RV MARIA S. MERIAN

MSM126 “Jellyweb Madeira”

February 9 – March 4, 2024

4th weekly report (February 26 – March 3, 2024)

Background: The focus of cruise MSM126 “Jellyweb Madeira” lies on the pelagic deep sea, harboring the most extensive but also least explored habitats for life on earth. A particular knowledge gap in this system concerns the biodiversity and functional role of gelatinous zooplankton (the “jelly web”). With cruise MSM126, we aim to improve the understanding of deep sea biodiversity and of the structure and functioning of food webs, focusing on the marine systems surrounding Madeira Island in the Eastern Central Atlantic Ocean. To do so, we are conducting habitat and biodiversity exploration and dedicated food web sampling, using a wide range of established and novel in-situ observation (e.g., pelagic and benthic camera observation systems, remotely operated vehicle ROV PHOCA), remote sensing (multibeam mapping, ADCP), measurement (CTD and additional sensors) and sampling technology (various nets, ROV PHOCA samplers, water samplers). Samples are used for experimental approaches on board and for laboratory analyses including (meta)genomic and stable isotope analysis after the cruise. Our cruise consortium includes GEOMAR Helmholtz Centre for Ocean Research Kiel (lead), University of Southern Denmark, MARE Madeira/ARDITI Portugal, University of Hamburg, AWI Bremerhaven, Smithsonian Museum of National History, and the University of Western Australia.

Weekly report:

Overview: All cruise objectives for the period of February 26 – March 3, 2024 were met, yet again benefiting from continuous 24-hour operations without loss of working days, under continued good weather and sea state conditions and optimum working conditions on board.

Table 1 Gear deployments during cruise MSM126 between February 9 and March 3, 2024, by priority working area (see Figure 1 for details).

Gear	Underway	PLA	CAN	RID	EDD	Purpose	Total
WS-CTD		6	35	16	5	Oceanographic profiles; water samples	62
BONGO		2	5	3		Shallow mesoplankton sampling (to 250 m)	10
IKMT		1	5	2		Meso- and macroplankton sampling (to 800 m)	8
MSN		4	6	7		Depth-resolved plankton sampling (to 1000 m)	17
PLA		1	7	8		(Gelatinous) plankton sampling (to 250 m)	16
WP3				1		(Gelatinous) plankton sampling (to 250 m)	1
WP2			1			Plankton sampling (to 250 m)	1
OFOS		1	4	3		Optical Ocean Floor Observation System	8
PELAGIOS			1	2		Optical Pelagic Observation System	3
ROV			13	5		Optical observations; benthic & pelagic sampling	18
Multibeam	3	3	10	4		Mapping	20
TSG	2					Temperature and salinity transect	2
ADCP	2		1		1	Current measurements	4
Total	7	18	88	51	6		170

The focus in the reporting period lay on (1) the completion of food web sampling in the Ribeira Brava Canyon and the Plateau area on the central and western southern side of Madeira (Figure 1), (2) ROV-based pelagic and benthic sampling and observations, (3) the recovery of the food fall experiment in the Canyon area set out in week 2 of the cruise with ROV PHOCA, (4) additional multibeam mapping and optical surveys of the sea floor and (5) CTD casts to increase the temporal resolution and depth range coverage of oceanographic measurements. This completed the successful in-depth coverage of all three priority working areas of the cruise (Table 1).

