



# Conciliating artisanal and recreational fisheries in Anegada Bay, Argentina

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## ABSTRACT

Recreational and artisanal fisheries are common activities in Latin America often interpreted as competitors due to the use of common-pool resources in coastal areas. Conflicts between the (historical) artisanal fisheries (AF) and recreational fisheries (RF) in Anegada Bay resulted in the prohibition of the former. This study addresses key fisheries characteristics to detect the degree of spatio-temporal overlap between them considering the annual dynamic of the coastal fish assemblage and proposed management alternatives. Both fisheries exerted different fishing effort coinciding with the dynamic of the fish assemblages but partial temporal and spatial overlap where apparent especially during one month. However, both fisheries focused their catches on different target species thus greatly reducing the overlap in resource use. Moreover, the low proportion of juveniles caught, limited fishing effort using selective bottom gillnets and scarce total harvest (168 tonnes/years) for AF compared with those of RF harvest (631 tonnes/years) in Anegada Bay poorly justifies the actual prohibition. However, the vulnerability index of AF landings resulted in higher values than the RF. To resolve conflicts, a co-management including AF, RF and industrial (trawl) stakeholders and non-fishing community is suggested. Because of the economic importance of fishing for local people, an efficient inter and intra-sector communications process and new fisheries guidelines are urgent for the equitable use of fisheries resources without compromising the goals of a protected area.

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## 1. Introduction

Fisheries and coastal systems are intrinsically diverse, complex and dynamic (Jentoft and Chuenpagdee, 2009). Moreover, an ongoing coastal area migration is happening in many parts of the world (Pauly, 2006) which is adding pressure onto the resources, and consequently, is increasing the competition among the numerous users of these limited resources (Jentoft, 2000). The demands of new actors in coastal areas (recreational fishers, conservation organisations, scuba divers, tourist operators, among others) and the consequent diversity of usages have added a complexity to the interactions thereon. They are creating new governability chal-

lenges that are ultimately aimed towards a shared and rational use of coastal marine resources. However, in finding practical management solutions about resource sharing have proved to be very difficult, since human dimensions are involved on multiple levels, horizontally between the users and vertically between the users, managers, scientists, politicians, and the public at large (Arlinghaus, 2005).

In the last few years, there has been an international increment of concern about the roles that are played by artisanal and recreational fishing in global catches and in local economies (Coleman et al., 2004; Béné, 2006; Chuenpagdee et al., 2006; Cooke and Cowx, 2006; Teh and Sumaila, 2013). For example, the artisanal fisheries sector involves 50 million people (Berkes et al., 2001). They harvest an estimated 21 million tonnes per year in marine environments (Chuenpagdee et al., 2006) and represent a huge socio-economic relevance for many coastal populations (Allison and Ellis, 2001;

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Berkes et al., 2001; Andrew et al., 2007; Zeller et al., 2007). For the case of recreational fisheries, approximately 11.5% of the world's population is involved in capturing 12% of the total global catch (Cooke and Cowx, 2004). This produces high revenues for both developed and developing countries (Pitcher and Hollingworth, 2002). These values rearrange these fisheries into the foreground and show the need to improve our knowledge about artisanal and recreational fisheries in coastal zones, in order to secure their sustainable development (Salas et al., 2007; Chuenpagdee, 2011).

Evaluations that try to account for the conflicts between the fishery sectors and to quantify their reduction under alternative policies are still preliminary (Pitcher and Hollingworth, 2002). The understanding of conflicts is a prerequisite for the planned sustainability actions (Renae, 2006). Intra-sectoral conflicts, especially between the artisanal and recreational fisheries, may be due to several reasons, such as: i) the current increment of recreational fisher's participation rates, together with the improved accessibility to previously remote fishing areas (Arlinghaus, 2005); ii) a spatiotemporal overlap, since fishing is practised and is restricted to within a few nautical miles from the coastline, due to the seasonal nature of available resources, especially in temperate environments; iii) a mutual mistrust about fishing practices or their impacts; and iv) different views and priorities about the guidelines for the sustainable use of resources which are not based on knowledge as much as they are on one's own values and interests (Jentoft and Chuenpagdee, 2009). Besides, intra-sectoral conflicts can be more severe when two fisheries share the same target species whereas inter-sectoral conflicts with non-fishing stakeholders, governance institutions, and citizens in general, can drive up the expense of fishery management (Arlinghaus, 2005).

