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Functional trait-based approaches as a common framework for freshwater and marine ecologists

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Context and objectives

Aquatic ecologists face a common challenge: identifying the **general rules of the functioning of aquatic ecosystems** and developing a more predictive ecological understanding. However, freshwater and marine ecologists traditionally form two distinct scientific communities. A **common framework** is needed to transcend fields specificities and taxonomy by providing sharable tools.

Our goal is to advocate the use of functional trait-based approaches as a common framework for aquatic ecologists.

Functional traits are morphological, physiological or phenological feature measurable at the individual level, from the cell to the whole-organism level, which impacts fitness indirectly via its effects on growth, reproduction and survival (Violle et al. 2007, Oikos).

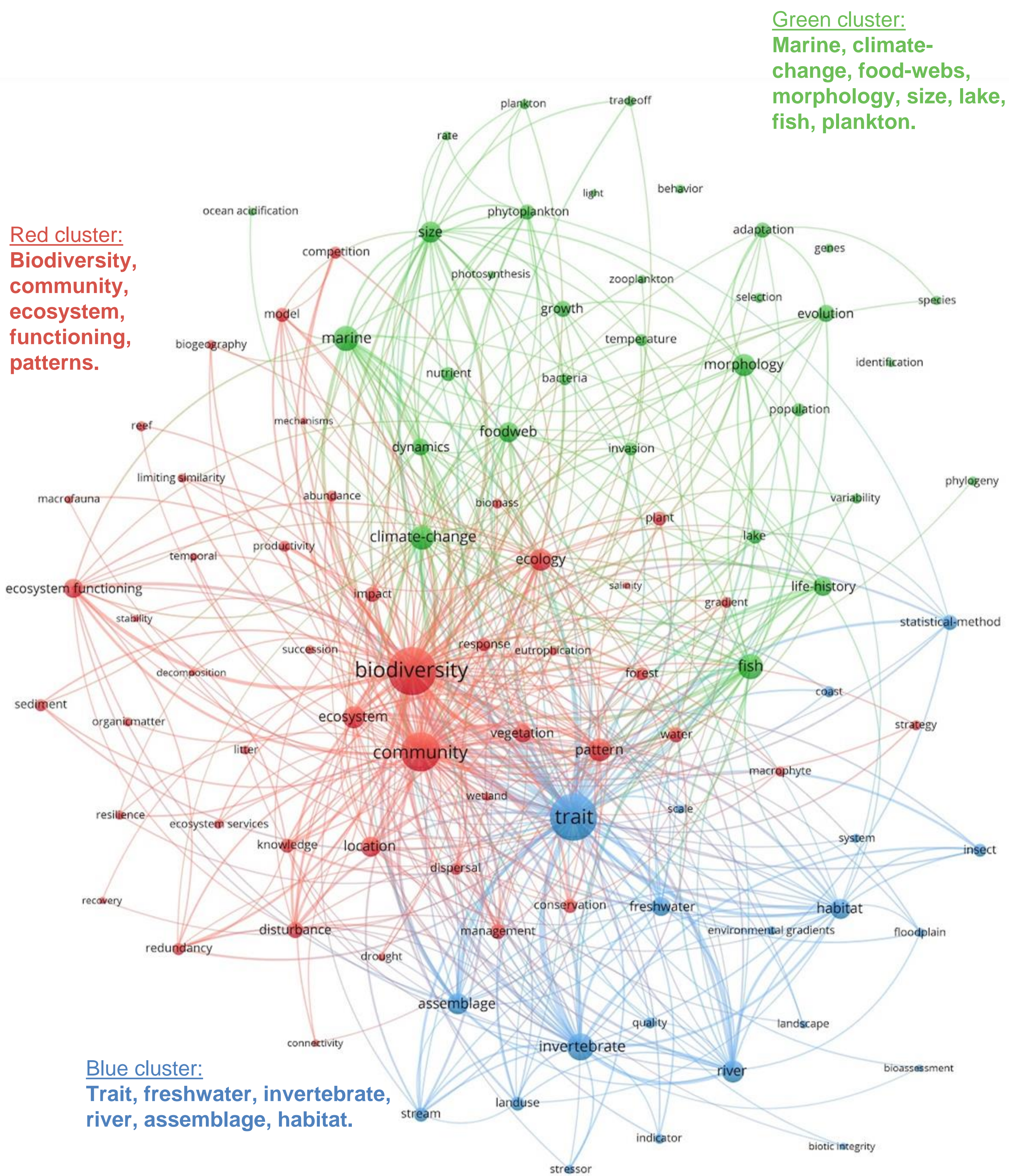


Figure 1: Network map representing the keywords used in publications related to trait-based approaches in aquatic ecology. The co-occurrence network is based on the top 100 keywords used in 2,476 articles extracted from Web of Science. It highlights the topics for which functional-trait approaches have been used. Three clusters are identified and underline the need of more interactions between freshwater and marine ecology.

