

## Spear fishing ban in MPAs: the rational choice?

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### Summary

Spear fishing is currently banned from most of the world MPAs. We reviewed the literature and found that a significant number of works supporting this exclusion are overly speculative or had notable flaws in their methodology. We combined interviews to spear fishers with an historical archive of spearfishing competitions to investigate the actual effects of this activity. In Galicia (NW Spain) spear fishers caught 16% of the annual landings on the common species to the commercial fisheries and had a relevant impact on top-predators. However, their exploitation costs (-5.47 €·kg<sup>-1</sup>) was higher than those of the commercial fishery (-3.67 €·kg<sup>-1</sup>). These expenses could benefit local economies near MPAs if controlled admission is granted, particularly if spear fishers pay for access.

### Introduction

Spear fishing is a particularly controversial fishing technique. There are few studies on its consequences (Pawson *et al.* 2004) but in practice it has been regulated and subjected to several restrictions, e.g. its ban in most MPAs (Badalamenti *et al.* 2000; Francour *et al.* 2001). Currently, the 4000 spear fishers operating in Galicia (NW Spain) have been excluded from the three existing MPAs.

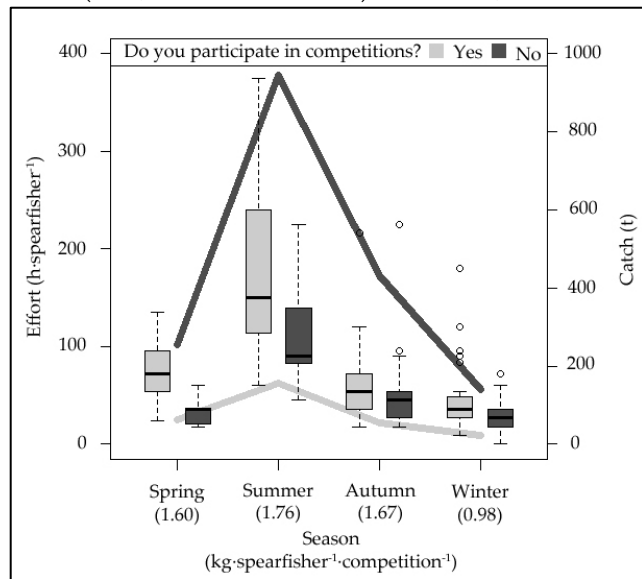
### Materials and Methods

We reviewed the history of spearfishing regulations in MPAs, and established comparisons with works supporting these regulations. We also investigated the impacts of the spear fishers by estimating their annual catch in Galicia (in 2007) by combining the seasonal effort, obtained in 54 questionnaires answered in 2003, with the seasonal CPUE obtained from an historical archive with information on 864 spearfishing competitions (1953–2007; N=13427). Thereafter, we distributed the estimated catch among the species. Finally, to explore their potential benefits on the economy of the local human populations, we compared the annual production costs of spear fishers and commercial fishers. Costs of spear fishers were obtained in 100 questionnaires performed in 2003 (Club Subacuático Bahía de Vigo, pers. comm.) and commercial costs from (Cambiè *et al.* 2012).

### Results and Discussion

Spear fishing is currently prohibited in most of the world MPAs (Badalamenti *et al.* 2000; Francour *et al.* 2001; Oracion *et al.* 2005), including the Fort Jefferson National Monument (Florida, USA), the first MPA (1935). Moreover, spear fishing has been also banned from MPAs where was a traditional fishing method (Oracion *et al.* 2005). However, works analysing the specific impact of spear fishing are scarce and therefore, it is remarkable the quantity of studies that support its exclusion from MPAs, particularly in the Mediterranean. By way of example, Ojeda-Martinez *et al.* (2009) stated that spear fishing has relevant impacts on fish populations, based in papers that did not analyse the impact of spear fishing, or had severe flaws in their methodology, e.g. Jouvenel and Pollard (2001). Furthermore, Francour *et al.* (2001) speculated that the examples of semi-protected areas where professional fishing is allowed demonstrate “without ambiguity”[sic] the negative impact of spear fishing, and the limited impacts of commercial fishing. However, how a MPA allowing spear fishing and excluding commercial would have done? In Galicia, the annual fishing effort showed seasonal patterns and was

higher in the spear fishers that participated in competitions (57% of total). We estimated that spear fishers caught 16% of the annual landings on the common species to the commercial fisheries, a lower percentage to that obtained in relatively close areas (29%; Lloret *et al.* 2008). However, because its selectivity, spear fishing has a relevant impact on large, sedentary, top-predators (Lloret and Font 2013). In this regard, recreational catches on *Labrus bergylta* (1546 t), *Dicentrarchus labrax* (136 t) and *Diplodus sargus* (73 t) were similar or even higher than commercials (266 t, 277 t and 345 t, respectively). Spear fishers spent 3872 € per year on fishing equipment, boats, fuel, permits and travel expenses including food and overnight stays. Consequently, their mean exploitation costs (-5.47 €·kg<sup>-1</sup>) was higher than those of the commercial fishery (-3.67 €·kg<sup>-1</sup>), while it is true that after the sale, commercial fishers obtained a net profit (1.98 €·kg<sup>-1</sup>). A regulated, controlled access of spear fishers to some MPAs, particularly if spear fishers pay a fee for their access, should be explored to benefit local economies.



**Figure 1. Seasonal fishing effort of spear fishers. The lines show the annual estimated catch. The average CPUE is shown in brackets.**

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