Conservation and restoration of marine ecosystems in the context of deep-sea mining

DEEP REST – 4th Newsletter

Nursery of shrimp *Rimicaris chacei* near the TAG hydrothermal active mound. *Maractis rimicarivora* anemones and a zoarcid fish are visible. ©Nautile/Bicose3 cruise

June - September 2023

Editorial – *Dear DEEP REST team, I hope you all had a nice summer and that the fall was not too hectic for you. Since the last Newsletter, a few cruises have taken place (Momarsat 2023, BICOSE3), results of our research were presented during the 7th International Symposium on Chemosynthesis-Based Ecosystems and the 56th European Marine Biology Symposium in Iceland. And some great news! DEEP REST was endorsed in the Ocean Decade 2030 through the Challenger 150 program and our mid-term report was submitted in October, showing the diversity of actions completed within the project. We are also delighted to welcome several new undergraduate and graduate students working with us.*

This Newsletter is yours, to share information, questions and adventures! Do not forget to keep aside whatever you think would be an interesting news item for this community for the next edition.

-Jozée

A week in Spain with the European Marine Board.

Riwan Leroux, post-doc at Ifremer

Ambassador of the European Marine Board

From October 7th to 14th 2023, I went to Santiago and Vigo, in Spain. The first part of the mission was to animate a forum I organized with the three other ambassadors of the European Marine Board (EMB). We welcomed 40 early career scientists to learn about merging science and policy making. We also discussed about how to increase their involvement in decision making and policy consultations. It was really successful for teaching as well as networking. The second part of the mission was dedicated to EurOCEAN 2023 conference which also focused on linking research and policies.

Riwan Leroux –second to the right- at the Eurocean conference
© Lalo R. Villar & European Marine Board

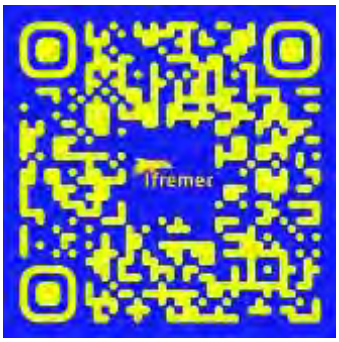
This conference was organized by the EMB and brought together researchers, stakeholders and European level policy makers. We had the chance, as EMB ambassadors, to give a speech about the forum outcomes and how early careers should be better taken into account in the policy and research decision making.

Finally, the last two days, I attended the EMB plenary where we discussed about future activities. Among other things, we talked about authorship, we agree to welcome a new member: the Cyprus Marine and Maritime Institute. We also decided the next topic we will write on: Measuring, reporting and verifying marine carbon dioxide removal. As a reminder, I currently work with EMB on a future science brief (~50 pages) on deep-sea and ocean health. The first draft is almost finished and we will soon share it to members to have internal review. The expected publication is planned for late spring 2024.

The PROTECT project

Riwan Leroux, Jozée Sarrazin, Denis Bailly & Marjolaine Matabos

Riwan Leroux made a presentation of the PROTECT project at the 56th European Marine Biology Symposium in Iceland during the first week of September 2023. He presented the mapping of all research activities that occurred at the Lucky Strike hydrothermal vent field and exposed the future research needed to implement this study into a solid management framework for the Azorean Marine Protected Area. Finally, he advertised the questionnaire asking the deep-sea community their expertise to weight the impacts from different research activities. **Scientists' contribution is still needed** to have a robust estimation of our impacts on ecosystems as researchers (scan the QR code to contribute).



Momarsat 2023 - A challenging but successful cruise!-

Jozée Sarrazin & Marjolaine Matabos (Ifremer)

The Momarsat 2023 cruise was held from July 9 to July 28th 2022 onboard the French research vessel L'Atalante with the ROV Victor6000 at the Lucky Strike vent field - northern Mid-Atlantic Ridge - to carry out the yearly maintenance of the EMSO-Azores observatory. Once again, we ensured the turnover of the full platform and sensor array and started another year of data acquisition! Led by Marjolaine Matabos, the team of 18 scientists from Ifremer, CNRS (IPGP, GET, MIO), University of Western Brittany (UBO) and University of the Azores worked together to achieve the substantial sampling plan paramount to the long-term monitoring of the vent field.

