

Abstract

The main objective of this research is to determine the characteristic morphometric (geometric), energetic and "spectral" characteristics (dependence of the volume backscattering strength on frequency) spatial distributions of the volume backscattering strength, including their temporal variability for scattering on fish clusters in the Puck Bay.

Justification of the research: Puck Bay is a unique natural habitat, highly sensitive to anthropogenic factors. Because of its distinctive characteristics, it is impossible to apply hydroacoustic methods developed for other waters of the Baltic Sea and, therefore, to adapt expert knowledge regarding the characteristic features of spatial distributions of volume backscattering strength from deep-water areas of the Polish part of the Southern Baltic Sea to the Puck Bay. As remote hydroacoustic methods in the study of marine ecosystems are not yet fully exploited in the Baltic Sea, the abovementioned circumstances make the research, the results of which are presented in this dissertation, very important. Without conducting research aimed at determining the characteristic features of spatial distributions of the volume backscattering strength for the scattering of acoustic waves on biological objects in the Puck Bay, it is not possible to develop hydroacoustic classification methods for the studied area.

Results: Studies have shown that the nature of spatial distributions of the volume backscattering strength for acoustic wave scattering on fish clusters in the outer Puck Bay is significantly different from the nature of distributions observed hydroacoustically in the deep-water part of the Gulf of Gdańsk and in the Gdańsk Deep.

Hydroacoustic measurements, the results of which are presented in this dissertation, increase understanding of seasonal and diurnal variability of parameters describing spatial distributions of the volume backscattering strength for the scattering of acoustic waves on fish clusters. A difference in the nature of the temporal (daily and seasonal) variability of these parameters compared to the previously studied deep-water areas is demonstrated.

Hydroacoustic measurements using a split-beam sonar, carried out continuously throughout migration, allowed for insight into how organisms move in the water depths. Such detailed research has not been done in deeper areas of the Gulf of Gdansk and the Gdansk Deep in

the past. Conducted measurements not only provided insight into characteristic features of migration in the outer Puck Bay, but also showed differences with the above-mentioned areas.

For the first time:

- detailed research was carried out for acoustic shoals for the Polish areas of the Southern Baltic Sea,

- daily and seasonal changes in the frequency response for clusters of organisms for the Baltic Sea were analyzed and interpreted,

- analysis of the features of the specific spatial distributions of the volume backscattering strength (for scattering on fish) was carried out as a preliminary effort necessary for the development of hydroacoustic classification methods for the Baltic Sea. The first attempts at classification were made.

Significance of the conducted research: The results that are presented in this dissertation belong to an innovative world trend in the development of hydroacoustic. This trend involves development of new hydroacoustic classification techniques, including increasing the area of their application to the study of broader array of parameters, specifically the components of marine ecosystems and their characteristics. Presented research will be used to develop hydroacoustic classification methods to study the state and functioning of the ecosystems of the Baltic Sea.

It should be emphasized that the deep-water part of the Outer Puck Bay was selected for research because hydroacoustic research of a biological nature so far has been carried out there to a very limited extent and where gaps in knowledge regarding seasonal and daily changes in spatial distributions, biomass, behavior and species composition of fish are present. Insights gained from this work, regarding the spatial distributions of fish, are important for further ichthyological and ecological research of this area.

Conducted research also has an important practical dimension, because the knowledge gained and the steps taken towards the development of classification hydroacoustic methods, open new opportunities for understanding the functioning of the ecosystem in the Gulf of Gdansk, and will contribute to the improvement of the scientific basis of the innovative approach, which is the ecosystem approach for the integrated management of marine areas.

