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Factors driving the implementation of fishery reforms

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ABSTRACT

The challenges of common-pool resource harvesting have confronted the world's fisheries for centuries. Efforts to mitigate these challenges have led to an extensive literature on fishery *performance* under alternative management practices, but relatively little evidence exists on the factors that drive the *adoption* of these management approaches. In this study, a database describing 67 fishery cooperatives around the world is analyzed to help fill this gap. The analysis is focused on two widely implemented catch share management strategies, Territorial Use Rights Fisheries and Individual Quotas. Our empirical approach and interpretation of results are organized according to Ostrom's social-ecological systems framework. Among the evaluated factors, governance aspects appear to be most important to management adoption, specifically the presence of legal conditions on cooperative existence, and the strength of law and stability of governing institutions. It is postulated that the same factors that favor adoption of specific catch share management strategies would also generally play a positive role in their performance. If this is true, our results highlight the importance of considering both sets of factors when trying to spread the implementation of management tools, and show that enabling conditions associated to existing governance structures deserve great emphasis by those who seek to adopt management strategies like catch shares.

1. Introduction

Mismanagement, in concert with various other factors, has led to the decline and collapse of fisheries in marine ecosystems around the world [1,2]. An array of solutions have been proposed and adopted in response to these declines. Some have been successful in halting or reversing these trends [3–5], but a key question remains unanswered for all successful strategies: what factors enabled the adoption of these strategies into practice in the first place? Answering this question allows a more profound understanding of the enabling conditions for future implementation of solutions, thereby enhancing the pace for scaling successful alternatives. This implementation issue is addressed here for one class of fisheries solutions – catch shares – which have in many cases worldwide been shown to reverse the pace of fisheries decline [4–10].

Fishery declines and collapses are increasingly being recognized as a result of misaligned incentives. In open access regimes fishers lack incentives to conserve and invest in the resource stocks they harvest, because the rewards from such actions would largely accrue to other harvesters [11,12]. Farmers, by contrast, invest extensively in land and livestock sustainability, because they have at least some level of ownership of the resources involved and have greater incentives to ensure long-term resource health. Catch shares aim at realigning incentives by allocating harvesting rights to individuals or groups as secure assets, such as shares of an annual quota or physical sections of the ocean. The resulting sense of ownership would encourage fishers to harvest sustainably [4]. Two common versions of catch-shares are the Individual Quota (IQ) and Territorial Use Rights Fishery (TURF). The Individual Quota system assigns shares of a fishery's annual total allowable catch to individual fishermen or to groups of resource users, with some variations of this system allowing the trade of assigned rights with other individual resource users in a free market [13]. TURF systems, on the other hand, assign harvesting rights on a spatial basis, typically to a community or defined group of users [14].

The performance of catch shares has been evaluated for a

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variety of fishery types, generally with the focus on functionality and performance. Numerous studies have shown that catch share management is associated with better resource performance on both economic and biological dimensions (including increased vessel profitability, output prices, target species biomass, target species stock productivity, user compliance, user participation in governance, and community welfare, and decreased effort and vessel numbers [14–21]. This work has explored relationships between the performance of such systems, and the biological, socio-demographic, economic, ecological, or cultural characteristics of the resource and its users. These comparisons can be useful for identifying factors that drive success in operating catch share systems, but social and ecological factors might play another key role – affecting the likelihood of a tool's adoption in the first place [22]. While knowing what makes existing systems effective is critical, spreading the use of management strategies like catch shares on a large scale critically depends on knowing which factors act to facilitate or inhibit their implementation in a broader context.

When seeking to understand what factors enable the implementation of a catch share management strategy, it is useful to organize the potentially complex variables in terms of a comprehensive, dynamic, social-ecological system [23]. The process leading to adoption of specific management strategies is arguably complex, with a potentially large number of relevant variables operating and interacting at multiple scales. This poses challenges for understanding why a specific institution, such as a catch share, is adopted in some circumstances but not in others [24]. Natural resource systems also involve multiple disciplines, which all use different frameworks and vocabularies to analyze the system as a whole. Because of this complexity, these systems might benefit from analysis designed with a single framework that classifies information for application by multiple disciplines. To deal with this complexity in the context of rights based management implementation, Ostrom's social-ecological system (SES) is applied as an organizing framework [25; see Section 2].