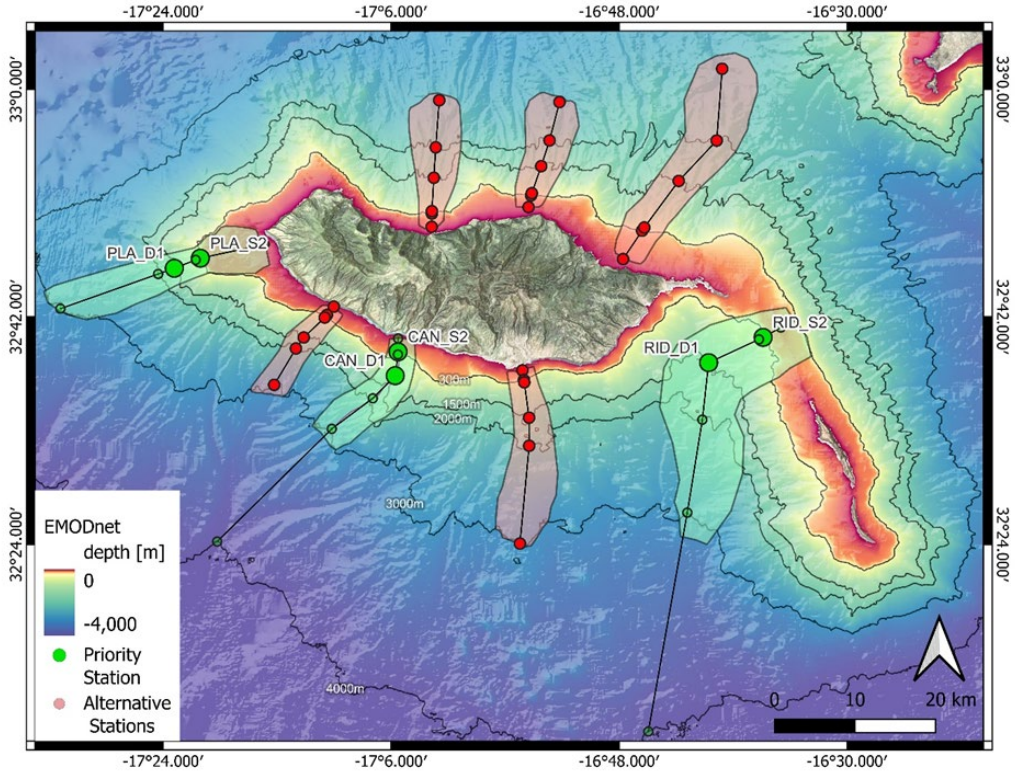

Figure 1 Working areas and stations of cruise MSM126. We have now successfully covered all three priority working areas, the Madeira Desertas Ridge area (“RID”), the central Canyon (“CAN”) and the western Plateau (“PLA”).

The reporting period also included successful board visits of the film maker Uli Kunz (Submaris) and colleagues to obtain footage for an outreach film on the expedition, as well as of taxonomic experts and resource management agency representatives (Directorate of the Sea) from Madeira, with the help of the expedition boat of cruise partner MARE Madeira/ARDITI Portugal.

Following the completion of scientific operations, RV MARIA S. MERIAN entered Funchal harbor at 08:00 on March 2, 2024, for a short visit to drop off Madeira researchers and equipment, before embarking on the transit to Las Palmas, Gran Canaria, where the vessel arrived on March 3 at 21:30, thus ending the seagoing part of expedition MSM126.

Studying the pelagic food web structure and functioning of Madeira (provided by Jamileh Javidpour, Sonia Gueroun, Florian Lüskow, Nicole Aberle-Malzahn, Manfred Kaufmann, Jan Dierking)

One core component of cruise MSM126 “Jellyweb Madeira” was the assessment of the vital, yet not fully appreciated, role of gelatinous zooplankton in marine (deep sea) food webs. Applying advanced observation and sampling techniques in Madeira – an understudied region within the Macaronesian Islands— our project seeks to deepen the understanding of oceanic biodiversity from the epipelagic to

the deep-sea and of the structure and function of food webs in these systems. The project also provides a baseline to assess the impact of climate change and human activities on these sensitive marine ecosystems.

Specifically, to assess the functional biodiversity, trophic dynamics, and carbon flow off Madeira, we applied stable isotope (SI) analysis and quantitative community composition assessments from lower to upper trophic levels. The sampling strategy of MSM126 entailed the in-depth sampling of three replicated station pairs ("shallow" at 300 m depth and "deep" at 1500 m depth covering three working areas on the south side of Madeira, see Figure 1). Given the interest in a range of trophic levels, and considering the fragile nature of gelatinous zooplankton, a variety of sampling methods was used:

