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Advancing knowledge on marine connectivity is key to support transition to a sustainable blue economy

Oceans and seas cover more than 70% of the Earth and deliver multiple ecosystem services, including some that shape human societies (e.g., food provision, climate regulation). Marine assets represent the 7th largest economy in the world. Sustainable management of the oceans and seas is, therefore, essential. Yet, their protection lags far behind that of terrestrial habitats.

Marine ecosystems are highly vulnerable to anthropogenic pressures, and most experience multiple, concurrent threats (e.g., habitat loss, overfishing, warming). Over the last century, 90% of marine top predators have disappeared and many coastal and oceanic habitats have been destroyed or severely degraded. Unprecedented losses in marine biodiversity are occurring, compromising the health (function and resilience) of ecosystems. Given the importance of marine wildlife and habitats to society and the linked fate of marine and terrestrial ecosystems, rapid, informed actions are needed to mitigate unwanted consequences of ongoing changes.

Planning sustainable development of the world's oceans requires a thorough understanding of marine biodiversity and its role in the healthy functioning of ecosystems. For this, gathering knowledge on the connectivity among marine populations and habitats is a crucial first step, as it can not only help conserve vulnerable species and ecosystems, and control the spread of invasive species, pathogens and aquaculture escapees, but also construct effective networks of protected areas, and promote sustainable fisheries' management.

The new COST Action *Unifying Approaches to Marine Connectivity for improved Resource Management for the Seas* (SEA-UNICORN) brings together a broad interdisciplinary community of scientists, stakeholders and policymakers, from more than 100 organizations across Europe and beyond. In the coming years, the network will foster interdisciplinary collaborations, and share expertise at local, regional, and international levels to advance knowledge and unify concepts and approaches in the emerging field of Marine Functional Connectivity (MFC). The Action will also provide the data needed to support the conservation and sustainable management of the seas. The Slovenian researchers involved in the COST Action are Dr Andreja Ramšak from the National Institute of Biology and Dr Jerneja Penca from the Euro-Mediterranean University.

The challenge

Quantifying connectivity at sea is complicated because marine ecosystems are particularly difficult to access and survey. Therefore, marine connectivity research so far mostly focused on species-specific approaches, using a wide variety of complementary direct and indirect methods from multiple research fields, to describe the movements and distribution of individuals, populations or species. Recent breakthroughs linking individual movements and trait expression to ecosystem functions, however, have allowed advancing research in this field, and led to the emergence of the concept of Marine Functional Connectivity (MFC).

MFC characterizes all the migratory flows of marine organisms that determine the interdependency of populations, species and ecosystems at sea and also at the land-sea interface. MFC assessments allow us to better understand the complex relationships between marine species or communities and the different habitats they rely upon. Therefore, gathering effective knowledge on MFC can greatly improve our ability to refine marine management and conservation strategies.

Information on MFC is now available for a broad range of aquatic organisms (from viruses to whales) and across all marine eco-regions. However, several methodological barriers and knowledge gaps need to be addressed to understand MFC at a global scale and to predict how MFC may be altered by global change. Bridging gaps between research fields and combining innovative approaches with traditional methods offers unprecedented opportunities for advancing MFC research at the community and ecosystem levels.

The Action

The SEA-UNICORN COST Action gathers MFC scientists from diverse research teams, disciplines and countries. Its members have expertise encompassing all oceans and seas and all major marine taxa (from viruses to whales), including invasive species and species connecting the land-sea interface. This breadth will allow the Action to make strong advances in MFC knowledge and generate invaluable academic and applied results. The Action will also forge stronger links between scientists, policymakers and stakeholders to promote the integration of MFC knowledge into decision support tools for marine management and environmental policies. This integration will help define appropriate conservation measures for spatial planning and governance.

Prof Oscar Gaggiotti, the Action Vice-Chair adds *"By improving knowledge on the flows of organisms at sea and their ecological and genetic consequences, and by ensuring that it matches the needs of national and international managers and policymakers, we hope to help define adequate strategies for sustainable management, at sea but also at the land-sea interface."*

Additional information.

To learn more about the Action its network and its objectives, please visit its new website (https://www.sea-unicorn.com) or the Action's page here

Fit-for-purpose MFC science and data are urgently needed to inform marine policies in support of the sustainable development goals for a well-functioning ocean described in the 2030 Agenda of the UN Decade of Ocean Science for Sustainable Development