

## Understanding marine predator habitat use in the Mediterranean through eDNA

### Contacts

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### Project summary

Understanding how animals use their habitats in relation to environmental and ecological factors is fundamental to basic ecological studies, evaluating potential exposure to impacts from human activities, and assessing species vulnerability to climate and ecosystem change. Such knowledge is also vital for spatial conservation planning, including determining where to site protected areas and evaluating how species might interact with existing protected areas.



*Common dolphins (NOAA, public domain)*

Marine vertebrates are particularly challenging to study because they are highly mobile, are often in remote areas, and are difficult to observe directly. However, tagging and telemetry studies, combined with the growing availability of remote sensing data and novel spatial statistical tools, is allowing the development of large scale habitat usage for many marine predator species. Such models are becoming increasingly important for marine spatial planning.

However, such studies are potentially limited by expense, logistical challenges, and data collection may be focused on relatively small numbers of focal species.

In recent years rapid development of high throughput DNA sequencing technology has facilitated sensitive new approaches to quantifying biodiversity in environmental samples, such as soil and water, collectively known as environmental-DNA (eDNA). These techniques give new ways to detect single species of interest, or to profile species communities from trace amounts of DNA shed into the environment. In the context of marine ecosystems, eDNA may offer complementary and sometimes alternatives to other established approaches such as telemetry and population surveys to evaluating the spatial distribution of biodiversity. Potential

benefits include the ability to survey for multiple species simultaneously, and across time series and large spatial areas at relatively low cost.

In this project we will develop and validate new eDNA tools targeted to monitoring marine vertebrates (with a focus on cetaceans, and large predatory fish), and apply them to evaluate spatial and temporal variation in habitat use by the focal species in the Mediterranean Sea, and assess to what extent eDNA based surveys correlate with conventional methods for monitoring marine biodiversity. The work is a collaboration between Dr Simon Goodman (University of Leeds, UK) and Dr Elena Valsecchi (University of Milano-Bicocca, Italy) within the framework of the MeD for Med project, an initiative to develop and apply eDNA to biodiversity monitoring in the Mediterranean Sea.

With support from Italian shipping companies, and marine mammal observer programmes (run by ISPRA, Italian Higher Institute for Environmental Conservation and Research), we will use passenger ferries traversing Mediterranean routes as mobile sampling platforms. These routes are ideal since they traverse many known marine biodiversity hotspots, and collaboration with marine mammal observer programmes allow cross checking of eDNA results against visual detections of cetaceans. In addition we will also undertake systematic sampling of other locations based on existing published data and models of Mediterranean marine biodiversity, to evaluate the predictive capacity of eDNA tools. Ultimately such eDNA tools have potential to become an essential part of biodiversity monitoring tool kits, with direct implication for conservation management, and evaluating environmental impacts from human activities.



*Mediterranean ferries will be using as platforms for sampling eDNA at sea.*

### **Aims:**

1. Develop and validate novel eDNA tools for detection and monitoring marine vertebrates with a particular focus on cetaceans and large predatory fish.
2. Develop efficient ship-based eDNA sampling platforms, and compare eDNA surveys against marine mammal observer records.
3. Compare eDNA measures of diversity against existing data on spatial marine biodiversity in the Mediterranean to evaluate the utility of eDNA as a marine biodiversity monitoring tool.

### **Expected outcomes:**

New eDNA tools for marine biodiversity monitoring; new streamlined sampling pipelines that are suitable for routine deployment on regular shipping, by non-specialists; new data on cetacean and other marine predator habitat use in the Mediterranean; the potential to support and refine impact assessments and spatial marine planning currently achieved with other data sources.

### **Methodologies**

The project will involve a combination of fieldwork based in the Mediterranean to collect eDNA samples from ship and boat based platforms, laboratory work to extract, process and sequence eDNA (with primary focus on Illumina based platforms but with potentially opportunities to test others such as Nanopore), and analysis of eDNA sequence data via

relevant bioinformatics pipelines. Spatial eDNA data will be integrated with data from marine mammal observer programmes and published data on the spatial distribution of Mediterranean biodiversity in order to compare patterns of marine predator habitat use inferred from different methodologies.

## Requirements

Hons degree and/or Masters in a topic relating to Biology, Zoology, Ecology, Genetics, Marine Sciences, Biodiversity, Evolution, Bioinformatics, Maths & Biology etc. An interest in working at the interface of ecology, biodiversity and population/evolutionary genomics is desirable. Prior experience of bioinformatics is helpful but not essential. However interest in developing skills in bioinformatics and computing is important.

## Training

Amongst other topics, training will be provided in field and laboratory skills relevant to eDNA and metabarcoding projects, population and evolutionary genetics/genomics, metabarcoding data analysis pipelines, phylogenetics, bioinformatics, spatial statistical modelling in R, and use of high performance computing facilities. As well as on the job training within our research groups, the student will have chance to participate in national and international training workshops on these topics, and to present results at various conferences at home and overseas.

## Research context and partners

This project is part of a collaboration involving researchers from the University of Leeds and University of Milano-Bicocca, Italy. The student will join the Ecology and Evolution group in the School of Biology, Leeds, and will be integrated with the [LIDA](#) and [Leeds Omics](#), virtual institutes which encompass a large group of researchers working on genomics and bioinformatics related projects. The student will also spend significant time working with Dr Valsecchi in Milan, conducting fieldwork in the Mediterranean, and visiting other collaborating institutions across Europe and further afield.

## How to apply

For details on how to apply, please see our NERC-DTP website here:

<http://www.nercdtp.leeds.ac.uk/>

## Further reading / bibliography

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