Deep-Sea Life

Issue 12, December 2018

I suggest you may like to take some time to put your feet up and relax before 2019 is upon us, and flick through Deep-Sea Life Issue 12 to see what your colleagues have been up to. Quite a lot as it happens! They have been re-visiting Tasmanian seamounts, exploring Puerto Rico and US Virgin Island deep-sea habitats, discovering new seeps in the Bering Sea, looking at new sponge grounds and describing new sponge species off the Azores and Canada, amassing new records for deep-sea fauna in the NW Pacific and Arctic, examining the sensitivity of UK deep-sea habitats, and heading off to new areas to explore in the Gulf of Mexico, Australian abyss and SE Pacific seamounts. And that's not all! There are new resources for scientists (e.g. stable isotope ratio database), outreach materials (e.g. educational videos about the Gulf of Mexico) and a plethora of meetings and opportunities. All that, along with many recent publications on a wide range of subjects so you can keep up to date with the latest findings. So, make yourselves comfortable and start by enjoying this photo of the issue showing an origami-inspired rotary-actuated dodecahedron sampling device (AKA the "RAD Sampler"), which is capable of rapidly encapsulating mid-water organisms using a standard manipulator system. The RAD Sampler was tested in collaboration with the Monterey Bay Aquarium Research Institute, and was used to encapsulate a variety of deep-sea mid-water organisms in Monterey Canyon. The device requires only a simple rotary actuator to achieve complex motion, and has numerous potential applications beyond mid-water sampling. (see paper abstract and link on page 39). Thanks to Brennan Phillips for sending this stunning image along.

Thanks too for all the community submissions for DSL12. The editors, Abigail Pattenden (University of Limerick, Ireland), Eva Ramirez-Llodra (NIVA, Norway), Paris Stefanoudis (Nekton Foundation, Oxford, UK) and I all thoroughly enjoyed reading about your work during the editing process.

Dr Maria Baker (Editor)
INDEEP/DOSI co-lead
University of Southampton

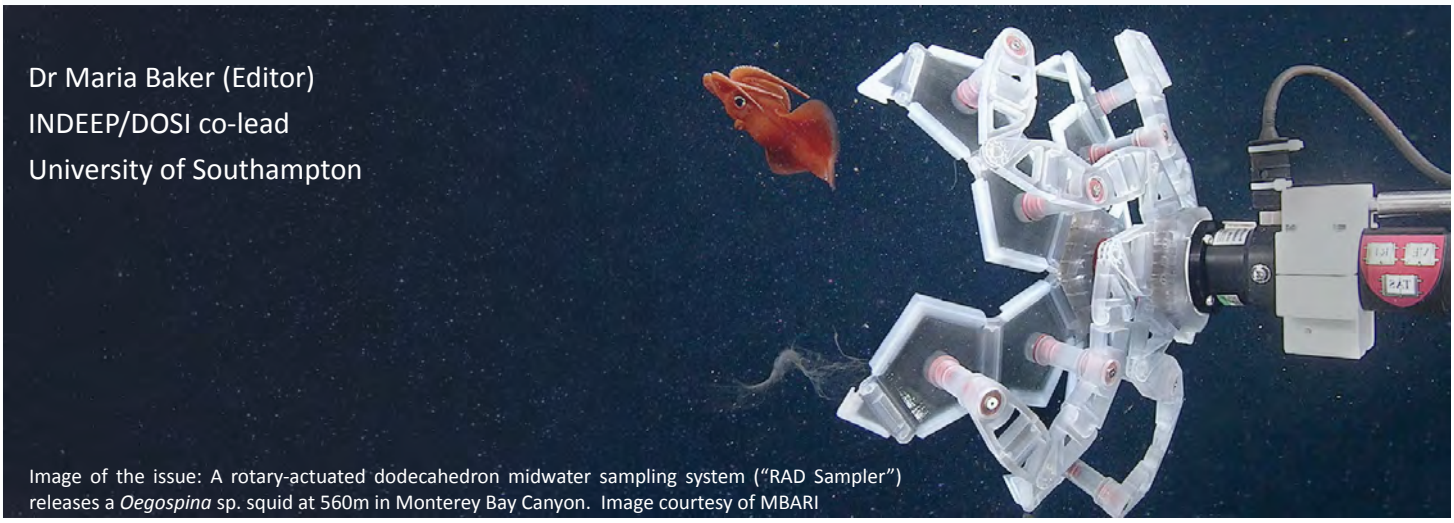


Image of the issue: A rotary-actuated dodecahedron midwater sampling system ("RAD Sampler") releases a *Oegospina* sp. squid at 560m in Monterey Bay Canyon. Image courtesy of MBARI

Issue Contents

Cruise News

Tasmanian seamounts: have deep-sea corals recovered?

Alexandra A.-T. Weber

Marie Sklodowska-Curie Fellow, Museums Victoria

Email: aweber@museum.vic.gov.au

The Tasmanian Seamounts form a cluster of extinct underwater volcanoes to the south of Tasmania (Australia). Due to the uplifted topography of seamounts, marine currents are locally enhanced, which allows suspension feeders to dominate the seamount benthos by making use of the increased nutrient availability. One particularly abundant species of coral (*Solenosmilia variabilis*) forms dense reefs that offer shelter to many benthic invertebrates. Despite the high and largely understudied biodiversity recorded on these seamounts, some were subjected to heavy trawling for the orange roughy (*Hoplostethus atlanticus*) between 1987 until 1999, after which this area became the world's first deep-water marine park. However, due to the slow growth rate of *Solenosmilia*, the coral communities have probably not yet recovered from trawling impacts.

Figure 1. RV *Investigator*. Image courtesy of Alexandra A.-T. Weber / CSIRO

In order to assess the status and recovery of deep-sea coral communities on Tasmanian seamounts, a team led by Alan Williams (Commonwealth Scientific and Industrial Research Organisation, CSIRO), assisted by Malcolm Clark and Thomas Schlacher, organised a deep-sea voyage on the RV *Investigator* (23.11.18-19.12.18). The distributional extent, habitat associations, composition, biodiversity, and biological traits of deep-sea coral and associated fish communities off Tasmania will be determined and mapped using towed camera surveys, baited video imagery, water chemistry and biological collections. A unique aspect of this survey is that post-trawling data are available from previous surveys that started 20 years ago. Thus this voyage will provide a comparative framework and a robust set of empirical data on conservation status, resilience and recovery potential to enhance management and conservation of deep-sea coral habitats in Australia. Finally, these results will have international relevance to understanding and managing fishing impact on comparable deep-sea coral communities.

For more information on the survey: https://www.nespmarine.edu.au/seamounts/landing-page

Océano Profundo 2018: exploration of deep-sea habitats of Puerto Rico and the U.S. Virgin Islands aboard NOAA Ship *Okeanos Explorer*

Daniel Wagner[1], Stacey Williams[2], Steve Auscavitch[3], Derek Sowers[4] and Scott France[5]

[1]NOAA Office of Ocean Exploration and Research, South Carolina, USA; [2]Institute for Socio-Ecological Research, Lajas, Puerto Rico, USA; [3]Temple University, Philadelphia, Pennsylvania, USA; [4]NOAA Office of Ocean Exploration and Research, Durham, New Hampshire, USA; [5]University of Louisiana at Lafayette, Lafayette, Louisiana, USA

Between October 30 and November 20, 2018, the National Oceanic and Atmospheric Administration (NOAA) and partners conducted a 22-day telepresence-enabled expedition on NOAA Ship *Okeanos Explorer* to collect critical baseline information about unknown and poorly understood deep-water areas surrounding Puerto Rico and the U.S. Virgin Islands. The goal of the Océano Profundo 2018 expedition was to use remotely operated vehicle (ROV) dives in combination with mapping operations to increase our understanding of deep-sea ecosystems of this poorly studied region, as well as to provide a foundation of publicly-accessible data to spur further exploration, research, and management activities.

Using NOAA's dual-body ROV the expedition completed 19 successful dives ranging in depth from 250 to 5,000 m to explore a wide diversity of habitats and geological features, including deep-sea fish habitats, deep-sea coral and sponge communities, midwater habitats, submarine canyons, submarine landslides, and more. Midwater explorations at depths ranging from 300 to 900 m were also conducted during two dives to investigate the diversity and abundance of the largely unknown pelagic fauna of the region. Overall, hundreds of different species were observed, including several potentially undescribed species and several range extensions. Throughout the expedition, 81 biological samples were collected (39 primary and 42 associated taxa), 19 of which represent either range expansions or potential new species. The remainder of the biological samples were collected to support studies on connectivity and biogeographic patterns across the Atlantic Ocean.

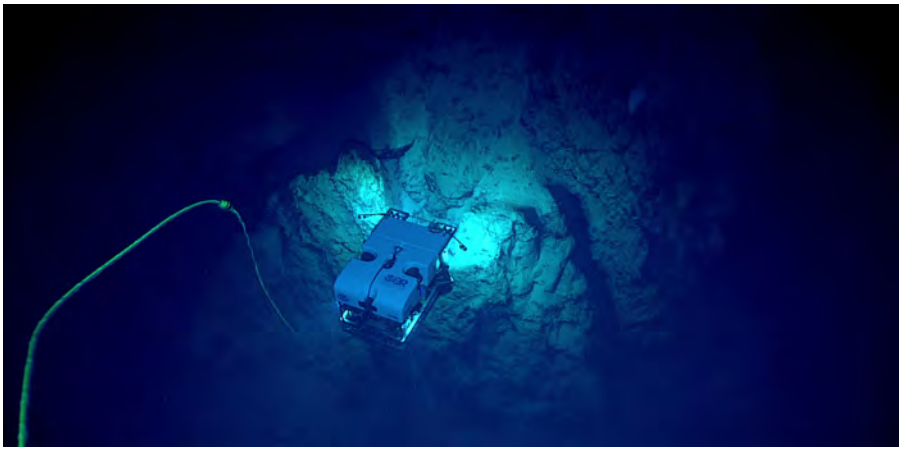


Figure 1. ROV *Deep Discoverer* exploring a narrow ridge at depths between 2,610-2,789 m off the south shore of Puerto Rico.

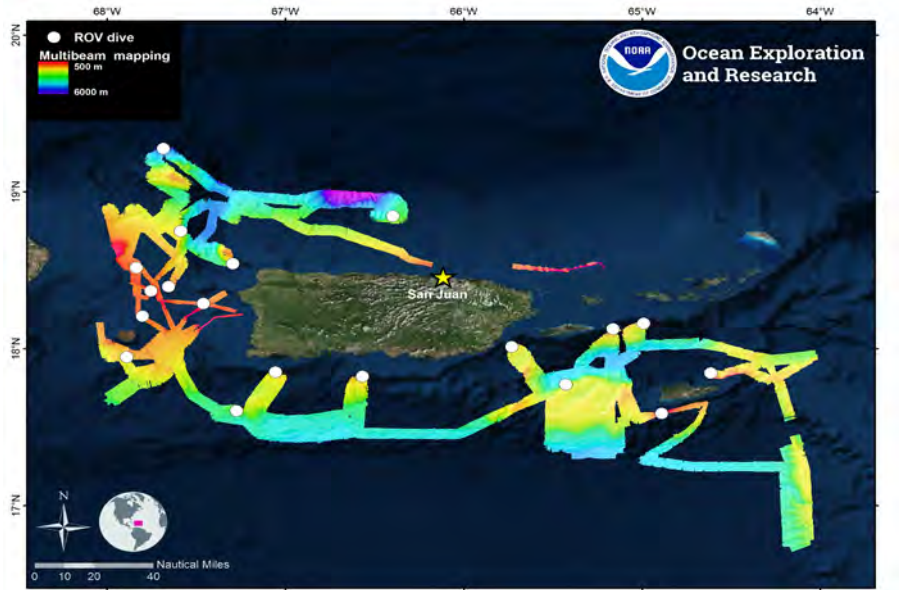


Figure 2. Overview map showing the locations of ROV and mapping operations completed during the Océano Profundo 2018 expedition.

Six high-density communities of deep-sea corals and sponges were documented during the expedition. Commercially important deep-water fish species were documented on six dives, including a sighting of the queen snapper (*Etelis oculatus*) at a record depth of 539 m. Other noteworthy ROV observations included a translucent egg case with a catshark embryo actively swimming inside, first-time documentation of

several species of deep-sea urchins feeding, and documentation of three species of sea stars that are likely new to science. Additionally, the expedition investigated diverse geological features, including two large submarine landslides, one of which is believed to have caused the large tsunami of 1918. Eight rock samples were collected for geochemical composition analyses and age-dating to increase our understanding of the geological context of this region. In addition to ROV dives, the expedition also included mapping operations using four different sonar systems (multibeam, single beam, sub-bottom profiler and ADCP). Over 14,959 km^2 of seafloor were mapped over the course of the expedition, including areas around Mona Island, Saba Valley, and Engaño Canyon that had never before been mapped using high-resolution sonars.

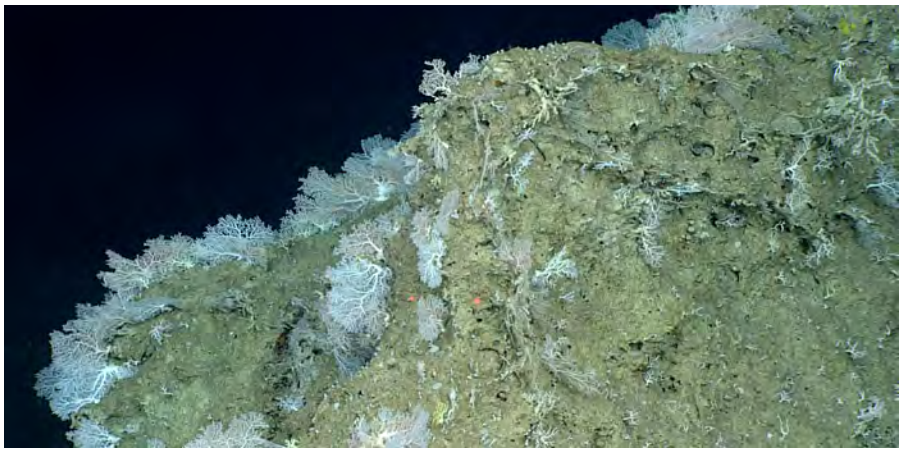


Figure 3. High-density community of stylasterid corals recorded at 300 m west of Desecheo Island off the west shore of Puerto Rico.

Figure 4. Commercially valuable queen snapper *Etelis oculatus* seen at a record depth of 539 m off the south shore of Puerto Rico.

