

A multi-component analysis of species diversity of groundfish assemblages on the continental shelf of the Gulf of Lions (north-western Mediterranean Sea)

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Received 7 July 2006; accepted 11 December 2006

Available online 26 February 2007

Abstract

The multi-component aspect of species diversity of groundfish assemblages was examined on the basis of a set of experimental trawl surveys conducted on the continental shelf of the Gulf of Lions. The structure of species diversity was investigated through the simultaneous analysis of indices relating to 4 diversity components: (1) the number of species (species density S and Margalef's D_{mg} index), (2) rarity (number of species with less than 5% of occurrence), (3) evenness (Heip's E_{Heip} and Berger–Parker's $1/d$ indices) and (4) taxonomic diversity (Δ , Δ^* , Δ^+ , A^+). In addition, two popular heterogeneous indices (Simpson's $1 - D$ and Shannon's H' indices) combining the number of species and evenness were also considered. PCA based on Spearman's correlation coefficients was carried out to investigate empirical relationships between these 11 indices while generalized linear models (GLMs) were used to analyse diversity patterns in relation to bathymetry. Our results showed that the 11 species diversity indices studied might be grouped into 6 complementary components: (1) number of species (species density S and Margalef's D_{mg} index), (2) evenness (E_{Heip} , $1/d$, H' , $1 - D$, Δ), (3) rarity and each of the 3 other measures of taxonomy: (4) Δ^* , (5) Δ^+ , and (6) A^+ . This result showed not only that a single diversity index cannot provide a complete description of species diversity but also that – in some cases – it cannot even encapsulate a complete description of a specific diversity component. In addition, in contrast to their expected theoretical properties, some descriptors appeared to be redundant in our field study. Finally, we found that the influence of depth on diversity patterns is usually significant but weak and varies according to the diversity components considered. Our findings – which show that diversity descriptors may respond in different ways to habitat degradation or loss – highlight the complexity of defining priority areas of protection taking simultaneously into account the main characteristics of diversity.

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Keywords: diversity indices; groundfish assemblages; taxonomic relatedness; Mediterranean Sea

1. Introduction

Interest in biological diversity has recently increased in response to the damage caused to ecosystems by anthropogenic activities. For conservation purposes, the number of species

has traditionally been used as a surrogate for monitoring species diversity (Rosenzweig, 1995; Gaston and Spicer, 1998). However, species diversity now appears as a complex concept which requires measures that take into account other facets of diversity (Purvis and Hector, 2000). Along these lines, some studies have focused on a restricted subset of species to deal with the concept of rarity, which refers to species whose relative abundance or range size falls below some threshold. However, measuring diversity through the number of – total or

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