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TURFs and ITQs: Collective vs. Individual Decision Making

JOSÉ P. CANCINO
Pontificia Universidad Católica de Chile

HIROTSUGU UCHIDA
University of Rhode Island

JAMES E. WILEN
University of California, Davis

Abstract *While most of the attention in the scientific and policy literature on rights-based institutions has been devoted to Individual Transferable Quotas (ITQs), there are alternatives that involve different configurations of use rights. One such alternative is a space-based option commonly referred to as Territorial Use Rights Fisheries (TURFs). TURFs have been utilized in island fisheries off Southeast Asia for decades, and they have been well studied, particularly by anthropologists and sociologists. This paper discusses case studies of TURF organizations in Japan and Chile from an economics perspective. We discuss the historical origins of each system, outline the legal and institutional structures of the systems, and then discuss how each system manages nearshore coastal resources. We discuss similarities and differences across the many specific collective management structures adopted by Japanese and Chilean TURF organizations. We then discuss how outcomes differ from what might emerge under ITQs.*

Key words Collective management, resource management, rights-based fishery management, TURFs.

JEL Classification Code Q22.

Introduction

Since the earliest experiments in Iceland and New Zealand with rights-based fisheries policies, most of the literature and policy attention has been devoted to Individual Transferable Quotas (ITQs). At the same time, there has been resistance to wholesale adoption of ITQs in many countries, for reasons that are both spurious

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José P. Cancino is an assistant professor in the Departamento de Economía Agraria, Facultad de Agronomía e Ingeniería Forestal, Pontificia Universidad Católica de Chile, Avenida Vicuña Mackenna 4860, Macul, Santiago de Chile, Chile, email: jcancino@uc.cl. Hirotsugu Uchida is an assistant professor in the Department of Environmental and Natural Resource Economics, University of Rhode Island, 1 Greenhouse Road, Kingston, RI 02881, U.S.A., email: uchida@uri.edu. James E. Wilen is a professor in the Department of Agricultural and Resource Economics, University of California, Davis, One Shields Avenue, Davis, CA 95616, U.S.A., email: wilen@primal.ucdavis.edu

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and substantive. ITQs have been subject to a fairly constant din of criticism by skeptics since they were first proposed as a scheme for rationalizing fisheries in the 1970s. Early skeptics acknowledged that ITQs had promise to reduce common property waste, but doubted that the transactions costs of enforcing and administering such a radical change could ever be overcome. But even as enforcement and administrative infrastructures were being successfully developed and implemented in Iceland and New Zealand, new doubts were expressed over the breadth of settings within which they might successfully operate. The highly cited Copes' critique offered many reasons why we might expect ITQs to fail in practice, including data fouling, black market off-loading, and high-grading, among others (Copes 1986).

As experience has accumulated, most of the Copes' critiques have proven unfounded. ITQs have been adopted in a variety of biological, technological, and institutional settings, and there have been no notable failures to improve fisheries economic efficiency or sustainability and ease of management, compared with *status quo* regimes (Arnason 1993; Pascoe 1993; Newell, Sanchirico, and Kerr 2005). More recent criticism of ITQs has focused on the distributional aspects associated with the actual rents that have been generated. The Icelandic Supreme Court challenge to Iceland's ITQ system is a case in point, but not the only case that has focused on perceived fairness of the actual distribution of quota rents. The "fairness" issue cuts across various concerns, including the fairness of excluding some bona fide fishermen in the initial allocations, the fairness of granting initial wealth to original participants, and the fairness associated with inevitable structural changes that often shift centers of processing and secondary impacts (*e.g.*, Matulich and Sever 1999).

Regardless of the source or veracity of the criticisms, ITQs have attracted detractors as well as ardent supporters. As experience with ITQs accumulates, it is important to reflect on the nature of their strengths and weaknesses, and to synthesize some consensus over the kinds of settings in which they have been most successful. This paper takes a step in that direction but in a roundabout way, by examining some fisheries that are successfully managed but in which ITQs *have not* been used. In particular, we focus on Territorial Use Rights Fisheries (TURFs). These systems are best contrasted with ITQs because, within the context of rights-based management, they involve collective and coordinated decision making. Our discussion is mostly anecdotal at this stage, summarizing initial findings from ongoing survey work that is aiming to understand in some detail how TURFs operate, the biological and socioeconomic settings they operate within, and strengths and weaknesses as institutions. In the end, studying fisheries in which collective rather than individual rights have been granted helps fill out our intuition and test various economic hypotheses about how rights-based systems mitigate the problems of open access and the race to fish.

The paper is organized as follows. The next section reviews some of the basic characteristics of TURF systems, and the following section presents the specific settings in which they have evolved in Japan and Chile. We then discuss what TURFs can do that ITQs fail to do and provide specific examples drawn from empirical analyses undertaken in both Japan and Chile. Finally, the last section sets forth the lessons derived from our analyses.

