

Assessment of dietary patterns and prey consumption of marine mammals

Grey seals (*Halichoerus grypus*) in the Baltic Sea

Thesis for the degree of Doctor of Philosophy

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Examinator: Professor Kristina Sundbäck, Institutionen för biologi och miljövetenskap, Göteborgs universitet.
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Abstract: The Baltic Sea has been severely affected by pollution and resource overexploitation during the last centuries. The grey seal (*Halichoerus grypus*) is a good example of how a species can be affected by such changes. In the early 1900s grey seals were common, but hunting and environmental contaminants caused a rapid decline to the verge of extinction in the 1970s. Since the 1980s the population is increasing. This has intensified the conflicts between seals and fisheries, and resource competition between seals and the fishing industry is a matter of debate. This thesis examines dietary patterns and prey consumption by grey seals collected in the Baltic Sea in 2001-2005. It is the first comprehensive study of the Baltic grey seal diet since the early 1970s.

Dietary studies of marine mammals generally suffer from a number of possible biases, both concerning the methodology and how the samples are collected. This thesis applies different methods to increase the accuracy and quantifies the uncertainties of the dietary estimates. Conventional analysis of prey remains in the digestive tracts showed that the diet differed between seals from the Gulf of Bothnia and the Baltic Proper, and also between young-of-the-year animals and older animals. Herring (*Clupea harengus*) was the main prey in all areas and age groups, followed by sprat (*Sprattus sprattus*) in the south, and common whitefish (*Coregonus lavaretus*) in the north. Furthermore, the digestive-tract contents of seals collected from certain fishing gear was different from seals collected away from fishing gear. Size and numerical correction factors were used to compensate for biases introduced by digestive erosion of prey otoliths, and additional prey hard parts, other than otoliths, were used to increase the detection level of prey items.

The intake of prey biomass by the Baltic grey seal population was estimated using a bioenergetic model and data on population size and diet composition. On a larger spatial scale, the total fish removal by grey seals was negligible. Nevertheless, the predation by seals can have impact on individual prey species and local fish stocks. Concerns for competition between seals and fisheries were augmented by overlapping length distributions of seal prey and commercial catches.

The use of fatty acid signature analysis (FASA), which provides long-term dietary information, irrespectively of identifiable prey remains, to a large extent manifested the results from the conventional analysis. However, the application of FASA indicated different feeding habits between male and female grey seals, which were not found using conventional methodology. Application of FASA on marine top predators relies on the background data of the FA signatures of prey species. Grey seal prey species in the Baltic Sea showed a relatively large overlap in FA composition. The intra-specific variation in some species even exceeded the inter-specific variation, which needs to be considered when applying FASA in ecological assessments of fish predators in the Baltic Sea.

This study presents a compilation of techniques applicable to assessments of dietary patterns and ecological roles of marine mammals. The results suggest that a combination of different methods, each with its own unique potential as well as limitations, is advisable. Efforts should be made to develop and refine these methods and use them in combination with additional techniques to advance the understanding of the ecology of grey seals in the Baltic Sea.

Keywords: Grey seal, *Halichoerus grypus*, Baltic Sea, diet, predation, fish, consumption, fatty acid signature analysis, bioenergetics, foraging ecology.

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