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Quota compliance in TURFs: An experimental analysis on complementarities of formal and informal enforcement with changes in abundance

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ABSTRACT

We explore the effects of different enforcement mechanisms, including formal, informal, and both together, on individual compliance behavior under a system of territorial use rights in fisheries (TURFs). Our design considers different stock abundance levels and the effect that such differences may exert on extraction decisions and compliance behavior. The analysis is based on a framed field experiment conducted with artisanal fishers in central-southern Chile. Our results indicate that, regardless of the level of biological productivity within the managed areas, the combination of formal and informal enforcement mechanisms reduced individual extraction and transgressions more than did formal enforcement alone. However, in the case of abundance, the use of a combination of enforcement mechanisms did not accomplish more than informal enforcement alone in reducing individual extraction and transgressions. We also found that while formal enforcement tends to complement informal enforcement, it may also crowd out efforts from the group to control peers under low biological productivity. We discuss the policy implications of our results for the proper design of TURFs-based fisheries management.

1. Introduction

The use of decentralized fisheries management systems based on property rights is gaining support among fishery managers. These systems offer the opportunity for better management, from an economic as well as ecological perspective. In the context of artisanal fisheries, one such system includes creating and allocating territorial use rights in fisheries (TURFs). Under a TURFs system, rights to manage and exploit natural resources in a defined geographical space can be assigned to individual agents, organized groups of individuals or coastal communities (Charles, 2002; Wilen et al., 2012).

Under a TURFs management regime, users are responsible for defining an exploitation plan, identifying operational rules, restricting harvest, and defining monitoring and enforcement strategies (Wilen et al., 2012). However, the state can still play an important role in the system's implementation and functioning, especially when the TURFs regime is introduced in coastal fisheries where property rights have never been in place. To our knowledge, the interaction between the state and organized users in solving these problems remains. How do the efforts of users holding TURFs rights to restrict harvest interact with similar efforts by the external authority? What are the consequences in terms of individual extraction behavior related to the presence (or absence) of control by self-governing groups and the external authority?

This work presents the results of a field experiment designed to explore the effects of different enforcement mechanisms – formal (external), informal (local), and both together (co-management) – on individual compliance behavior under a TURFs. Our design also considers different stock abundance levels and the effect that such differences may have on extraction decisions and compliance behavior. The field experiment was conducted with artisanal fishermen living in central-southern Chile, who are members of organizations exploiting benthic resources under TURFs regulation.

There is an increasing literature which analyzes the conditions under which local communities are able to successfully manage a resource (e.g., Ostrom, 1990; Ostrom and Walker, 1991; Ostrom et al., 1992). The issue of non-compliance in fisheries has been considered since the seminal work of Sutinen and Andersen (1985); for a review, see Nostbakken

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(2008). However, the interaction in terms of monitoring and enforcement by both the users and central authority – either in general or in the context of TURFs – has not received much attention.

Our analysis uses a framed field experiment composed of six treatments, divided into two scenarios: high biological productivity (abundance) and low biological productivity (scarcity) of a target species. For each scenario, three treatments are considered: formal (external) enforcement, informal (local) enforcement and both combined (co-management). Our primarily purpose is to measure the effects of different enforcement mechanisms on harvesting and compliance decisions.

Our experiment considers exogenous variation in a resource's availability. The motivation is twofold. First, there is empirical evidence of high spatial heterogeneity in terms of biological productivity; one example is the case of the Chilean TURFs (González et al., 2006; Aburto et al., 2013). Second, the existing literature provides evidence on the potential consequences of levels of resource abundance for extraction decisions and transgressions by subjects, based on several experimental designs in common property resource (CPR) games (Blanco et al., 2011; Osés-Eraso and Viladrich-Grau, 2007; Osés-Eraso et al., 2008). Some experiments have focused on users' responses to exogenous changes in the availability of CPR. For instance, Osés-Eraso and Viladrich-Grau (2007) observed that the extraction level decreases when a common resource is scarce. By contrast, in a similar design, Blanco et al. (2011) found that users reduced extraction when the stock decreased moderately (i.e., a couple of rounds). However, extraction immediately increased when the resource was reduced to a size at which it could be completely depleted. Others have considered situations in which the changes in abundance are endogenous (e.g., Cárdenas et al., 2013; Osés-Eraso et al., 2008; Moreno-Sánchez and Maldonado, 2010). For example, Cárdenas et al. (2013) explore the consequences of heterogeneous agents and endogenous stocks in a series of field experiments for fisheries, water irrigation, and forests. The design for each resource considered different sets of regulations faced by subjects. In the case of fisheries, they found a decrease in stock over time and observed that, once a low stock level was reached, recovery efforts were not successful.