TURF Management Systems in Japan and Chile

TURFs have been widely implemented in nearshore coastal fisheries of Japan and Chile. Much of Japan's coastal waters are divided into TURFs that are administered by local Fishery Cooperative Associations (FCAs). In order to collectively manage the fisheries within their TURFs, members of FCAs have further spontaneously subdivided into smaller and more specialized Fishery Management Organizations (FMOs). FMOs typically manage single-species fisheries within the larger TURF. Fisheries managed by FMOs include sedentary and mobile species, using gear that spans everything from diving to bottom trawls. In Chile, the nearshore coast is also divided into TURFs managed by local fishermen's organizations that are responsible for using and managing the resources within each TURF. The Chilean TURF system is divided into spatial units that are locally called Management and Exploitation Areas of Benthic Resources (MEAs) (González 1996; Montecinos 2000).[1]

There are several common aspects in the Japanese and Chilean systems. Both begin with well-defined spatial units (TURFs) that clearly delineate spatial zones in the nearshore coastal environment. In both systems, exclusive access rights are granted to well-defined groups of fishermen associated with local fishermen's cooperatives. Finally, in both systems, fishermen self-manage by implementing and enforcing various strategies, generally guided by overarching federal-level constraints and targets. Of particular importance from a research perspective, each system contains hundreds of relatively autonomous collective management institutions, each of which has developed its own practices that fit local conditions, the make-up of the group of users, and historical preconditions. This breadth of institutional evolution presents a large amount of variation with which to study factors that determine or hinder success of various collective management institutions.

While the two systems have elements in common, their historical experiences and institutional maturity levels are quite different. For example, the Japanese TURF system has its origins in institutions that were developed in the feudal era some centuries ago. The Japanese system is thus very mature, and it has evolved slowly in a bottom-up manner (Makino and Sakamoto 2002). In contrast, the Chilean TURF system was introduced recently (in the early 1990s) by the national government in response to evidence of management failure in the shellfish fisheries (Castilla 1994; González 1996; Castilla *et al*. 1998; Bernal *et al*. 1999; Meltzoff, Lichtensztajn, and Stotz 2002; Gelcich *et al*. 2005). The Chilean system is still undergoing rapid evolution and change.

The scientific information necessary to manage both systems is gathered and disseminated via partnerships between the TURFs and federal agencies responsible for their oversight. Both systems devolve responsibilities for management to local fishermen organizations, but both are constrained by Total Allowable Catch (TAC) limits and conservation guidelines that are set at the federal level. In the Japanese system, local extension scientists play a liaison role between FCAs and the federal government, conducting science that informs setting of TACs and monitoring performance in order to ensure sustainable resource use. In Chile, federal regulatory agencies set TAC limits, size limits, and gear restrictions which then are self-enforced and managed at the local level. Resource health and stock status are evaluated yearly for each MEA by consultant biologists, and the information is used by the federal regulators to modify regulations where necessary.

In the next sections, we elaborate on events behind the creation and evolution of TURFs in Japan and Chile, and then discuss the structure and operations of FMOs and MEAs and the manner in which they self-manage the resources within their respective TURFs.

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[1] The MEA acronym strictly refers to the seabed area that is managed by a fisher's organization. We use this acronym in a more general sense to refer to the combination management organization and TURF.

Evolution of TURFs in Japan

TURFs are the dominant form of fisheries institution governing Japan's extensive near-shore fisheries. Access rights within each TURF are managed and coordinated by local Fishery Cooperative Associations that have been historically associated with the coastal zone encompassed within the TURF. The Japanese system consists of some 1,600+ FCAs with TURFs.[2]

The Japanese fisheries management system is hierarchical and begins with legal rights to coastal resources that are held at the federal level on behalf of the public. The federal government sets broad management policies, particularly biologically determined TACs, some gear prohibitions, minimum size limits, and season length restrictions. The science backing these biologically motivated objectives is partially decentralized to scientists at research stations at the prefecture level (equivalent to states in size). The central government sets the overarching regulations and devolves use rights for near-shore coastal fishery resources to the groups of local community fishermen organized in FCAs (Makino and Matsuda 2005).

The historical details of FCAs and TURF evolution have been documented in the literature (Asada, Hirasawa, and Nagasaki 1983; Ruddle 1987; Yamamoto 1995; Makino and Sakamoto 2002); here we present them briefly. FCAs in Japan have their origins in fishermen's guilds formed in the 16th century. In the feudal period, coastal villages that did not have enough arable land to grow rice were the only communities allowed to fish. For these villages, fishing was the only source of their livelihood, and they were given specified areas of nearshore coastal water for their exclusive use. To protect these areas against outside poachers, fishermen's groups formed guilds that asserted territorial rights over coastal water adjacent to the villages. These *ad hoc* use rights were given formal legal status as TURFs in 1901 with the enactment of the Fishery Law. Later, in 1948, the Fishery Cooperative Law transformed the guilds into FCAs, and granted them status to represent user groups within the TURFs.