All 14.2 TB of data collected during the expedition, including video and environmental data collected on every ROV dive, mapping data, oceanographic and meteorological data, will be made publicly available through national archives in the coming months. Highlight images, videos and description of the accomplishments of the expedition, as well as educational materials, are already available via the expedition website. A total of 63 scientists, managers, and students from 37 institutions in seven countries participated in the expedition as members of the science team through telepresence.

Multidisciplinary exploration of the chemosynthesis-based communities in the Bering Sea during the 82nd Cruise of RV *Akademik M.A. Lavrentyev*

Elena M. Krylova[1], Andrey V. Adrianov[2], Sergey V. Galkin[1], Vitaly A. Denisov[2], Vladimir V. Ivin[2,3], Andrey N. Malutin[2], Pavel E. Mihailik[4], Vladimir V. Morduhovich[2,5], Nikita S. Polonik[6], Nadya P. Sanamyan[7], Vladimir A. Shilov[2]

[1]Shirshov Institute of Oceanology, Moscow, Russia; [2]A.V. Zhirmunsky National Scientific Center of Marine Biology, Vladivostok, Russia; [3]Berg State Research Institute on Lake and River Fisheries, St-Petersburg, Russia; [4]Far Eastern Geological Institute, Vladivostok, Russia; [5]Far Eastern Federal University, Vladivostok, Russia; [6]V.I. Il'ichev Pacific Oceanological Institute, Vladivostok, Russia; [7]Kamchatka Branch of the Pacific Institute of Geography, Petropavlovsk-Kamchatsky, Russia

Email: elenamkr@mail.ru

Reducing environments are widely distributed across the world's oceans at different depths and latitudes in various geological settings. However, until now there has been no evidence of reducing biotopes in as large a region as the Bering Sea, with exception of the Piip's Volcano in the south-western basin corner. Nevertheless, occasional records of empty valves of chemosymbiotrophic bivalves, solemyids and vesicomyids on the continental slope of the Bering Sea indicated the existence of reducing environments.

On 2 June 2018 a multidisciplinary expedition onboard RV *Akademik M.A. Lavrentyev*, conducted by the A.V. Zhirmunsky National Scientific Center of Marine Biology, set out for a 1.5-month cruise to discover and explore unknown or poorly-known chemosynthesis-based communities of the Bering Sea (Fig. 1).

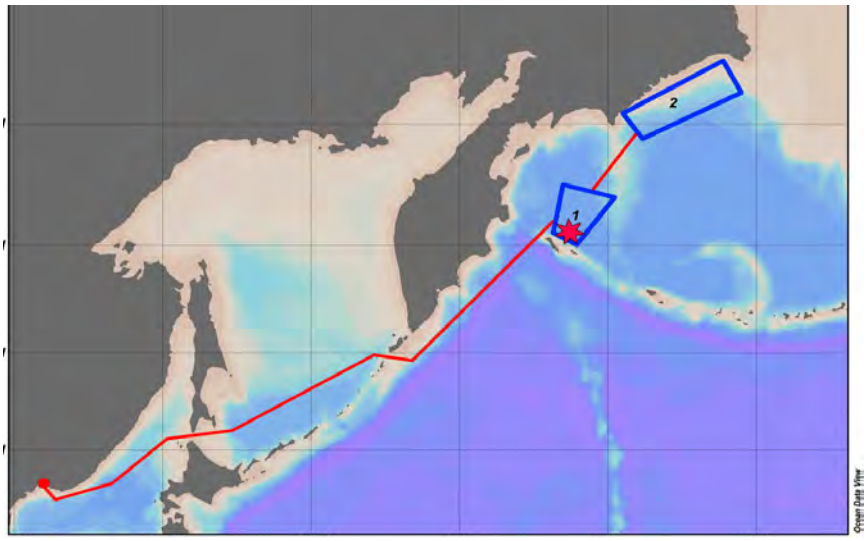


Figure 1. RV *Akademik M.A. Lavrentyev* track (red line) and study areas: southern slope of the Vulkanologov Massif (1) with the Piip's Volcano (star) and Chukotka slope of the Bering Sea (2).

The primary objectives of the expedition were to survey areas with potential reducing conditions in the Bering Sea, including hydrothermal vents and cold seeps, to study their geological settings and chemical composition of fluids, and to explore the composition and structure of chemosynthesis-based communities hosted by reducing environments.

The main tool for the exploration of these chemosynthetic ecosystems was the ROV *Comanche 1*. A total of 21 ROV dives were completed between 356 to 3931m depth. Biological and geological samples were collected and more than 32 hours of video footage were recorded. Additionally, water samples were taken at different water depths for the identification of methane content and various chemical parameters and plankton samples.

The expedition also studied the distribution of macro and mega-benthos on the southern slope of the Vulkanologov Massif (south-west Bering Sea) between 475 to 3931m depth. The most characteristic features of bathymetric distribution were the presence of dense populations of benthopelagic Trachymedusae at the depth of about 2600 m, massive aggregations of the acorn worms Enteropneusta (fam. Torquaratoridae) at the depth of about 1900 m (Fig. 2), and glass sponge reefs inhabited by rich and diverse fauna at depths of 1010-1760 m. We contributed to the knowledge on composition and functioning of previously recorded hydrothermal communities of the Piip's Volcano (Figs. 3-5).

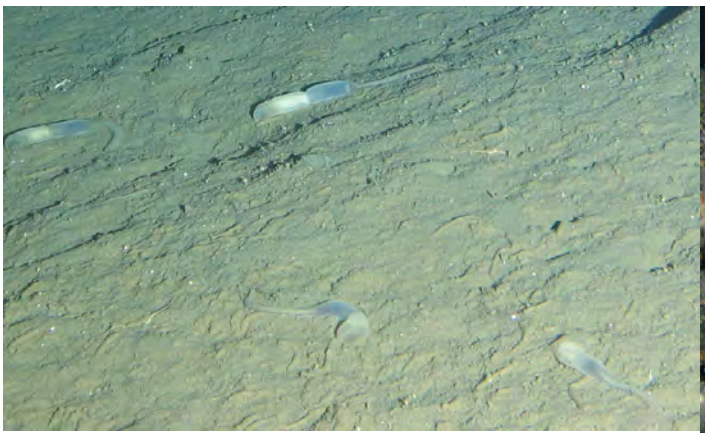


Figure 2 (above left). Acorn worms (Enteropneusta, Torquaratoridae), southern slope of the Vulkanologov Massif, 1897 m.

Figure 3 (above right). Kingdom of anthozoans on the northern top of the Piip's Volcano, 380 m: bed of zoantharians to the right, small sea anemones Sagartiidae gen. sp. to the left and around the large orange sea anemone *Actinostolidae* gen. sp., *Corallimorphus pilatus, Anthomastus ritteri* and rockfish *Sebastes* sp.

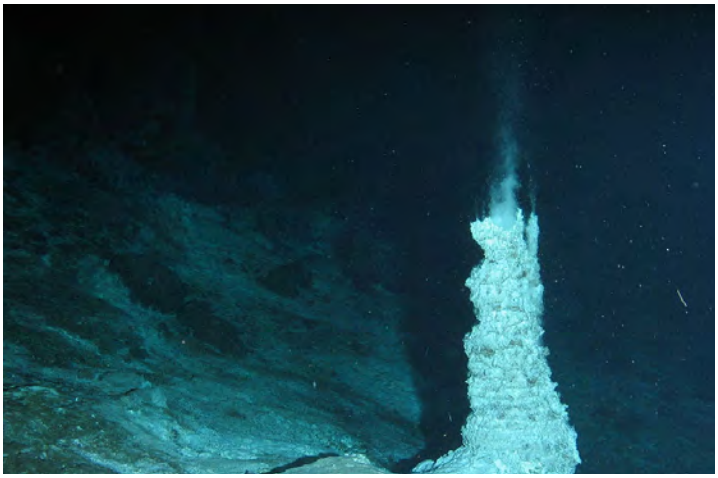


Figure 4. Northern top of the Piip's Volcano, 388 m, anhydrite chimney.

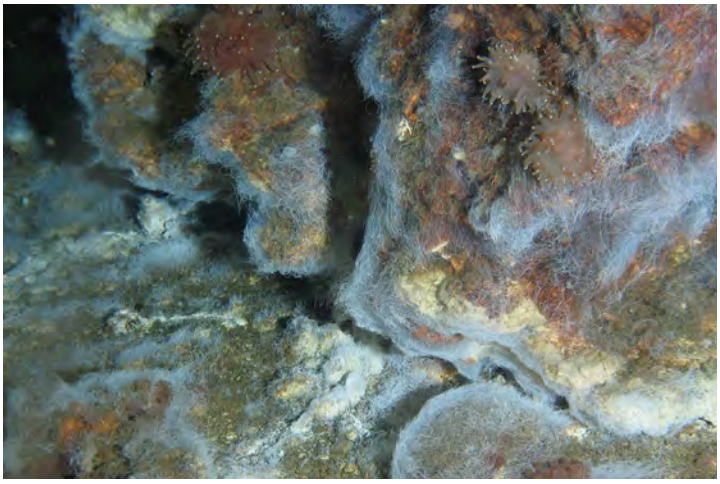


Figure 5. Southern top of the Piip's Volcano, 470 m, bacterial mat and *Corallimorphus* sp.

However, one of the main results of the expedition was the discovery of a new seep region on the Chukotka slope of the Bering Sea between 400-700 m. Five seep sites were located. They could be divided into three types by depth of occurrence and the composition of background fauna. The seep specialist, bivalve *Calyptogena pacifica* (Pliocardiinae) was present in communities of all three types (Fig. 6).

The first type included seep communities from depths of 647-695 m with the background fauna comprising *Ophiophtalmus normani* (Ophiuroidea) and *Macrura Natantia.* Other seep specialists besides *C. pacifica* in these communities were the siboglinid worms. Faunal diversity and abundance in these communities were much higher compared to the background. Communities of the second type occurred at depths of 417-429 m. The background fauna there included the coral Protoptilum with the commensal ophiuroid *Asteronyx* and the echinoid *Brisaster latifrons*. The latter was obviously attracted to the seep areas where its abundance was higher than in the background (Fig. 7). The third type included communities from 400-402 m depth with the background fauna mainly consisting of sea anemones of the family Sagartiidae. An apparent response of the background fauna to seeps at this depth was not recorded.

Chemosynthesis-based communities on the Chukotka slope of the Bering Sea are the northern-most of their kind in the Pacific, and the Chukotka population of Calyptogena is the northern-most Recent population of pliocardiines in the World Ocean. There is reason to believe that reducing communities on the slope of the Bering Sea are distributed much wider than currently documented, and further research efforts will result in discovery of more northern areas with reducing environments.

The expedition was financed by the Federal Agency of Scientific Organisation of Russia with participation of Russian Science Foundation (project no. 14-50-00034) and Russian Foundation for Basic Research (project no. 18-05-60228).

Figure 6 (above left). Population of *Calyptogena pacifica,* 660 m, Chukotka slope.

Figure 7 (above right). The echinoids *Brisaster latifrons* attracted by bacterial mat, 417-429 m, Chukotka slope.

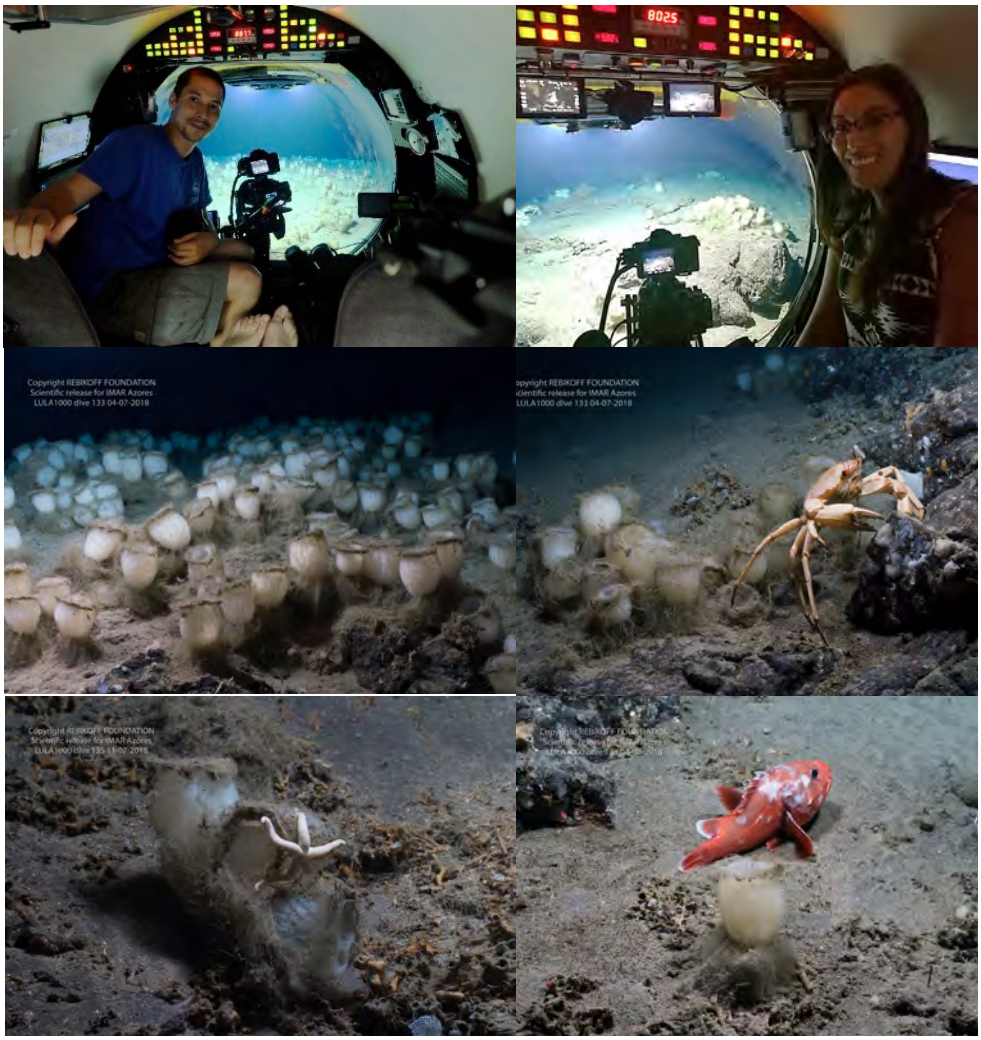
Sponges on the rocks:
Exploring a new deep-sea sponge ground of the Azores (Portugal)

Marie F. Creemers, Christopher Pham, Antoine Defise, Joana Goulard, Vasco Smith, Ana P. Silva, Ana Colaço

OKEANOS/ IMAR/ MARE - Department of Oceanography and Fisheries, University of the Azores, 9901-862 Horta, Portugal

Email: marie.f.creemers@uac.pt

The recent discovery of a large aggregation of *Pheronema* sponges south of Pico island (Azores, Portugal) led to an exploratory campaign aboard the manned submersible *LULA1000* of the Rebikoff-Niggeler Foundation in July 2018. Three dives were performed between 700 and 950 meters to obtain high-resolution imagery of this spectacular habitat, and to collect seawater and sponge samples to investigate the functional ecology and microbiology of *Pheronema* sponges. For that purpose, all dives were documented with high-resolution video footages and close-up still images, meanwhile sponges and seawater samples were also collected.



