Early Career Scientist Session

# A changing Arctic Ocean and its communities

Eva Lopes
Faculty of Sciences of University of Porto (FCUP); Interdisciplinary Centre of Marine and Environmental Research (CIIMAR)

Changes in the heat content of Pacific and Atlantic water masses are shifting isotherms north with an impact on nutrient redistribution and evidence of distributional shifts in several Arctic and sub-Arctic species. Marine prokaryotes and unicellular eukaryotes play pivotal roles in marine ecosystems by maintaining key biogeochemical cycles (e.g., Nitrogen, Carbon, Phosphate) that sustain water column primary productivity. However, little is known about the implications of the predicted Arctic Ocean changes on the phytoplankton and prokaryotic interactions taking into account an integrated view of all the microplankton components. Analysing the change in the redistribution of plankton microbial communities and their functions within the changing Arctic Ocean will be of great relevance since they form a web of highly diverse species and functions that quickly react to change, dictating shifts on ocean primary production and consequently on ecosystem sustainability. In my PhD project, I aim to investigate the Arctic Ocean prokaryotic and unicellular eukaryotic communities from a community dynamics and ecological perspective by understanding how planktonic prokaryotic and unicellular eukaryotic communities interplay with each other. My project benefits from a long-term international planktonic monitoring program in the Svalbard region coordinated by the Norwegian Polar Institute (NPI) and Interdisciplinary Centre of Marine and Environmental Research (CIIMAR) that is generating an extensive data set to investigate how the planktonic microbial communities respond to changes in the Arctic Ocean hydrology and physical properties caused by climate change. These surveys cross fjord, shelf, and oceanic domains and include a total of 17 stations sampled once per year, at different water column depths. Weekly monitoring sampling (May to September) has also been applied to one station located in Kongsfjorden since 2019. On behalf of my PhD tasks, I had already the opportunity to participate in these Arctic weekly monitoring campaigns, where I was responsible for collecting and processing all genomic samples to study the diversity and function of planktonic microbiomes. Nevertheless, I participated in these surveys with some preliminary results on the analysis of the prokaryotic and protist genomic data sets generated from the 2019 and 2020 campaigns. For this analysis, a 16S and 18S rRNA gene sequencing approach was employed to identify and characterize microbial communities at 15 m depth and 10 m above the bottom (300 m) and to observe how they changed over the course of spring and summer. Results showed differences between the microbial communities from 2019 and 2020, characterized by contrasting environmental conditions. In 2019, there was a warm spring with little sea ice, while in 2020, the spring was cold with more extensive sea ice cover. The structure of the communities of both years was

significantly influenced by the same parameters: temperature, nutrients, chlorophyll, and phaeopigments. Interestingly, the communities were distributed, in a hierarchical cluster analysis, by years and not by depth. Regarding alpha diversity, the warm year 2019 presented higher diversity than the cold year 2020.

My participation in the Mirai expedition gave me the opportunity to largely expand the studied region to the Pacific Arctic giving me the chance to include observations to understand how the increase both of the Atlantic heat flow ("Atlantification") and of the Pacific heat inflow to the Arctic ("Pacification"), will promote shifts in Arctic plankton microbiome diversity and on its interactions. During the Mirai expedition, I collected seawater samples in multiple stations at different depths for microplankton analysis, by using the same methodologies that are applied in the Svalbard region monitoring programs. Moreover, on the of the R/V Mirai, a microcosmos experience was performed, where the Pacification phenomenon was reproduced. The aim was to mix surface waters, collected at 100m, with bottom waters, collected at 300m, and analyse which interactions between the communities change during the period of 48 hours of incubation. Water collected at 100m was classified as "Remnant Winter Water" and water collected at 300m was classified as "Atlantic Water". I performed this same experiment during the Svalbard region 2023 campaign, by mixing North Atlantic and Polar water masses. The output of these microcosmos experiences will allow us to observe how these communities change their interactions in these changing environments and especially will allow us to see if the communities on the different sides of the Arctic Ocean have or do not have the same behaviour. Icebreaker research vessels provide the chance to perform seawater sampling in more restricted areas, with more safety, and for a longer period of time. Furthermore, these vessels present new technology and a greater chance to have more international collaborations. My participation in campaigns on the new Japanese icebreaker will allow me to expand my research area and the temporal scale of my studies. Additionally, it will help me answer my scientific questions regarding the continuous heat inflow to the Arctic and compare how the different sides react to it.