



Sustainable management of mesopelagic resources

Reporting

Project Information

SUMMER

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[Project website](#)

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Periodic Reporting for period 3 - SUMMER (Sustainable management of mesopelagic resources)

Reporting period: 2022-09-01 to 2023-08-31

Summary of the context and overall objectives of the project

The objective of SUMMER is to establish a protocol to accurately estimate mesopelagic fish biomass, quantify the ecosystem services provided by the mesopelagic community (food for aquaculture, for humans, for other wild fish, climate regulation and potential for bioactive compounds) and develop a decision support tool to quantitatively balance the trade-offs between the different services for any

given exploitation scenario.

With a potential biomass of mesopelagic fish of 10 times more than all other fish together, we have to evaluate whether and how mesopelagic resources can be exploited without compromising the essential ecosystem services they provide. As the mesopelagic is among the last untouched ecosystems of the planet, this is the last chance and first time to do things in the right way, i.e. to first obtain scientifically sound data, create models and exploitation scenarios and only then - if regarded possible from an ecological, social and economic point of view - exploit in a sustainable manner.

Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far

This report covers project work performed from the start of the project up to month 48. One project activity has been the review and compilation of existing knowledge and complement it with new data and analytical outputs concerning the mesopelagic zone. This includes establishing the main predator species and preys of mesopelagic species. Results show that far from being a homogeneous whole, mesopelagic fish species can feed on a high diversity of resources, and numerous trophic interspecific segregations appear to structure oceanic food webs. Species that appear to be close taxonomically or morphologically appear to have adopted different feeding strategies. It has been further obtained how all top predators depend to varying degrees on mesopelagic resources.

We have confirmed by the analysis of three contrasting sea-basins how the diel vertical migration is affecting the biomass estimates. Overall, a “How to estimate mesopelagic biomass” guide has been produced. Reducing the uncertainty of the estimations will require the combination of different methods. Using models, an estimation of the global biomass gives us a result that is 10-fold lower than previous estimations, but we can also confirm that they account for 87% of the pelagic biomass and that their slow metabolism makes their productivity low and highly vulnerable to fishing.

We have presented the first direct comparison of three key components of the Biological Carbon Pump at contrasting sites. Regarding these active fluxes it has been obtained that migratory mesopelagic fish are responsible for 9-28% of the total export of carbon to the twilight zone.

Regarding the potential availability of the Ocean Twilight Zone (OTZ) as a source of PUFA (e.g Omega-3) novel insights into the identity and biogeography of potential microbial omega-3 producers has been developed based on metagenomic data mining. However, the exact products of the putative omega-3 biosynthetic gene clusters identified remain unknown and should be assessed further to verify their ability to produce these fatty acids. Also, most of the identified candidates remain uncultured, which implies that this is not a short-term route to obtain microbial PUFA suppliers. We have obtained how the mesopelagic layer is an interesting niche to find novel bioactive compounds. Furthermore, the gut microbiome of some mesopelagic fish species is dominated by potential omega-3 fatty acid producers, which could represent alternatives for omega-3 production relevant in the fields of nutraceuticals and aquaculture. Finally, we obtained how although technically feasible, financially processing fishmeal and oil or hydrolysates from mesopelagic fishes seems complex.

An economic analysis of whether it is worth exploiting or not the OTZ has been performed. Result is clearly driven by the uncertainty, in terms of the ecological effects on other species, carbon sequestration and provisioning of fishmeal and fish oil, and even further on the economic parameters of the evaluation (i.e. prices of all these ecosystem services). Nevertheless, results suggest that currently the nonexploitation or low exploitation rates are preferred than a generalized commercial exploitation. It was stated that all the results were subject to a large uncertainty, which has been addressed by implementing the results in a tool that allows understanding the role of each particular source of uncertainty in the results. In addition, it has also been screened through a literature review, the potential regulatory framework of fishing mesopelagics, both under the scope of RFMOs, high seas treaties, and under the specific eyes of the EU fishing regulatory framework. Results show that there are pieces of the different regulations that potentially could affect mesopelagic fishing.

Within this period SUMMER partners have published 30 peer-reviewed articles. 21 data resources were published in open access, including georeferenced data archived at PANGAEA, genetic resources published via GenBank's Short Read Archive, and data and code deposited at GitHub with DOI registration at Zenodo. A SUMMER school in which new scientists were trained in a full week course covering all aspects of the SUMMER research program, from data obtention to data treatment, including different techniques and assessment on producing advice. In addition to the normal dissemination procedures through social media, we released the "Metropelagic" exhibition. At different metro stations in Bilbao, pictures of the mesopelagic diversity were exhibited. We are also engaging with MEESO on organizing our final symposium. On this last, JETZON and SFI (Norway) projects have also presented their willingness to participate. Finally, a workshop with the industry was held in which interesting discussions around a potential mesopelagic fishery took place.

Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)

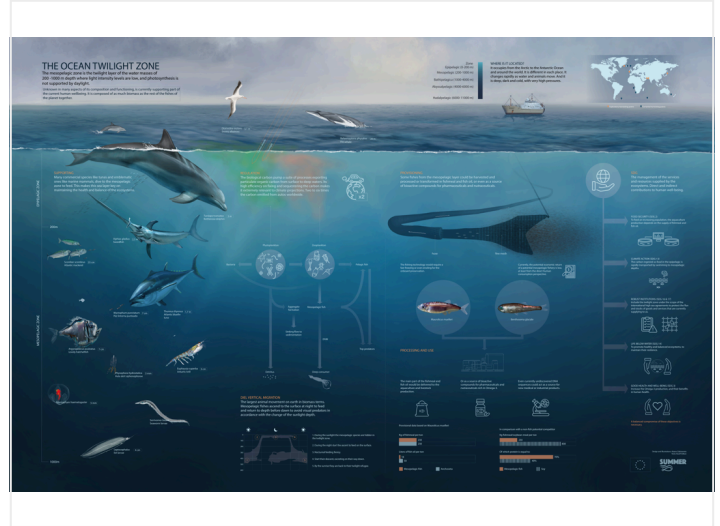
So far, it has obtained new insight in terms of biodiversity of this sea layer, carbon fluxes and therefore the role of the OTZ in the carbon sequestration, and specifically of the diel vertical migration of mesopelagic fishes. We now know that global biomass estimates are still complex although confirmed how mesopelagics represents approximately 87% of the pelagic biomass, and that far from being a homogeneous whole, mesopelagic fish species can feed on a high diversity of resources, and numerous trophic interspecific segregations appear to structure oceanic food webs. Species that appear to be close taxonomically or morphologically appear to have adopted different feeding strategies. We also have learnt how their slow metabolism makes their productivity low and highly vulnerable to fishing.

Based on these results, a tradeoff analysis of the ecosystem services currently provided by the mesopelagic layer and their potential under exploitation has been performed. SUMMER has also tested and validated methods to estimate abundance of biomasses of mesopelagic fishes. Based on that the two main objectives of SUMMER are on track: How to estimate biomass has been achieved producing a guide. The answer to the question of fishing them or not is still pending, but the models

and the analysis from the social perspective have been produced. It is acknowledged that results are still under big uncertainties, but SUMMER is on track to reduce them in the next reporting period.



The Metropelagic exhibition in the metro stations in Bilbao (Spain)



The Ocean Twilight zone and its values. Alazne Zubizarreta and Raúl Pallezo

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