Fisheries Management and Ecology

Fisheries Management and Ecology, 2014, 21, 454–469

The use of spearfishing competition data in fisheries management: evidence for a hidden near collapse of a coastal fish community of Galicia (NE Atlantic Ocean)

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Abstract The use of commercial catch statistics to estimate overfishing consequences has been criticised, but alternative long-term data sets are rare. Long time-series data sets from recreational fisheries competitions have been used to infer trends in coastal fish communities. Here an historic archive (1953–2007) of recreational spear fisheries in Galicia (NW Spain) was employed to estimate long-term changes in coastal ecosystems. Using generalised additive regression models, decreases in the abundances of coastal rocky reef fishes of up to 76% over the last 50 years were found. In the same period, the mean body weight also decreased by 76%. In addition, relative catch frequency has decreased for the most valuable commercial species. Overfishing, amongst other human impacts, has brought these ecosystems so close to collapse that it is urgent to implement measures to ensure their recovery.

KEYWORDS: ecosystem management, predictive modelling, recreational costal fisheries, restoration.

Introduction

Marine ecosystems currently suffer the cumulative effects of traditional fisheries along with commercial industrial fisheries developed more recently (Morato *et al.* 2006; Swartz *et al.* 2010). Fishing effort is now exerted over a wide range of habitats, depths and trophic levels (Essington *et al.* 2006; Sethi *et al.* 2010). Despite increased fishing efficiency of the commercial fleets (Christensen *et al.* 2003; Anticamara *et al.* 2011; Watson *et al.* 2014), worldwide catches are declining (Watson & Pauly 2001; Kelleher 2005; FAO (Food & Agriculture Organization of the United Nations) 2012). A variety of studies have found severe effects of overfishing on marine resources, for example local extinctions (Fogarty & Murawski 1998; Dulvy *et al.* 2000) and declines in species diversity (Worm *et al.* 2006), in the size of commercial species (Baum & Myers 2004; Sibert *et al.* 2006; Myers *et al.* 2007), and in the abundance of sharks (Baum *et al.* 2003; Campana *et al.* 2004), tunas (Hampton *et al.* 2005) and other fishes (MacIntyre *et al.* 1995; Jennings & Blanchard 2004; Levin *et al.* 2005).

The current overexploitation of most of the world's fishing grounds (Worm *et al.* 2009) could lead to a general collapse of fishery resources (Jackson 2001; Pauly *et al.* 2003; Zeller & Pauly 2005) and to large-scale extinctions (Malakoff 1997; Roberts & Hawkins 1999). Furthermore, humans have overexploited >90% of the economically important species of the coastal seas (Lotze *et al.* 2006), and in Europe, there are concerns regarding the long-term sustainability of local fish stocks (Froese & Proelß 2010; Thurstan *et al.* 2010; Guénette & Gascuel 2012). However, there is strong disagreement amongst scientists as to the impact of overfishing (for a synthesis, see Banobi *et al.* 2011). Some of the differences derive from abundance estimates that are based on catch data from commercial fisheries. The time data series used are unreliable before 1970 in most cases, and

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 doi: 10.1111/fme.12095