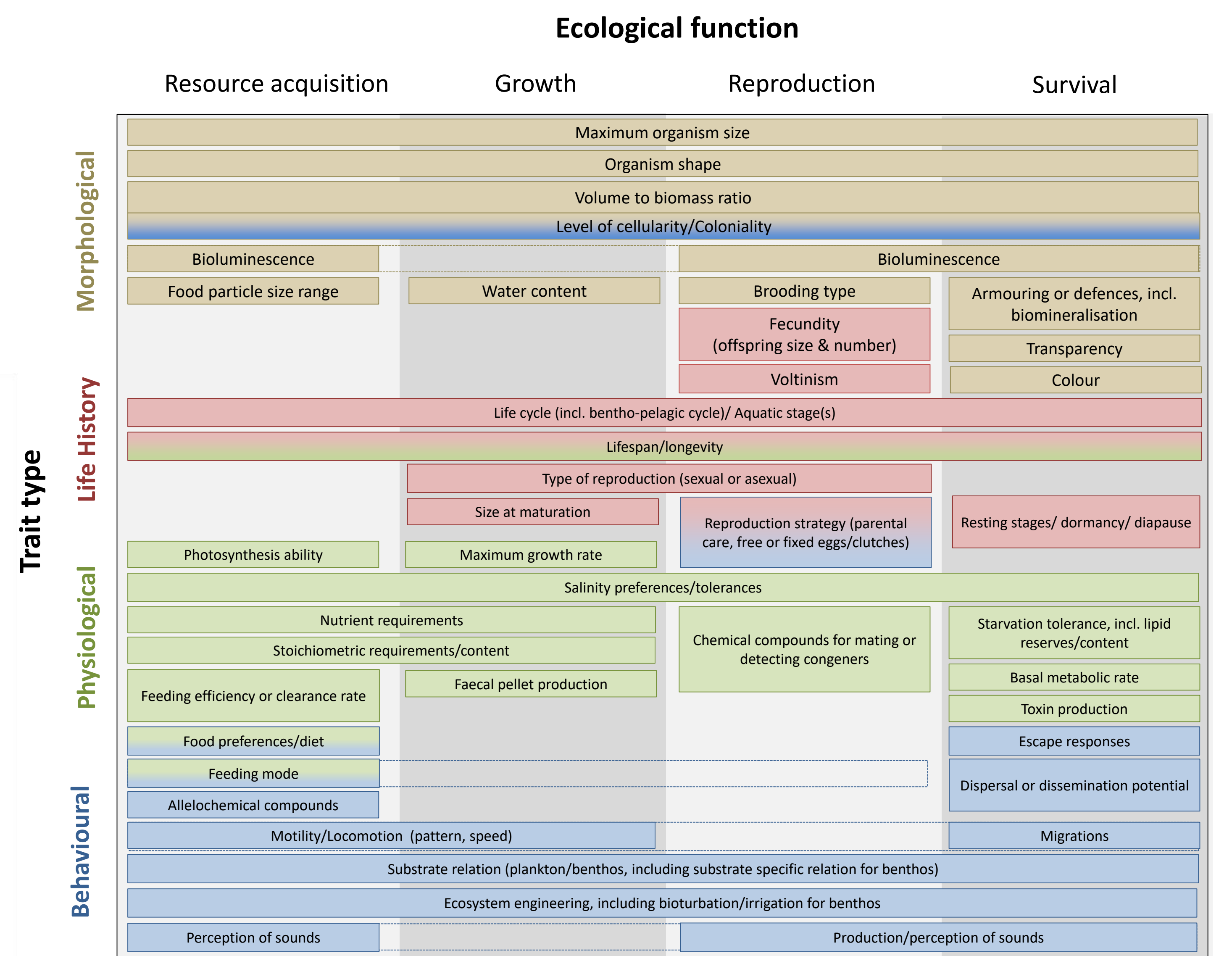
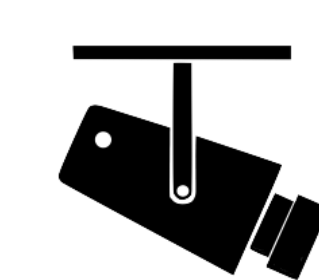


Figure 2: Unified typology of aquatic functional traits. This typology focuses on the key traits that transcend the taxonomic peculiarities of the different aquatic ecosystems. They are classified by type and ecological function as in Litchman & Klausmeier (2008, *Annu. Rev. Ecol. Evol. Syst.*).

New tools for functional trait-based approaches



EMPIRICAL: traits measured in situ and in the laboratory. Recently, several databases became available, but often focusing on a limited number of organisms and traits.



IMAGING/ACOUSTIC: behaviour and traits with morphological or acoustic signature, measured automatically with high frequency. Opportunities from artificial intelligence recognition and classification.



OMICS: give access to structures and functions at different molecular levels.



MODELING: simulation of the distribution and dynamics of traits, in relation with biogeography, biogeochemical cycles or impact of human pressures.

Opportunities and common challenges for aquatic ecologists

- ⇒ **Studying functional diversity over various spatio-temporal scales:** Using functional traits as a common currency among marine ecologists, these approaches could revealing hidden patterns of diversity.
- ⇒ **Trait-based monitoring, conservation, and management of aquatic ecosystems:** functional traits provide integrative tools for biomonitoring, ecological quality assessment of aquatic ecosystems, and biodiversity conservation in the context of global changes.
- ⇒ **Disentangling food web structures and trophic interactions:** functional traits provide new insights for studying biotic interactions, trophic structures, and relationship between diversity and ecosystem functioning.