

The Role of Sharks and Rays in the Mediterranean Deep-Sea Food Web

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Abstract

Sharks and rays (hereafter referred to as "elasmobranchs") are large and emblematic fishes that are threatened by human activities throughout the world's oceans. The Central Mediterranean deep waters between Sicily and North Africa boast a complex and diverse ecosystem under substantial fishing exploitation, while also being a hotspot for elasmobranch diversity, which led to its recent designation as an IRSA (Important Shark and Ray Area, <https://sharkrayareas.org/e-atlas/>). This provides a compelling case for thorough ecological investigations, in order to meet the delicate management challenges of the region. The proposed project aims to unravel the ecological role of elasmobranchs in the deep waters of the Strait of Sicily (SoS), with emphasis on three key objectives: (i) investigating the trophic ecology of targeted elasmobranch species; (ii) identifying the habitat preferences of species and the corresponding ontogenetic shifts; (iii) assessing the ecological role of the elasmobranch community and modelling the impact of fishing in the deep-sea food web. Specimens will be collected from MEDITS scientific trawling campaigns, and from the sampling of commercial catches, leveraging already established fisheries data collection programs (EU fisheries data collection framework). The project will employ a combination of complementary techniques, including gut content analysis (GCA), stable isotope analysis (SIA), DNA barcoding, and gut and fecal DNA barcoding and metabarcoding. Bioinformatics, downstream statistics, SIA mixing models, and food web modelling approaches will be employed to interpret data, infer patterns, and generate forecasts.

The intellectual merit of the project lies in its interdisciplinary approach that merges ecology, chemistry, molecular biology, and fisheries biology; in its focus on this highly endangered taxon in one of its few remaining Mediterranean strongholds; and in its mission to generate original knowledge that will be germane to devising practical solutions for the long-term future of this important ecosystem.

This study will have a broader impact, beyond the specific findings on the investigated species: the outcomes will inform marine ecosystem management practices, guiding conservation strategies for elasmobranch populations in the SoS, in alignment with the broader goals of the Italian National Research Programme regarding knowledge advancement on Mediterranean marine ecosystems. The interdisciplinary approach will influence future studies across the Mediterranean region and beyond, emphasizing the importance of integrating diverse methodologies towards a comprehensive understanding of marine ecosystem; it will also inform on the efficacy and feasibility of non-invasive methods to study trophic ecology of marine megafauna. Multi-institutional international collaboration among Stazione Zoologica Anton Dohrn, universities and research centres in Rome, Palermo, Mazara del Vallo, and Liverpool will offer invaluable training opportunities and career development for the PhD candidate and will help establishing new collaborative links among researchers.