

Advancing Area-Based Planning and Network Approaches in Areas Beyond National Jurisdiction: A Global Review of Data on Connectivity for Migratory Marine Animals

Avanzando los Mecanismos de Ordenación Basados en Zonas Geográficas en Áreas más Allá de la Jurisdicción Nacional: Una Revisión Global de los Datos sobre la Conectividad de Especies Migratorias Marinas

Faire Progresser les Mécanismes de Gestion Basés sur des Zones Géographiques dans les Zones Au-delà de la Juridiction Nationale: Un Examen Complet de la Connectivité des Animaux Marins Migrateurs

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ABSTRACT

Due to their wide-ranging behaviors, migratory fish, marine mammal, seabird, and sea turtle species experience a variety, and increasing amount, of anthropogenic pressures over the course of their life histories. Combined with conservation strategies that largely fail to consider spatial connectivity over the life cycle, these threats are resulting in declining populations worldwide. It has become clear that there is a major knowledge gap on marine migratory connectivity on the high seas that can be provided the many marine spatial planning initiatives involving areas beyond national jurisdiction (ABNJ). The Marine Geospatial Ecology Lab (MGEL) of Duke University is leading a consortium to develop The Migratory Connectivity in the Ocean (MiCO) system to fill this knowledge gap. MiCO seeks to compile and, where necessary, synthesize scaled-up knowledge on migratory connectivity for species utilizing ABNJ. MiCO will convey information on connectivity among “nodes” (aggregations of areas used for a particular life cycle activities) and via “corridors” (aggregations of paths animals travel between nodes). Data from a wide array of sources including telemetry, mark/recapture, stable isotope, genetic, and acoustic sampling are being gathered from direct contributions by collaborating partners and a systematic literature review. The literature review encompasses over 200 species listed in the Convention on Migratory Species (CMS) or managed by a Regional Fisheries Management Organization and the complete system will address nearly 1,000 migratory species across the four taxa. Over 50% of the species in the literature review are listed as Near Threatened, Vulnerable, Endangered, or Critically Endangered by the IUCN, including 20 listed as EN or 13 as CR. Here we present initial results detailing the information available on ecological connectivity in or across ABNJ.

KEYWORDS: ABNJ, connectivity, area-based management, migration, movement

INTRODUCTION

Throughout the 20th century, advancements in technology have fueled the expansion of sectoral industries and extractive activities, which have ventured deeper and further into the open-ocean than ever before (Swartz et al. 2010, Merrie et al. 2014). The expansion of these activities into the open-ocean is particularly worrisome given the scale, complexity, and deficiency of monitoring, control and enforcement mechanisms. The United Nations responded to this increase in interest over maritime resources and space by summoning three UN conventions to discuss the future of ocean governance. These efforts culminated in 1982 with the creation of the Law of the Sea Treaty, which represents the first set of internationally approved guidelines to manage the world’s oceans (UNCLOS 1982). The UN Convention on the Law of the Sea (UNCLOS) led to the creation of 200nm jurisdictional maritime boundaries for coastal and archipelagic States and addressed, *inter alia*, responsibilities for conservation and best practices for different industrial and research activities, within national waters and shared areas beyond national jurisdiction (ABNJ; high seas). Almost four decades later, the dimensions (and resulting impacts) of today’s industries in the marine realm are far greater than the existing ones when UNCLOS was drafted, there is concern that the current provisions under UNCLOS for high seas management and conservation (UNCLOS – Part VII) aren’t sufficient; consequentially, the UN is convening an international process to draft a new international legally binding instrument to protect biodiversity in ABNJ. One of the pillars of this new international effort is the adoption of adequate area-based management measures to protect marine biodiversity; this is a particularly challenging task for most of the marine vertebrates in the high seas, many of which engage in long-distance seasonal migrations and movements which makes them hard to study, manage and conserve. There is evidence that the populations of marine migratory species are experiencing steeper declines in abundance than those of species which do not migrate across jurisdictional boundaries; straddling and migratory fish stocks are overfished or experiencing overfishing at over double the rate of stocks which stay within national waters (64% vs 28%) (FAO 2014). Recent advancements in our ability to track species using bio-logging devices is revolutionizing our understanding about how marine migratory move throughout the world’s oceans (Hussey et al. 2015) and about the connectivity between geographically distant ecosystems (Webster et al. 20002). Advances in this form of research have propagated across the main migratory marine vertebrate groups: sea turtles, marine mammals,

seabirds, and fish (Block et al. 2011), unveiling trans-oceanic migrations (Block et al. 2001) circumpolar migrations (Weimerskirch et al. 2015), and pole-to-pole migrations (Egevang et al. 2010). Even though this new type of information is keystone for informing area-based management in ABNJ, synthesized and easily-interpretable knowledge about the spatial and temporal patterns of species distributions in the world's oceans is limited. A consortium of academic and scientific organizations is currently developing an open-access online system to gather, aggregate and describe the current state of knowledge on the Migratory Connectivity in the Ocean (MiCO) for fish, seabirds, sea turtles, and marine mammals worldwide. This synthesis of migration data is intended to facilitate area-based and other forms of management in ABNJ by providing taxa-specific information on the distribution and connectivity of each of the MiCO species and areas of ecological importance (Figure 1) for their life cycles.