The existing literature using experimental methods has also addressed the possibility of complementary relationships between formal regulation and informal mechanisms to reduce over-exploitation and induce conservation. Vélez et al. (2010) discuss the results of field experiments designed to test for the possibility of a complementary relationship between communication and formal regulation to conserve a natural resource in a community (i.e., nonbinding agreements). These experiments were conducted in different regions of Colombia. The primary conclusion from this work is that the hypothesis of such a complementary relationship depends on the specifics of the regulation and on the communities where they are imposed. More recently, Lopez et al. (2013) reported their results from conducting standard public good games experiments on the Pacific coast of Colombia. The framed field experiments were designed to examine impacts from the introduction of external regulations on community enforcement efforts (i.e., monitoring and sanctioning). The main result is that government regulations are complementary to informal efforts. Although the introduction of external regulations resulted in a reduction in sanctioning efforts from individual subjects, contributions and earnings were higher in the presence of government control than in the case of pure peer monitoring and sanctioning. Moreno-Sánchez and Maldonado (2010) investigated the effects of internal communication, external regulation, and the interaction between internal regulation and non-coercive authority intervention – they call this co-management – on fishermen's extraction decisions. They found that co-management exhibits the best results, in terms of both reduction in extraction and resource sustainability of a CPR in protected areas.

In our study, the strategy of co-management, which relies on informal enforcement in combination with formal enforcement, presents the greatest decrease in levels of extraction and transgression compared to either formal or informal enforcement alone.

The results also show that there are significant differences when fishermen face abundance and scarcity. In situations of abundance, with quota enforcement, fishermen reduce extraction, presenting lower levels of extraction and transgression. Under situations of scarcity, however, even when fishermen reduce extraction, they present higher transgression and extraction levels than in scenarios of abundance, with extraction levels above the Nash equilibrium. Furthermore, we found that subjects are willing to impose sanctions on peers, even at a cost to themselves, as part of an informal enforcement mechanism.

This paper is organized as follows. Section 2 includes a brief description of the Management and Exploitation Areas of Benthic Resources (MEABR) in Chile. Section 3 presents the main hypotheses. Section 4 contains a description of the experimental design and procedures. Section 5 presents the results from the application of field experiments involving fishermen who belong to MEABRs. Finally, Section 6 presents our primary conclusions.

2. System of Territorial Use Rights in Chilean Fisheries

One example of a TURFs system is the Chilean Management and Exploitation Areas of Benthic Resources (MEABR), which was implemented in 1997. Under this system, exclusive rights of use and exploitation of benthic resources are assigned in five-mile coastal strips reserved for artisanal fisheries to legally establish organizations of artisanal fishermen (Gelcich et al., 2010; González, 1996).[1]

MEARBs can be requested by artisanal fishing communities that establish a legal organization and present a proposal for exploitation and management that must include a base situation study in which the existing benthic resources in the area are described in terms of species, quantities, and location, as well as a management and exploitation plan (MEP) specifying a set of actions intended to guarantee sustainable management. The MEP includes an area's initial characteristics and the benthic resource extraction plan, which specifies harvesting periods and techniques (Sobenes and Chávez, 2009).[2]

The MEABR is controlled on the basis of a total allowable catch (TAC) quota, which consists of a fraction of the total number of mature available individuals of the species in the area. Consequently, every year, organizations that have been assigned MEARBs must hire registered consultants for follow-up studies, on the basis of which permissible catches are defined for the species that the government will authorize according to conservation and sustainability criteria (Gelcich et al., 2010; Sobenes and Chávez, 2009).

Monitoring and enforcement to deter illegal extraction in MEARBs are carried out in two ways: firstly, by the government through the maritime authority, the Chilean Navy (i.e., formal enforcement); and secondly, by fishermen who belong to these organizations (i.e., informal enforcement), in a process that includes patrolling the areas to detect poachers and imposing sanctions according to their regulations and MEP. Organizations' monitoring activities usually involve either hired guards or members who take monitoring shifts themselves.

[1] According to the Undersecretary of Fisheries (Subsecretaría de Pesca (SUBPESCA), 2013), by March 2013 there were 773 management areas in the country, of which 512 have been assigned. There are also 354 MEARBs in progress. In the Biobío Region, where this study takes place, 76 management areas have been established to date, of which 56 have been assigned. There are also 24 MEARBs in progress. The Biobío Region has an area of 26,391.17 ha (23% of the national total). It is one of the 15 regions that are political-administrative divisions of the country. The Biobío Region is located in central-southern Chile bordering the El Maule Region to the north, the La Araucanía region to the south, the Republic of Argentina to the east, and the Pacific Ocean to the west.

[2] The main objectives of assigning a MEARB are: (1) to conserve benthic resources and protect the sustainability of artisanal fisheries; (ii) to maintain or increase the biological productivity of benthic resources; and (iii) to encourage and promote participatory management (Subsecretaría de Pesca (SUBPESCA), 2000).