
Estuarine Soundscapes: Characterizing habitat-associated underwater sound from an ecological perspective

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Abstract

Despite their potential importance to marine ecological processes such as larval orientation and settlement, the soundscapes of most coastal and estuarine habitats have not been characterized. Different seafloor habitat types likely produce distinct soundscapes due to differences in the physical and biological contributors to ambient sound. To investigate habitat-related estuarine soundscape patterns we comprehensively measured the sounds of oyster reef and nearby off-reef soft bottom areas in Pamlico Sound, North Carolina, USA, and applied several soundscape analysis approaches to characterize the acoustic variability. Short- and long-term acoustic sampling across the estuary found distinct acoustic patterns in oyster reef habitats compared to surrounding off-reef areas, with reefs producing higher levels of sound within frequency bands dominated by snapping shrimp sounds and the vocalizations of reef-dwelling fish species. Compared to soft bottom habitat, oyster reefs had consistently higher sound pressure levels at higher frequencies (~2-23 kHz) and higher acoustic diversity index values. Passive sound propagation surveys as well as a novel drifting hydrophone technique found that the distinct acoustic characteristics of oyster reefs were highly localized to the habitat. The spectral dissimilarities between concurrent recordings in the two types of habitats were consistent over the summer/fall sampling season and across three years; however, the acoustic signal strength differed between reef sites, likely reflecting differences in their biological or physical properties. This study serves to establish a possible ecological function of the estuarine soundscape as a reliable indicator of habitat-type and habitat quality to dispersing organisms, and also highlights the need to study the drivers of soundscape variation in estuarine and coastal systems to develop effective soundscape analyses and meaningful acoustic diversity indices. Further characterizations of habitat-related acoustic patterns are necessary to evaluate the potential adverse effects of anthropogenic noise or soundscape degradation on marine ecosystems.

Keywords: estuaries, oyster reefs, drifting hydrophones, acoustic diversity

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