Since FCAs are typically associated with the marine ecosystems that have been historically used off corresponding coastal communities, each FCA often encompasses a large number of diverse fisheries. FCAs are generally granted responsibility for managing all of the fishery resources within their jurisdictions. These resources may include sedentary shellfish fisheries like clams, mussels, sea urchin, and abalone, as well as mobile species like shrimp. They also include moderately mobile groundfish, including various flatfish and rockfish, and more mobile fish like mackerel and herring. Typical FCAs in Japan often encompass a wide range of gear types including dredges, gillnets, seines, and small trawls. They also include fisheries prosecuted by divers.

Evolution of TURFs in Chile

The Chilean coast is a particularly rich source of benthic resources that are important both economically and socially to coastal communities. The Chilean shellfish fishery targets more than 40 species, which constitute the main economic resource for many small-scale fishery organizations. Among the most valuable shellfish species is the so-called Chilean abalone or *loco*. Divers pry the *loco* from rocky habitat and they are then collected by local buyers and shipped mainly to the lucrative Taiwanese and Japanese markets. In addition to *loco*, Chilean near-shore fisheries also

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[2] From the National Federation of Fishery Cooperatives Associations website: www.zengyoren.or.jp/syokai/jf_eng2.html

include sea urchin and limpets. Both species are harvested by divers and also exported primarily to Taiwan and Japan.

In the early 1980s, the sharp rise in demand for shellfish, mainly from foreign consumers following Chile's economic liberalization, led to a dramatic uncontrolled increase in harvest and a rapid decline in stocks (Bustamante and Castilla 1987). After the failure of traditional command-and-control regulations, a new Chilean Fishery and Aquaculture Law (CFAL) was implemented in 1991. This regulatory framework sought to rehabilitate shellfish stocks damaged during the export boom and to ensure the rational, sustainable exploitation of fishery resources (Castilla 1994).

The CFAL was a bold, forward-looking piece of legislation with two major innovations. First, it resolved contentious conflicts over access to fishing grounds between the small-scale and the industrial (company-owned) fleets by assigning an exclusive fishing area within five miles from the shore to the small-scale local fishermen. Secondly, the law introduced limited entry/access rights management tools by establishing spatially delineated Individual Nontransferable Fishing Quotas (INFQs) within numerous local zones known as *Benthic Regime of Extraction* (BRE) (Bernal *et al*. 1999; Castilla and Defeo 2001; Leiva and Castilla 2002).

The individual quota system within the spatial system of BREs was implemented at a national scale between 1993 and 1999, mainly in the *loco* fishery. This tool required a strong monitoring and enforcement effort directed at the fishermen and at pre-established landing sites and processing plants (Bernal *et al*. 1999; Castilla and Defeo 2001; Leiva and Castilla 2002). While forward looking and bold, the individual quota/BRE system collapsed under the inability to monitor harvests and appropriately enforce the individual-based quota landings system (Leiva and Castilla 2002). Chile's extremely long coastline, coupled with the isolation of many areas and poverty, resulted in a system that was essentially impossible to enforce even with the best of intentions.

In an attempt to overcome the quota system's main limitations while retaining the TURF features of the BREs, a refinement that devolved control and enforcement to local groups, rather than individuals, was implemented in the late 1990s. This system is currently in place. Chile's locally controlled collective management system builds, as does Japan's, on historically important harvester communities that have dominated the coastal system. The fisheries off most Chilean *caletas*[3] are organized by members of fishermen's unions, called *sindicatos*. Alternatively, fisheries may be managed by other important local fishermen's organizations, including trade unions and cooperatives. These three types of organizations have operated for decades and have played a key role in the implementation of TURFs (Castilla and Fernández 1998; Castilla *et al*. 1998). When the new TURF system was formed, the local organizations became a vehicle for identifying the class of potential participants and for motivating locally oriented leadership under the new system.

TURF-based Fishery Co-management: FMOs and MEAs

In Japan, the FCAs have inherited a strong historical sense of ownership over the resources within their TURFs. This has, in turn, paved the way for the intensification of collective management within the TURFs, above and beyond the level of management dictated by federal TAC, size limit, and gear restrictions. The intensified collective management is carried out with FMOs within each TURF. FMOs are

[3] *Caletas* are sites usually located around coastal coves that serve as operational bases for local small-scale fleets.

generally subsets of fishermen within FCAs, often defined by target species and/or gear group. They have often formed in response to declining fish stocks, depressed ex-vessel prices, and excessive competition within a TURF. Most FMOs are thus affiliates of their parent FCAs, and they inherit the benefits of established TURFs and limited entry of new members. Federal agencies offer support for FMOs per their request, but unlike Chile, there are no mandatory reports and oversight by technical consultants (see details below). The decentralized operation of FCAs is also inherited in the operation of FMOs. The number of FMOs has increased since the government began recording their statistics in 1988, with the most recent count being 1,608 as of 2003 (MAFF 2006).