Ostrom's SES framework classifies the many variables involved in a social-ecological system (SES) within four categories: characteristics of the institutions governing the system (governance system); socioeconomic characteristics of those using the resource (actors); characteristics of the resources that are being used (resource unit) and the physical areas that contain these resources (resource system) [25]. This framework has been applied by others in linking the performance of a given management approach to the attributes of a community of resource users [5,17,24,26–30]. However, it has not to our knowledge been used to understand what characteristics lead to the adoption of specific management approaches. Designing our study according to Ostrom's framework allows for results that account for complexity, are systematically comparable between fields, and are applicable to real world, common pool resource problems.

A large sample is needed to empirically test the relationships between SES variables and catch share adoption. Ovando et al. [31] provides a database of 67 cooperative fisheries around the globe, along with data on their underlying traits and management choices. Data on these cooperative fisheries were grouped under Ostrom's SES principles to provide a clear framework for assessing how traits of SES influence catch share adoption. While causality cannot be determined through this analysis, the diversity of fisheries used in our study provide a robust platform for assessing how the adoption of catch shares is related to the underlying SES traits of a fishery. Further, because the database compiled by Ovando et al. [31] includes only fisheries that have operating cooperatives, factors determining whether or not fishery cooperatives will form in a particular set of circumstances cannot be examined. The important question of which factors influence the implementation of cooperative management, however, can be addressed.

2. Methods

2.1. Data

Our data included variables from a database compiled by Ovando et al. [31] using literature reviews and standardized surveys. The database describes 67 cooperatives from throughout the world, each containing fisheries for one or more target species, resulting in 103 fisheries in total (Supporting material can be found online at: http://dx.doi.org/10.1016/j.marpol.2012.03.012). The cooperatives involved demonstrate wide geographic, socioeconomic and institutional ranges, however they are inevitably skewed towards more developed countries, since more literature is available for cooperatives in developed countries than developing countries [31].

Some variables (such as biological characteristics) varied across species within a cooperative and some variables (such as governance characteristics) were cooperative specific, staying constant for all species within the cooperative. Each cooperative was treated as a single observation, since outcomes of management stayed constant between species in the same cooperative. All variables were made numeric, all missing values were omitted, and all values for individual fisheries were replaced with the arithmetic average of observations in the same cooperative. Due to limited data, all the forms of IQ systems are identified (e.g. individual transferrable, vessel and effort quotas) as simply individual quota systems. Observations that exhibited both IQ and TURF outcomes were included in both categories. Data gathered did not indicate if the dual outcomes in these cases occurred concurrently or sequentially. Therefore, correlation differences between single IQ or TURF outcomes vs. dual IQ-TURF outcomes and SES variables could not be determined. All statistically evaluated variables, along with their definitions and results, can be found in Table 1.

2.2. Statistics

Variables were chosen for analysis by considering their interactions and outcomes in the context of Ostrom's framework. Knowledge drawn from current literature describing the effects of variables on the performance of various systems informed our hypotheses of how these interactions and outcomes could potentially drive management decisions, and thereby be important system attributes to explore. Twenty-two of the extensive set of variables described in Ovando et al. [31] were chosen, and those that contained insufficient data were dropped. These 22 input variables were regressed against the two outcome variables, TURF and IQ. Of the variables initially evaluated in independent bivariate regressions, all the variables that showed significance were included (p value greater than .08) in two full models, one for TURF and one for IQ. This full model was created using the *logit* function for multi-variate logistic regressions in STATA. Variables showing the least significance in these full models were dropped in a step-wise fashion until all variables showed significance (exhibiting the smallest p values relative to other variables). Interaction terms between the remaining significant variables were then added to these simplified models, and models with interaction terms on their own were also estimated. Several models for each outcome variable showed high significance compared to the other models. The AIC (Akaike Information Criterion), which measures the relative quality of a statistical model for a given data