# Advancing an ecosystem-based approach to underwater noise management by implementing a trait-based framework

Calonge, A; Eicher, H; Krång, AS; Debusschere, E; de Jong, K; McQueen, K; Ainslie, MA; den Held, ME; Rumes, B; and Schnitzler, JG

**Arienne Calonge**
arienne.calonge@vliz.be
Flanders Marine Institute (VLIZ), Belgium

Managing the ecological threats of underwater radiated noise (URN) demands a scientifically valid and biologically relevant Underwater Noise Limit Value (UNLV). Moving beyond a primarily pressure-based approach focused on quantifying sound pressure levels, an ecosystem-oriented, risk-based framework to manage URN was proposed. To support this risk-based framework, a trait-based vulnerability scoring system was developed for marine mammals, fishes and invertebrates, which allows the selection of indicator species from multiple taxa in setting regional UNLVs. The scoring system quantifies intrinsic vulnerability through evaluating multiple attributes such as the species' capacity to produce and sense sound, documented impacts from URN and general vulnerability related to life-history traits and socio-ecological status. In conjunction, the scoring system evaluates the quality of the data used for the assessment, highlighting species with a robust evidence base of vulnerability to URN. The vulnerability scoring system offers an adaptable framework that can be applied across different regions and refined as bioacoustics research evolves. Seasonal distribution maps of indicator species overlaid with sound level maps, generated under current and future policy scenarios, provide full transparency on the extent of habitats exposed to the stressor and the subsequent ecological implications of selecting different regulatory UNLVs. By linking URN to habitat loss and its consequent impacts on vulnerable populations, a holistic and ecosystem-based URN assessment can be achieved, delivering essential information that will support marine spatial planning and compliance to the Marine Strategy Framework Directive.