The Chilean counterparts of FCAs and FMOs evolved in a somewhat different manner. The Chilean TURF system assigns permanent management rights to groups of fishermen that have self-organized and been legally sanctioned to co-manage their MEA. Fishers' organizations must successfully develop exploitation plans that are consistent with federal biological guidelines and then exploit the resource cooperatively. The government imposes closed seasons and minimum harvest sizes designed to ensure that groups do not overexploit the resource (González 1996; Castilla *et al*. 1998; Bernal *et al*. 1999; Castilla and Defeo 2001; Leiva and Castilla 2002). Another distinctive feature of the MEA system, in comparison to the Japanese system, is that government officials monitor fishery status through mandatory technical consultant's reports (SUBPESCA 2000). The first MEAs were established in 1997, and there are now about 300 actively engaged MEAs along the 4,600+ km long Chilean coastline.

Both MEAs and FMOs are allowed considerable latitude to establish their own internal management schemes with which to direct the fisheries within their respective TURFs. In Chile, the large variation in ecosystem types, biological productivity, access to markets, and opportunity costs of participants has led to correspondingly large variations in internal methods used to manage and monitor each MEA. Japanese nearshore ecosystems witness the same kinds of variations but, in addition, typically involve a larger and more diverse number of targeted species and fishing gear. The spectrum of internal self-management methods involved is broad in both systems. Some areas and fisheries have not progressed much beyond an unregulated race to fish among the (closed) group of participants. Others have adopted extremely time- and effort-intensive rules of use.[4] Some of the innovations in cooperative management and coordination are described in later sections.

Basic Characteristics of FMOs and MEAs

We now examine some of the often presumed necessary conditions for successful collective management of common property resources, and fishery resources in particular (*e.g*., Olson 1965; Christy 1982; Ostrom 1990; Pintassilgo and Duarte 2000). These include small membership size, targeted species type, and membership control.

Membership Size

One of the most widely mentioned attributes for successful collective management is size, such that the smaller the group size, the better the anticipated chance of success, *ceteris paribus*. According to the 1998 Fishery Census, 47.3% of FMOs in

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[4] Information is based on the authors' fieldwork.

Japan had membership sizes of 30 or less, while 17.2% of FMOs had 100 members or more. The trend is toward smaller FMOs (Lou and Ono 2001). Based on the recently conducted survey by the authors, the average FMO membership size is 53. Chilean MEAs have slightly larger membership sizes; at the national level the average is 62, with a range of 25 to 890.[5] Within the most intensively managed Fourth and Fifth Chilean Administrative Regions,[6] the MEA membership size ranges from 25 to 440, with an average of 80.[7]

Although the tendency is toward formation of co-management groups that are reasonably small, the correlation of size with the success of fishery collective management is still unclear. For example, a small pink shrimp fishery FMO in Suruga Bay, Japan, known for its enduring success, has 120 members, while a surf clam fishery FMO in northern Fukushima prefecture is struggling to sustain the organization with 18 members. In the Chilean case, there are MEAs with more than 150 members located in rural areas that are successfully managing their resources, while others with 30 or fewer members located close to relatively poor towns are obtaining very poor results.[8]

Targeted Species Type

Japanese FMOs target a variety of species. According to our recent survey, the majority of surveyed FMOs (77 out of 116) targeted sedentary species, such as clams and abalone. Nineteen FMOs targeted spiny lobster, followed by 14 FMOs targeting moderately mobile groundfish, and 6 FMOs targeting migratory species, such as mackerel and bonito.

The Chilean MEA system was designed primarily to regulate benthic fisheries that are relatively sedentary, spatially structured, and mostly exploited by small-scale fishermen. The main species exploited under the MEA system are *loco*, limpets, sea urchins, pink clams, and scallops. Seaweed extraction is also important. Official records indicate that about 80%, 60%, and 50% of the MEAs have *loco*, limpets, and sea urchin, respectively, among their targeted species.

These observations are consistent with the claim that less mobile, less migratory species are more suitable for co-management, especially those based on TURFs (Christy 1982). However, the sedentary species/success hypothesis may be confounded with another equally important correlate, namely that many targeted sedentary species are also highly valuable. Chile's *loco* is certainly valuable; popular targeted species in Japan, such as spiny lobster, abalone, and scallops, also obtain higher prices. In fact, many MEAs and FMOs appear to focus much of their effort on collective marketing activities of the products they harvest.

Controlling Entry of New Members

To be successful, fishery management based on FCAs and MEAs requires the control of entry. If entry is left uncontrolled, then the so-called "new member problem"

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[5] Based on unpublished data provided to the authors from SUBPESCA. Twenty-five members is the required minimum to form a *sindicato*.

