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Recreational fishing on the West coast of the Northern Adriatic Sea (Western Mediterranean) and its possible ecological implications

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HIGHLIGHTS

- Marine recreational fishing on the West coast of the Northern Adriatic Sea was assessed.
- CPUE and annual catches have been assessed.
- For some species, annual catches resulted to be comparable or higher than commercial ones.
- Possible ecological effects have been analysed by using trophodynamic indicators.
- The need to consider MRF in the management planning was stressed.

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ABSTRACT

The marine recreational fishing (MRF) represents one of the most popular activities along the coasts of numerous countries around the world, in particular in the Mediterranean Sea. Despite the evidences of potential effects on the marine biodiversity and commercially exploited stocks, a sound information base and adequate management plans are still lacking, both at the national and basin level. An analysis of the MRF on the West coasts of the Adriatic Sea was carried out, in 2014, by using a standardized questionnaires approach, aiming to describe the state of the art and to preliminarily assess catches, in comparison with the commercial ones, at the regional scale. Gilt-headed seabream, European seabass, cuttlefish, squid and Atlantic bluefin tuna resulted the anglers' preferred species, even if the top five in term of caught biomass were bluefin tuna, seabream, cuttlefish, common dolphinfish and little tunny, in the order (accounting up to 60% of total catches). The exploitation level resulted to be significant, as confirmed by the comparison with commercial fisheries, being the MRF captures 30% or 45% of the artisanal fishery in the same area, with some species, such as bluefish, bonito, pandora and picarel, showing larger values. The preliminary assessment of ecological effects, highlighted that the exploitation use about 10%–16% of energy fixed by the primary production (Primary Production Required to sustain fishery), but the ecosystem effects are still sustainable (Lindex and probability to be sustainable fished). However, combining catches by MRF with those by small scale fishery completely changes the situation, showing an unsustainable condition, suggesting the need for taking into the account also MRF in the future management planning for the Adriatic coastal area.

1. Introduction

Worldwide, marine recreational fishing (MRF) is a high participation activity of large economic and social value (in Europe, it has been estimated to generate a total expenditure over 25 billion € per year, Pawson et al. (2008)). As recreational fishing demonstrated to exert a potential impact on marine biodiversity and exploited stocks (Coleman et al., 2004; Lewin et al., 2006; Strehlow et al., 2012), and to be a source of conflict with commercial activities (Cooke and Cowx, 2006), in the last three decades it has gained an increasing scientific interest.

Recreational fishing has been described as one of the most popular leisure activities in the coastal areas of numerous countries around the world, particularly in the Mediterranean Sea (Sutinen and Johnston, 2003; Moutopoulos et al., 2013). Although MRF represents an expanding activity, a sound information base and adequate management plans are still lacking, both at the national and basin level (Gaudin and De Young, 2007; Lee and Chang, 2008).

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Such factors would contribute to guarantee economic, cultural, and social benefits and to protect the marine resources from overfishing and other negative impacts.

In Italy, for instance, data about the MRF is scattered and not homogeneous among different sources, in relation to both number of anglers and caught biomass (Cingolani et al., 1999; Romanelli and Fiori, 2013). The activity is regulated by law (max 5 kg per day per person, or one specimen if heavier), but it does not require a licence (as opposed to fresh and brackish waters); only tuna fishing needs a specific registered permission, since this species is subjected to TAC regulation (Silvestri, 2013). For these reasons, the regulation of recreational fisheries is difficult and often leads to conflicts between the commercial and recreational sectors.

Despite the fact that the Adriatic Sea represents one of the Mediterranean areas in which the MRF has a long tradition and showed a recent rapid growth (Gaudin and De Young, 2007), no real assessment has been performed recently. This is of particular importance when considering the need for an integrated management plan of the coastal area. As consequence of the recently (2010) implemented ban for the trawling fishery inside the three miles from the coast (having the effect to completely eliminate the local derogations in place until 2010; see Pranovi et al., 2015) indeed, along the Western coast of the Adriatic Sea only two commercial fisheries are allowed: the stripped venus clam (*Chamelea gallina*) mechanical harvesting (by hydraulic dredge) and the artisanal fishery (by static gear). Given the fact that also the MRF seems to concentrate in this area, in order to maximize the positive effects of this measure, a new approach that takes into the account all different activities dealing with the exploitation of renewable resources in the area, is needed (Pranovi et al., 2015).