Despite delayed departure of the ship, numerous breakdowns and technical issues with the submersible and the observatory infrastructure, all objectives were achieved. This success would not have been possible without the adaptability, support and flexibility of all teams and more particularly the ship crew, which had to adapt continuously to a changing program.

The Momarsat 2023 great team on the R/V L'Atalante on the Lucky Strike vent field. © Eloi de L'Estourbeillon/Momarsat 2023

This year, as part of the DEEP REST Rest project, we conducted new experiments. The deposition of sulphide particles on vent assemblages using the SPIDER benthic chamber was used to examine the impacts on vent faunal biodiversity and physiology. On-board and in-situ incubations of the *Bathymodiolus azoricus* mussel to a fluorochrome aimed to assess its growth rate. Moreover, a new diffuse-flow site spotted to the south of the Cimendef sulphide structure appears promising for future integrated multidisciplinary studies.

Marine life accompanied us all along the cruise with dolphins, sharks, tuna and whales. At the bottom, we had a nice and rare encounter...

The encounter of Victor6000 with a *Grimpotheutis* octopus at 1697 m depth. ©Victor6000/Momarsat 2023

The EMSO-Azores observatory is part of the One Ocean Network for Deep Observation action of Ifremer endorsed by the UN Ocean Decade program (https://www.oceandecade.org/actions/one-ocean-network-for-deep-observation/).

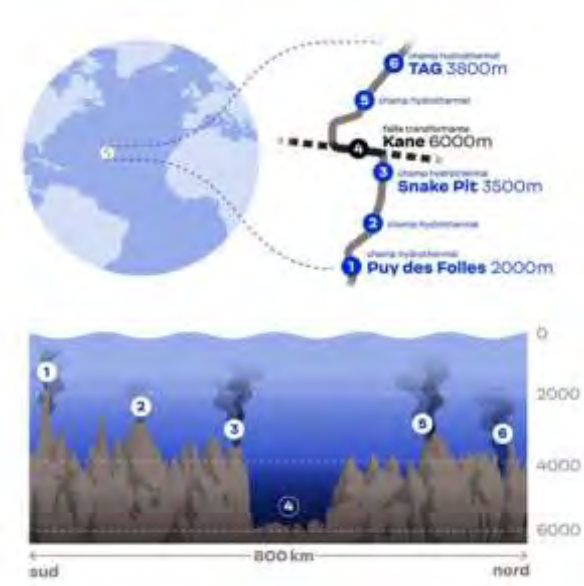
On the way back to Horta, cruise participants Jozée Sarrazin and Marjolaine Matabos, with Ana Colaço, were invited by the Azorean government to give a conference following the exhibition of Damien Roudeau drawings (from Momarsat 2022 cruise) at the Fabrica Baleia.

Drawings from the Momarsat 2022 cruise by the artist Damien Roudeau were shown at the Fabrica Baleia in Horta during the month of July.

Marjolaine Matabos, Jozée Sarrazin and Ana Colaço giving a conference for the general public at the Fabrica Baleia on July 30th 2023

BICOSE3 cruise on the Mid-Atlantic Ridge

Jozée Sarrazin



Map of the sites that will be visited during the cruise.

The Bicose3 cruise is taking place right now! The research vessel Pourquoi pas? with the manned Nautile submersible on-board left the port of Las Palmas October 22nd for a 47-day cruise. Led by Marie-Anne Cambon (Ifremer), thirty scientists boarded the ship to study five hydrothermal fields spread over 800 kilometers along the Mid-Atlantic, to depths of over 3 700 meters. With 30 dives with the Nautile submarine, we aim to establish a precise map of the hydrothermal fields, from the most active to the fossil sites, and of associated faunal communities, in order to gain a global understanding of the functioning of these environments. This campaign is in line with Ifremer's ongoing research to unravel the mystery of the formation of these deep-sea ecosystems and understand the life cycles of the species inhabiting them.

