MEESO survey to the North Atlantic Ocean, 1-30 June 2021

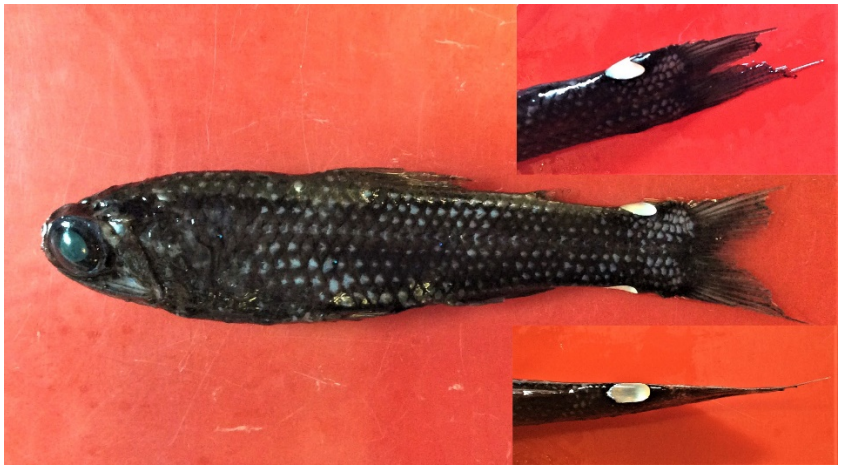
R/V “G.O. Sars”, surveying the North Atlantic Ocean mesopelagic sone during the light summer nights. Photo: Chris Lindemann.

As part of the MEESO field campaign, the Norwegian Research Vessel, G. O. Sars, is surveying the mesopelagic ecosystem of the North-East Atlantic and the Norwegian Sea. The cruise started in Bergen, Norway, 1 June and ends there 30 June.

Scientists from the University of Bergen and the Institute of Marine Research in Bergen, Norway, are using new technology, partly developed in MEESO, like non-graded trawls and underwater towed systems with optical sensors and broadband multifrequency acoustics to investigate the mesopelagic ecosystem and map the biomass distribution of the mesopelagic community and its possible drivers.

So far we have identified more than 90 species of fish and the diversity of crustaceans, gelatinous plankton and cephalopods has proven to be high as well. A marked fall in diversity and the vertical extent of the mesopelagic deep scattering layers were observed as we moved from the Iceland Basin, south of Iceland and west of the Faroe Islands, into the Norwegian Sea.

The Common fangtooth *Anoplogaster cornuta* (127 mm SL) is not only the fish species with the longest teeth in relation to body length, it also has an amazing pattern of bony ridges on its head. Photo: Rupert Wienerroither.



The Mirror lanternfish *Lampadena speculigera* (97 mm SL) has a large heart-shaped luminous gland on top and an oval luminous gland below its caudal peduncle. These are mainly used for inter- and intraspecific communication. Photo: Rupert Wienerroither.

The Stoplight loosejaw *Malacosteus niger* (228 mm SL) is one of very few deep-sea species that can produce and see red light. This enables him to see and at the same time not to be seen, making him the perfect predator. Photo: Rupert Wienerroither.

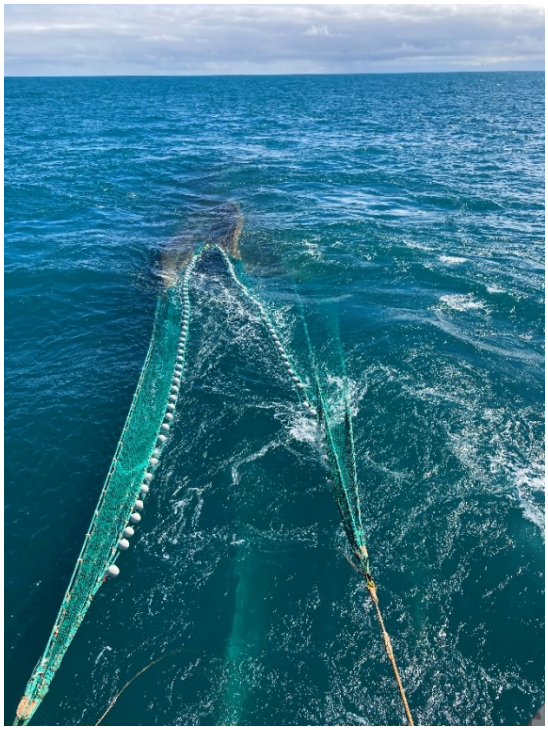
Greenland argentine *Nansenia groenlandica* (123-142 mm SL) and Pelican eel *Eurypharynx pelecanoides* (300 mm TL) occupy partly the same habitat but go for different strategies: huge eyes and tiny mouth versus tiny eyes and enormous mouth cavity and pharynx. Photo: Rupert Wienerroither.