Within this context, the paper aims to:

- estimate the resources exploitation rate by marine recreational fishing;
- compare results with the commercial fisheries data;
- assess possible ecological effects at the ecosystem level.

2. Materials and methods

2.1. Survey methodology

In order to characterize the recreational fishing activity on the northern Adriatic coasts, an interview campaign aimed at anglers was set up, using standardized questionnaires.

A preliminary phase of the research in 2013 was devoted to identify the biological, economic and social parameters to be included in the questionnaires, in order to estimate different aspects related to the complex phenomenon of the marine recreational fishing (MRF) along the Adriatic coast. The main questions regarded the fishing techniques, fishing grounds (inshore vs. offshore areas and relationships with the presence of submerged structures), preferences in terms of target species, catches, fishing effort (in terms of number of trip per week in the different seasons), cost per trip and possible interactions with the commercial fisheries. A first version of the protocol was then tested on a small group of anglers, by mean of face-to-face interviews. Subsequently, anglers were identified thanks to local associations, in particular FIPSAS (Italian Recreational Fishing and Underwater Activity Federation) and contacted by various means (directly meeting them, at the bait shops, straight at the quay, by e-mail), proposing them to compile the online questionnaire form. About 500 anglers, who lived on the Italian Northern Adriatic coast or visited it frequently have been contacted during 2014.

2.2. Data analysis

Based on collected data, the annual effort per angler (in terms of the number of trips per year) and the catch per unit effort (CPUE, in terms of kg per angler per trip) were estimated. Combining information for each target species, the average yearly catch was also estimated. The bootstrapping method was applied to estimate the 95% confidence interval (Shao and Tu, 1996; Lehtonen and Pahkinen, 2004). According to the procedure, CPUE samples were randomly drawn from the database, repeating the process for 1000 times. Once built, the new dataset (composed by all targeted species) was used to estimate the confidence interval ($\alpha = 0.025$).

To calculate total catches per year, two different sources for the number of anglers in the area were used: the Italian Recreational Fishing and Underwater Activity Federation (FIPSAS) and the Ministry (MIPAAF) that reported 1624 and 2633 anglers, respectively.

In order to compare MRF catches with the commercial fishery landings, official statistics for the region (MIPAAF, 2014) and data from the Chioggia fish market, the largest one in the Northern Adriatic Sea, were used.

2.3. Trophodynamic indicators

To investigate possible effects of the MRF exploitation on the marine ecosystem, two different trophodynamic indicators have been applied.

The Primary Production Required to sustain fishery (PPR) is a measure of the level of exploitation of the studied area (Pauly and Christensen, 1995), accounting for the fraction of Primary Production sequestrated by fisheries. The method is based on the trophic level of the caught species, the energy transfer efficiency between trophic levels, and on the primary productivity of the basin, combined as follow,

$$PPR = \sum_{i=1}^{n} \frac{L_i}{CR} \left(\frac{1}{TE}\right)^{(TL_i - 1)} \quad (1)$$

with L_i = landing of the i-species;

CR = conversion rate of wet weight to carbon (fixed at 1:9, according to Pauly and Christensen, 1995);

TE = transfer efficiency (fixed at 10.5%, according to Libralato et al., 2015);

TL = trophic level of i-species.

The PPR is commonly expressed as a percentage of the total primary production. Primary production for the NAS was estimated by using monthly chlorophyll-a data derived from MODIS satellite (http://neo.sci.gsfc.nasa.gov/), according to Behrenfeld and Falkowski (1997).

The Loss in Production Index (Lindex) allows assessing the effects of the loss in energy due to the exploitation as it propagates through the trophic web (Libralato et al., 2008; Coll et al., 2008).

The Lindex is defined as:

$$Lindex = \frac{PPR\, TE^{TLc-1}}{PP \ln(TE)} \quad (2)$$

where PPR = Primary Production Required (see above);

TE = transfer efficiency (fixed at 10.5%, according to Libralato et al., 2015);

TLc = mean trophic level of catches,

PP = Primary Production (see above).

The method allows also estimating the probability that such energy loss is sustainable for the ecosystem on the basis of a nonlinear empirical relationship between the Lindex and the probability to be sustainably exploited (psust), according to the analyses carried out by Libralato et al. (2008).

3. Results

A total of 100 compiled questionnaires have been collected, with a return rate of 20%.