From bycatch to barcodes: Integrating trawling surveys and eDNA in the Gulf of Castellammare (Sicily)

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Abstract:

Fishing has both direct and indirect impacts on habitats, influencing the diversity, structure, and functioning of benthic, demersal and pelagic communities. Bottom trawling is among the most impactful fishing practices in the Mediterranean Sea, but the composition of bycatches and discards, and its implications for ecosystem health and fisheries management are still only partially documented. Moreover, despite the Mediterranean being a recognized biodiversity hotspot, DNA barcode reference libraries for many local taxa remain incomplete, limiting the full application of DNA-based tools.

This study, carried out within the framework of the National Biodiversity Future Center (NBFC), aims to characterize benthic, demersal communities inside and outside the Gulf of Castellammare (Sicily, Italy), while also generating reference DNA barcodes for currently underrepresented taxa, using both active capture methods and seawater eDNA.

Fieldwork was conducted between 3 and 12 September 2025 at six sites: three inside the Gulf, where trawling has been banned since 1990, and three outside, in trawled areas. At each site, benthic and demersal fauna were sampled by three 30-min bottom trawls; the catch was sorted into commercial and bycatch fractions, and each specimen was coded, photographed, preserved in ethanol, and is being identified using DNA barcoding. At the same sites and depth, three replicate 4 L seawater samples were collected and filtered onto 0.22 µm membranes and are being processed for third-generation sequencing with Oxford Nanopore Technologies.

Specimens were subsequently grouped into morphospecies based on photographic documentation and preliminary results show that 636 samples corresponding to approximately 100 morphospecies of six different phyla were collected for the molecular analysis. Overall, around 65 morphospecies were recorded inside the gulf and about 40 outside.

This study provides new molecular data that will help fill current gaps in barcode reference libraries and offer a baseline to assess trawling impacts, help resolve taxonomic uncertainties, guide adaptive management measures and enhance seafood traceability and sustainability.