A female Bulbous dreamer *Oneirodes eschrichtii* (122 mm TL), males of this species are dwarfs, but not parasitic. Photo: Rupert Wienerroither.

Large pelagic shrimps were also important contributors to the mesopelagic biomass. This one measuring more than 10 cm total length, we caught regularly in the Iceland Basin. Photo: Webjørn Melle.

The fishing master repairing the fine meshed trawl. Photo: Webjørn Melle.

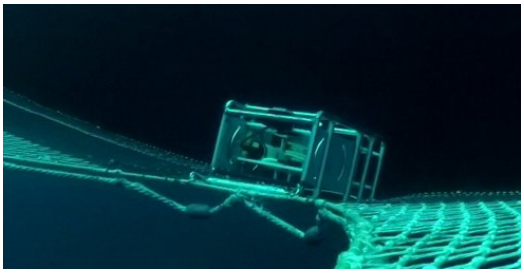
Vertical migration among mesopelagic species is known to be pronounced spanning several hundred meters from daylight till the darkest hours of the night. Although we are now experiencing the lightest nights of the year, we have seen extensive vertical migration and the migrations are recorded by trawls with Deep Vision, Multinet and submersible acoustics on our towed system, MESSOR, down to 1000 m depth.



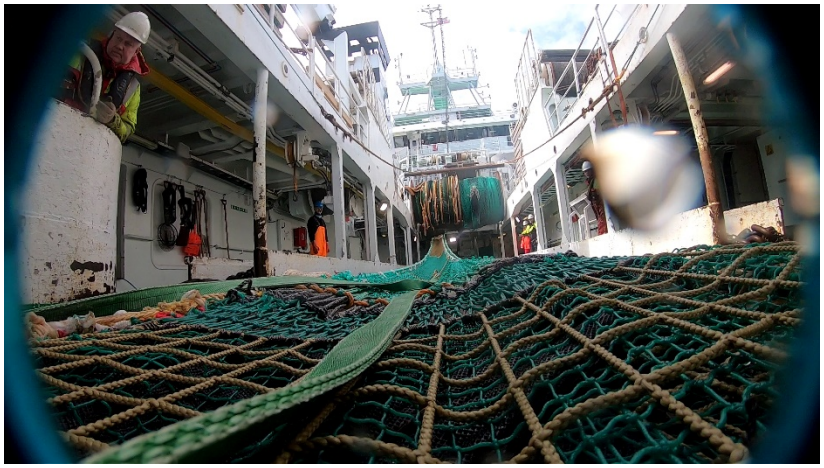
Shooting the 280 Egersund Micronekton trawl. Opening area about 345 m^2, 16-mm stretched mesh size (7x7 mm mesh opening). Photo: Webjørn Melle.

Ålesund harbour. Changing crew and calibrating broad band acoustics on the MESSOR, towed platform. Photo: Webjørn Melle.

Abundance and biomass estimation by non-graded trawls: The sampling volume of our trawls are estimated by use of new technology. The height of the trawls is recorded by the difference between two depth sensors at the bottom and top of the trawl, while the width is recorded by Scanmar distance sensors on both sides of the trawl walls. This gives the opening area of the trawl, while the flow into the opening is continuously recorded by an ADCP mounted on the trawl footrope, heading upwards.



