

13.01.2019 14°30'S 076°01'W a few miles of the Peruvian coast

MSM80 CUSCO

Fourth weekly report for the period from 07.01. till 13.01.2019

Last week started with a low and stress for many scientists on board. On 07 January, five out of seven of our regular sampling gears showed malfunctions, all at the same station. It almost seemed as if they had made an appointment for the most inconvenient moment, immediately before the 24 hours-station, for which we were dependent on a smooth procedure and trouble-free deployment of all scientific gears.

Thanks to the efforts of the technicians on board, in particular, the members of the scientific-technical service (WTD), all technical problems could be solved within a few hours and gears were repaired. It is almost magic, how skilful WTD and the entire crew of R/V Maria S. Merian come up with solutions. There is always an alternative or a brilliant idea for a „Plan B“ so that the scientific work can continue. Therefore, we are very grateful to the entire crew of R/V Maria S. Merian.

From 07 to 08 January we sampled our first 24 h-station according to plan, at 12°S above the continental rise at 1.600 m water depth. Four times during the day, we deployed the CTD and a multiple opening/closing net, both at daylight and during darkness. In addition, we developed a special sampling scheme for the hours of sunset and sunrise. The objective of this programme was a detailed and high-resolution study of the diel vertical migration (DVM) of zooplankton.

Every evening shortly before sunset, plankton organisms all over the world ocean start their daily (more accurately nightly) ascent to the sea surface in order to feed on phytoplankton (micro-algae) during the night. At sunrise, they descend again to several hundred metres of water depth, where they stay during the day, better protected from pelagic fish and energy saving with a reduced metabolism at the colder temperature at greater depths. This phenomenon is called diel vertical migration and presents the by far largest animal migration and biomass shift on the planet.

Due to our research programme at the 24 h-station, we could observe this event live. Exactly half an hour before sunset, the krill species *Euphausia mucronata* began to migrate from its daytime distribution at 300 m depth to the sea surface, where it spent the night. The interdisciplinary co-operation of biologists, biogeochemists and physical oceanographers on board allowed us to gather a comprehensive data set to study DVM of krill in the Humboldt Current and its effects on the carbon flux to the deep sea.

Krill, copepods and other crustaceans comprise the major fraction of zooplankton biomass. In the framework of the CUSCO project and during this expedition, a team of four biologists from the BreMarE centre (Bremen Marine Ecology) of the University of Bremen is studying these organisms. The four scientist from Bremen are working closely together with two colleagues from the Peruvian fisheries research institute IMARPE.

According to the first preliminary results of the research cruise, the pelagic community and in particular the zooplankton in the Humboldt Current off Peru are characterised by a very low species richness and biodiversity. Only three species are responsible for the major fraction of biomass, and they are spatially separated. On the wide and shallow shelf, the copepod *Calanus chilensis* occurs in high densities in the upper 50 m of the water column. At night on the shelf, red squat lobsters of the species *Pleuroncodes monodon* ascend to the surface and often dominate plankton catches in terms of biomass. However, during daytime these crustaceans sit on the seafloor and, therefore, should not be considered typical members of plankton. Above the continental rise, lantern shrimp *Euphausia mucronata* (krill) are the dominant zooplankton. Due to the dominance of such few species, the

pelagic food web is rather simple and less complex, which might be one of the reasons for the high trophic transfer efficiency in the Humboldt Current.

Another characteristic of the Peruvian coastal upwelling system is the pronounced oxygen minimum zone (OMZ), extending from water layers closely above the seafloor on the shelf to areas far offshore, where the OMZ is exceptionally thick (200 to 600 m water depth). Dissolved oxygen concentration drops to 0 mg per litre seawater. Hence, the OMZ here off Peru is much more pronounced than in other coastal upwelling systems and plays an important role for the dispersal and vertical distribution of organisms. For most species, the OMZ represents a barrier preventing migrations, whereas specifically adapted species such as the krill *Euphausia mucronata* find refuge within the OMZ from competition and/or predation by other less tolerant species, in particular fishes. We biologists are particularly interested in the physiological adaptation strategies, which allow certain species to inhabit the OMZ at least temporarily.

The pronounced OMZ leads to a concentration of biological activity and interactions in a thin surface layer of the ocean, where sufficient oxygen is available. This might create more efficient feeding conditions for fish, as their prey is spatially restricted and, hence, concentrated in a smaller volume.

