Akademisk avhandling för Filosofie Doktorsexamen
Thesis for the Degree of Doctor of Philosophy

Spatial distribution and conservation planning of seabed biological diversity

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Avhandlingen kommer att försvaras offentligt fredagen den 9 december 2011 kl 13.00, på institutionen för Marin Ekologi, i lokalerna på Hättebäcksvägen 8, Tjärnö, Strömstad. Opponent är Dr Vladimir Kostylev från Natural Resources Canada, Dartmouth, Canada.

The oral defense of this thesis will take place at 13:00 on Friday December 9th 2011 at the Department of Marine Ecology, at the facilities of the laboratory at 8 Hättebäcksvägen, Tjärnö, Strömstad. The opponent is Dr Vladimir Kostylev from Natural Resources Canada, Dartmouth, Canada.

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ABSTRACT: Knowledge of spatial patterns of biota has become a commodity for conservation practitioners and spatial ecologists alike. This type of information enables the identification of representative and unique biological features (at some nominal scale) which itself constitutes the application *par excellence* of knowledge of biodiversity distribution as it relates to the design of reserve networks and the realization of spatial planning. Furthermore, insight into the spatial distribution of the various components of biological diversity provides a way of addressing issues of fundamental ecology relating to the processes influencing the variation of ecosystem structure across space.

The present thesis is concerned with methods (and related issues) to document the spatial distribution of diversity at the assemblage (or community) level, which is later proven to be an adequate surrogate for diversity patterns at the species level, and therefore an adequate approach for identifying sites representative of regional biodiversity. This was investigated across the benthic portion of a Marine National Park off the West coast of Sweden. At the center of this thesis is the production of a map of benthic biotopes by use of automated, objective methods, of measurable accuracy, and that can support marine spatial planning.

In Papers **I** and **II**, I address various aspects related to the data model underpinning this map. Paper **I** deals with patterns of spatial patchiness of benthic communities, which helped determine the appropriate resolution at which epibenthic biological diversity in this area is best investigated. Here, spatial autocorrelation is measured at a range of scales and used to determine an appropriate grain size for subsequent sampling. This will become a backbone of this study, as it determines the (only) spatial scale for which the findings are relevant. In Paper **II** I assess the performance of classifications of communities at varying levels of compositional detail as a way of calibrating the classification scheme to be used as the basis for the map.

Paper **III** is a case study of predictive mapping of communities. The process was driven by patterns of occurrence of benthic communities, which were then extrapolated using observed biota-environment relationships, by means of full-coverage variables derived from multibeam data. This approach draws heavily from the field of distribution modelling of species and/or communities. Further, I present a number of analysis techniques that are new to benthic ecology, and virtually new to predictive mapping in general (albeit not to the field of predictive, statistical modelling, and classification algorithms).

In Paper **IV** I evaluate the applicability of the produced map of benthic biotopes as a tool for conservation planning. Particularly, I test the value of the outputs from the model introduced in Paper **III** (i.e., the biotopes with their associated spatial attributes) as conservation features, or surrogates for biodiversity, in the context of systematic conservation planning, to represent biodiversity at other hierarchical levels and across ecological niches.

Keywords: Spatial autocorrelation, ecological classifications, distribution modelling, biotopes, conservation planning, biodiversity surrogates, GIS, spatial ecology, benthos, fjord.