Look for the press release: https://www.ifremer.fr/fr/presse/47-jours-en-mer-pour-explorer-la-biodiversite-cachee-dans-les-grands-fonds-marins

Beyond the Depths: Surveying the Social Value of Deep-Sea Ecosystems

Asif Khan & Thomas Van Rensburg (University of Galway)

Within the scope of WP5, we are leading the design of the choice experiment surveys and reviewing the valuation of hydrothermal vent (HV) ecosystem services (ES) in the context of deep-sea mining (DSM). At the same time, we have drawn on the extensive scientific experience of colleagues in the project in order to examine the multifaceted aspects of HVs. These discussions have led to the identification of significant HV-ecosystem services and typology of social and economic values and related management and governance issues and helped to identify relevant case study sites, which are essential to our research - namely - nMAR and AMOR. Rather uniquely, the case studies also potentially include sites of international jurisdiction.

In order to integrate a range of viewpoints and inform the development of the empirical surveys to be carried out, we have conducted four focus groups during September and October 2023, linked to the case study sites and these involve public respondents from Norway and Portugal/Azores. These interactive sessions have been key in capturing public opinion, enabling us to identify and prioritize the people's most valued attributes as well as attitudes and opinions to inform our upcoming choice experiment survey design and imminent deployment.

As we move forward, the next steps involve refining our insights from our pretesting/piloting process to gather survey data from public stakeholders from Norway and Portugal/Azores, which will be followed by an empirical analysis to examine public values of ecosystem services in the deep sea. The results of this endeavour will be crucial in informing and shaping environmental policy, both in the context of national and international jurisdiction particularly as it relates to the conservation, restoration, and management of HV ecosystem services amid the emerging concerns of DSM.

Marine areas beyond national jurisdiction, geopolitics and international relations: The geographical structure of the high seas and the seabed

Juan Luis Suárez de Vivero, Professor Emeritus
Universidad de Sevilla, Spain

The marine areas beyond national jurisdiction (ABNJ), composed of the high seas and the seabed and subsoil, or the Area in legal terminology, are becoming increasingly relevant both in the geopolitical arena and in international relations and ocean governance.

The growing strategic interest in ABNJs, in which marine genetic resources (MGR) play a leading role, is analysed in the framework of the process of geopolitical change triggered by the transformation of States' territorial bases (which have a greater marine component in most coastal States) and the weakening of the principles of ocean governance -especially regarding the common heritage of mankind- in the sphere of international relations. A selection of geopolitical aspects of the areas beyond national jurisdiction are examined taking as the scope of analysis the northern region of the Atlantic Ocean that includes part of the Mid Atlantic Ridge, where the United Nations Seabed Authority manages several exploration contracts.

The Agreement on biodiversity in areas beyond national jurisdiction (BBNJ, 2023) shifts the geopolitical spotlight onto the maritime areas that represent common interests and now become part of the geography of territorial tensions. Advances in innovation and the knowledge economy create a new image of the seabed that is no longer linked to the expectations of mining. Marine genetic resources are now the standard of the new opportunities in the marine world. This new area of territorial tension represents a challenge to common goods and the principles that drove the United Nations Convention on the Law of the Sea.

Suárez de Vivero, J L (2023). Marine areas beyond national jurisdiction, geopolitics and international relations: The geographical structure of the high seas and the seabed· CEDEPEM, Policy Brief, Vol. 1, nº 3, 2023.

Nuit Européenne des Chercheurs – European Researchers Night

Océanopolis, Brest (Brittany, France), 29th September 2023

Alicia Veuillot, Ifremer

This event called “No(s) futur(s)” took place in Brest (Brittany, France) on September 29, 2023, where we were welcomed at the Océanopolis aquarium. Several stands represented Ifremer with the aim of introducing the different professions, study areas, tools and main objectives of our research to the general public.