[6] The Fourth and Fifth Regions are located in the central zone of Chile. In the early development stages of the TURF system, fishermen's organizations located in these regions showed a high interest in implementing this tool. In these regions, there is also relatively more available information from government sources.

[7] Information based on authors' fieldwork in Chile.

[8] Information based on authors' fieldwork in Japan and Chile.

will undermine stability (Pintassilgo and Duarte 2001). The Japanese Fishery Cooperative Law prohibits FCAs from rejecting *eligible* individuals seeking to join them (Article 25). The eligibility condition is that an individual must be a working fisherman, defined by (*i*) his/her local residency, and (*ii*) a minimum annual number of days engaged in commercial fishing. Since an individual cannot engage in commercial fishing without being a member of local FCA, new membership seekers must be hired by the incumbent fishermen in order to fulfill the minimum-days condition. FCA members can thus effectively prevent potential new members to becoming eligible by moderating their use of new labor (Uchida 2004a).

The Chilean legislation also prohibits fishermen's organizations from rejecting individuals seeking to join them. Since the organizations are allowed to establish their own internal regulations, however, practices have evolved that serve as entry barriers. For example, many request up-front payments from potential new members to have access to the MEA's benefits. In some cases, new members are also required to work for a certain period of time (usually six months) without pay before being eligible to receive their share of the MEA's benefits. These internal regulations allow MEAs to control entry of new members.

What Can TURF Systems Do That ITQs Fail to Do?

Economic theory suggests some reasons why ITQs might not achieve full potential, and many of these were elucidated by Copes (1986). Because ITQs decentralize decision making, any situation in which residual externalities remain are axiomatically failing to achieve rent maximization. In this section, we discuss some of the limitations of ITQs that might be addressed by a well-designed TURF system.

A fundamental observation that should be emphasized is that, while the granting of an allocation to a group is a necessary condition for avoiding common property overexploitation and rent dissipation, it is not sufficient. This is because the simple allocation to a group does nothing to eliminate the inherent race-to-fish incentives faced by the individual members of the closed class. These individual race-to-fish incentives are eliminated or mitigated when quotas are distributed to individuals in ITQ systems, but a TURF must manage the inherent incentives if group allocation is to successfully generate returns. Given that allocations are initially vested in the group, it must devise means to make and enforce internal decisions that govern the coordination and success of group operation. The range of designs that potentially might be used to manage these functions is wide, from schemes that lease out allocations and simply collect rents, to others that finely prescribe behavior of participants in order to achieve various efficiency and distributional objectives. In the next subsections, we describe some of the key aspects that ITQs fail to take into account but that are properly addressed by TURFs.

Spatial Allocation of Effort

ITQs that are allocated across whole fisheries, or across the broad range of a population's home range, are not capable of accounting for spatial heterogeneity. This heterogeneity is important in most fisheries, and quite important in some. It may arise out of the essential patchiness of resources, spatial productivity differences, or spatial profit differences associated with the location of ports and distribution facilities (Sanchirico and Wilen 1999). Regardless of the origin, spatial heterogeneity in profits leads to inefficient use of the spatial mosaic, as the most profitable patches are relatively overexploited, in spite of the generic incentives provided by ITQs to maximize value.

In Japan, some FMOs coordinate their members' fishing effort with the aim of mitigating inefficient allocation of effort over space (Gaspart and Seki 2003; Baba 1991; Uchida 2004b). In order to eliminate the race to fish and congestion at hot spots, some FMOs rotate access to fishing grounds on a daily (or longer time interval) basis. The rotation pattern may be predetermined, or it may be continuously directed by a collective decision-making body consisting of FMO member representatives. FMOs with too many members for a given resource stock or fishing ground may also take turns fishing in addition to rotating the fishing grounds.

In practice, effort coordination and rotation schemes designed to optimize spatial effort distributions should lead to differential catch rates across coop members. If this differential is not mitigated, it has the potential to undermine the very existence of FMOs. Japanese FMOs handle this distributional consequence of effort assignments in two ways. First, they may rotate fishing opportunities so that assignments rotate over hot spots and cold spots in some regular way. The pollock fishery FMO in Hokkaido operates in this manner, and its rotation scheme is so complicated that it has three layers of rotation. The end result is that throughout the season, each vessel has an equal chance of harvesting in any given fishing ground. Second, FMOs may pool income and distribute total proceeds back to fishermen. Gaspart and Seki (2003) view income pooling as an important device that supports effort coordination, since with a pooling arrangement everyone receives an equal amount regardless of the place he/she was assigned.

