

Analyzing Marine Predator Diets of the Iroise Sea

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Deciphering complex marine food webs is one of the major topics of study in marine research. Food web analyses can detect and highlight environmental variations, whether they are caused by anthropogenic activities or otherwise, as well as contribute to fundamental ecological understanding. Conservation concerns also require detailed knowledge of predator diet, in particular when an overlap between diet and commercial resources is suspected.

The Iroise Sea is located in the northwest of France and is surrounded by the Bay of Biscay at the south and by the Celtic Sea and the English Channel at the west and north.

The Iroise Sea hosts a surprisingly rich marine biodiversity, including emblematic and flagship marine mammal species. Their biodiversity is monitored primarily by a stranding network and the successful application of the DNA barcode approach (Alfonsi *et al.* 2013, DOI: [10.3897/zookeys.365.5873](https://doi.org/10.3897/zookeys.365.5873)). Two species are particularly interesting: the harbour porpoise (*Phocoena phocoena*) and the grey seal (*Halichoerus grypus*). The grey seal is distributed in the

North Atlantic temperate to sub polar waters. The Molène archipelago is its southernmost location in Europe, making this particular settlement outstanding. The harbour porpoise has clearly made a global southward shift for some years in the Northeast Atlantic, including a comeback along the French Atlantic coast starting in the 1990s.

A suspected overlap between traditional fishing and the diet of two marine predators prompted conservation concerns.

The Iroise Sea is a UNESCO Biosphere reserve because of its natural richness. This led to the creation of the first French Marine Park in 2007, named "Parc Naturel Marin d'Iroise". One of the goals of the Iroise Marine Park is to protect and maintain the rich biodiversity

of the area, but also to preserve relevant and sustainable human activities, in particular, traditional fishing targeting sea bass, Atlantic pollock, European pilchard, monkfish, and crabs.

In this context, the interactions of marine mammal species with fisheries need to be identified, specifically in terms of competition for fish resources, marine mammal by-catch, and depredation.

Through a **multidisciplinary project** led by Iroise Marine Park that joined scientists and fishermen, we undertook a study of the diets of grey seals and harbour porpoises, using animals by-caught or stranded in the Iroise Sea. While ingested prey is conventionally identified by its hard remains

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(otoliths for fishes and beaks for cephalopods), the last decade has seen the use of molecular approaches that aim to identify remaining prey DNA, particularly in cases where only soft remains of prey are found in the stomach contents (e.g. when seals eat fish bodies without the head). Some of these approaches, which are highly informative but still expensive and challenging to implement, make use of NGS to identify multiple prey DNA in feces.

We tested whether the diet analysis of grey seal and harbour porpoise could be improved by using a simple, easy to use and economic method based on DNA barcoding. We studied the stomach contents of 11 grey seals and seven harbour porpoises using two complementary methods: the classical method of observation and taxonomic identification of prey hard remains and a DNA-based identification of soft tissues. We identified nine fish species thanks to this parallel use of a classical taxonomic determination and a simple DNA barcoding approach. The number of prey item species identified per predator increased by nearly a third for the grey seal and by 21% for the harbour porpoise through the use of DNA barcoding. All of the DNA sequence data obtained are publicly accessible on BOLD in the project *Identification of diet of marine mammals [DBMM]*.

The results of our study suggest that grey seals and harbour porpoises in the Iroise sea do not seem to target the most important species for fishermen, with the exception of the sea bass identified in one grey seal. Therefore, only limited competition seems to exist for this

natural resource between fishermen and grey seals in the Iroise Sea.

Once again the DNA barcoding approach has been used successfully. Because sampling the stomach contents of marine mammals that are found dead is highly opportunistic and occurs only infrequently, it is necessary that their analysis be as complete as possible. As shown by our study, the number of prey species identified is optimized by using both visual and DNA-based identification and we therefore believe that DNA barcoding should routinely be used for diet analysis of marine top predators.

*This study is part of a multidisciplinary project named **INPECMAM** which brings together the Iroise Marine Park, Océanopolis, BioGeMME, Le Muséum National d’Histoire Naturelle, and le comité départemental des pêches du Finistère. The experimental work presented in this article was mainly performed by **Eléonore Méheust**. For more information about the results, see DOI: [10.1080/17451000.2014.943240](https://doi.org/10.1080/17451000.2014.943240)*



Above: Prey soft remains.

Below: Otoliths of European pollack (*Polachius polachius*), blue whiting (*Micromesistius poutassou*), and European hake (*Merluccius merluccius*).