Above: Christopher Pham and Marie Creemers (members of the Azores SponGES team, IMAR-Dept. of Oceanography & Fisheries) diving in the submersible LULA1000 of the Rebikoff-Niggeler Foundation to explore a Pheronema sponge aggregation. Photo credits: Rebikoff-Niggeler Foundation.

During each dive, we were stunned by the high density of sponges and the great diversity of organisms associated with these aggregations, which included gorgonians, black corals *Leiopathes* sp., cf. *Bathypathes* sp.), paxillosid asteroids, carid shrimps, ceriantharian tube-dwelling anemones and erected bryozoans (*Reteporella* sp.) among others. In addition, various fish were encountered, such as the blackbelly rosefish (*Helicolenus dactylopterus*), the monkfish (*Lophius* sp.), the channeled rockfish (*Setarches guentheri*) and sea toads (*Chaunax* sp.). Moreover, different species of deep-sea cephalopods were observed within and in the vicinity of the ground, including oegopsid squids and octopods (cf. *Pteroctopus tetracirrhus*).

Back in the laboratory, sponge biometrics were measured, and pieces were taken for biochemical and food chain analyses. Additionally, the associated epifauna and infauna were collected for identification and quantification.

This expedition to a unique sponge ground revealed a diverse ecosystem inhabited by numerous benthic and bathypelagic species. Upcoming results of the food web analysis will help to understand and quantify the importance of

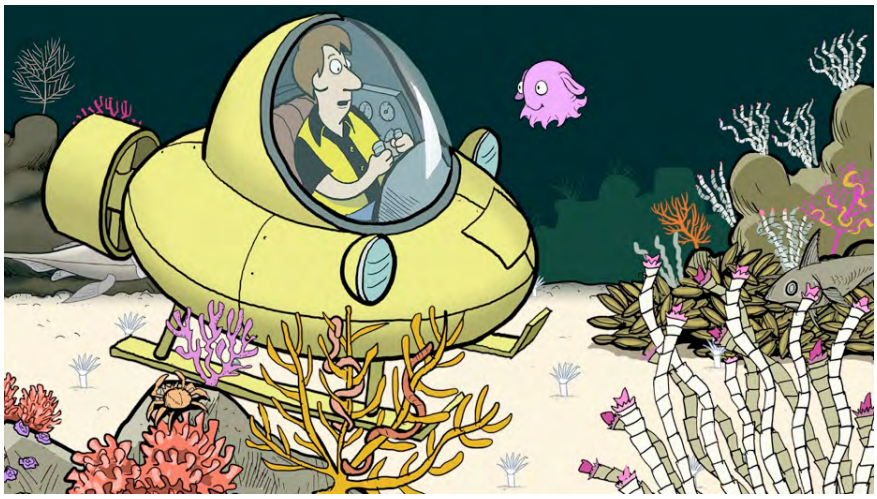
Pheronema aggregations as a food supply for their associated fauna. Moreover, additional sponge samples were collected during other summer cruises of 2018 at different locations around the Azores. These samples will be analyzed following the same protocol to investigate the ecological role of *Pheronema* sponges at a larger spatial scale.

This research has been performed in the scope of the SponGES project, which received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 679849. Ana Colaço is supported by Programa Investigator (IF/00029/2014/CP1230/CT0002) from the FCT. The authors would like to acknowledge the *LULA100* pilot and co-pilot Joachim and Kirsten Jakobsen from the Rebikoff-Niggeler Foundation for the videos and images. This document reflects only the authors' view and the Executive Agency for Small and Medium-sized Enterprises (EASME) is not responsible for any use that may be made of the information it contains.

Project Focus

Watch The Adventures of Zack and Molly!

http://www.ecogig.org/zackandmolly



ECOGIG video series and learning guide now available to the public!

The Adventures of Zack and Molly is a new, three-part video series about an unlikely duo exploring the deep ocean produced by ECOGIG in collaboration with Sherman's Lagoon creator and filmmaker Jim Toomey.

Zack is more interested in the small world of his smartphone than the larger world around him. His online request for a roommate is answered by Molly, a tech-savvy Dumbo Octopus on a mission to tell the world about the importance of the deep ocean. Molly wants to use Zack's apartment for her global communications headquarters, but Zack is skeptical. To win Zack over, Molly takes him to her deep ocean home in the Gulf of Mexico to see its unique features and diverse marine life, and to help him understand how human activities threaten its health.

Where can I view the series?

On YOUTUBE
On VIMEO

Learning guide

The LEARNING GUIDE provides discussion points, connections to Next Generation Science Standards, hands-on activities, and further resources.

ECOGIG GLOBAL: ECOSYSTEM IMPACTS OF FLUID AND GAS INPUTS FROM THE GEOSPHERE

The ECOGIG Global Program aims to bring together scientists in a trans-disciplinary framework to discover, examine, and understand the broad implications of fluid discharge on biological and chemical dynamics of ocean systems. Our efforts focus on five themes: Geophysical Drivers; Biological Community Structure; Regulation of Biological Activity; Geochemical Dynamics; and Ocean Connectivity and Resilience. These themes are inter-dependent to varying degrees; our goal is to bridge long-standing gaps between disciplines to promote holistic discovery. Our overall goal is to connect the disciplinary dots to identify the geophysical, climatic, and geochemical drivers that generate variations in

biological populations and activity in the sediments and waters influenced by fluid discharge and to constrain the fate of discharged materials in the system.

Deep-sea soft-bottom benthic communities: Exploring biogeography and genetic connectivity of southeast Pacific Seamounts

Eulogio Soto[1], Eduardo Quiroga[2]

[1]Universidad de Valparaíso, Chile; [2]Pontificia Universidad Católica de Valparaíso, Chile

Email: eulogio.soto@uv.cl, eduardo.quiroga@pucv.cl

Deep-sea benthic communities inhabiting the sediment seafloor of seamounts located in the southeast Pacific Ocean will be investigated. The study site will cover a longitudinal transect at 25-26°S from Chilean continental margin (77°W) to the Indo-West Pacific Region (112°W), exploring target seamounts on Nazca Ridge (Nazca-Desventuradas Marine Park), Salas y Gomez Ridge and near Easter Island (now named Rapa Nui). The main goals will be to investigate the biogeography and genetic connectivity of benthic communities; assess their response to different food supply regimes in terms of biodiversity, benthic standing stock, and describe the main sediment drivers (biogeochemical variables) affecting to the fauna distribution patterns. In this sense, seamounts from highly productive areas to oligotrophic areas will be sampled to test a first hypothesis related to how different food supply regimes to the seabed influence the benthic standing stock and biodiversity. Additionally, we postulate that Salas y Gomez Ridge would be a transitional zone between Nazca Ridge and Easter Island Ridge, therefore this zone may act as biogeographic-genetic 'stepping stones' between both zones. The oceanographic cruise will be carried onboard R/V *Mirai* in 2019 and sediment samples will be taken on target seamounts using Multiplecorer and Agassiz trawl. Results will allow the description of soft-bottom benthic fauna from one of the most unexplored regions in the world; to improve our knowledge and understanding of biogeographic distribution patterns and their genetic connectivity and assessing the standing stock response to different food supply regimes for this fauna. Information obtained will allow a review of the geographic boundaries of bathyal benthic fauna in the region and support management measurements for newly created Marine Protected Areas, considering the current high fisheries pressures, global change increasing and relevant conservation categories (VME, EBSAs) that these seamounts have.

The project is led by Dr Eulogio Soto (Universidad de Valparaíso) and Dr Eduardo Quiroga (Pontificia Universidad Católica de Valparaíso) both from Chile. Dr Greg Rouse (Scripps Institution of Oceanography, University of California in Sand Diego) and Dr Jeroen Ingels (The Florida State University) are scientific partners. The research is part of the "East/ Central Pacific International Campaign (EPIC)", MR18-06 on board the R/V *Mirai*, Jamstec and will take place during Leg 3 (Chief Scientist: Dhugal Lindsay, Jamstec) from 27 January 2019, Valparaiso, Chile to 2 March 2019, Papeete, Tahiti, French Polynesia.

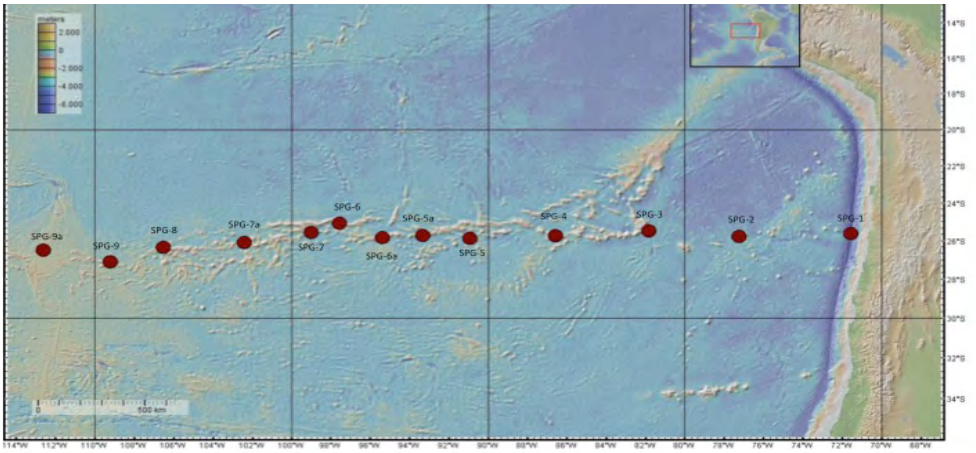


Figure 1. Study site showing the sampling stations.

Post-cruise funding is highly required and necessary for sample analysis and outreach.

Deep-sea fauna in the NW Pacific: biodiversity patterns and future invasions into the Arctic Ocean (Beneficial Project)

Hanieh Saeedi*[1,2,3], Marianna Simõesa,[2], Angelika Brandt[1,2]

[1]Senckenberg Research Institute and Natural History Museum; Department of Marine Zoology, 60325 Frankfurt am Main, Germany; [2]Goethe University Frankfurt, Institute for Ecology, Diversity and Evolution, 60438 Frankfurt am Main, Germany; [3]OBIS Data Manager, Deep-Sea Node

Email: hanieh.saeedi@senckenberg.de; Marianna.simoes@senckenberg.de

Over the last year we have studied the biodiversity patterns of the shallow and deep-sea fauna of the NW Pacific and Arctic Ocean. In collaboration with researchers from New Zealand (Dr. Mark Costello, University of Auckland) and Senckenberg Biodiversity and Climate Research Centre (Dr. Dan Warren), we analyzed 34,916 distribution records of 17,414 species from 0 - 10,900 m depth, 0 to 90 degrees latitude, and 100 to 180 degrees longitude. This study is an important contribution to the marine science society in order to better understand the biodiversity patterns of shallow-water and deep-sea species, and their driving factors. This is the first time that the biodiversity of the NW Pacific and its adjacent Arctic Ocean have been studied at this scale, and that environmental driving factors were considered. We considered how using different biodiversity indices could change the results and interpolation of the important driving factors in creating the biodiversity gradients. To our knowledge, this is the first time that the biodiversity of the NW Pacific has been studied, including all shallow-water and deep-sea marine species. The results are very important as we show that species richness decreases at the equator and towards the deep sea.

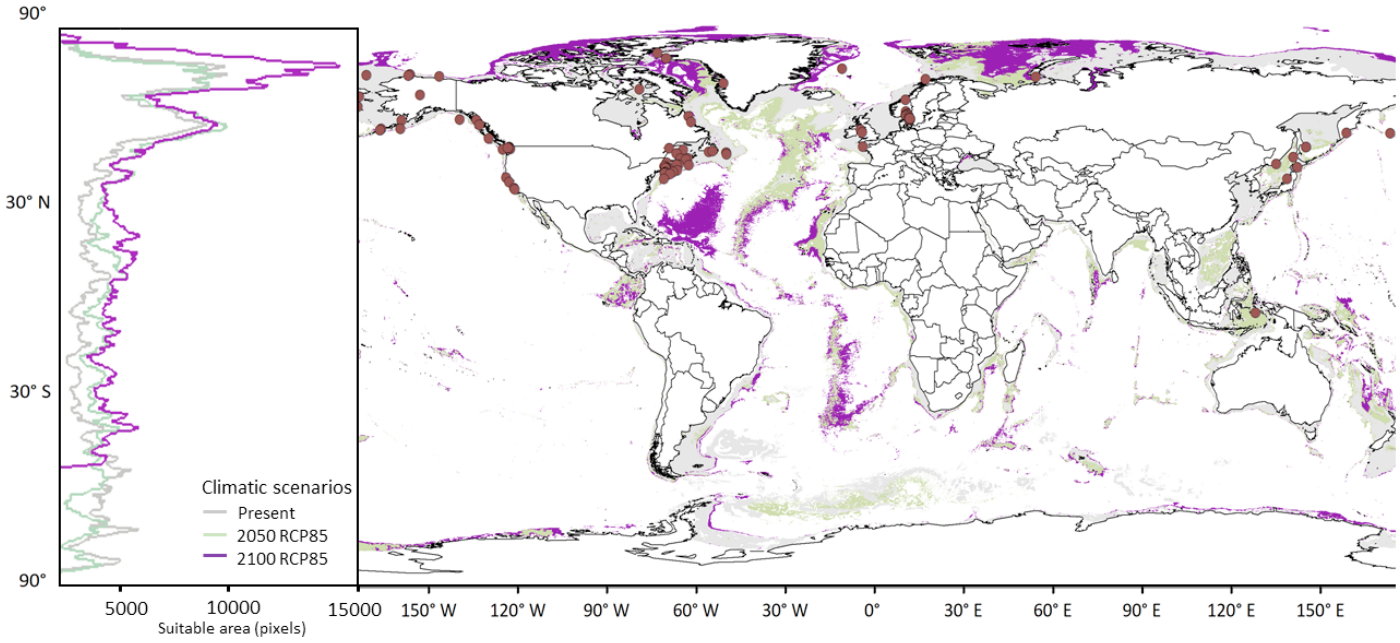


Figure 1. Current and future suitable areas for *Hemiarthrus abdominalis* (Kroyer, 1840). Histogram (left) shows latitudinal distribution of areas that will become suitable for invasion under different future climatic scenarios (present in grey, 2050 in green and 2100 in purple). Map (right) shows binary layers of suitability and distribution records for *H. abdominalis* in brown circles (colors correspond to histogram densities).

