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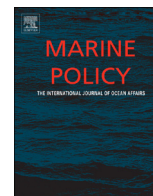
Co-management in Europe: Insights from the gooseneck barnacle fishery in Asturias, Spain

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ABSTRACT

In recent years, cooperative management systems have received attention as a means towards sustainable fisheries. Since its inception and for the past 20 years, the gooseneck barnacle fishery in the coast of Asturias has been co-managed by assigning Territorial User Rights to fishers' associations, allowing fishers to participate actively in the management and data gathering processes. Here, 20 years of landings, in-depth interviews and focus groups were used to characterize the emergence and social-ecological properties of the system. The system consists of 7 management areas each one some tens of kilometers long. The incorporation of fishers' knowledge has successfully led to within-area fragmentation of the management units down to single rocks as small as 3 m long, which are managed according to different protection levels. The system has empowered resource users and provided an opportunity for the use of both scientific information and fishers' knowledge to be integrated in management guidelines. Results suggest the adaptive capacity provided by the co-management framework has been essential to manage this heterogeneous fishery. The gooseneck barnacle fishery and its historical developments illustrate the potential for establishing co-management systems for small-scale fisheries in Europe.

1. Introduction

Fisheries worldwide are currently experiencing a paradigm shift from a top-down approach towards more bottom-up, community based efforts [1,2]. This requires changes in regulatory frameworks in order to address the underlying social, economic and cultural systems [3]. As part of this paradigm shift, co-management has been proposed as a promising strategy to achieve sustainable fisheries since it has the potential to strengthen community integration [4], enhance fishing stocks [5], empower resource users [6], adapt to changing conditions [7] and incorporate both fisher's knowledge and scientific information in management strategies [8].

Co-management consists in the cooperation of governments and users in the exercise of resource management [9], where both parties share authority and responsibility [10]. Co-management systems vary according to the extent of authority delegated to each party, ranging from *instructive*, where the decision-making process is centralized and the resource users are instructed on the decisions, to *informative*, where decisions are made locally and the government agencies are informed [11]. Cooperative systems aim to create a situation in which the rewards for cooperation are greater than those for competition [12], thus avoiding the *tragedy of the commons* [13]. Furthermore, a key component in co-management systems is their inherent adaptive capacity. The concept of adaptive management was first proposed by Holling [14], it refers to a dynamic management process where policies are continuously improved according to updated information about the state of the system [15]. Recently, many successful case studies on co-management implementation have been documented [1,8,16], most of which are located in developing nations. Paradoxically, research shows that co-management has higher probability of success in areas with a high Human Development Index (HDI) [2].

European fisheries have faced increasing pressure for the past 50 years causing a depletion of stocks [17,18]. Fisheries management in Europe has focused on a top-down approach [19], where management strategies are a matter of international policy [20]. Several strategies have been employed to ensure the sustainability

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of fishing stocks in the European Union, such as the Common Fishery Policy (CFP). The CFP aims to guarantee sustainable fish stocks and the economic welfare of fishing communities. However, according to the Green Paper for the reform of the CFP, as of 2009, 88% of fishing stocks were being overexploited and sustainable management had not been achieved [21]. The lack of success of the CFP has been attributed to a number of caveats in its framework and implementation. Highlighted among these caveats are, the lack of approval by the public [22], the implementation of an open access policy and numerous subsidies which promote the race for fish [17] and a framework that deters the incorporation of scientific knowledge [23]. Furthermore, an important criticism to European policy is its focus on industrial and large scale fleets which leads to the neglect of the small-scale artisanal fishery sector [24], these small-scale fisheries comprise an important proportion of the European fleet [25] and are essential in maintaining coastal communities [26]. Most of these downfalls come from the CFPs inherent top-down approach. The EU has acknowledged the need for a regionalization of the CFP, where a greater involvement of stakeholders should be encouraged [21]. The application of collaborative policies, such as co-management, could potentially improve EU fishery policy.

The gooseneck barnacle (*Pollicipes pollicipes*) fishery in the Asturian coast (North Spain) is currently an important component of the artisanal fleet in this area [27]. In 1994, a co-management system was implemented in the Asturian gooseneck barnacle fishery, which continues to date. According to informal observations, co-management has enabled the sustainability of the system. However, an in-depth study of the system has not been attempted. Here, the implementation and development of this co-management system are explored. Co-management has allowed for an adaptive learning-based approach and a fine-scale management of the fishery (down to 3 m; Fig. 1), thereby endorsing the match of social, biological and management scales. Thus, the co-management system aids in the sustainability of the gooseneck barnacle fishery. The illustration of the Asturian gooseneck barnacle system provides insights about the potential for co-management implementation and its prospects as a management approach in a broader European context.