- Sea water: water samples were taken for the analysis of phytoplankton, microzooplankton, heterotrophic nanoplankton (HNFs), phytopigments including chlorophyll a, nutrients, and bacterial DNA/RNA to support comprehensive food web analyses. Optimal sampling depths were determined based on the CTD downcasts. Samples were then either immediately filtered or preserved for later examination including abundance, biomass and taxonomic composition of the respective groups incl. seston samples for SI analyses.
- Bacterial carbon uptake: Water from three depths (shallow, chlorophyll maximum, and deep water layers) was incubated with labeled ^{13}C for 24 hours to measure bacterial carbon uptake rates.
- Meso-and macrozooplankton: Samples for quantitative and qualitative analyses were obtained using a diverse array of different nets as well a suction and detrititus samplers attached to ROV PHOCA. Specifically, mesozooplankton was sampled qualitatively with a Bongo net, and macroplanktonic jellyfish, ichthyoplankton, and cephalopods were collected using an IKMT or a ring net. Additional samples of fragile gelatinous fauna were taken with the ROV PHOCA. Finally, depth-resolved mesozooplankton sampling for qualitative and quantitative analyses was conducted with a multi-net. Samples of different taxa were first preserved at -20°C and then freeze-dried directly on board for subsequent SI analyses; less common taxa were also photographed and genetic samples were taken for later identification and as vouchers.
- Carbon-specific respiration measures: The ring net was used at each station to obtain intact specimens for respiration measurements; after the end of experiments, these individuals were also sampled for SI analysis.

Preliminary Results

Nutrients, base of the food web and lower trophic levels: The successful completion of sampling at all six food-web stations yielded a total of 228 phyto- and microzooplankton, HNFs, DNA, seston, and labeled carbon samples. All seston samples were oven dried and sealed for later analysis upon return. Phyto- and microzooplankton samples were partially counted on board, with further analysis to be conducted at Hamburg University's laboratory and by the group of Prof. Aberle-Malzahn. Samples for pico- and nanophytoplankton were fixed and filtered, respectively, and will be analyzed in Prof. Manfred Kaufmann's lab at the University of Madeira.

Higher trophic levels: For the meso- amd macrozooplankton fraction, 543 samples for SI analysis were collected, (Figure 2). The most abundant taxa were euphausiids and calanoid copepods among crustaceans, and chaetognaths, hydromedusae, and siphonophores among gelatinous organisms.

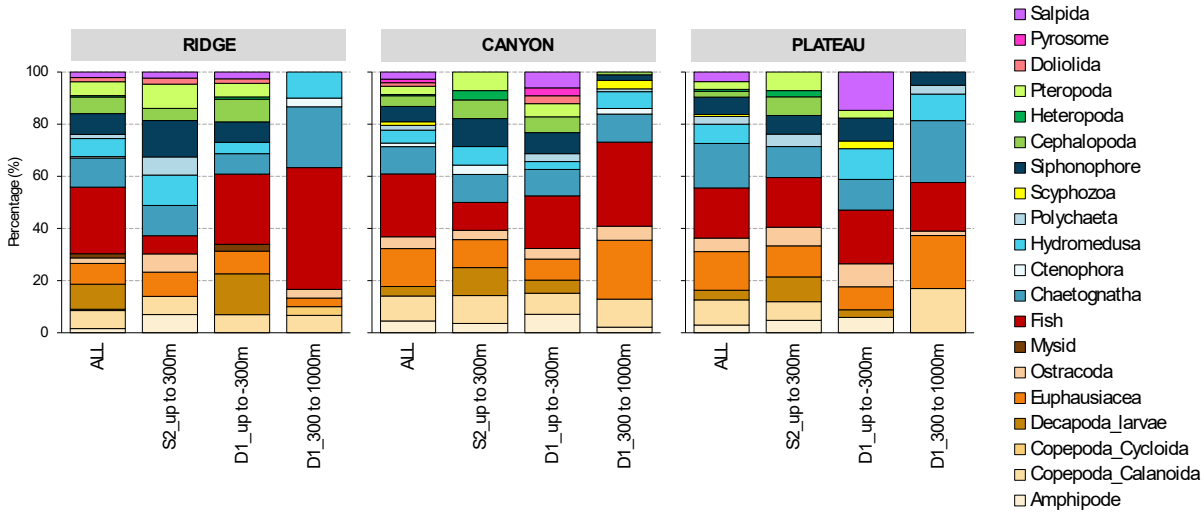

Figure 2 Overview of the proportion of the taxa sampled for stable isotope analysis in the three study areas (Ridge, Canyon, and Plateau) on shallow (S2) and deep (D1) stations (also see Figure 1).