Recreational and artisanal fisheries are frequent coastal activities in many parts of the world, including the Latin American countries (FAO, 2012a,b; Defeo, 2014). Argentina, for instance, has an extended marine shoreline (5000 km) where artisanal fishing is becoming a permanent livelihood for many people (Elías et al., 2011). In Anegada Bay, in the Northern Argentinean Patagonia, artisanal fisheries have been taking place for more than 100 years. Such fisheries provided a major source of food, employment, and economic benefits to the ancient inhabitants of Anegada Bay showing a temporal increase between 1939 and 1945, due to the demands of shark-oil from the school shark [*Galeorhinus galeus* (Linnaeus, 1758)] and then the fishing efforts decreased (Lasta et al., 2001). Until 2007, artisanal fishing was developed by following the fishing regulations imposed by the enforcement authority (Dirección Provincial de Pesca, Provincia de Buenos Aires <http://www.maa.gba.gov.ar/pesca>), but after was banned.

On the other hand, in Anegada Bay, the beginnings of the recreational fisheries took place 6 decades ago, but there is evidence of an abrupt increment over the last 15 years. Previous results on recreational fisheries have shown the current relevance of this activity, in terms of attracting tourism ( $39,649 \pm 9320$  people per year for the last ten years), increasing the employment demands, and the incomes that this produces (Llopart et al., 2012). Over time, however, the conflicts involved in these two fishery sectors, including the local non-fishing stakeholders, have led to a prohibition of artisanal fishing in the bay. Even though, such a decision was not based on an integral evaluation. To partially address this gap of information, the objective of this study was to obtain a comprehensive framework for both artisanal and recreational fisheries in the bay and then to analyse to what extent such activities were overlapped on a spatio-temporal basis, regarding the amount and the types of fish caught. The main reasons for the conflicts and the governance constraints are also analysed, in order to propose sustainable management alternatives to enhance the fisheries management and the fish conservation in the marine protected area of Anegada Bay.

## 2. Materials and methods

### 2.1. Study area

Anegada Bay is located along the southern coastline of the Buenos Aires Province, Argentina (Fig. 1). This zone is a protected nature area of multiple uses, being considered as part of North Patagonia. The area protects several types of coastal environments, e.g., marshes, tidal plains, and sandy beaches (Penchaszadeh et al., 2003). The bay comprises of small islands and banks that are connected by a diffuse network of channels with depths ranging from 10 m to 24 m in the main channel (Lucifora, 2003). The tidal regime is predominantly a mixed semidiurnal, with a maximum amplitude of 2.56 m and a minimum of 1.73 m (SHN, 2009). The water temperature ranges from 6.8 °C in winter to 19.2 °C in summer, while the salinity varies between 32.5 and 35.0 PSU (Borges, 1997, 2006). The climate is dry (300 mm/year of precipitation) and the prevailing winds are from the northwest.

#### 2.1.1. Recreational fishery

The main recreational fisheries (RF) take place in San Blas Bay, both from the shoreline and from boats (Fig. 1). The shore-based RF (SRF) are carried out along 4 km of the village's coastline, on a steeply sloping pebble and gravel beach, and for 4.4 km on a gently sloped sandy beach, located to the south of the village. For the purposes of this study, the fishing information from these two sites is presented together, as both being SRF.

For the assessment of RF, we developed a two-stage stratified sampling design. The two variables considered were the fishing places (shore-based and boat-based) and the fishing efforts over time [i.e., months and also weekdays and weekend days (Malvestuto and Knight, 1991)]. We conducted a roving-creel survey (Robson, 1991; Pollock et al., 1994; Sullivan et al., 2006) during 108 days of field work between April 2009 and April 2010 (except for May and August of 2009) and we used a semi-structured questionnaire (Sudman and Bradburn, 1982) in order to obtain information about the anglers preferences and their fishing trips. After each angler's interview, the species composition and the number and the length of fish caught were recorded and compared with minimum legal catch size and length at first maturity. The total weight was estimated from the length-weight relationships for each species in the study area (Llopart, 2011). The basic catch and effort statistics were calculated following the procedure of Pollock et al. (1994). The details about the formulas employed and the sampling design can be found in Llopart et al. (2012). For the case of the SRF, two daily instantaneous counts of the anglers were made.

Since the particular dynamics of boat-based recreational fishery (BRF) prevented the implementation of access point surveys (Pollock et al., 1994), their catch estimation was carried out in a different way. In order to get an estimated of the amount of catches, the total number of boats available to rent (between 35 and 40), the number of BRF anglers per year (11,430), the mean duration of the fishing trip (4 h) and total number of fishing trip per month (2321 per season) were registered and contrasted with official records. In the landing port, the catch amount and composition (in percentages) were recorded (N = 130 records) during all months of the 2009–2010 fishing season and validated at fillet processing plants (N = 50 samples). This information was supplemented by the records of the daily catches of one boat randomly sampled considered to be representative of the others and also supported by more than 30 BRF fishing trips in every month of the season and in at least 10 different sites within the bay. The number of daily fishing trips made by all of the boats during each month of the year was provided by the coastal guard placed in San Blas Bay. The BRF catch per unit effort (CPUE) was estimates from the total catch of species during a mean fishing trip time and then expanded to the total fishing

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