At the BEEP (Biology and Ecology of Deep Marine Ecosystems) stand, we presented three different deep ecosystems: cold water corals at seamounts, hydrothermal ecosystems at ocean ridges as well as polymetallic nodules at abyssal plains. Photographs, diving videos and samples (substrata, corals and associated fauna) were presented to give an initial description of these deep areas. A parallel was made between the resources provided and the threats weighing on each of these environments. Several issues were raised, notably that of trawling on corals, potential mining on nodules and the peripheries of hydrothermal vents.

As part of the international DEEP-REST project, Riwan Leroux (Ifremer post-doctoral student) explained the impacts of scientific research in deep environments (artificial lighting, noise, release of ballasts, sampling, etc.) and Alicia Veuillot (Ifremer PhD student) showed one of the artificial colonization devices deployed at hydrothermal vents to explore the faunal colonization and potentially considered as a restoration mean in in the event of mineral resource exploitation.

Elisa Cavallin, law researcher at Ghent University

Elisa is an environmental law researcher at Ghent University at the Faculty of Law and Criminology in the Department of European, Public and International Law. For the DEEP REST project, she will explore the legal aspects related to deep-sea bed conservation and restoration under the supervision of Prof. Dr An Cliquet and Prof. Dr Klaas Willaert.

Elisa holds a Master's degree in Law (University of Padua, IT) and an LL.M. in International and European Law (Ghent University, BE), where she also worked as a legal researcher on the application of the EU species protection law with respect to renewable energy projects across several EU countries.

After her studies and research experience at Ghent University, she worked for a couple of years in the European Parliament as a policy adviser on energy, biodiversity, agriculture, animal welfare and human health issues.

From 2019 to 2023, Elisa worked as a doctoral researcher at Hasselt University in the context of a FWO-SBO project. She has researched the legal aspects of biochar production and use, with particular attention to potential input materials, including waste materials and virgin natural resources, and regulation of impact assessment and industrial emissions associated with biochar production.

The common thread in the areas and topics she covered in the course of her various work and research experiences is the balancing of broader economic and industrial interests with environmental protection, conservation and restoration.

Shani Friedman, post-doc fellow, University of Brest, France

Dr. Shani Friedman is a lawyer and a postdoctoral researcher in international law at UBO-AMURE, working with Dr. Denis Bailly and Dr. Manuel Bellanger as part of the DEEP REST project. Within the project, she researches different questions relating to the legal regime and governance framework of deep-sea mining such as liability, sharing of benefits and interaction with other frameworks within the law of the sea, such as the BBNJ agreement.

Dr. Friedman received her PhD from the Faculty of Law, Hebrew University of Jerusalem, where she focused on the governance framework and social construction of the continental shelf regime. Dr. Friedman also earned a L.L.B from the Hebrew University of Jerusalem, M.A in International Relations from the Hebrew University of Jerusalem and B.A in political science and Middle Eastern studies, Ben-Gurion University, Beer-Sheva. Dr. Friedman researches various topics within the field of the Law of the Sea, which is her main field of expertise, and international institutions and the interaction between international law and international relations, including theoretical aspects.

Gayathra Bandara, Ghent University, Belgium

Gayathra Bandara is a Sri-Lankan student within the MSc programme IMBRSea (International Master of Science in Marine Biological Resources), which is coordinated by Ghent University in Belgium. In January 2023, he will start processing sediment meiofaunal samples for his MSc thesis project entitled «*Impact on meiofaunal assemblages by the pre-prototype nodule collector "Patania II" in the Pacific Clarion Clipperton Fracture Zone (CCFZ)* » under the supervision of Dr. Ellen Pape.

The samples for this MSc thesis were collected during a two-month sampling campaign to the CCFZ (November-December 2022) aboard the German research vessel Sonne. During this campaign, the sites of nodule collector tests conducted 1.5 years before, were revisited and sampled to evaluate environmental impacts. Using microscopy, Gayathra will analyze sediment samples for meiofaunal higher taxonomic abundances from the collector track area and from areas with varying levels of sediment deposition sampled within the GSR (Global Sea Mineral Resources) exploration contract area. Meiofaunal data will be linked to abiotic sediment data such as sediment grain size, pigment levels and carbon and nitrogen content.