Our limited understanding on the cumulative human impacts on open-ocean ecosystems, calls for urgent renovation of the research, management and governance structures operating in the open-ocean, which must strive to implement adequate, sometimes spatially-explicit, conservation measures to attenuate negative ecological impacts. MiCO is designed as an initial step towards aggregating important information about migratory biodiversity in the high seas, with the intention of bridging

an existing gap between ecological research and the governance frameworks that operate in the open-ocean systems and provide protection to migratory vertebrates.

RESULTS AND DISCUSSION

To date [March 2018] the MiCO consortium consists of 21 active partners which include data warehouses, national observing systems, taxa conservation groups, museums, environmental non-governmental organizations, universities, intergovernmental commissions and UN Conventions (micosystem.org/partners). As the development of the MiCO online system continue, the MiCO consortium is engaged in a comprehensive and systematic literature review of more than 200 marine migratory seabird, sea turtle, fish and marine mammal species worldwide, while the complete system will address nearly 1000 species. The literature review targets publications addressing the migratory ecology of any of the MiCO migratory species which use any of the following forms of biological or ecological sampling: telemetry, mark and recapture, stable isotope analysis, genetic connectivity analysis or passive acoustics data (specific to marine mammals).

The knowledge gathered from this literature review will be complemented with bio-logging and sampling data contributed by our research partners. All contributed information will be aggregated across space and time prior to making it freely accessible in the MiCO portal; thus

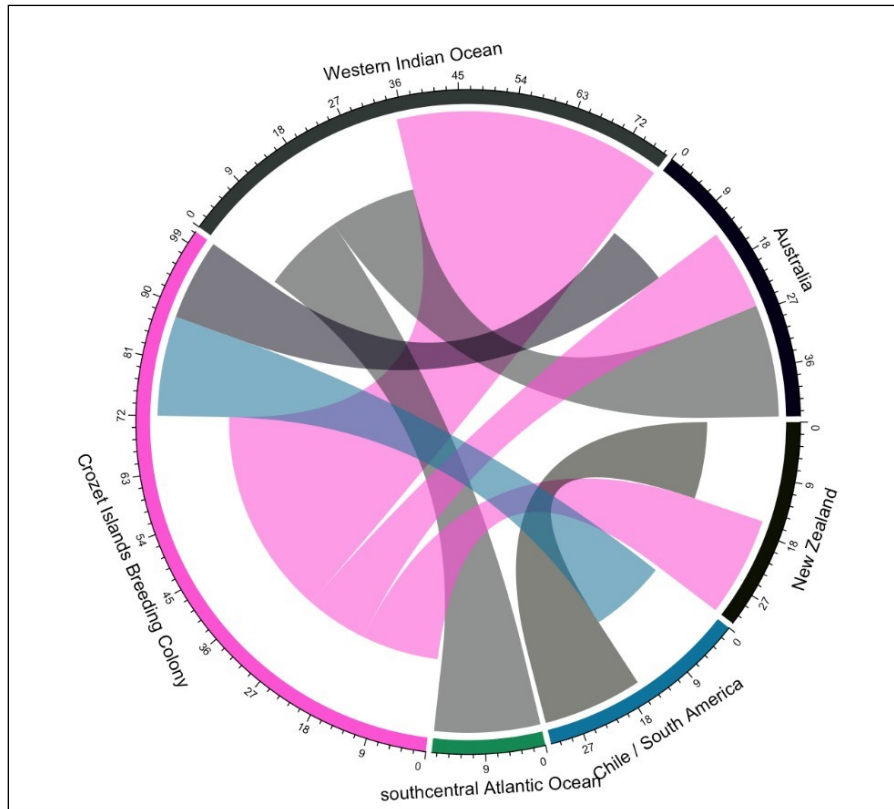


Figure 1. Visualizing connectivity for seabirds: Chord diagrams of wandering albatross in the Southern Hemisphere as informed by bio-logging data.

protecting any raw data contributed to the system.

The system will allow for both State and non-State actors to access information about:

- i) Sites of ecological importance across taxonomic groups,
- ii) Multi-species sites of importance,
- iii) Trans-boundary connectivity estimates between coastal waters and ABNJ, and
- iv) Distribution and timing of migratory corridors across taxonomic groups.

This information will be pivotal for the assessment of trans-boundary environmental impact assessments and the management of transboundary and straddling target and non-target species.

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