MASTS-SFC Saltire Emerging Researcher Scheme (MASTS-SERS)

Final Report

MASTS in association with the Scottish Funding Council supported the Saltire Emerging Researcher Scheme, which represented an important and exciting opportunity for Post Graduate Researchers (PGR) and Early Career Researchers (ECR) to engage in substantive collaboration with colleagues from Europe (EA, EEA and EFTA countries).

The scheme aimed to promote mobility between Scotland and European research partners with the aim of strengthening existing, and seeding future, research relationships. Participants are expected to demonstrate the impact of their exchange through the publication of novel research work, the formation of new collaborations and project/ funding submissions, and the dissemination of their results.

As your exchange has now come to a close, we ask that you reflect on the exchanges and provide a report by filling in the form below. The reports will need to demonstrate the potential benefits of the grant for both the recipient and their collaborators. Please return this within four weeks of completing your exchanges to **masts@st-andrews.ac.uk**. When you do so, you are agreeing that your answers may be used to promote the activities of MASTS, including being used on the website and social media channels.

Please note that MASTS may also contact you, the participants, and/or your supervisors to gather additional post-exchange impact information. This information must be provided on request.

Contact information

Participant name	Dr Irma Cascão
University & Department	University of the Azores. Institute of Marine Sciences - Okeanos
Email address	irma.cascao@gmail.com
Host name	Professor Andrew Brierley
University or Institution & Department	University of St Andrews. School of Biology, Scottish Oceans Institute
Email address	asb4@st-andrews.ac.uk

Scottish Funding Council
Comhairle Maoineachaidh na h-Alba

Scottish Government
Riaghaltas na h-Alba
gov.scot

Exchange overview

Title	Estimation of biomass and distribution of mesopelagic organisms around the Azores
Start date	01/08/2022
End date	16/09/2022
Project location(s)	Pelagic Ecology Research Group Scottish Oceans Institute University of St Andrews East Sands St Andrews Fife, KY16 8LB Scotland, UK

Abstract (max 300 words)

Provide a brief summary of the exchange using language accessible to a non-specialist. Describe what the exchange objectives were, the activities that were carried out, and the subsequent outcomes. This may be published on the MASTS website.

The ocean's mesopelagic zone (200-1000 m deep) harbours highly diverse and abundant communities of fish, cephalopods, crustaceans and gelatinous animals. These organisms are believed to play a major role in drawing carbon dioxide from the atmosphere, and in marine trophic networks, acting both as voracious consumers and key prey to top predators. However, there remains considerable uncertainty about the biomass and trophic importance of mesopelagics because we lack fundamental information on species composition, biomass, spatial distribution and vertical migration.

One of the main goals of this exchange was to contribute to two ongoing projects - SUMMER "Sustainable management of mesopelagic resources" and MEESO "Ecologically and economically sustainable mesopelagic fisheries" - more specifically, to determine the best combinations of methods to obtain accurate estimates of the biomass and biodiversity of the mesopelagic community, and to provide regional and global estimates of mesopelagic fish. The other goal was to strengthen the applicant's expertise in the analysis of acoustic data collected from scientific echosounders.

During the exchange, we defined a protocol to estimate mesopelagic density, and although not initially foreseen, we are improving a school/scattering layer detection algorithm in Python (created by Dr Roland Proud) to classify and characterise the mesopelagic community, both critical tools for the analysis. As a result from this exchange, the establishment of the protocol are ongoing, including the analyses of (1) existing acoustic data collected concurrently with environmental DNA to identify species composition and compare abundance estimates from both methods, and (2) a large acoustic dataset collected off the Azores to estimate the distribution and abundance of mesopelagic organisms in the region, based on the biodiversity information acquired above, to contribute to projects deliverables. The main outcome of this exchange is improved skills and increased knowledge in using 'Echoview' software and Python, and in the processing/analysis of acoustic data.

Impact (max 600 words)

Please demonstrate the impact of your exchange from your perspective, and that of your exchange partner. Describe what the wider benefits of the exchange were to you as participant, your own and host institutions, and the wider community.

This exchange is part of an existing research collaboration between the Azores Whale Lab (Institute of Marine Sciences - Okeanos, University of the Azores) and the Pelagic Ecology Research Group (PERG) (Scottish Oceans Institute, University of St Andrews) in the scope of EU H2020 projects SUMMER and MEESO.

This valuable exchange provided the opportunity to meet and work with Prof Andrew Brierley and his senior postdoc Dr Roland Proud at the Scottish Oceans Institute in St Andrews, experts in the ecology and behaviour of fish and zooplankton using acoustic data collected from scientific multifrequency echosounders, and to get involved in acoustic related projects.

During my visit, PERG' researchers warmly welcomed me into their group and provided their time and expertise in analysing and interpreting these types of acoustic data, along with technical support providing access to their licenced copy of the industry-standard data-processing software 'Echoview'.

I gained valuable training in that software (e.g., applying automated pre-processing methods or multifrequency techniques to discriminate between taxonomic and size groups), using it to its fullest capability, learning up-to-date best practices, and improving my personal development and competences. Additionally, I learned computer programming and coding in Python (a powerful open-source software tool to develop custom algorithms for processing fisheries acoustics data), thereby acquiring new aptitudes in my research field.

We defined a protocol detailing all steps involved in the analyses for density estimation of the mesopelagic organisms to ensure standardization of procedures, as well as the development of an efficient school/scattering layer detection algorithm in Python to classify and characterise the mesopelagic community.