Similar management schemes are in place in Chilean MEAs. There are two general methods for allocating the MEA-specific TAC among members, each of which has ramifications in terms of basic incentives as well as for distribution. One prominent method is simply to evenly apportion the total MEA-specific TAC among production units.[9] Some MEAs take the next step by collectively managing the temporal and spatial application of effort, distributing proceeds to their members via a pooling arrangement. Whether this step is taken seems to depend heavily on transactions costs, which encompass factors including group size, leadership, education, isolation, alternative income, *etc*.[10] Other MEAs allow individual production units to fish their specific allocation over time and space as they wish, but pay the production units according to the quality (generally size) of the product they harvest. Both schemes effectively set up within-MEA individual quota systems, which remove some of the incentives to race for fish. Still other MEAs leave the MEA-specific TAC unallocated, but distribute proceeds to members via a pooling arrangement. These schemes are often combined with a rotating effort assignment plan that equalizes work burden and spreads effort spatially in a more efficient manner. In some cases of rotating harvest systems, piece-rate schemes are also used to take advantage of divers' different skill levels and to promote effort (discourage shirking).[11]

In terms of larger-scale spatial effort coordination, there are instances in which Japanese FMOs have coordinated with neighboring FMOs, and some cases where they merged. This has happened when neighboring FCAs share a population that, for example, moves across boundaries over its yearly cycle. In the small pink shrimp

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[9] A production unit typically consists of a diver, two crew members, a vessel, and gear.
[10] An illuminating case study that illustrates an intertemporal externality not resolved by an ITQ system, and the somewhat unsuccessful attempt to manage that residual externality collectively, is in Bisack and Sutinen (2006).
[11] Under either allocation method, usually a fee is taken to pay for the baseline studies, the yearly direct biological assessments, and organization's activities, which may include marketing, effort administration, and policing the boundaries of MEAs.

fishery in Suruga Bay, shrimp move from south to north between adjacent FCAs during the year, gaining size and weight and market value in the process. Disputes arose because fishermen from the southern FMO took the shrimp before they were large enough to maximize value. The solution was to merge the two FMOs and operate over the two regions jointly, with most harvest taken in the northern FMO after the merger.

In Chile, the legislation does not allow MEAs to formally merge. There are instances, however, in which fishermen's organizations from different MEAs work jointly to make decisions about harvest timing, and then collectively market their products to export buyers. These are some examples that highlight the potential for spatially organized TURF systems to achieve efficient spatial effort allocation, not only within an FMO or MEA, but across them if necessary.

Self-monitoring, Enforcement, and Sanctions

Self-governance based on peer pressure constitutes the basic principle of monitoring and enforcement in FMOs and MEAs. In FMOs, monitoring may literally be achieved by peer pressure, or a committee of member representatives may undertake monitoring and enforcement tasks. Some FMOs explicitly specify sanction procedures, such as confiscation of harvest and prohibition of fishing by violators. FMOs with pooling arrangements may punish the violators by reducing their distribution shares.

Chilean MEAs have also implemented a system of explicit graduated sanctions according to the severity and context of the fault. These sanctions are mostly pecuniary, aimed at addressing shirking problems and, in extreme cases, include the expulsion of the member from the organization. Most MEAs have implemented special committees, constituted on a rotating basis of three or four members of the organization, who are in charge of applying the sanctions. The fact that all members agree on the sanctions also helps to keep non-compliance at a low level.

Multi-species Management and Habitat Enhancement

Other reasons that might lead ITQs to be less than fully efficient are externalities associated with multi-species interactions. Since most programs grant ITQs to individual species, there is generally little attention paid to interaction among species. In principle, these could be handled at the decision point of setting TACs, and, in principle, it might even be possible for ITQ holders to negotiate with each other over multi-species linkages. In practice, however, predator-prey and other "ecosystem effects" are generally not explicitly addressed in ITQ systems. Similarly, artificial enhancement or investment in habitat preservation may be collectively valuable to the group of ITQ holders but difficult to initiate even when obviously efficient.

Many Chilean MEAs are engaged in various strategies aimed at rebuilding stocks. In addition to rather traditional methods, such as self-imposed closed seasons to allow natural restocking, some MEAs transplant organisms to areas of better food supply. Some MEAs also control less commercially valuable species that represent the food supply for other more valuable species. For example, the highly valuable *loco* positively selects prey species such as sea squirts and barnacles (Stotz *et al*. 2003). Accordingly, some MEAs have chosen not to exploit these prey species at all, extract them in very controlled quantities, or even increase their stocks through repopulation programs.

The management of predator-prey relationships is rather rare in Japan, probably because FMOs are formed around specific species. However, there are a few cases that have actually been implemented.[12] On the other hand, a significant number of FMOs are engaged in single-species aquaculture and habitat enhancement, both of which benefit FMO groups focused on more intensive management. Naturally, these operations are most likely to occur for sedentary species. The most prevalent aquaculture operations are in abalone fisheries and kelp enhancement, with some also beginning to occur for flatfish. Abalone is high valued, and typical operations grow the spat out on shore facilities and then plant the juveniles in habitat thought productive. Revitalizing the "ocean forest" of kelp and seaweed is also a popular activity that aims to restore habitat for various species.

