Abstract: The biological diversity of coastal areas is exposed to multiple threats, making the need for effective management tools more and more important. To develop such tools, however requires knowledge about the distribution of fauna. The general aim of this thesis was to evaluate the possibilities for developing predictive models of infaunal assemblage structure. This aim was app roached by (1) estimating spatial and temporal patterns of biodiversity of infauna to contribute to a better understanding of scales of structuring processes, and the scales at which predictions are relevant, and (2) by building and testing models using information about environmental conditions often demonstrated to explain patterns, and testing their predictive power using independent data.

To evaluate spatial and temporal patterns, variability of abundance of common infaunal taxa and measures of richness were estimated and tested in northern Bohuslän (a county on the Swedish west coast) at several hierarchical scales from meters to kilometres on three different occasions, using uni- and multivariate analysis of variance. To try and explain these patterns, predictive models of abundances of common taxa and measures of diversity, were developed using multiple linear regression (MR) and regression tree methods (RT). Variables derived from maps (such as degree of wave exposure) and from the sediment were used as predictors. The performance of the models was subsequently tested with independent data sampled from new locations in a different year. Secondly we developed and tested predictive models of presence/absence of common taxa. We also evaluated the possibilities for large-scale generalisation in terms of spatial variability. Patterns of spatial variability were estimated at a hierarchy of scales within regions (from meters to 100 km) and then compared among five regions located along a stable 1200 km salinity gradient.

In northern Bohuslän variability was often important among bays (10^3 m apart), locations (10^2 m apart), and replicate samples (3-6 m apart) both for univariate variables, such as number of taxa and total abundance, and for multivariate measures of the whole infaunal assemblage. The important spatial scales for abundances and diversity typically varied interactively in time and the important spatial scales also varied among taxa. Many taxa showed significant relationships with environmental variables but only models of abundance for one taxon, chironomid insects were significant for both MR and RT when tested with independent data. Correlations were equally strong for models developed by MR and RT but predictions made from RT were quantitatively more precise than those made by MR. Similarly models predicting presence/absence of fauna resulted in several significant relationships but only models for phyllodocid and spionid polychaets and rissoid gastropods, were significantly better than random when tested. Comparisons of spatial patterns observed in northern Bohuslän to those in other parts of Swedish coastal areas showed that patterns generally were inconsistent among regions for all univariate response variables. Multivariate measures of whole faunal assemblage structure were however, consistent in the three most saline areas, and spatial patterns in northern Bohuslän were surprisingly similar to those observed two years earlier.

An important lesson from these studies is that significant fauna-environment relationships do not necessarily have strong predictive power and thus may be of little practical use. This emphasises the need for validating models using independent data. A second lesson is that spatial patterns differ among regions. This means that predictive models in different regions should focus on different environmental factors and different spatial scales. This also affects the possibilities for generalising results from local studies and for optimizing monitoring and conservation strategies.

In summary, spatial and temporal patterns of infauna have been successfully quantified. In contrast, these first attempts to predict several properties of infaunal assemblage structure at the scale of locations using five predictor variables were less successful. Therefore, further studies of models predicting alternative properties of the assemblages at alternative spatial and temporal scales using more refined predictors are warranted.