

Southern Ocean mesopelagic organisms: scales, drivers and the effects of climate variability

Supervisors

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Project description

Background: Mesopelagic fish remain one of the least investigated components of the open-ocean ecosystem, and yet are likely one of the most abundant vertebrates on earth. Conventional trawling estimates suggest their biomass is ~1000 million tonnes. However a recent analysis of acoustic data and modelling show that the global estimate of these fish is at least an order of magnitude higher, and that they may respire ~10% of primary production in deep waters (Irigoiien et al. 2014).

Southern Ocean mesopelagic fish (dominated by myctophids) occupy an important trophic status, as zooplankton consumers (e.g. of copepods and euphausiids) and as prey to many marine higher predators such as penguins, seals and cetaceans. Myctophid biomass in the Southern Ocean has been linked to bathymetric, geographic and seasonal factors, although studies have been limited to using data from a small number of nets over limited spatial scales. New techniques in acoustic target identification and target strength modelling, combined with an international acoustic data sharing network (www.sona.aq) will enable basin and Southern Ocean scale synthesis providing fundamental information on the biomass and drivers of myctophid distribution. Environmental variables (e.g. sea-surface temperature, primary productivity and oxygen concentration) from satellite and global syntheses (e.g. MODIS and WOCE) will be used to derive relationships that, combined with global climate models, will predict future responses to projected climate variability. This project has the potential to inform management and future sustainable exploitation policy for the Southern Ocean, and to provide important parameters to resolve the global carbon cycle.

Rationale: To estimate the distribution and biomass of myctophid fish in the Scotia Sea and the Southern Ocean, to relate their distribution to physical parameters such as water masses, fronts, oxygen concentration and productivity, and to consider the impact of changing climatically influenced environmental parameters on the future Southern Ocean populations of myctophid fish.

Specific Objectives:

- 1) Determine the distribution of myctophid fish in the Scotia Sea and Southern Ocean using historical acoustic data sets.
- 2) Refine multi-frequency acoustic target identification techniques for mesopelagic organisms

3) Model the target strength of key Southern Ocean myctophid species

4) Resolve the basin scale relationships between myctophid fish and the physical environment (e.g. sea-surface temperature, frontal position (dynamic height), oxygen concentration).

5) Model the impact of climatically influenced environmental parameters on the distribution and biomass of mesopelagic organisms

Reference:

Irigoien et al. 2014. Nature Communications 5, Article 3271