At the moment, we are finishing the last station work on the section at 14°30'S and will head further south, again with the ScanFish in tow and looking for an active upwelling cell with cold nutrient-rich water at the surface close to the coast.

Although the week was rather stressful at the start, it turned out to be very successful in the end with interesting results, many samples and still more data, which will bring us closer to answering the research questions of the CUSCO project, how to explain the high trophic transfer efficiency and the high fish yield of the Peruvian upwelling system. The atmosphere on board is still very good after the first half of the cruise.

With best regards from all cruise participants,

Holger Auel

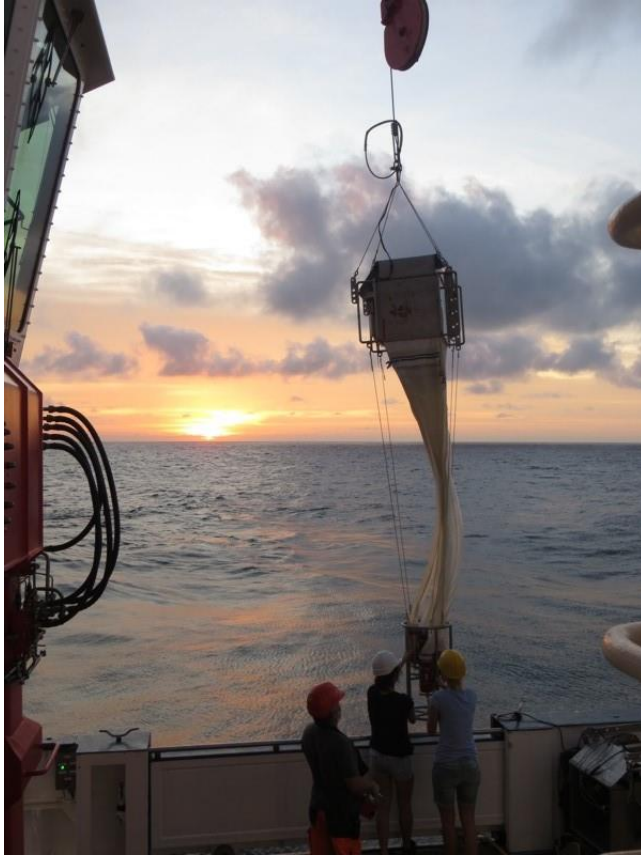


Fig. 1: Biologists from Bremen University deploying a multiple opening/closing net at sunset (Foto: H. Auel)

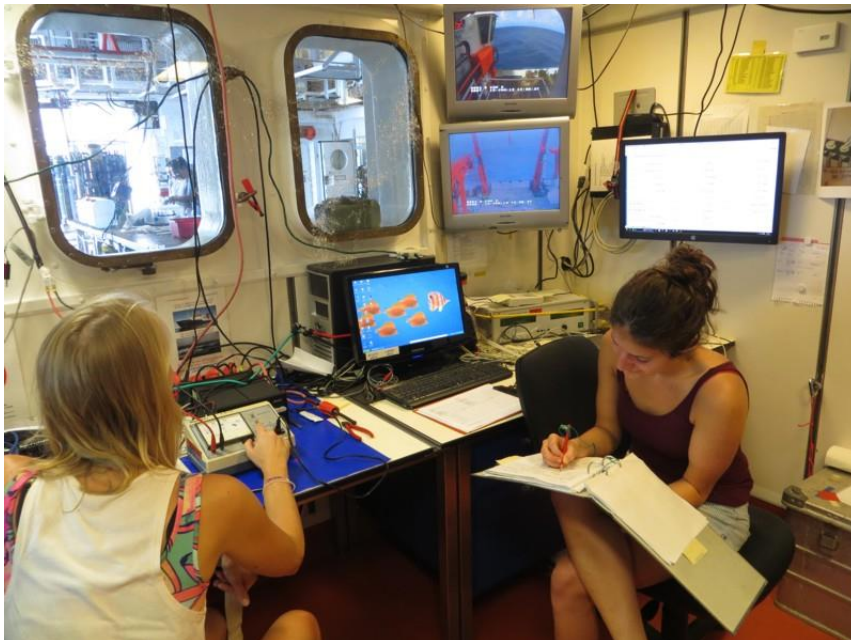


Fig. 2: Control stand for the multiple opening/closing nets (Foto: H. Auel)



Fig. 3: Red squat lobster *Pleuroncodes monodon*. (Foto: H. Auel)