From the dataset built on the NW Pacific and Arctic fauna, we will assess the shift of current suitable habitat for species from the NW Pacific in the face of anthropogenic climate change over the remainder of the century. For this, two projects are being developed with a focus on taxa represented in the NW Pacific fauna that are considered to be efficient invasive species and are reasonably well-sampled geographically: crustaceans (fig. 1) and bivalves. The dataset includes occurrence records obtained through sampling in the NW Pacific, i.e., the Beneficial project, as well as the Ocean Biogeographic System (OBIS) and Global Biodiversity Information System (GBIF), comprising more than 5 million global records for more than 700 species. The forecast of habitat suitability is based on a machine-learning technique

called maximum entropy modeling, where the correlation between a set of environmental grids and georeferenced occurrence localities, generates a model expressing probability distribution of predicted suitability of conditions for the modelled species. In collaboration with researchers in the United States (Marlon Cobos, University of Kansas), we developed robust models calibrated using two distinct environmental datasets, seven feature classes and nine regularization multipliers, resulting on 126 models per species. Model selection was done based on statistical significance, prediction ability, and model complexity. Final model projections were built under three distinct extrapolation settings and evaluated based on overall model variability. Preliminary results indicated multidirectional distributional shifts, but considerate poleward distributional shifts, characterizing the Arctic Ocean as a highly risked habitat considering future climatic scenarios. Moreover, for the first time we provide statistical assessment of environmental variable relevance for each species distribution. The impact of present climate changes on deep-sea biology is limited to a few example species, and the effects on ecosystem functioning and biodiversity remain almost completely unknown. Thus, this study is highly relevant for conservation planning purposes aiding determination of areas of gain, loss and stability of habitat suitability under future climatic scenarios, for shallow-water and deep-sea fauna. Future steps include measuring geographical and environmental suitability centroid shifts of individual species, and investigation of impacts at the community level.

Towards a global, freely available database of stable isotope ratios for deep-sea ecosystems

Loïc N. Michel

Ifremer

Email*:* loicnmichel@gmail.com

There is a long tradition of using stable isotopes to study trophic interactions in deep-sea ecosystems. This method has brought many insights over the years. However, the vast majority of past studies are site-specific and, as a result, much is left to discover about factors globally influencing food web structure in deep-sea ecosystems.

To help address this issue, we are setting up a large-scale compilation of stable isotope ratios in deep-sea organisms. The compiled database will soon be freely available online. In doing so, we aim to provide the deep-sea community with an open data-analysis tool that can be used in the context of future ecological research, and to help deep-sea researchers to use stable isotope markers at their full efficiency. Moreover, the database will offer a stable and visible place to store your isotopic data, which will ensure that your hard-earned data points will receive the attention they deserve and continue to do so in the future.

To maximise the scope of the project, we are looking for raw data underlying either published articles or unpublished / grey literature. If you are willing to contribute, or if you have any question about the project, please contact Loïc N. Michel (loicnmichel@gmail.com) or visit https://loicnmichel.wordpress.com/deepseabase/.

This project's core working group currently includes Loïc N. Michel, Stanislas F. Dubois, Karine Olu, Jozée Sarrazin (Ifremer, FR), Brian Hayden (University of New Brunswick, CA), Gilles Lepoint (University of Liège, BE), and Gauthier Schaal (University of Western Brittany, FR).

Exploration of the deep Eastern Gulf of Mexico

J. Ingels[1]; S. Brooke[1], A. Baco-Taylor[1], S.L. Morey[2]

[1]Florida State University; [2]Florida Agricultural and Mechanical University

The Florida State University Coastal and Marine Laboratory, on the Gulf of Mexico (GoM) coast in north Florida, is a beautiful place. It is not uncommon there to see ospreys and bald eagles eyeing the coastline, pelican formations flying low, dolphins churning the water in a feeding frenzy, or sharks cruising the shallows seeking out their next meal. It is also a place where a clear view of the horizon when standing on the beach is the rule, rather than the exception. Unfortunately, this is not the case everywhere in the GoM, with 1000s of miles of pipelines and 100s of oil and gas platforms to the west of Florida. The image that illustrates this like no other was shown during Tracy Sutton's plenary talk at the Deep-Sea Biology Symposium in Monterey last September (Fig.1). This map shows the stark contrast between the unexplored nature of Florida's Gulf waters, and the waters to the west, taken over by energy production. The contrast is the result of Florida's federal exemption for oil and gas exploitation, and in Florida's state waters there is an oil drilling ban which has recently been voted into the state's constitution. Whether or not the federal exemption will last into the longer-term future is unsure, but in the meantime it does mean that the waters are unaffected by oil and gas drilling and are underexplored, with relatively little research effort in the region.

Most deep-sea research in the deep GoM has focused on the northern region, particularly areas that are important for the energy industry. These efforts, funded primarily by the Bureau of Ocean Energy (BOEM), have contributed to the discovery of extensive chemosynthetic and deep-sea coral (DSC) communities in the northern GoM, advancing our understanding of sediment infaunal communities. New research efforts recently funded by the National Academies of Science Gulf Research Program will expand physical oceanographic observations and study of the deep Gulf, but there will be few if any new observations on the outer shelf and escarpment in the eastern Gulf. The eastern GoM, therefore, remains relatively unexplored; the moratorium on oil and gas extraction has precluded this area from BOEM funding, and the deep west Florida slope is a remote and challenging place to work. In recent years, NOAAs Office of Ocean Exploration and the NOAA Deep Sea Coral Research and Technology Program have conducted a number of mapping and surveying cruises on the West Florida Slope. Multibeam bathymetry revealed a topographically complex area with scarps, mounds and ridges that are conducive to development of DSC ecosystems. Remotely operated vehicle (ROV) surveys confirmed the presence of abundant and diverse deep coral communities, including several large Lophelia pertusa reefs at depths of ~500m, and diverse assemblages of octocorals and black corals along the scarps and ridges of this topographically complex region (Fig. 2).

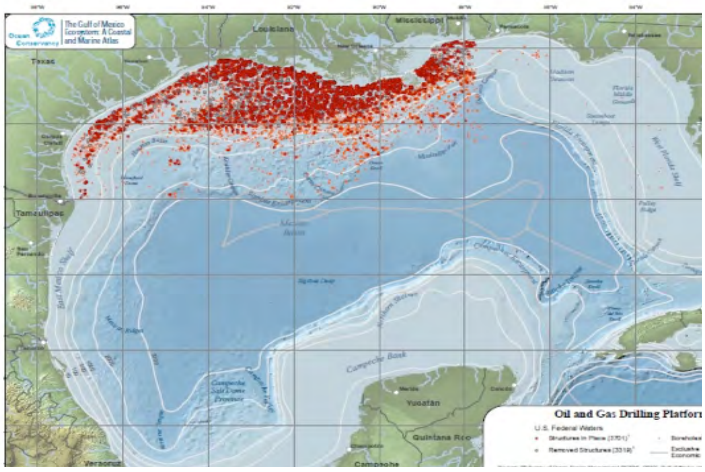


Figure 1. Map of Gulf of Mexico, US oil and gas drilling platforms and boreholes

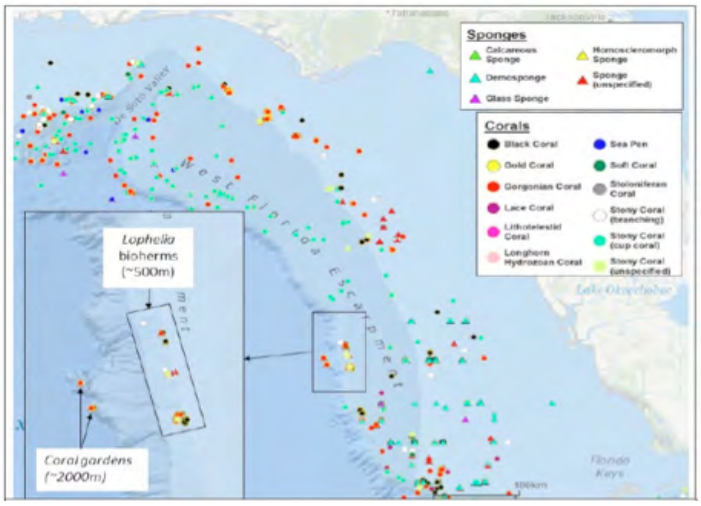


Figure 2. Coral and sponge records for the eastern GOM. Black inset box shows area of extensive *Lophelia* mounds at 500m, but there are very few records >1000m depth along the entire length of the Florida escarpment. Image courtesy of DSCRTP Data Portal.

Under the lead of Dr. Sandra Brooke, a team of Florida

Figure 3. Golden crab hiding in deep-water coral reef (Lophelia) on the west Florida Slope (Credit: Ross et al. 2010 ROV *Kraken*, USGS DISCOVRE)

State University (Brooke, Jeroen Ingels, Amy Baco-Taylor) and Florida Agricultural and Mechanical University (Steven Morey) scientists were awarded a grant under the NOAA Ocean Exploration call, to investigate deep-water ecosystems in the Gulf of Mexico.

The one-year project will focus on the deep (>1,000m) habitats and associated communities of the West Florida Slope. Bathymetric maps, habitat suitability models and a high-resolution oceanographic model will be used to select target study sites, and the oceanographic model will be validated using meiofaunal communities in a novel approach. New information on deep coral habitats and associated communities will be generated using digital imagery, and species assemblages will be identified using morphological taxonomy and genetic techniques. An ROV and benthic sampling cruise has been planned to take place in autumn 2019.

Collaboration with NOAA will ensure the new data and the high resolution oceanographic model is incorporated to refine the coral predictive habitat models for deeper portions of the Gulf of Mexico.

Deep ocean discoveries appeal to the public sense of exploration and help to create excitement for ecosystems that are inaccessible to the vast majority of people, but are vulnerable to human activities. This project has great scope for such discoveries and outreach opportunities. Information generated by this work will be disseminated to the scientific community, resource managers and the general public, to stimulate future research and conservation efforts.

Polychaete assemblage composition and distribution from Australia's Eastern Abyss

Laetitia Gunton[1], Elena Kupriyanova[1,2], Pat Hutchings[1,2], Robin Wilson[3], Anna Murray[1], Hannelore Paxton[1,2], Ingo Burghardt[1], Jinghuai Zhang[1,4], Tim O'Hara[3]

[1]Australian Museum Research Institute, Australian Museum, 1 William Street, Sydney, NSW 2010, Australia; [2]Macquarie University, Sydney, NSW 2109, Australia; [3]Museums Victoria, GPO Box 666, Melbourne, VIC 3001, Australia; [4]South China Sea Environmental Monitoring Center, State Oceanic Administration, 155 Xingangxi Road, Guangzhou, P. R. China

Email: Laetitia.gunton@austmus.gov.au

The abyssal environment makes up around 30% of Australia's marine territory, and off the east coast the shelf break usually occurs within only 15 km of the shoreline. Despite this, very few studies have investigated the Australian abyssal environment. The 31-day expedition 'Sampling the Abyss' on board the Marine National Facility research vessel *Investigator*, led by Museums Victoria and supported by CSIRO and NESP Marine Biodiversity Hub in 2017, was the first Australian research cruise focused on investigating the abyssal environment from Tasmania to southern Queensland. Forty-nine beam trawl samples were collected from 13 sites. These trawl samples were conducted at both lower bathyal (~ 2500 m) and abyssal depths (~ 4000 m). A total of about 600 polychaetes from 24 families were recorded, with Ampharetidae, Maldanidae and Onuphidae being the most abundant polychaete families. Further investigation into these families revealed new species and interesting patterns in species abundance and distribution between sample

sites and sample depths. This project will contribute to the understanding of polychaete abundance, diversity and connectivity in the poorly-sampled deep-sea environment off the coast of Australia.

To view our poster from the Deep-sea Biology Conference 2018 please see here or for more information contact me (Laetitia.gunton@austmus.gov.au).

Hats off to this collaboration: SponGES pairs up with Ocean Tracking Network to study unique deep-water sponge

Gabrielle Deveau

Ocean Tracking Network, Dalhousie University, Canada

In the summer of 2016, technicians from the Ocean Tracking Network (OTN) discovered a unique species of marine sponge growing on their receiver moorings during a routine service trip of the Halifax Line — OTN's longest acoustic tracking array, stretching over 200 kilometres from Halifax to the Scotian Shelf break. The species was identified as the Russian hat sponge (*Vazella pourtalesii*) by Dr. Ellen Kenchington, a research scientist with Fisheries and Oceans Canada (DFO).

Figure 1. ROPOS arm collects Russian Hat sponge (*Vazella pourtalesii*) from the seafloor for research off Nova Scotia's coast (photo: CSSF using ROPOS Zeus-Plus HD camera)

Kenchington studies Russian hat sponges through the EU Horizon 2020-funded Deep-Sea Sponge Grounds Ecosystems of the North Atlantic (SponGES) project, a research initiative to improve the preservation and sustainable exploitation of Atlantic marine ecosystems. After discovering the species' apparent fondness for OTN's equipment in 2016, samples were collected from moorings over the following year to study their population structure, reproduction, and the genetic kinship between the sponges within and between receiver moorings.

Figure 2. OTN receiver float covered in *Vazella* sponges, amongst other biofouling (photo: DFO)

Russian hat sponges create habitats for other species, influencing the abundance of invertebrates and fish in the area by forming three-dimensional structures on the seafloor that fish and crustaceans can find shelter and safety in as well as some food resources. Understanding their distribution and how these sensitive organisms adapt to changing ocean conditions will be vital in their conservation and the preservation of biodiversity in areas where they're found.

