Underwater acoustic characterization of shallow marine waters - PhD outline

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Humans mainly depend on light to detect and understand their environment. But what do animals do in environments where little light arrives? This is the case for marine ecosystems. Through fluids like water; sound propagates much more efficiently than light. This suggests why most of the species living underwater do not rely on their vision to interact with their environment but on sound. Consequently; sound can give substantially more information than images; especially in an environment so turbid as the Belgian Part of the North Sea (BPNS); where light is strongly scattered and absorbed. Therefore; sound is proposed as a new monitoring tool for marine ecosystem health.

To conduct this research; it is firstly required to obtain underwater sound data over time at various locations. Thanks to the recently developed simulation methods; it is also possible to propagate the received acoustic waves to cover greater areas without the need to record every single point; becoming a very cost-effective technique to monitor marine environments.

Afterwards; the sound habitat can be characterized. One possible strategy is to detect acoustic events; including anthrophonic; biophonic and geophonic occurrences; and correlate them with ecological data. The detection of events has been already broadly studied and used to identify and monitor several species (especially marine mammals) and to model human-generated sound sources; which are omnipresent in the BPNS. Nevertheless; the sound characterization of most species still remains unknown; particularly in the invertebrates and fish community; an important biological component of the BPNS.

Other approaches to correlate sound and ecology are being explored in this PhD project; where several acoustic features will be identified and correlated with temporal or spatial ecological patterns. To do so; existing acoustic indexes such as Acoustic Complexity Index (ACI); Acoustic Richness (AR) or Acoustic Spectral Entropy (H) can be used. However; in order to detect other acoustic features rather than the already defined indexes; Artificial Intelligence (AI) is more convenient. AI can also be applied to obtain a model representing the relationship between sound and ecological indicators.

Once the relevant events and features are detected and the model is created; acoustic habitats can be characterized and mapped in space and time.

Keywords: Bioacoustics; Marine soundscape; Underwater Acoustics; AI