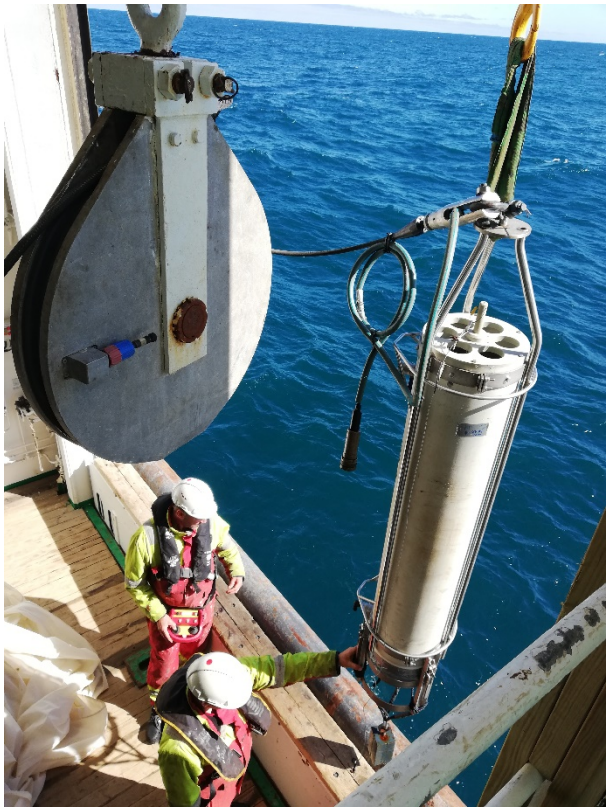
The ADCP attached to the trawl during a haul. Photo: Mel Underwood.


Trawl on deck. Any catch? Photo: Mel Underwood.

During the cruise we used submersible broadband acoustics and optical sensors on the towed platform, MESSOR, to quantify abundance and biomass of mesopelagic organisms down to 1000 m. In combination with non-graded trawls with Deep Vision (cod-end camera system) and new developments in the use of acoustic models, we will improve our knowledge of mesopelagic stock's biomass and their ecological role.

From the surface mixed layer sinking particles are impacted by physical and biological factors, leading to fractionation, aggregation and recycling (amongst other processes) and thus modulating carbon export to the deep ocean. If diel vertically migrating fishes and zooplankton eat more of their food in the epipelagic than in the mesopelagic, they will likely contribute, via active carbon flux, to increased vertical carbon flux and sequestration. This is because the carbon ingested as food in the epipelagic is rapidly transported by swimming to mesopelagic depths.

Here, parts of this carbon are respired as CO_2, excreted as DOC, defecated as POC, and consumed by stationary mesopelagic piscivores. To investigate this potentially important link to carbon sequestration, and thus climate change, we collect water samples above and below the deep scattering layers with large (100 L) water bottles, called Marine Snow Catchers (MSC). The MSC, in combination with Flowcams, allows us to estimate sinking velocity and size distribution of organic particles, including marine snow and faecal pallets. We analyse these particles for their carbon content, other major elements, as well as bacterial abundances and diversity. This will allow us to get a better understanding of remineralisation rates.



Retrieving Snow Catcher from mesopelagic depths. Photo: Chris Lindemann.

Food/feed safety and security

During the cruise we collect mesopelagic species to investigate the levels of contaminants including heavy metals and persistent organic contaminants as well as nutrients such as fatty acid and amino acid profile, vitamins and minerals and bulk nutrients. Using existing regulations and recommendations, the safety of different mesopelagic species will be evaluated as food or feed and how they can contribute into nutrition security.

We also study the transfer and magnification of the measured nutrients and contaminants in the mesopelagic food webs of the North Atlantic.

Samples from the captured species are homogenized onboard and then will be sent to different laboratories at IMR for the measurement of nutrients and contaminants using accredited methods. Photo: Atabak Mahjour Azad.

Scientific crew

Atabak Azad, Mette Agersted, Babak Khodabandeloo, Thor Klevjer, Chris Lindemann, Monica Martinussen, Webjørn Melle (cruise leader), Jon Rønning, Espen Strand, Tatiana Tsagaraki, Mel Underwood, Rupert Wienerroither

Thanks to the captain and crew of G. O. Sars for excellent cooperation during the 30 days at sea.