In the summer of 2017, OTN participated in an oceanographic cruise in partnership with DFO and the SponGES project. The eight-day voyage took place aboard the CCG *Martha L. Black*, sailing from Sydney, Nova Scotia and returning to port at DFO's Bedford Institute of Oceanography in Dartmouth.

The ship set out to gather information on the Russian hat sponge inside the Emerald Basin and Sambro Bank areas. The areas, known to contain dense populations of *Vazella* from previous studies, are currently closed to all bottom fishing

Figure 3. *Vazella* sponges settled in the crevices of OTN receiver float (photo: DFO)

Figure 4. Aggregation of *Vazella* sponges on the seafloor off Nova Scotia's coast (photo: CSSF using ROPOS Zeus-Plus HD camera)

Figure 5. Aggregation of *Vazella* sponges on the seafloor off Nova Scotia's coast (photo: CSSF using ROPOS Zeus-Plus HD camera)

to protect these extraordinary animals. Sponges were collected from the seafloor using a Remotely Operated Platform for Ocean Science (*ROPOS*) — a large ROV, the Canadarm of ocean exploration, owned and operated by the not-for-profit Canadian Scientific Submersible Facility (CSSF).

During the cruise, OTN field technician Joe Pratt was on a mission to recover a receiver mooring from the Halifax Line, which was cleared of biofouling *Vazella* on a previous trip in the prior year. The task proved more difficult than expected aboard the CCG Martha L. Black.

"We had a few issues with the recovery — the station we wanted, mooring 276, was in an area known to be densely populated with *Vazella* sponges, but the receiver was non-responsive. We tried to grab the one next to it, but we still couldn't get a signal," said Pratt. It's possible the equipment struggled to communicate with the mooring's acoustic release underwater, likely due to the ship's underwater engine noise. After several unsuccessful attempts, Pratt boarded a rescue craft where he successfully released and recovered another adjacent mooring about 500 m away. When asked about the overall mission, Pratt was pleased. "Despite the rough seas and difficulties in the field, the whole crew was great to work with. It's a very interesting project to be a part of." Recruits of *Vazella* sponge that settled on the receiver over the year will provide researchers with more accurate measures of the species' growth rate.

Assessing the sensitivity of UK deep-sea habitats using the MarESA approach

Matthew Ferguson, Ellen Last and Laura Robson

Joint Nature Conservation Committee, Peterborough, UK

Email: ellen.last@jncc.gov.uk

In today's world of increased demand for resources, such as food and minerals, mankind is once again looking toward the sea. Developments in technology have moved deep-sea fishing and mining from science fiction to fact and assessing the potential impact that these changing pressures will have on deep-sea ecosystems is now paramount.

In light of this, Joint Nature Conservation Committee (JNCC) are undertaking sensitivity assessments for a range of deep-sea biotopes in UK waters, using the Marine Evidence Based Sensitivity Assessment (MarESA) method (Tyler-Walters *et al.*, 2017). This method, developed by the Marine Biological Association, takes an evidence-based approach, whereby the resistance (likelihood of damage from a pressure) and resilience (rate of recovery from an abated pressure) of each biotope are assessed and combined to give an overall sensitivity score per pressure. Using peer-reviewed literature, grey literature and expert judgement, all documented in a detailed evidence base, this work aims to improve our ability to assess the potential impact of a range of pressures on deep sea ecosystems

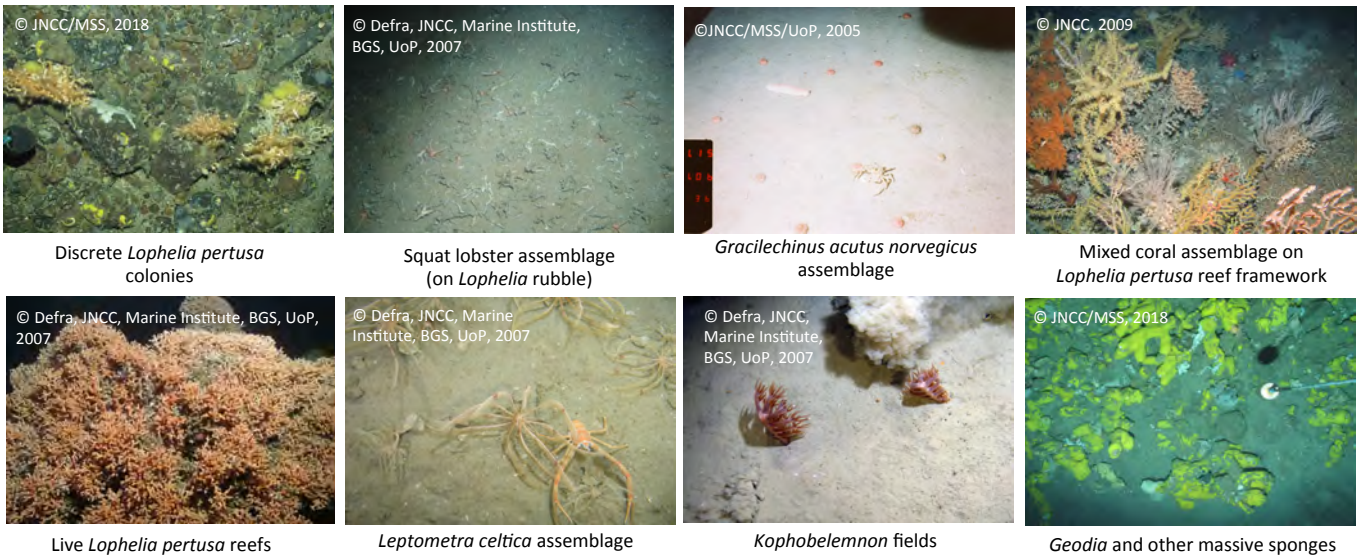


Figure 1. Priority biotopes for assessment.

Using the deep-sea section of the marine habitat classification for Britain and Ireland (Parry *et al.*, 2015), we have prioritised a number of deep-sea biotopes to assess, in collaboration with external experts, based on the known availability of evidence. Our first set of priority biotopes for assessment is shown in Fig. 1, and includes biotopes relating to coral gardens, cold-water coral reefs and deep-sea sponge aggregations.

So far, this work has encountered a number of challenges. Firstly, there is limited baseline evidence on the background biology of many of the characterising species. Secondly, there is often limited information on the effects of pressures on characterising species, making the use of proxy species and pressures unfortunately inevitable. Finally, the paucity of long term studies in the deep-sea makes assessing the resilience of communities with any confidence difficult, especially given the slow growth, longevity and late maturation of many deep-sea taxa.

As this work develops, we are calling for peer reviewers to review the prioritised assessments to ensure that these assessments, which will be published on the MarLIN website, are scientifically robust and fit for purpose. If you are interested in peer-reviewing an assessment, then please contact ellen.last@jncc.gov.uk.

Effects of sedimentation from deep-sea mining: A benthic disturbance experiment off New Zealand.

Malcolm Clark, Scott Nodder, Joanne O'Callaghan, Ashley Rowden, Vonda Cummings, Chris Hickey

NIWA, New Zealand

BACKGROUND

Uncertainty about the effects of sediment plumes created by human activities in the deep sea, such as from potential deep-sea mining and bottom trawling, is a major environmental concern in New Zealand - it was a major issue in two applications for offshore mining being turned down. This led to funding from the Ministry of Business, Innovation and Employment to support a 5 year research programme (2017-21): The Resilience Of deep-sea Benthic communities to the Effects of Sedimentation ("ROBES"). In this project we are undertaking research on the effects of sedimentation, to inform options for how to manage such effects on the environment.

Figure 1. The Benthic Disturber being deployed down the stern ramp of NIWAs research vessel.

The research programme has two components, a field survey experiment with in situ observations of a sediment plume, and laboratory-based experiments. In combination, the two approaches will provide information on the concentrations and distances over which impacts of suspended sediment on faunal communities become 'ecologically significant', as well as assess the short to medium term resilience and recovery of species and communities.

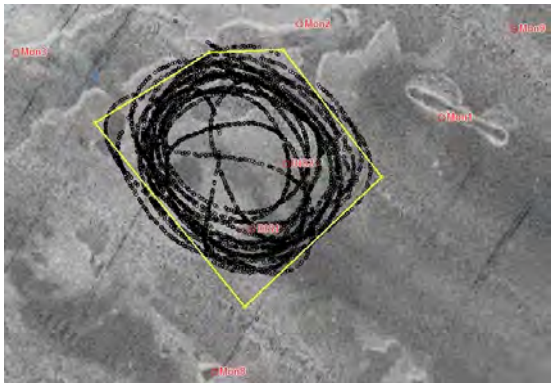


Figure 2. The track of the Benthic Disturber during one of the disturbance periods.

BENTHIC IMPACT SURVEY

In May-June a survey was carried out on the Chatham Rise east of New Zealand. The site was near prospective phosphorite nodule resources, at depths of 500 m. Baseline data were collected on bathymetry, topography, water column characteristics, sediment composition, and faunal community structure and abundance prior to disturbance, and then up to twice post-disturbance. Key elements included:

- A "Benthic Disturber", built in the 1990s by NOAA was refurbished by Okeanus S&T and brought in from the US (Fig. 1). It created a sediment plume on 3 occasions with towing periods between 12 and 30 hours (Figs. 2-4).
- Current flow was assessed using the vessel ADCP, an underwater glider, and a moored ADCP.
- Water column data were collected from a CTD-rosette, multibeam echo-sounder, and fisheries acoustics sounders. Several sounder transect surveys were run to map the pre- and post-disturbance area, and a CTD grid was completed immediately after disturbance events to sample the plume.

Figure 3. The Benthic Disturber being monitored during operation (the chimney plume is on the left screen)

- Three benthic landers were deployed downstream of the disturbance site with an array of sensors, including sediment traps.
- Detailed sediment sampling with a multicorer (supporting onboard respiration and ecotoxicology experiments and sediment profiling), and extensive deep-towed camera stations were completed.
- Live sponges were collected for sedimentation experiments back at the laboratory.
- Three mooring arrays were re-deployed at the end of the survey for a further 12 months to monitor current and sediment dynamics.

RESULTS

The Benthic Disturber failed to produce as extensive a sediment plume as hoped, as the fluidising system didn't penetrate and stir up the heavier silty component of sediments in the area. Hence there was little immediate visual impact as the fine sediments appeared to disperse rapidly in the relatively fast bottom current conditions. Nevertheless, the complex interaction of multiple gear types and disciplines planned for the survey worked well overall. The survey collected a large amount of oceanographic, sedimentological, and biological data that provide significant insights into plume effects and will support a wide variety of analyses in coming months.

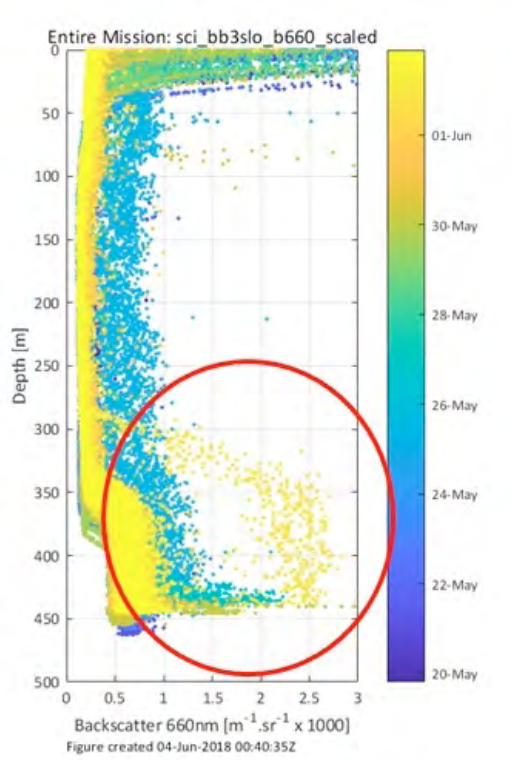
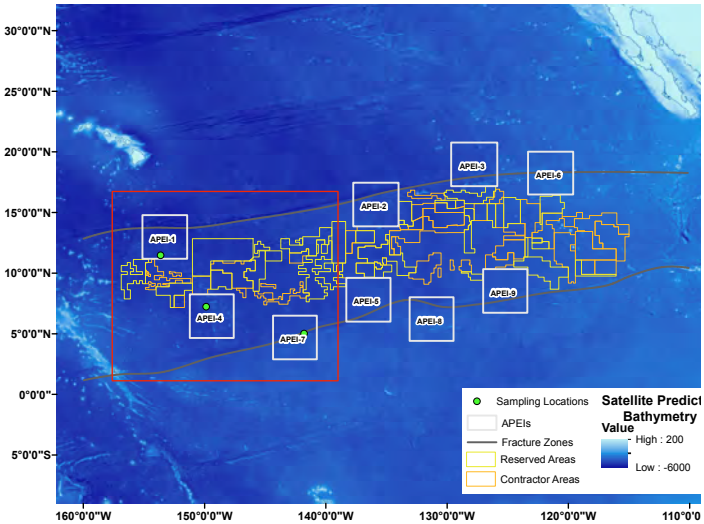


Figure 4. A plot of optical backscatter data collected by the glider, showing a plume extending from the seafloor at 450 m to 300 m (circled).

Exploration of biodiversity and ecosystem structure on seamounts in the western CCZ

Jeffrey C. Drazen[1], Matthew Church[2], Thomas Dahlgren[3], Jennifer Durden[1], Adrian Glover[4], Erica Goetze[1], Astrid Leitner[1], Craig R. Smith[1], Andrew Sweetman[5]

[1]University of Hawaii, [2]University of Montana, [3]Univesity of Gothenberg, Sweden, [4]Natural History Museum, London, [5]Herriot Watt University



More than one million square kilometers of the abyssal Pacific seafloor in a region called the Clarion Clipperton Zone (CCZ) has been identified for possible seafloor nodule mining. Manganese nodules are a potential source of copper, nickel, cobalt, iron, manganese and rare earth elements—metals used in electrical systems and for electronics like rechargeable batteries and touch screens. Nodule mining is expected to result in the destruction of marine life and seabed habitats over large areas, affecting sites that are directly mined as well as adjoining areas impacted by sediment plumes created by mining activities. Despite these impending activities, the seafloor

Figure 1. Map of the Clarion-Clipperton Zone (CCZ) with mining license areas outlined in color and the Areas of Particular Environmental Interest or no mining zones outlined in white. The green dots in APEI 1, 4 and 7 represent the general sampling areas during the cruise. Map courtesy of DeepCCZ Expedition.