This international-mobility/collaboration scheme has been a huge opportunity to work closely with experts in this field to strengthen my skills and know-hows, and to specialize in this research area, contributing to the consolidation of an important line of research at the Institute of Marine Sciences - Okeanos. Likewise, this opportunity has strengthened an existing research collaboration between the two research groups (Azores Whale Lab and PERG) and will contribute to PERG's work to provide regional and global estimates of mesopelagic fish, as well as, to the deliverables of the SUMMER and MEESO projects. Moreover, it has encouraged the discussion and scientific production, broadening cooperation to other research lines and creating synergies that, in the medium and long term, could promote joint application to other research calls.

Outputs (max 300 words)
Has this exchange resulted in clear outputs, such as the generation of a proposal, research results, or publication? Please provide brief details here. Do any of these outputs have relevance to larger programmes such as the UN SDGs, Blue Economy Action Plan etc?[1]

The research outputs of this exchange are the protocol and the school/scattering layer detection algorithm in Python. Both outputs are critical tools for the analysis of echosounder data and will therefore have a huge impact in the field (and well beyond this collaboration and the projects).

A large acoustic dataset collected off the Azores has been pre-processed, and their analyses are critical for the deliverables of the SUMMER and MEESO projects.

Furthermore, the acoustic data from the Azores will be used in global estimates of mesopelagic biomass and biodiversity, thus contributing to increase knowledge and preserving biodiversity and ecological functioning of mesopelagic ecosystems, and ensuring that any future harvesting is done sustainably, without compromising the critical ecosystem services provided by these group (e.g., carbon sequestration and role in trophic webs). Hence, these outputs will contribute to several UN SDG (e.g., 14 & 12) and Decade for Ocean Science. In addition, this exchange has improved the professional skills and competences of researchers working within Blue Economy.

The main outcome of this exchange is increased knowledge and strengthened expertise in the processing and analysis of acoustic data, particularly in using the software 'Echoview' and Python programming language in which I lacked training.

The Future (max 300 words)
How do you plan to ensure a sustainable collaboration in the longer-term and maximise opportunities and impact in the future? How will you carry forward the benefits now the exchange has been completed? Please outline five concrete plans for future collaboration as a result of your exchange.

In the next few months, we will be working together in the establishment of the protocol and in the analyses of existing acoustic data from the Azores, to contribute to SUMMER and MEESO deliverables, and to produce a joint scientific publication on the estimation of biomass and distribution of mesopelagic organisms around the Azores.

Plus, a dedicated cruise in the Azores is planned for July-August 2023 within the projects. We plan to deploy PERG's new equipment (deep-water stereo camera/submersible echosounder) for sampling the mesopelagic zone (200-1000 m depth) to capture simultaneous video images and acoustic detections of mesopelagic organisms. This will contribute to Prof Brierley's lab efforts to determine the best combination of methods to obtain accurate estimates of the biomass and biodiversity of the mesopelagic community.

[1] All successful applicants will be expected to represent, promote and formally acknowledge the sponsors (MASTS, SFC & Scottish Government) during the course of their project and in any subsequent related outputs. All research outputs and any material used publicly must carry the funders' logos. The following acknowledgement should be used in all publications resulting from this funding. ["This work received funding from the Scottish Funding Council Saltire Emerging Researcher Scheme and the MASTS pooling initiative (The Marine Alliance for Science and Technology for Scotland) and their support is gratefully acknowledged. MASTS is funded by the Scottish Funding Council (grant reference HR09011) and contributing institutions"]

In mid-December 2022, we will submit an abstract for the 2023 ICES Fisheries and Plankton Acoustics Symposium to be held in Maine (USA) on 27-30 March, under the theme session on *Organism Detection: Models, Measures, and Classification*. The goal is to expand on this work and submit a manuscript to ICES Journal of Marine Science.

Furthermore, this exchange encouraged ideas and discussion of cooperation to other research lines. Both research groups (Azores Whale Lab and PERG) are extremely fascinated in exploring the acoustic data in relation to megafauna (predators) movements and behaviour to understand possible drivers of fine-scale foraging behaviour. Thus, we plan to organize a research visit for Dr Roland Proud (and possibly Prof Andrew Brierley) to the Azores under SUMMER and MEESO.

Any further comments (max 500 words)

Please use this space to provide any additional comments. These may include, but are not limited to; what you would do differently if you could take the exchange again; what contingency measures you had to use (if any); details of any unexpected benefits or problems; any significant variations in costs;

Fortunately, no contingency measures were used.

As the duration of the exchange was shorten:

1. Some activities are currently ongoing to produce results. Some difficulties occurred during learning process, very common in acoustics. Yet, this process was efficiently accomplished and extremely valuable for my development and skills.

2. Unfortunately, due to time it was not possible to visit Dr Douglas Speirs and Prof Michael Heath (SUMMER and MEESO partners) at the University of Strathclyde to get involved with testing their deep-water stereo camera/submersible acoustics at the Scottish Association for Marine Science, which will be used to enhance the accuracy of biomass estimates.

I am so grateful to MASTS-SERS and PERG for supporting my visit at the Scottish Oceans Institute in St Andrews, and to have had this opportunity to work closely with experts in this research field.

Final expense report

Item Number	Description	Cost per Unit	Number of Units	Total Amount (£)
1	Travel	(1120.50 €) £947.05	1	(1120.50 €) £947.05
2	Accommodation	£100.51	48 days	(5613.01 €) £4824.38
3	Living expenses	£10.87	48 days	(585.72 €) £521.58
4	Echoview licence			£666.99
Total				**£6960.00**
In-kind contributions				
In-cash contributions				
Grand Total (Total requested from scheme + In-kind + Cash)				**£6960.00**