2. Methods

2.1. Study area and settings

The Asturian co-management system is located between the Eo estuary (29T 666839 4827388 UTM) and the eastern most part of Cape Peñas (29T 667714 4827400 UTM). It is divided in 7 regions with distinct management, denominated management *plans* for their Spanish name, which depend on the regional government (*Principado de Asturias*) and the local fishers' associations known as *cofradías* (Fig. 1). Currently, the *Tapia-Figueras*, *Viavélez*, *Ortiguera*, *Puerto de Vega*, *Luarca*, *Cudillero-Oviñana* plans are seasonal with a harvest season that starts in October and ends in April, and a total individual daily allowable catch (TAC) per fisher that varies between 6 and 8 kg. However, the *Cabo Peñas* plan, which comprises the *Luanco-Bañugues cofradías*, allows harvesting all year with a constant daily TAC of 8 kg per fisher.

2.2. Characterization of the system

The distribution and dimension of the Asturian gooseneck barnacle co-management plans was characterized using the *Principado de Asturias Coastal and Marine Geographic Information System*. Each co-management plan is subdivided into management zones, which can be separate rocks, groups of rocks, or small coastal strips. Furthermore, information on the commercial quality of each zone was gathered from the *Dirección General de Pesca Marítima del Principado de Asturias* (DGPM) official records. The quality of each zone was determined at the inception of the co-management plans by incorporating fishers' knowledge and was further corroborated by *in situ* inspections by personnel from the DGPM and SIGMA S.L. in 2006 and 2008 [28].

To explore the seasonality of the co-management system daily records for landings in 233 fishing zones within 6 plans were analyzed for the 1994–1995 to 2010–2011 fishing seasons. The *Luarca* plan was excluded due to gaps in the datasets. One-way analysis of variance (ANOVA) was performed to test for differences in landings among months.

Information on the yearly management of the fishing zones was obtained through the *Boletín Oficial del Principado de Asturias*. The type of ban applied to each zone for the 2000–2001 to 2010–2011 fishing campaigns was recorded. These were divided in 3 categories: total, partial or no ban. Linear regression analysis was used to test the effect of bans on next year's landings. Landings were standardized [29] by zone to make comparisons among zones. All linear regression assumptions were tested.
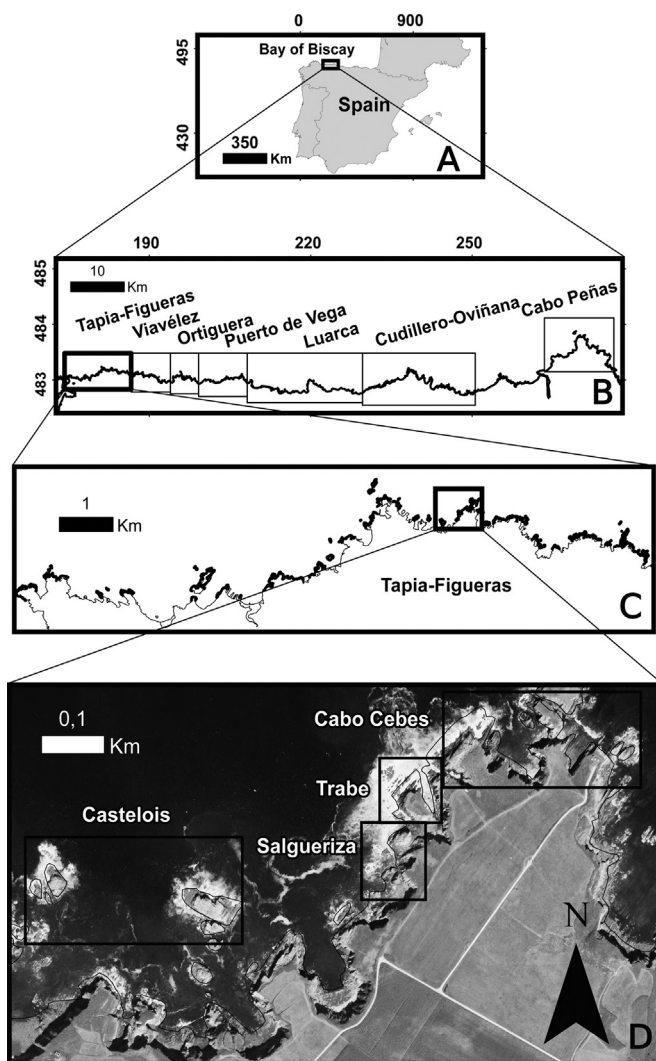

Fig. 1. (A) Location of the study area. (B) Map of Asturian coast showing the seven co-management plans. (C) Fine-scale map of the *Tapia-Figueras* plan. (D) *Castelois*, *Salgueriza*, *Trabe* and *Cabo Cebes* exploitation zones in the *Tapia-Figueras* plan. *Castelois* represents an area of regular quality which receives a no-ban management; *Salgueriza* is a good quality area which is managed by partial ban; *Trabe* is a bad quality area which also receives a no-ban treatment and *Cabo Cebes* is a good quality area managed by implementing total bans.