

San Martin, Gustavo, Ana M. Parma and J. M. (Lobo) Orensanz, 2010. "The Chilean Experience with Territorial Use Rights in Fisheries", In R. Q. Grafton, R. Hilborn, D. Squires, M. Tait and M. Williams, *Handbook of Marine Fisheries Conservation and Management*, (forthcoming) Oxford University Press.

Schlager, Edella, 1994. Fishers' Institutional Responses to Common-Pool Resource Dilemmas. In Ostrom, *et al*, 1994. *Rules, Games, and Common Pool Resources*, Ann Arbor: University of Michigan Press.

Tang, Shui Yan, 1994. Institutions and Performance in Irrigation Systems. In Ostrom, *et al*, 1994. *Rules, Games, and Common Pool Resources*, Ann Arbor: University of Michigan Press.

Townsend, Ralph E., 2005. Producer Organizations and Agreements in Fisheries: Integrating Regulation and Coasean Bargaining. In Donald R. Leal, ed. *Evolving Property Rights in Marine Fisheries* Oxford: Rowman & Littlefield Publishers, Inc.

Wilen, James E., and E. J. Richardson, 2008. Rent Generation in the Alaskan Pollock Conservation Cooperative. In R. Townsend, R. Shotton and H. Uchida, eds., *Case Studies in Fisheries Self-Governance*, Rome: Food and Agriculture Organization of the United Nations, 2008.

Table 1. Percentages of fishery cooperatives adopting specific regulations or actions

Coop activity or regulation	**All Cooperatives**	**Developed countries (OECD)**	**Developing countries (non-OECD)**
Non-management actions			
Marketing	39%	44%	33%
Profit Sharing	47%	37%	59%
Catch and effort management			
Catch Restrictions	15%	22%	9%
Gear Restrictions	45%	28%	61%
Size Limit	11%	16%	7%
Season restrictions	35%	30%	40%
Coordination and policing			
Coordinating effort & harvest	65%	80%	48%
Gear Sharing	30%	27%	36%
Enforcement	56%	42%	70%
Codified Penalties	36%	43%	30%
Stewardship of fish stocks			
Spatial restrictions	31%	26%	36%
Restocking	11%	10%	13%
Habitat Restoration	3%	0%	8%
Change in gear	29%	24%	34%
By-Catch Avoidance	26%	48%	2%
Research Support	47%	62%	34%
Sample Size	67	38	29

Note: Information is from (Ovando et al. 2011).