Diversity: Preliminary identification on board yielded more than fifty taxa not previously reported from Madeira waters, including siphonophores, thaliaceans, hydromedusae, and coronamedusae, significantly enhancing our understanding of the region's marine biodiversity (Fig. 3).

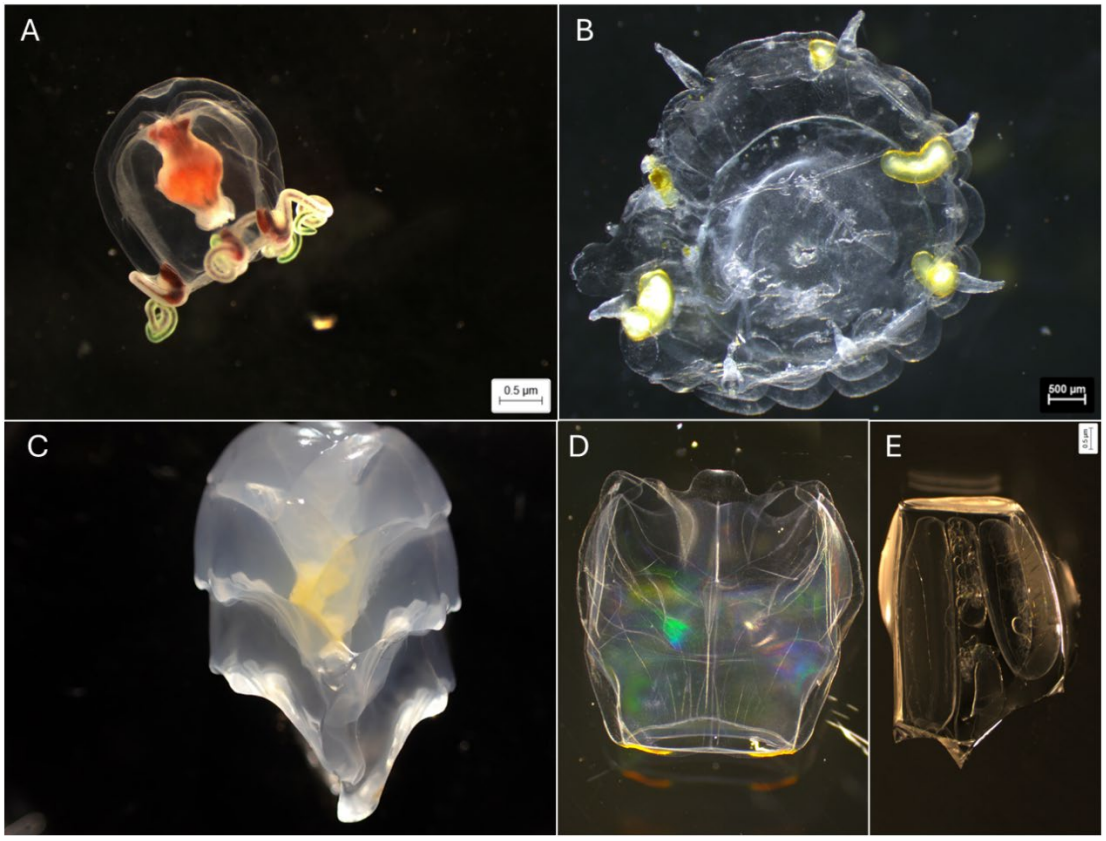

Figure 3 Some of the new records for Madeira Island: A: the anthomedusa Cysteis sp.; B: the coronamedusa Nausithoe marginata; C, D and E: the siphonophores, Hippopodius hippopus, Marrus sp., and Ceratocymba leuckarti. Photo: Sonia KM Gueroun.