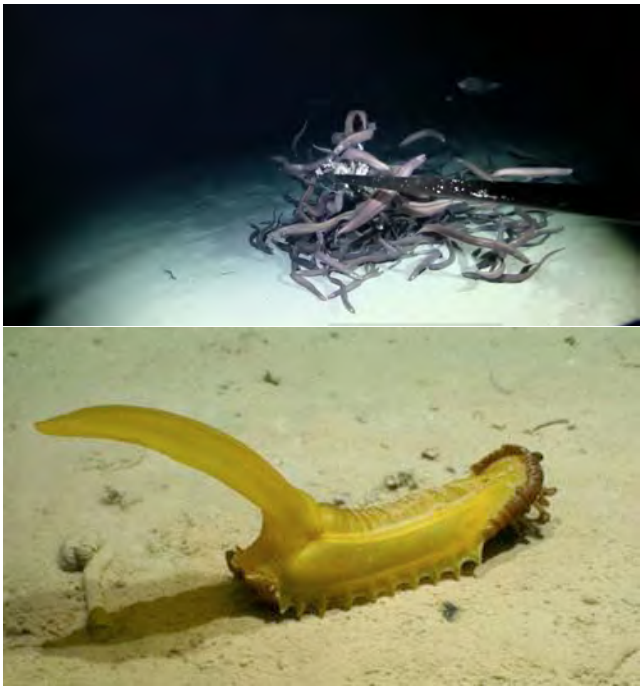


Figure 2 (top). Large numbers of synaphobranchid eels (Ilyophis aryx) on a deep seamount (~3200m) in APEI 7. Image courtesy of DeepCCZ Expedition.
Figure 3 (bottom). A large abyssal sea cucumber (Psychropotes longicauda). Image courtesy of DeepCCZ Expedition.

fauna of the western CCZ and its seamounts had never been explored. The DeepCCZ Expedition was the first to study the diversity of organisms on seafloor plains and seamounts in areas currently designated as “no-mining areas” in the western CCZ. A major goal is to determine whether these protected areas are adequate to conserve the biodiversity in the region from the destructive activities of seafloor mining.

The expedition used a broad suite of state-of-the-art deep-sea technologies to study the biodiversity and ecology of abyssal organisms. Twelve dives were conducted with UH’s new remotely operated vehicle (ROV) Lu’ukai, which used robotic arms and deep-sea cameras to photograph and collect animals, manganese nodules, and sediments from greater than three miles deep. An autonomous respirometer descended to the seafloor to measure biological activity and food-web structure of deep-sea sediment communities. Baited stereo cameras attracted and measured the mobile predators at the top of the deep-sea food chain. Water filters were deployed autonomously to the seafloor to capture the larvae of the benthic fauna and in order to evaluate connectivity. Samples for subsequent DNA analyses were collected from the environment, and from individual animals, to test new approaches to assess biodiversity and ecological functions of microbes and animals living in sediments, on manganese nodules, and in the overlying waters. DNA samples from the animals collected will also aid in the identification and description of the many new species discovered, and to assess their occurrence across the abyssal Pacific Ocean.

The data and samples collected on this cruise are currently being analyzed, and are expected to substantially improve understanding of the biodiversity and ecology of the vast and poorly studied CCZ. More than 100 species of large animals were collected or videotaped at the seafloor, such as sea cucumbers, sponges and a huge squid worm. Many of these animals appear to be newly discovered species. Baited camera video shows that the fish assemblages on seamounts, with previously unknown aggregations of eels, are different than the neighboring rattail and cusk eel dominated abyssal plains. Many more results are being generated. In addition to being used to assess the adequacy of conservation measures, these data will also be incorporated into a regional synthesis of the CCZ, to be used to make science-based recommendations to the International Seabed Authority and other stakeholders concerning environmental protection and management for deep-sea mining in the CCZ.

The authors wish to acknowledge their funders - Gordon and Betty Moore Foundation, NOAA Ocean Exploration and Research, the Pew Foundation and the University of Hawaii.

The International Association of Biological Oceanography (IABO) is inviting those interested in marine biodiversity research to become part of the community!

Patricia Miloslavich
President of the International Association of Biological Oceanography
University of Tasmania, Hobart, Australia

The International Association of Biological Oceanography, founded in 1964, is one of the scientific members of the International Union of Biological Sciences (IUBS: http://iubs.org/) which in turn is one of the members of the International Science Council (ISC: https://council.science/). IABO is also an Ex-officio member of the SCOR's Executive Committee (http://www.scor-int.org), serving as a reporter for SCOR activities and as a liaison with SCOR's working groups.

The goal of IABO is to promote the advancement of knowledge of life in the ocean and to facilitate interdisciplinary scientific research

To address this goal, the main objectives of IABO are to:

- Promote the study of marine biology, biological oceanography and other related sciences
- Promote interdisciplinary communication between marine biologists and other ocean stakeholders by organizing and supporting international forums, including the World Conference in Marine Biodiversity
- Encourage international networking and collaboration between organizations and individuals with similar aims and interests
- Recognize and award outstanding accomplishments in marine biodiversity science

If you would like to become part of the IABO community, please let us know your contact information, affiliation and interest by completing this short form at: https://goo.gl/forms/Krhwor860GxhCl5q1

You can also follow us on Facebook at: https://www.facebook.com/groups/IABOgroup/

Meetings & Workshops

7th INTERNATIONAL SYMPOSIUM
DEEP-SEA CORALS
July 29-August 2, 2019 | Cartagena, Colombia

https://www.deepseacoral2019.org/

The 7th International Symposium on Deep-Sea Corals is the premier meeting for scientists, explorers, managers, policymakers, industry specialists and students to exchange ideas and share knowledge of deep-sea and cold-water corals and their ecosystems. Topics of this meeting will include biodiversity, ecology, evolution, environment, climate, fisheries, sponges, associated fauna, mesophotic ecosystems, anthropogenic impacts, technology, and conservation.

Organizers: Juan Armando Sánchez (Universidad de los Andes), Santiago Herrera (Lehigh University), and Luisa Dueñas (Universidad Nacional).

INCISE2018: discussing the latest research on submarine canyons

Veerle AI Huvenne[1], Jaime S Davies2, Jingping Xu[3] & the INCISE Community

[1]National Oceanography Centre, Southampton, UK; [2]University of Plymouth, UK; [3]Southern University of Science and Technology, Shenzhen, China

The 4th International Submarine Canyon Symposium, INCISE2018, took place in Shenzhen, China from 5-7th November 2018. Expertly organised by our colleagues from the Southern University of Science and Technology (SUSTech), the meeting offered three days of inter-disciplinary presentations on all things canyon, followed by a fieldtrip to Roc Ancient City and the Roc Peninsula National Geological Park. More details can be found on the INCISE2018 website (https://incise2018.sustc.edu.cn).

The aim of the International Network for submarine Canyon Investigation and Scientific Ex-change (INCISE) is to bring together scientists from all disciplines working in submarine canyons, and to stimulate discussions that will cause a cross-fertilisation of ideas; ultimately leading to a better understanding of submarine canyons as major systems in our oceans. With that in mind, the INCISE2018 programme provided plenty of opportunities for dialogue - something the participants certainly made use of! The open, friendly atmosphere also let early career researchers gain confidence discussing their science with the whole community.

INCISE was formed in 2012, and since then has

produced review papers, two special issues (see elsewhere in this Newsletter), a submarine canyon database and lots of collaborations. The network has four Working Groups focussing on Canyon Processes, Patterns & Heterogeneity, Canyon Conservation, and New Technologies. If you are interested in INCISE, or would like to join, have a look at www.incisenet.org, or email incise.network@gmail.com.

The next Submarine Canyon Symposium, INCISE2020, will take place in Cork, Ireland, and we already invite all of you to participate. Watch this space!

18th International Colloquium on Amphipoda

26 - 30 August 2019

Dijon, France

We are happy to announce the 18th International Colloquium on Amphipoda (ICA), which will be held in Dijon (France), from 26 - 30 August 2019.

As in all the preceding editions, the colloquium will hosts every aspect of studies on amphipod crustaceans (systematics, ecology, biogeography, physiology, genetics, ecotoxicology etc.).

Above all, following a long-lasting tradition, the International Colloquium on Amphipoda will be an exciting forum for scientific exchanges among researchers, where students find a unique environment to meet and connect with senior researchers.

Three plenary lectures will open each conference day. Invited speakers are:

- Prof. Alex Ford (University of Portsmouth, United Kingdom)
- Dr Nicolas Puillandre (Museum National d'Histoire Naturelle, France)
- Dr Jose Manuel Guerra Garcia (University of Sevilla, Spain)

On the sidelines of this conference, a Mini-Workshop around DNA barcoding and BOLD will take place on Friday afternoon. This Mini-Workshop is specifically targeting Amphipodologists who are already using DNA-barcodes and who are interested in using or improving their current use of BOLD.

Further details can be found on the 18th ICA Dijon 2019 website.

We look forward to see you at the 18th ICA!

Please feel free to send an email to ica-2019-dijon@hotmail.com if you have any questions.

Thierry Rigaud & Rémi Wattier, coordinators.

Scientist Profiles

Marianna Simões

Postdoctoral Researcher

Goethe University Frankfurt & Senckenberg Research Institute and Natural History Museum, Germany

Email: mariannavpsimoes@gmail.com

Website: https://mariannasimoes.wixsite.com/website

Access to full publications: https://www.researchgate.net/profile/Marianna_Simoes

I am an evolutionary biologist with my research focus lying at the intersection of phylogenetics, spatial ecology and ecological biogeography, with a particular interest in probing macroecological and macroevolutionary patterns and processes. I am interested in various macroecological topics including niche conservatism, latitudinal diversity gradient, invasion dynamics and Eltonian noise hypothesis. As part of my research, I integrate fieldwork, systematics, spatial ecology, ecological biogeography and bioinformatics with the purpose of understanding the evolutionary processes governing biodiversity assemblages and how these change across space and time. Thus far, much of my research has focused on the evolution of leaf beetles (Chrysomeloidea), a very large and diverse group of phytophagous beetles, but I have also worked, in collaboration with colleagues, on other groups including birds, bees, wasps and ultimately my work is question driven.

Currently, I am a postdoc at the Senckenberg Research Institute and Goethe University (Frankfurt, Germany), studying alien invasions into the Arctic Ocean by deep-sea and shallow-water invertebrates from the Northwest Pacific and adjacent marginal seas, in times of rapid climate change - Beneficial Project*.

Biography:

- 2018 – Posdoctoral Researcher in Ecological Biogeography, Goethe University Frankfurt & Senckenberg research Institute and Natural History Museum, Germany
- 2017 - Ph.D. (Ecology and Evolutionary Biology), University of Kansas, U.S.A.
- 2012 - M.Sc. (Zoology), Universidade Federal do Rio de Janeiro, Brazil
- 2010 - B.Sc. (Biology), Universidade Veiga de Almeida, Brazil.

Areas of expertise:

- Ecological and Historical Biogeography

- Bioinformatics and Data Analysis
- Macroecology and macroevolution
- Taxonomy & Systematics (molecular and morphological, with emphasis in Coleoptera)

**Beneficial Project: The project a bilateral collaboration between Russian (Russian Academy of Science) and German (Senckenberg research Institute and Goethe University) research institutes, with the aim to provide a comprehensive study of the biogeography and biodiversity of the NW Pacific area, through integration of data gathered from NW Pacific deep-sea expeditions and online databases. The dataset compiled and generated, provides a solid basis to understand biodiversity patterns and the effects of current and future climatic changes in the NW Pacific fauna. Moreover, this dataset will ultimately will be utilized to create a book describing the distributional patterns of the NW Pacific fauna, which will also provide information on highly abundant key species that might potentially invade the Arctic Ocean in the future, under decreasing sea-ice conditions.*

Opportunities

Marine Geospatial Modeller

Department of Zoology, University of Oxford

Closing date: 1st February 2019, 12:00
Grade 7: Salary in the range £32,236 - £35,211 p.a.

The Marine Geospatial Modeller will conduct research to study marine systems using a big data approach to ask questions within the fields of ocean risk, sustainable marine management and biogeography. This will involve sourcing, processing, integrating and analysing large amounts of spatial and non-spatial data. The results of this research will be integrated into an existing interactive database, and web-tool on spatial data related to the changing state of the global oceans, the Ocean Tool for Public Understanding and Science (OCTOPUS). This post will closely collaborate with the Geospatial software developer (job number 138647), and will be responsible for the focus of the applications on the user interface. Applicants called to interview will be expected to present their suggested research focus.

Applicants should have a PhD with postdoctoral experience in geography, environmental studies, or data science. Experience in geostatistics and GIS-based spatial modelling is essential. A strong track record in scientific peer-reviewed or other publications for the career stage of applicants is also required. Applicants should be proficient in the use of a scientific programming language such as Python, R, or Matlab to analyse and visualise large and complex geospatial data. A familiarity with the marine environment is also highly desirable for this post.

All applications need to be made online by 12.00 noon on 1 February 2019. Interviews will be held on 25 or 26 February 2019.

Click here to apply. Vacancy ID: 138648

Geospatial Software Developer

Department of Zoology, University of Oxford

Closing date: 1st February 2019, 12:00
Grade 7: Salary in the range £32,236 - £35,211 p.a

A Geospatial Software Developer is required to lead the further development of an existing interactive database and web-tool called OCTOPUS (Ocean Tool for Public Understanding and Science) aimed at collating spatial data related to marine biodiversity, ecosystem services and the changing state of the global oceans. A background in Geoinformatics, Geography, or Data Sciences is essential and skills required include: programming in Python with experience in geospatial data processing (e.g. GDAL, NetCDF) and web-development (e.g. Flask, Django);experience building geospatial web-applications with common JavaScript libraries (e.g. JQuery, OpenLayers, Leaflet), HTML and CSS; experience with relational database management systems and spatial databases preferably with PostgreSQL/PostGIS; and experience

with distribution of geospatial data and metadata through the web (e.g. Geoserver, Thredds, CSW, OGC Webservices). Use of Linux operating systems will also be required. The successful candidate should also hold a relevant PhD.

The postholder should be capable of working independently and also within a team and should be able to meet tight deadlines for Project Development and delivery of products for scientific analyses and preparation of papers and reports. The postholder will be expected to play a full and active role in further development of the OCTOPUS system, including the generation of new ideas, tools and contributions to the writing of proposals for funding. Excellent communication skills are an important aspect of the post.

All applications need to be made online by 12.00 noon on Friday 1 February 2019. Interviews will be held on either 25 or 26 February 2019.