The Chilean legislation has recently been amended to allow fishermen's organizations to implement small-scale aquaculture projects within the MEAs boundaries. To obtain the authorization to implement aquaculture projects, fishermen's organizations must follow an intricate procedure and meet a series of requirements. Preliminary evidence for sea urchin and scallop enhancement shows promising results regarding survival rates in some benthic habitats off the Chilean coast. Some MEAs targeting scallops have even developed complementary industries that sell excess wild scallops seeds collected within the TURF to other commercial scallop aquaculture operations, further increasing the economic benefits to their members. Additionally, as in the Japanese case, some MEAs are engaged in kelp enhancement activities to restore benthic habitat for some species.

Marketing Coordination

Other tasks not easily handled by ITQ systems are those associated with product quality, branding, and market timing coordination (Christy 1982). For example, actions that might differentiate a fish product, such as branding, involve up-front investments in order to create a local public good; the free-rider problem may prevent the initial investment.

The most frequently used collective activity in Japanese FMOs is centralized and coordinated marketing. Most FCAs have a marketing organization that includes an offloading and handling facility and sometimes trucks or a local retail market facility. This enables the FCA to maintain control over raw fish quality and delivery to wholesalers and auction markets. In addition to providing handling facilities, many FMOs also actively coordinate marketing in ways designed to enhance revenues to FMO participants. Most smooth harvests by controlling effort patterns to avoid market gluts, and many coordinate peak load harvest plans to accommodate special marketing events, such as gift giving around the New Year period and mid-summer. Most also coordinate quality control by setting size and condition standards, and some finance vessel quality investments such as icing capability and hold design. Some FMOs, such as the snow crab fishery FMO in Kyoto, have branded their products in order to gain a premium in the finely differentiated, sophisticated Japanese wholesale and retail markets.

The Chilean MEA system has also encouraged fishermen to better market their products to local and foreign buyers. MEAs have dramatically altered shellfish marketing practices, away from unstructured, unpredictable deals to sales that are now pre-arranged before shellfish are harvested (Parma *et al*. 2003). In addition, fishermen now make harvesting decisions for *loco* based not only on harvestable quantity, but also on sampled measures of key indicators of quality and market price, such as the average size of landings. They then use this information to negotiate with buyers

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[12] Personal communication with Professor Baba of Tokyo University of Marine Science and Technology.

and plan the harvest of appropriate *loco* sizes to meet buyers' needs. This information and negotiation advantage results in higher prices for their products. In addition, some MEAs have agreed to pool a portion of their TACs to secure better negotiation leverage. For example, 12 MEAs in the Fifth region have formed an export firm (marketing cooperative) for *loco*, limpets, and others products. This firm exports its products to specific buyers in China, Taiwan, and Japan. Exploratory shipments have also been sent to Belgium. In the last years, the marketing cooperative has also exported live *loco* to China and Japan, obtaining very high per-unit prices.

Other Chilean MEAs have organized operations to create new products specially designed for certain niche markets. For example, several are working to develop shore-based abalone culturing facilities.[13] These utilize integrated local seaweed extraction operations for feed, and fattened adult abalone are sent directly to the lucrative Japanese and North American markets.

Development of Other Ecosystem Services

Several Chilean MEAs are developing new companion industries that take advantage of the fact that the MEA is granted rights to space rather than just a collection of species. For example, one MEA near relatively wealthy towns has developed its own fishermen's market that includes lobster tanks with live fish and locally caught fish and shellfish for portside visitors. The same MEA established three diving trial zones within the TURF with different degrees of difficulty for Chilean dive tourists. Fishermen also developed submarine charts to allow self-guided tours through the diving trials. These marketing innovations would not emerge in an ITQ-based regulatory system, of course, because what makes them work is that organization members have been granted rights to a piece of marine ecosystem space, rather than just to the harvestable individuals within it.

To summarize, many of the collective actions mentioned above—effort coordination over space, pooling arrangements of proceeds, ecosystem management and habitat enhancement, marketing coordination, development of ecosystem services, and cross-TURF coordination—would not be likely to emerge under an ITQ system. In an important sense, many of these collective actions have been initiated precisely because access privileges to the resources within a unit of space have been granted to groups rather than to individuals. However, the downside is that granting to a group means that another administrative step is necessary to define conditions of use for its members. The important question is how large the gains from additional coordination are and whether they are large enough to compensate for coordination costs. Coordination costs are the direct transactions costs of actually operating coordinated activities. But there are also indirect costs associated with autonomy loss and reduced individual incentives to innovate. How these shake out on net balance is an empirical question that has not yet been satisfactorily addressed by economists.