Respiration experiments: The respiration rates measured for a wide range of species from 14 higher taxa combined with community composition data from multinet tows will allow scaling up to community respiration rates/carbon requirements. We then aim to compare respiration rates for organisms from Madeira ecosystems obtained here with those from other Atlantic regions. In total, 50 respiration experiments were conducted over the course of MSM126, including replicated measurements for larval fish, hydromedusae, and thaliaceans, with a focus on organisms from the mixed surface layer, which included at least the top 100 m at all sampling stations (see Fig. 4).

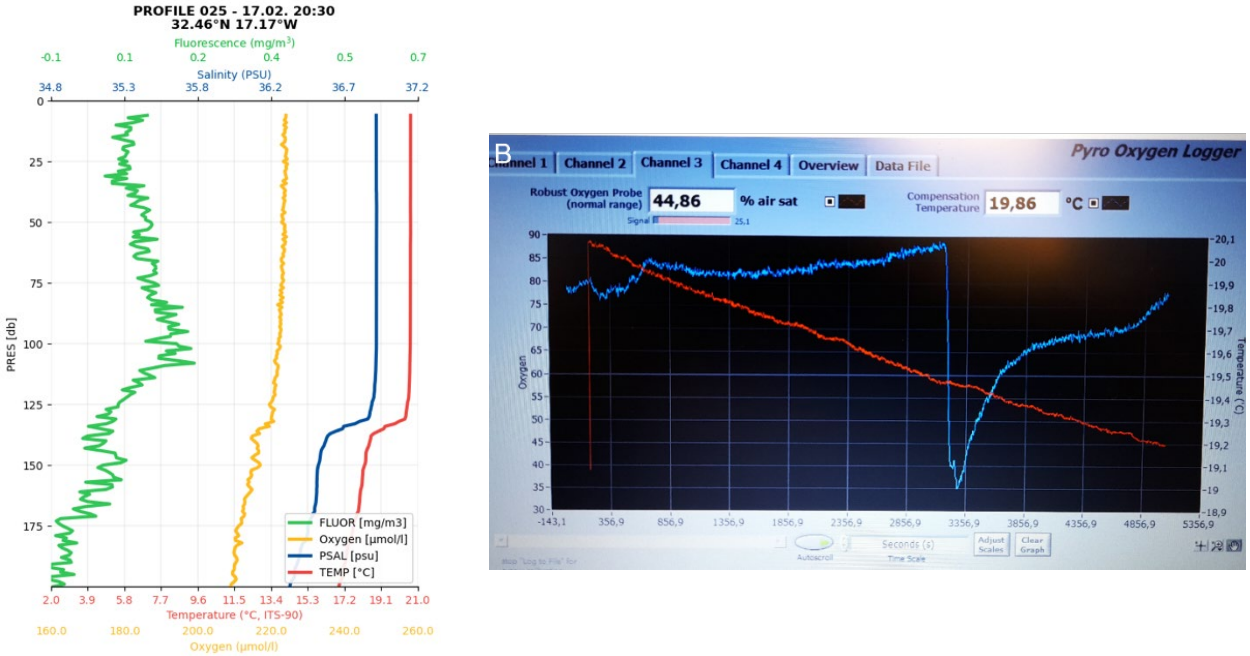

Figure 4 Left panel: CTD profile of the top 200 m of the water column on 17 February 2024. Right panel: Example of a respiration experiment with a fish larva monitored with FireSting technology (red curve: oxygen concentration, measured as percent air saturation, blue curve: temperature).

Conclusion

The arrival of RV MARIA S. MERIAN in Las Palmas concludes a highly successful expedition addressing knowledge gaps on the deep sea habitats and species communities surrounding Madeira Island, thus advancing understanding of the biodiversity and of the structure and functioning of food webs of the deep sea.

We want to use this opportunity to thank the entire crew of MARIA S. MERIAN for the outstanding support throughout the MSM126 that made this success possible.

Greetings from on board RV MARIA S. MERIAN on behalf of all participants,

Jan Dierking (Chief scientist MSM126)
GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany