Diversity of commercially exploited fish and invertebrates in Regional Seas[1]

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Abstract

Distribution range maps of commercially exploited species, defined as the marine fishes and invertebrates that are listed in fisheries catch statistics submitted by member countries to the United Nations' Food and Agriculture Organization (FAO), plotted onto a global ½° latitude/longitude cell grid, can be used to characterize the diversity of commercially exploited species in Regional Seas. Some caveats are discussed, notably the fact that low-latitude countries tend to taxonomically over-aggregate their fisheries statistics.

Introduction

Biodiversity – the variability among living organisms from all sources, including diversity within species, between species and of ecosystems (Convention on Biological Diversity 1992) – performs a multitude of services to humans. In the oceanic spheres, these include providing the basis for fisheries (for food or recreation), drug development or non-extractive use, such as providing scenery for scuba divers (Pauly *et al.*, 2005) and whale watchers (Sorongon *et al.*, 2010). Yet, this same biodiversity is coming under threat in the open ocean (Dulvy *et al.*, 2003). The main cause for this is fisheries (Pauly *et al.*, 2005), and the task is to design management regimes that minimize diversity loss (Alder and Wood, 2004). To this end, detailed knowledge must be available for the ecosystems and individual species occurrences at various places along with broad-based knowledge about global patterns of diversity. It is the latter that this index offers. The index is based on diversity of commercially exploited species, defined as the marine fishes and invertebrates that are listed (by at least one country, in at least one year since 1950) in fisheries catch statistics submitted by member countries to the United Nations' Food and Agriculture Organization (FAO).

Materials and Methods

Distributions of a total of 1,066 exploited marine fish (836 spp.) and invertebrate species (230 spp.) were predicted using the method described in Close *et al.* (2006), using an algorithm which uses probability of occurrence of a species on a ½° latitude by ½° longitude grid based on its depth range, latitudinal range and broadly known occurrence regions. The resulting distributions indicate average patterns of species' relative abundance in recent decades (i.e., 1980–2000). The species included in the analysis were all relatively abundant, by definition, since they must be included in the fisheries statistics of at least one FAO member country (see definition above). This also weighted the sample of marine biodiversity towards the species, which: i) contribute most to marine metazoan biomass; and ii) are more accessible to fishing gears.

The distributions were further refined by assigning habitat preferences to each species, such as affinity to shelf (inner, outer), estuaries and coral reefs. Such information was mainly obtained from FishBase

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(www.fishbase.org) for fish and SeaLifeBase for other taxa (www.sealifebase.org); both databases contain key information on the latitudinal and depth distribution of the animals in question, and on their occurrence in various parts of the world ocean. The distribution maps are available at www.seaaroundus.org, along with the habitat preferences and other parameters used in their construction.

Results and Discussion

The diversity of commercially exploited species is highest along the continental shelf and oceanic ridges, with species richness ranging from 0 to 346 species per cell (Figure 1). Latitudinal patterns of species richness of marine fish and invertebrates show a plateau of around 40ºN–30ºS and declines towards the poles. Species richness per cell also appears to decrease with increasing depth and distance from the coastline.

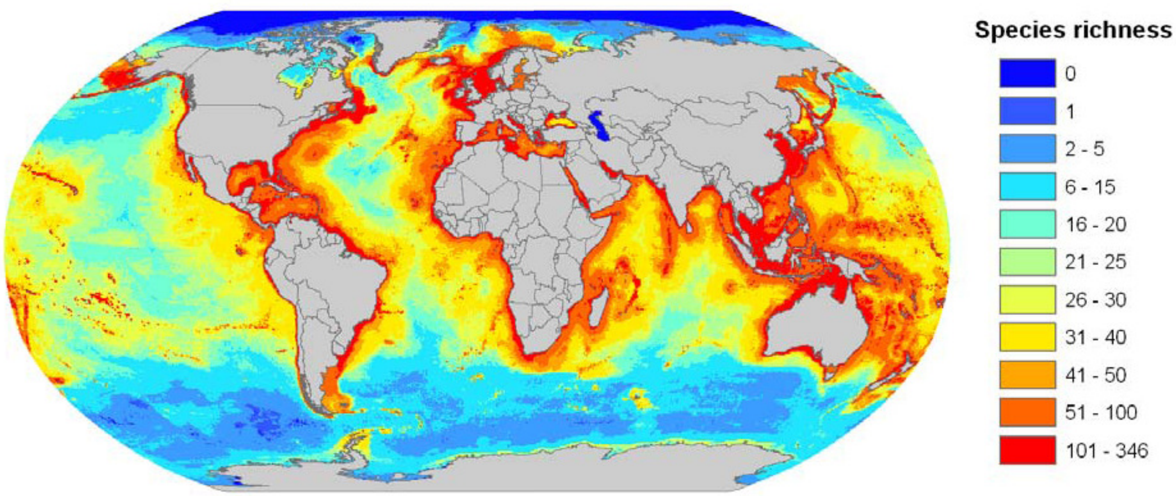

Figure 1. Species richness of exploited marine fishes and invertebrates by ½° cell.

The indicator shows that richness of exploited species is highest in tropical regions, which mimics empirically observed patterns of marine species richness reported by Hoeksema (2007), and specific groups, e.g., fishes (Carpenter and Springer, 2005; Cheung *et al.*, 2005; Bellwood and Meyer, 2009), bivalves (Roy *et al.*, 2000), gastropods (Rex *et al.*, 2005; Bellwood and Meyer, 2009), bryozoans (Clarke and Lidgard, 2000) and various invertebrates (Macpherson, 2002), as well as benthic marine algae (Kerswell, 2006). However, this is different for the high values in the Northeast Atlantic, which are probably an artifact of the very detailed fisheries statistics of the countries operating in this area, e.g., Norway. Indeed, the pattern does not fully reflect diversity patterns of marine fishes and invertebrates as a whole, because the species included in the calculation of this indicator are biased by different levels of taxonomic resolution in landing records of different regions. In particular, low-latitude (mostly developing) countries aggregate their reported catch statistics into higher taxonomic groupings, e.g., genera, family (Pauly and Palomares, 2005). This can be taken into account (by comparing each country's scores with the score of countries with which it shares species) when evaluating the relative thoroughness of countries' fisheries statistics (Pauly and Watson, 2008), but such procedure would not have any meaning when applied to oceanic regions. Thus, while it is straightforward to use the data in Figure 1 to compute scores for Regional Seas, further studies are required on what they mean in biological terms.

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