



Joint Action: a stepping-stone for underwater noise monitoring in Portuguese water (jUMP)

Highlights

The jUMP project aims to implement stepping-stone actions to contribute to the management of underwater noise in Portuguese waters to support the application of Descriptor 11 of the Marine Strategy Framework Directive (MSFD). A basic task is to inventory background information, by producing a catalogue of existing underwater recordings in the Portuguese marine waters, including Madeira and the Azores, characterize the type and distribution of noise-producing human activities, and compile information on the distribution of acoustically sensitive species. This research allowed to gather the following information on the state of marine Portuguese waters:

- In Portugal, general knowledge related to Descriptor 11 of the MSFD in marine waters is scarce.
- Acoustic measurements available on Portuguese waters have been made sporadically and limited in scope (e.g., short-term scientific studies).
- Information on anthropogenic noise sources (impulsive and continuous) is not enough to characterize their distribution and assess the state of the marine waters for the Descriptor 11.
- The most prevailing and common source of underwater noise is marine traffic, and most studies on impact of noise have been focused on this source.
- Currently, there is no baseline data for noise in Portuguese waters.
- Many sensitive aquatic animals, from invertebrates to marine mammals, occur in Portuguese waters. However, information regarding spatial and temporal distributions of sensitive species is insufficient.
- Underwater noise can cause many different effects on aquatic life, and most records have shown changes in behavior (e.g., changes in acoustic behavior, for acoustically active species; distribution patterns, mostly associated with seabirds; alteration or interruption of behavioral states, such as foraging or mating interactions).
- In Portugal, it is necessary to implement more monitoring programs and regulation of noise in the marine environment.
- In recent years, there has been an effort by some research groups to know more about anthropogenic noise and its impact on marine life in Portuguese waters.



The predominant continuous noise source in Portuguese marine waters is shipping. Due to the geographic position and port system, Portugal is an important logistics hub in Europe, and an increase in the naval industry, and subsequently in marine traffic, is expected. Other marine activities, like dredging, offshore marine renewables installation and operation, offshore construction works, seismic surveys, use of sonars, aquaculture and fisheries, are also expected to continue. Human activities which introduce noise in the marine environment will continue to increase in Portuguese maritime waters; thus mitigation measures should be applied in order to limit its impact. Understanding and monitoring potential impacts of anthropogenic sources on sensitive species will support on regulation of underwater noise, and prevent avoidable adverse effects in the marine environment.

Studies of underwater noise measurements and its impact have been more focused on areas associated with vulnerable species or important ecosystems, such as: the Sado estuary, habitat to the resident population of bottlenose dolphins (*Tursiops truncatus*) (Luís et al., 2012); the seamounts of the Azores, which are rich ecosystems in biodiversity, considered important in biological and socio-economic perspective (crucial for fishing communities) (Giacomello & Menezes, 2011); the lagoon of Ria Formosa, which plays a significant role in the occurrence and conservation of the natural populations of the long-nosed seahorse (*Hippocampus guttulatus*) (Palma et al., 2019); the Tagus river, for being the habitat of acoustically sensitive fish species such as the meagre (*Argyrosomus regius*) and the lusitanian toadfish (*Halobatrachus didactylus*) (Vieira et al., 2020).

There is a ~~gap in our~~ knowledge gap on the effects of noise on many species, especially fishes and invertebrates. For fishes, impact studies are usually related with acoustically active species. However, some studies show that commercial fish species (e.g., bluefin tuna) are sensitive to noise, and other species of which we are not yet aware could also be as sensitive (e.g., atlantic salmon, sea trout, sea breams). It could be important to study noise impacts on commercial fish species; if fishing stocks are already affected by overfishing, could underwater noise be an additional pressure on fishing stocks? Sharks also appear to be sensitive to noise, and since many species of sharks are in danger of extinction due to overfishing (mainly for sharks' fins), it is important to understand if noise could contribute to a greater pressure on these species. Several reviews have examined the various known effects of noise on marine mammals, still there is a lack of information regarding distribution patterns and (underwater and acoustic) behaviors. It is also important to study distribution patterns and learn more about migratory species in Portugal, from seabirds (e.g., common scoter and common tern), to sea turtles (e.g., loggerhead turtle), and whales (e.g., blue whale and fin whale). Understanding the importance of Portuguese marine waters for these species, could help us to mitigate potential noise impacts. Could underwater noise cause of disruption of migratory routes, and if so, what is the long-term impact on those species? It should also be pointed out that there is a growing interest and concern for the acoustic sensitivity of invertebrate animals such as cephalopods (e.g., squid and octopuses), crustaceans (e.g., crabs) and even cnidarians (e.g., medusas).

To better understand the effects of noise, there is the need to study hearing sensitivities of different species, and learn how important sound is to these species and how they respond to it. Furthermore, since many aquatic animals rely on sound to survive, it is important to understand its distribution and occurrence. Portugal could help to fill these gaps due to its rich marine biodiversity, and future studies should focus on monitoring anthropogenic noise sources and studying the effects of noise, and species temporal and spatial occurrences.



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