Click here to apply. Vacancy ID: 138647

Postdoctoral Position at the University of Hawaii at Manoa in Syntheses of Biodiversity, Connectivity and Ecosystem Function Across the Clarion-Clipperton Zone

Project Overview

The postdoctoral scholar will work in the laboratory of Dr. Craig R. Smith within the project titled: Ecosystem-wide survey of biodiversity, connectivity and ecosystem function across the deep seafloor biome of the CCZ to help assess and manage the impacts of polymetallic nodule mining (DeepCCZ), funded by the Gordon and Betty Moore Foundation, the Pew Charitable Trusts, and NOAA. This is an international study designed to survey and synthesize biological diversity and ecosystem functions across the abyssal Clarion-Clipperton Zone (CCZ) region targeted for manganese nodule mining (project PIs: Craig R. Smith, Jeffrey Drazen, Matthew Church, Thomas Dahlgren, Adrian Glover, Andrew Sweetman, Erica Goetze and Eric Vetter).

The postdoctoral scholar will work with project PIs to conduct a synthesis of patterns of biodiversity, connectivity and ecosystem function on abyssal plains and seamounts across the Clarion-Clipperton Zone (CCZ), particularly comparing areas protected from mining (APEIs) with nodule-exploration contract areas. Key postdoctoral activities will include: (1) collection and formatting of ecological and environmental data from the DeepCCZ project and from a broad range of scientists and ISA contractors working in the CCZ; (2) Statistical analyses of various data sets to address key questions related to patterns and drivers of seafloor biodiversity, biogeography, connectivity, and ecosystem function across the CCZ; (3) Helping to organize and conduct an international workshop in September-October 2019 to synthesize and summarize patterns of biodiversity/connectivity/ecosystem-function across the CCZ and identify major data gaps; (4) Help formulate scientific recommendations and write workshop reports concerning the representivity of the current network of APEIs across the region; (5) Lead the authorship of one or more publications in the peer-reviewed literature derived from the workshop. In addition, the postdoctoral scholar will have the opportunity to collaborate in a comparison of biodiversity assays from the western CCZ using eDNA techniques to more traditional seafloor imagery and collections of megafauna using ROVs.

Postdoctoral Opportunities and Responsibilities

The successful candidate will:

- Contribute to data synthesis and analyses across the project, conducting community and diversity analyses with statistical software, including univariate and multivariate statistical approaches (e.g., using R, Primer 7, EstimateS, etc.).
- Help in project coordination, planning, and logistics for the CCZ data-synthesis workshop.

- Participate in data collection, formatting, and integration for the workshop to help generate a broad synthesis of biodiversity, species ranges, ecological connectivity and ecosystem function across the CCZ.
- Lead a working group and synthesis effort for a key topic addressed in the CCZ data synthesis workshop.
- Author/co-author project reports and peer-reviewed scientific papers, and present scientific results at project meetings and international scientific conferences/workshops.
- Assist in public outreach concerning the project.

Minimum Qualifications

- PhD degree in Biological Oceanography, Marine Biology, or a closely related scientific discipline.
- Experience working with large data sets, and in conducting advanced statistical analyses with R or similar software.
- Demonstrated ability to understand oral and written documentation, to network and organize interactions e.g., workshops) with scientific colleagues, to write reports, lead authorship of peer- reviewed scientific papers, and communicate effectively in a range of professional and public situations.
- A track record of publication in peer-reviewed scientific journals.

Additional Desirable Qualifications

- Ocean-going experience onboard scientific research vessels, including prior involvement in deep- sea research expeditions.
- Demonstrated ability to work with ROV and/or other oceanographic imaging equipment, and knowledge of sample processing and analyses while at sea.
- Experience or ability to analyze seafloor imagery for megafaunal community studies (abundance, community structure, diversity) using image annotation software and statistical packages (e.g., R).

Stipend and Duration of Position

The stipend will be commensurate with qualifications and experience, and is expected to be in the range of $68,000 - $70,000 US per year. The position will be funded initially for 16 months, with potential for an extension to 22 months, based on acceptable performance and availability of funding. The successful candidate will be expected to make a 16-month commitment.

Application

Consideration of applications will begin on January 20, 2019, but applications will be accepted until the position is filled. Apply by submitting a curriculum vitae and statement of research interests, experience, and career goals by email to Craig R. Smith, Moore Project Principle Investigator (craigsmi@hawaii.edu). Please provide the name, email address and phone number for three professional references. Appointment will begin on approximately March 1, 2019, or as soon as possible after that date. In addition, to allow quick tracking of applications, please put in the subject line of the application email: “Moore Biodiversity Synthesis Postdoctoral Application”.

Research Zoologist

Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution

The Smithsonian’s National Museum of Natural History seeks a zoologist to conduct an integrative, specimen or collection-based research program in invertebrate evolution and biodiversity (exclusive of hexapods, myriapods, and arachnids). The successful candidate is expected to develop an internationally recognized research program that makes important contributions to understanding invertebrate evolution and biodiversity through synthetic research involving phylogenetics, genetics, anatomy, development, genomics, biogeography, conservation, informatics, or related fields.

Frequent publication of highly regarded papers in competitive, peer-reviewed journals, curation of collections in specialty area, service to the scientific community in leadership capacities, acquisition of external funding, engagement in outreach activities, and mentorship of students are expected.

Full-time, permanent appointment with full Government benefits to be filled at the GS-12 level; US citizenship and a one-year probationary period are required. The museum's authorized salary range for this position at this time is $81,548 - $86,984 per year. College transcripts and proof of U.S. accreditation for foreign study must be submitted online by the closing date of announcement. For complete requirements and application procedures go to www.sihr.si.edu or www.usajobs.gov and refer to **Announcement 19A-JW-304220-DEU-NMNH**. The announcement opens November 7, 2018. Applications and all supporting documentation must be received on-line by January 7, 2019 and must reference the announcement number. All applicants will be notified by email when their application is received. The Smithsonian Institution is an Equal Opportunity Employer.

Job Title: Faculty Positions

Department: Department of Ocean Science

Hong Kong University of Science and Technology (English-speaking establishment)

The Hong Kong University of Science and Technology is a world-class research institution with over 500 faculty members whose research ranges from science to engineering, business and social sciences. It is ranked No. 1 in Asia by QS World University ranking in 2011-2013. Located in the Clear Water Bay area, HKUST's campus has a magnificent ocean view and is widely known as one of the most beautiful campuses in the world. The city of Hong Kong ranks among the most international and dynamic cities.

The University has set up the **Department of Ocean Science** under the School of Science in February 2018. The new department will primarily focus on marine ecology (existing strength), oceanography, and ocean technology covering coastal region to **deep-sea**. The Department is seeking applications for tenure-track positions at the ranks of Assistant Professor or above in physical, chemical, biological oceanography, marine ecosystem dynamics, ocean sensor and sensing technology and ocean data science.

Applicants should have a PhD degree in any of the above fields, preferably with at least 2 years of postdoctoral experience. Successful candidates should have strong research track records. They are expected to establish an independent research program and contribute to the missions in undergraduate and postgraduate education of the newly established Department of Ocean Science. **The medium of instruction is English**.

HKUST offers internationally competitive salary commensurate with qualifications and experience. Fringe benefits include annual leave, medical and dental benefits. Housing benefits will also be provided where applicable. The University is committed to increasing the diversity of its faculty and has a range of family- friendly policies in place. Initial appointment for Assistant Professor/Associate Professor will normally be on a three-year contract, renewable subject to mutual agreement. A gratuity will be payable upon successful completion of contract.

Application Procedure

Application materials including a cover letter, detailed curriculum vitae, research accomplishment and proposal (maximum 3 pages), three representative publications and teaching statement (maximum 1 page) should be sent to the **Chair of Search and Appointments Committee** (ocessearch@ust.hk). Applicants should arrange at least 3 letters

from referees sent directly to the Chair of Search and Appointments Committee to complete their application. The recruitment process will continue until all positions are filled.

Funded PhD Studentships

NOC Biogeochemistry and Ecosystems Group, UK

Up to **10 funded PhD studentships** are available to study ocean biogeochemistry and ecology in conjunction with the National Oceanography Centre in Southampton and other collaborating institutions.

The NOC Ocean Biogeochemistry and Ecosystems group is globally renowned as a leading centre of excellence and innovation in marine science, bringing biologists, ecologists, modellers, remote sensing specialists and biogeochemists together to address major multidisciplinary problems.

For further information on the projects, please contact supervisors directly.
https://noc.ac.uk/files/documents/science/OBE_projects_NOC_2019.pdf

To apply please go to http://projects.noc.ac.uk/inspire/how-apply

All studentships are funded through the INSPIRE Doctoral Training Programme and all students will be registered at the University of Southampton (UoS).

The closing date for applications is 4 January 2019.

NEW! Transdisciplinary Research for Ocean Sustainability

Oct. 29, 2018 – This CRA call aims to contribute to the overall challenge of ocean sustainability, using the United Nations Sustainable Development Goal #14 (Conserve and sustainably use the oceans, seas and marine resources for sustainable development) as the overall framework.

This call encourages global partnerships of academics and non-academics to address one or more of the following topics:

- Pathways toward a sustainable and equitable use of oceans
- Accounting for and minimizing impacts of global change

All call documents, including guidelines for applicants, eligibility requirements, and the submission portal can be found at the Belmont Forum Grant Operations website: https://bfgo.org/opportunity/index.jsp#oceans2018.

Fourteen funding organisations from 12 countries have committed more than €15 million of cash and in-kind resources

for this call: Brazil, France, Germany, Iceland, India, Japan, Philippines, Russia, Saudi Arabia, South Africa, Sweden, and USA. Through the Swedish International Development Agency (SIDA), researchers from Somalia, Kenya, Tanzania, Mozambique, Comoros and Madagascar are also eligible for this call.
This call aims to support medium-size research projects with a direction of three to four years, with a recommended budget of up to €1.5 million. Note that some contributions are in-kind. See organizational annexes for specific constraints and requirements of your funding organization(s). Projects are expected to start in 2020.

Development of research consortia, supported financially **by at least three participating partner organizations established in three different countries**, is a key criterion. We encourage global geographic diversity to increase the scalability and applicability of the project outcomes. Consortium partners that are not eligible for funding from any of the participating funding agencies can participate in the research project at their own expense. Research consortia must address one or both topics described above.

Given the complexity and scope of the challenges, research consortia must be truly transdisciplinary, thus including **researchers from: a) social sciences/humanities/economy and b) natural sciences/technology, as well as c) societal partners (i.e. citizens, industry, civil society organizations), using a co-design, co-development and co-implementation approach**.

Proposals should also clearly demonstrate the **added value linked to the international nature of the projects** and to the level of collaboration between teams from different countries. A two-step process will apply, with a mandatory pre-registration of projects at the first step, and submission of invited full proposals at the second step. Pre-registrations and full proposals must be written in English and submitted electronically via the Belmont Forum Grant Operations website: http://bfgo.org.

Proposals will be evaluated according to criteria of **(i) scientific excellence, (ii) policy relevance and societal impact (which includes stakeholder engagement), and (iii) quality and efficiency of the project implementation**. Each research Partner in a project must comply with the eligibility criteria and rules of its funding organisation.

Before starting to prepare proposals, applicants are advised to contact their National Contact Points as listed in the annex documents for the call.

Opening of call for pre-registration (mandatory): Monday 29 October, 2018
Deadline for pre-registration (mandatory): Thursday 31 January 2019
Opening of call for invited full proposals: April 2019
Closing of call for invited full proposals: August 2019

12th Course
International School on Foraminifera
Urbino 9th - 28th June, 2019

micropaleontology press
New York • Krakow

The 12th Course on Foraminifera is designed to provide an overview of the Taxonomy, Ecology, Biodiversity, and Geological History of Benthic and Planktonic Foraminifera. This intensive course is intended for students interested in Micropalaeontology, Palaeoceanography, Palaeoecology, Climate History, Biology, and Environmental applications. The aim is to provide a primer on the study of foraminifera and examples of how foraminifera can be used as (paleo)environmental and (paleo)oceanographical proxies. We review the current classification schemes of the foraminifera, discuss their ecology and life history, review their usefulness for biostratigraphical applications, and use case studies to investigate the geological history of the group with lab and practical sessions. The entire course consists of approximately 60 hours of lectures and 60 hours of practical work.

Course Structure

Four distinct courses are planned: *Foraminiferal Introduction* (10-14 June), *Larger Benthic Foraminiferal Course* (15-18 June), *Smaller Benthic Foraminiferal Course* (20-24 June) and *Planktonic Foraminiferal Course* (25-28 June).

Teaching format

The course consists of lectures and practical classes covering the taxonomy, distribution, ecology, and paleoecology of foraminifera. Microscope lab sessions provide the opportunity for participants to learn the foraminiferal genera and species, and view Cretaceous to Neogene foraminiferal assemblages from Petroleum Exploration areas and ODP sites as well as Quaternary and modern assemblages. At the end of each lecture session, different tasks will be assigned to participants to reinforce the knowledge learned. Course materials include the lecture powerpoints and numerous pdf reprints of classic papers.

Correspondence and information

Dr. Fabrizio Frontalini - Università di Urbino, Campus Scientifico, Localita' Crocicchia, 61029 Urbino, (Italy)
fabrizio.frontalini@uniurb.it or isf@tmsoc.org Tel: (+39) 0722 304309, Fax: (+39) 0722 304220

How to make an application

Registration must be done by submitting the registration form that can be download from http://isf.tmsoc.org website, or by sending an email to isf@tmsoc.org

Lectures

Prof. Michael A. Kaminski, King Fahd University of Petroleum & Minerals (Saudi Arabia)
Dr. Fabrizio Frontalini, Urbino University (Italy)
Prof. Laia Alegret, University of Zaragoza (Spain)
Dr. Antonino Briguglio, University of Genova (Italy)
Dr. Claudia Cetean, Robertson Ltd (UK)
Prof. Rodolfo Coccioni, Urbino University (Italy)
Dr. Danielle Foy, Blue Phoenix Geological Ltd. (UK)
Prof. Andrew Gooday, National Oceanography Centre (UK)
Prof. Johann Hohenegger, University of Vienna (Austria)
Prof. Geraint Wyn Hughes, King Fahd University of Petroleum & Minerals (Saudi Arabia)
Prof. Michal Kucera, MARUM, University of Bremen (Germany)
Prof. Cesare Andrea Papazzoni, University of Modena e Reggio Emilia (Italy)
Prof. Jan Pawlowski, University of Geneva (Switzerland)
Prof. Maria Rose Petrizzo, Milano University (Italy)
Prof. Bridget Wade, University College London (UK)

For more information please visit our website at www.isf.tmsoc.org

Wanted

Dear colleagues,

I recently presented my PhD regarding the legal aspects of the sustainable exploitation of marine energy and mineral resources. This work concerns deep-sea mining as well as oil and gas and marine renewable energies.