Thesis student Gayathra studying CCFZ meiofauna with the stereomicroscope. © Ellen Pape, Marine Biology Research Group, Ghent University

This dataset will be compared to previously collected meiofauna and abiotic data from the area before and shortly (1 month) after the tests. The complete dataset will provide insights into the impacts of the nodule collector test on the benthic environment. Gayathra and Ellen are very much looking forward to see the results!

Nada Al-Damluji, Master Student, UGent

My name is Nada Al-Damluji, I'm an Iraqi Masters Student from the Marine and Lacustrine Science and Management Master Program (Oceans and Lakes) which is coordinated between Vrije Universiteit Brussel, Ghent University, and University of Antwerp. I have been processing sediment meiofaunal samples since October 2023 for my MSc thesis project entitled "*Assessment of mining impacts on deep-sea meiofaunal communities with the use of metabarcoding*" under the supervision of Dr. Lara Macheriotou and Professor Ann Vanreusel. These samples were collected at the abyssal plains of the Clarion Clipperton Fracture Zone (CCFZ).

This enormous stretch of soft sediment is covered by polymetallic nodules, which are consequently targeted for extraction by deep-sea mining. In the spring of 2021, a nodule extractor prototype created by the Belgian business Global Sea Mineral Resources (GSR) was tested for this purpose in the Belgian contractor area. In the winter of 2022, the impacted area was revisited and sampled. The purpose of my thesis will be to compare samples from both years in order to discover changes in meiofaunal alpha/beta diversity as well as phylogenetic community structure using metabarcoding. The completion of this thesis will provide insight into the possible effects of deep-sea mining on the benthic environment.

DEEP REST, endorsed by the UN Decade of Ocean Science for Sustainable Development 2021-2030

DEEP REST was recently recognized as a Decade action (No.36.4. entitled "Conservation of the deep-sea in light of mining) by the UN Decade of Ocean Science for Sustainable Development 2021-2030. Within the structure set out in the Ocean Decade Implementation Plan, our project is attached to the endorsed Decade program "No. 57. Challenger 150 - A Decade to Study Deep-Sea Life". Our contact persons are kerry.howell@plymouth.ac.uk and ahilario@ua.pt. You can now add two more logos to your presentations/communications and acknowledge the Ocean Decade and Challenger 150 program in your publications.

The **data management plan** still needs your input. Please take a few minutes to identify the data you will be using during our project.

Communication tools
Web site: https://deep-rest.ifremer.fr/
Mailing to deep-rest organization team (WP1): deeprest2022@gmail.com

General DEEP REST mailing list: deeprestall@listes.ifremer.fr
WP leader list: deeprestwpleader@listes.ifremer.fr

Our advisory board is composed of: Samantha Smith, Luciana Genio, Ricardo Serrao Santos and Claire Armstrong. You can see their profiles on the web site and contact them directly by using their mailing list: advisory_board_deep-rest@listes.ifremer.fr. Thanks to all of them for joining our team!

Please cite DEEP REST in your acknowledgements (publications, conferences, activities)

This research is part of the DEEP REST project that was funded through the 2020-2021 Biodiversa and Water JPI joint call for research projects, under the BiodivRestore ERA-NET Cofund (GA N°101003777), with the EU and the following funding organisations : Agence Nationale de la Recherche (ANR-21-BIRE-0003), France, Ministry of Agriculture, Nature and Food Quality (LNV), Netherlands, Research Foundation – Flanders (FWO), Belgium, German Federal Ministry of Research (BMBF) through VDI/VDE-IT, Germany, Environmental Protection Agency (EPA), Ireland, Fundação para a Ciência e a Tecnologia (FCT), Portugal, Fundo Regional para a Ciência e Tecnologia (FRCT), Portugal-Azores and State Research Agency (AEI), Spain.

-The end-