Discussion

This paper is intended to provoke some discussion and comparison of two kinds of rights-based systems, namely those that allocate harvesting rights on a species-specific basis to autonomous, independent individuals (the typical ITQ) versus the

[13] Currently, there are industrial shore-based abalone culturing facilities functioning throughout the Chilean coast, and some MEAs supply them with seaweed extracted from the TURFs.

option of granting rights to a spatially delineated marine ecosystem to a group (the typical TURF). As economists, we can speculate about this comparison by pointing out that the extent to which the potential yields from the two systems are likely to diverge is a function of the degree to which: (*i*) spatial heterogeneity exists; (*ii*) there are important multi-species interactions among species of interest; and (*iii*) there are other important ecosystem services not covered by the ITQ scope. In addition, however, the degree to which these two systems might diverge in practice also depends upon the effectiveness of the group managing the fishing organization at delegating, enforcing, and coordinating member activities. This is a much more complicated question that researchers, including Elinor Ostrom, have been pursuing for decades.

Our contribution to this long-standing question about collective versus individual decision-making draws on some anecdotal evidence from two systems based on TURFs, namely the Japanese and Chilean coastal collective management systems. The advantage of these examples is the breadth of cross sections. Each system contains hundreds of variations, essentially numerous experiments on different kinds of internal management methods. The examples run the gamut from those that are close to *laissez faire*, to interestingly intricate examples of fine-scale coordination over space and time.

In comparing these two case studies, there are some observations that are common to both countries' systems. First, cases in which substantial amounts of transactions costs have been incurred to squeeze rents out of a system seem to be those with the highest inherent ability to generate returns from coordination and intensification of management. Areas with high biological productivity that are close to marketing opportunities and that are shared by a reasonably small group with other labor opportunities seem to be most innovative and successful. Areas that are either biologically or economically marginal are managed with minimal inputs and coordination and are thus less successful. These results are what we would expect from organization theory.

An institution common in both Japan's and Chile's TURF systems is the use of pooling arrangements among fishing organizations. This is an ingenious institution because it essentially provides counterincentives to the race to fish. In particular, if one's harvest is pooled, it does not pay to invest in extra capacity or expend wasteful effort. At the same time, the pooling arrangement generates another incentive problem, namely the incentive to shirk. Our surveys have shown that FMOs and MEAs use a variety of means to reduce shirking, including formal sanctions, peer pressure, effort monitoring, and piece-rate payment schemes.

Another common aspect of collective management off Japan and Chile is the use of Coordinated Effort Management (CEM). CEM involves having a committee decide who is to fish where on a daily, or other regular basis. This is done for several reasons. First, it is a means of ensuring more even spatial distribution of effort for each species harvested. Individual rights-based methods do not solve the problem associated with over-harvesting of near-port, or high-productivity areas. CEM generally involves assignment of fishing places in order to avoid over-harvesting hot spots and allocations of some effort to other spots. The potential fairness problem of being assigned poor areas repeatedly is generally resolved by either rotating harvesting assignments, often in quite intricate patterns, or pooling the proceeds across all participants. Second, in its most refined version, CEM may involve committee-level decisions that trade off harvests of one species against others that may be linked in competing or complementary ways. The movement of animals to different habitats, repopulation programs, the addition of prey species, and habitat enhancement activities are all tactics that we would not likely observe in individual species-based systems.

Another tentative finding of our initial canvassing of FMOs and MEAs is that a significant amount of the apparent rent generation that seems to have emerged from rationalization comes not from input and cost saving, but from output or market value improvements (Homans and Wilen 2005). In preliminary statistical tests, differences in fishery performance attributable to FMOs seem mainly correlated with marketing organization activities. Marketing organization, in turn, typically involves market promotion, quality rules, market smoothing and harvest coordination, and port delivery smoothing.

In summary, our preliminary examination of the Japanese and Chilean TURF management systems provides food for thought about the possibilities for space-based, as opposed to species-based, rights-based systems. The advantage of space-based systems is that they make possible the elimination or mitigation of various residual externalities that are not readily handled by species-based rights systems. Chief among these is the uneven allocation of effort over space and time, both of which are the focus of much collective effort in Japan's FMOs and Chile's MEAs. We see evidence in both countries that institutions evolve to smooth effort over time and space in ways that also manage inequities and perverse incentives. The promise of mitigating these externalities comes at a cost, of course, since transactions costs of coordination must be overcome. The fact that there is such a wide spectrum of institutional evolution suggests that many factors condition whether the potential for coordination-based rent gains exceeds internal transactions costs. The trends in the development of the institutions that have, and are, developing are also interesting. Japan's system has devolved management into smaller specialized FMO groups, whereas Chile's system still focuses management on the entire marine MEA ecosystem. Chile's MEAs have been able, as a consequence, to implement certain measures not commonly found in Japan's FMOs, such as managing multi-species interactions. But the Japanese system has been in existence for close to four centuries, whereas the Chilean system is barely a decade old. This raises the question about whether the natural end point of institutional innovation favors more intensive species-focused management at the expense of system-wide management.

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