I wrote it in French at la Sorbonne University and I am now looking for an institution willing to help me translate it into English in order to reach a wider audience.

I am sure it would be very useful for scientists and policy-makers to work closer together. In order to do so, they need to understand what the other does. In this work, I tried to explain to lawyers what scientists focus on.

At the end of my PhD presentation, the professors of law declared that my research made them want to work more closely with scientists and economists with the common goal of better defending the marine environment.

My work is available here : https://halshs.archives-ouvertes.fr/tel-01905059v1

If you know anyone who could help me, please let me know!

Alix Willemez

Contact:
a.willemez@gmail.com
https://www.linkedin.com/in/dr-alix-willemez-ab135821/

Thank you very much for your support!

Hot off the Press

Sediment Microbial Communities Influenced by Cool Hydrothermal Fluid Migration

Zinke L.A., Reese B.K., McManus J., Wheat C.G., Orcut B.N., Amend J.P. (2018)

Frontiers in Microbiology, 9: 1249

Cool hydrothermal systems (CHSs) are prevalent across the seafloor and discharge fluid volumes that rival oceanic input from rivers, yet the microbial ecology of these systems are poorly constrained. The Dorado Outcrop on the ridge flank of the Cocos Plate in the northeastern tropical Pacific Ocean is the first confirmed CHS, discharging minimally altered <15□C fluid from the shallow lithosphere through diffuse venting and seepage. In this paper, we characterize the resident sediment microbial communities influenced by cool hydrothermal advection, which is evident from nitrate and oxygen concentrations. 16S rRNA gene sequencing revealed that Thaumarchaea, Proteobacteria, and Planctomycetes were the most abundant phyla in all sediments across the system regardless of influence from seepage. Members of the Thaumarchaeota (Marine Group I), Alphaproteobacteria (Rhodospirillales), Nitrospirae, Nitrospina, Acidobacteria, and Gemmatimonadetes were enriched in the sediments influenced by CHS advection. Of the various geochemical parameters investigated, nitrate concentrations correlated best with microbial community structure, indicating structuring based on seepage of nitrate-rich fluids. A comparison of microbial communities from hydrothermal sediments, seafloor basalts, and local seawater at Dorado Outcrop showed differences that highlight the distinct niche space in CHS. Sediment microbial communities from Dorado Outcrop differ from those at previously characterized, warmer CHS sediment, but are similar to deep-sea sediment habitats with surficial ferromanganese nodules, such as the Clarion Clipperton Zone. We conclude that cool hydrothermal venting at seafloor outcrops can alter the local sedimentary oxidation–reduction pathways, which in turn influences the microbial communities within the fluid discharge affected sediment.

Link to paper: https://doi.org/10.3389/fmicb.2018.01249

Spatial variability in recruitment of benthos near drilling sites in the Iheya North hydrothermal field in the Okinawa Trough

Masako M., Nakajima Y., Watanabe H., Sasaki T., Yamamoto H., Mitarai S. (2018)

Deep-Sea Research Part I, 135: 65–73

Due to increasing anthropogenic impacts on deep-sea hydrothermal vent ecosystems, it is essential to understand population structure and maintenance through larval recruitment and recovery of vent faunas after disturbances. In this study, we quantified vent animal recruitment in the Okinawa Trough, in the western Pacific Ocean. This is the first study to investigate recruitment patterns at a man-made hydrothermal vent. Colonization plates were deployed at three sites. Site 1 manifested new hydrothermal shimmering with small chimneys, white bacterial mats, and some alvinocaridid shrimp that arrived after drilling. Site 2 showed no evidence of newly arrived foundation species after drilling, and Site 3 had pre-existing animal communities in the vicinity of the new vent. Twenty-two months after deployment, colonization plates were retrieved and recruited animals were inventoried. Species composition and

abundance differed among sites, but relatively high similarity in species composition was observed at Sites 1 and 3, though not at Site 2. Newly established communities on the plates at Sites 1 and 2 (no pre-existing fauna) showed lower species richness and abundance than at Site 3. Differences in abundance and size-frequency distributions of major recruits on the plates (i.e. *Lepetodrilus nux*, *Bathymodiolus* spp.) suggest the importance of reproductive and early life-history characteristics in spatial variability of recruitment. *Lepetodrilus nux* populations established on the plates at Site 1 showed high genetic connectivity. These results illustrate the importance of localized recruitment, which may have a significant impact on sustainability of vent faunal populations, despite the existence of regional metapopulations.

Link to paper: https://doi.org/10.1016/j.dsr.2018.03.009

Strategic Environmental Goals and Objectives: Setting the basis for environmental regulation of deep seabed mining

Tunnicliffe V., Metaxas A., Le J., Ramirez-Llodra E., Levin L. (2018)

Marine Policy, 1-10

Deep seabed mining is a major new intersection of human enterprise and deep-ocean ecosystems. This paper reviews the concept and process for a holistic approach to planning environmental management in the deep sea based on Strategic Environmental Goals and Objectives. Strategic planning around the environment can establish a vision for the future condition of the ocean floor for which the International Seabed Authority (ISA) can draw on a wealth of precedents and experience. By engaging stakeholders and applying current knowledge of deep ecosystems, the ISA can build meaningful strategic environmental goals and objectives that give guidance to its own operation and those of its contractors. This framework builds understanding of the organization's aspirations at global, regional and contractor levels. Herein, some examples are suggested, but we focus on the process. To operationalize these goals and objectives, progress must be measurable; thus, targets are set, reports are assessed, and appropriate responses are awarded. Many management tools and actions are applicable for achieving environmental goals. To date, the ISA has considered marine spatial planning largely around the current exploration contract blocks. Other elements of environmental management, including the requirements for baseline studies, impact assessment, post-impact monitoring and the treatment of harmful effects and serious harm need to be implemented to support well-defined environmental goals and objectives. We suggest that this planning be executed for scales larger than individual blocks, through a Strategic Environmental Management Plan, to ensure sustainable use of ocean resources across the Area.

Link to paper: https://doi.org/10.1016/j.marpol.2018.11.010

Deep Reef Benthos of Bermuda: Field Identification Guide

Stefanoudis P.V., Smith S.R., Schneider C., Wagner D., Rivers M., Goodbody-Gringley G., Xavier J., Woodall L.C., Rogers A.D. (2018)

Deep Reef Benthos of Bermuda builds on the video and imagery data collected during Nekton's Mission – the XL Catlin Deep Ocean Survey - and provides a photographic guide for the visual identification of many of the corals, marine plants and other common invertebrates that inhabit Bermuda's outer deep reefs.

A *Placogorgia* sp. colony seen from the submersible Nemo, 200 m deep off the North Northeast side Bermuda.

This guide is designed to aid marine biologists, divers and naturalists with the identification of organisms as seen in underwater footage or live in the field.

Link to book: https://doi.org/10.6084/m9.figshare.7333838

Geographic and bathymetric comparisons of trace metal concentrations (Cd, Cu, Fe, Mn, and Zn) in deep-sea Lysianassoid amphipods from abyssal and hadal depths across the Pacific Ocean

Reid W.D.K., Cuomo N.J., Jamieson A.J. (2018)

Deep-Sea Research Part I, 138: 11-21

Figure 1. An amphipod from the genus *Hirondellea*, which was one of the species used within this study to look at large-scale variability in metal concentrations of deep-sea amphipods.

Spatial patterns in trace metal (Cd, Cu, Fe, Mn, and Zn) bioavailability were in analysed in deep-sea lysianassoid amphipods (*Eurythenes gryllus* and *Hirondellea* spp.) from three subduction trenches; the Izu-Bonin (8000-9000 m), Kermadec (3000-10,000 m) and Peru-Chile trenches (4500-6000 m). Geographical differences in metal concentrations were evident. Iron and Mn concentrations were higher in H. gigas from the Izu-Bonin Trench compared to the *H. dubia* from the Kermadec Trench. Copper and Cd were higher in the *E. gryllus* in the Peru-Chile Trench compared to Kermadec Trench. There were significant interactions between trench and depth for a number of metals. This was evident in the tissues of the genus *Hirondellea* where there was an interaction between trench and depth for Cu and Zn. Both these metals were found in higher concentrations at approximately 8000 m in the Izu-Bonin Trench compared to the same depth in the Kermadec Trench. At deeper depths, however, the opposite occurred. An interaction between trench and depth also occurred for Fe and Mn in *E. gryllus* where Fe and Mn were found in higher concentrations at approximately 4500m in the Kermadec Trench compared to the Peru-Chile Trench but the opposite was true at deeper depths. This indicated that the relation between metals and depth were not consistent over the depth ranges sampled. Cadmium in H. dubia from Kermadec Trench was the only metal that decreased in concentration across the depths sampled whereas Mn and Zn increased in concentrations with depth within this species and trench. The high concentrations of Cd within these amphipods suggested that the Cd-anomaly observed in polar amphipods could potentially be extended to deep-sea amphipods. Furthermore the low levels of Cu in E. gryllus may indicate Cu-deficiencies. These results indicated a complex relationship between depth and trench and metal concentrations in amphipods with Fe, Mn and Zn largely reflecting the concentrations in the environment.

Link to paper: https://doi.org/10.1016/j.dsr.2018.07.013

Mapping the resilience of chemosynthetic communities in hydrothermal vent fields

Suzuki K., Yoshida K., Watanabe H., Yamamoto H. (2018)

Scientific Reports, 8: 9364

Hydrothermal vent fields are vulnerable to natural disturbances, such as volcanic activity, and are currently being considered as targets for mineral mining. Local vent communities are linked by pelagic larval dispersal and form regional metacommunities, nested within a number of biogeographic provinces. Larval supply depends on the connectivity of the dispersal networks, and affects recoverability of communities from disturbances. However, it is unclear how the dispersal networks contribute to recoverability of local communities. Here, we integrated a population dynamics model and estimation of large scale dispersal networks. By simulating disturbances to vent fields, we mapped recoverability of communities in 131 hydrothermal vent fields in the western Pacific Ocean. Our analysis showed substantial variation in recovery time due to variation in regional connectivity between known vent fields, and was not qualitatively affected by potential larval recruitment from unknown vent fields. In certain cases, simultaneous disturbance of a series of vent fields either delayed or wholly prevented recovery. Our approach is applicable to a dispersal network estimated from genetic diversity. Our method not only reveals distribution of recoverability of chemosynthetic communities in hydrothermal vent fields, but is also a practical tool for planning conservation strategies.

Link to paper: https://doi.org/10.1038/s41598-018-27596-7

Point of View: Managing a sustainable deep-sea 'blue economy' requires knowledge of what actually lives there

Glover A.G., Wiklund H., Chen C., Dahlgren T.G. (2018)

eLife 2018 7:e41319

Ensuring that the wealth of resources contained in our oceans are managed and developed in a sustainable manner is a priority for the emerging 'blue economy'. However, modern ecosystem-based management approaches do not translate well to regions where we know almost nothing about the individual species found in the ecosystem. Here, we propose a new taxon-focused approach to deep-sea conservation that includes regulatory oversight to set targets for the delivery of taxonomic data. For example, a five-year plan to deliver taxonomic and genomic knowledge on a thousand species in regions of the ocean earmarked for industrial activity is an achievable target. High-throughput, integrative taxonomy can, therefore, provide the data that is needed to monitor various ecosystem services (such as the natural history, connectivity, value and function of species) and to help break the regulatory deadlock of high-seas conservation.

Link to paper: https://doi.org/10.7554/eLife.41319

Growth and Age of the Roughhead Grenadier Macrourus berglax in Waters off Southwest Greenland

Orlov A.M., Vedishcheva E.V., Trofimova A.O., Orlova S.Yu. (2018)

Journal of Ichthyology 58 (3): 389-395

Data on the age and growth of the roughhead grenadier *Macrourus berglax* from waters off Southwest Greenland have been obtained based on the analysis of otoliths. Specimens with a preanal length of 5–39 cm, a weight of 7–5275 g, and age from 2 to 22 years are recorded in trawl catches. Roughhead grenadier exhibits a similar rate of linear growth in waters off Southwest Greenland and other parts of the range in the Northwest Atlantic. No considerable differences from the rate of the linear growth calculated earlier from scales for the species in waters off West Greenland have been found. In the recent period, the rate of weight gain in roughhead grenadier in waters off Southwest Greenland has been lower than in the Northwest Atlantic in the first half of the 1980s. The age of mass maturation in males (7–9 years) and females (16–17 years) in waters off West and East Greenland is somewhat higher than in coastal waters of Norway and the Northwest Atlantic.

Link to paper: https://link.springer.com/article/10.1134/S0032945218030098

First insights into macrofaunal composition from the SokhoBio expedition (Sea of Okhotsk, Bussol Strait and northern slope of the Kuril-Kamchatka Trench)

Brandt A., Alalykina I., Fukumori H., Golovan O., Kniesz K., Lavrenteva A., Lörz A.-N., Malyutina M., Philipps-Bussau K., Stransky B. (2018)

Deep Sea Research Part II: Topical Studies in Oceanography, 154: 106-120.

Macrofauna (46,343 invertebrates from 41 taxa) were collected by means of a cam-era-epibenthic sledge (C-EBS) during the expedition SokhoBio (Sea of Okhotsk Biodiversity Studies) on board of the *RV Akademik M.A. Lavrentyev* in 2015. In total 11 sites and 22 stations were sampled at bathyal and abyssal depths ranging from 1696 m to 4798 m in the Kuril Basin of the Sea of Okhotsk (16 stations), the Bussol Strait (two stations) and western slope of the Kuril-Kamchatka Trench (KKT) (four stations). Polychaetes occurred most frequently in the samples with 17,546 individ-uals, followed by Peracarida with 14,099 individuals (5625 isopods, 3887 amphipods, 3225 tanaids, 1269 cumaceans, and 90 mysids), Copepoda (4679 ind.) and Bivalvia (3999 ind.). Numbers of individuals ranged between 140 at station 3–10–6383 at station 7–3. The numbers of taxa per station were smallest at station 3–10 (4 taxa) and highest at station 2–7 (31 taxa). Peracarida were the most common malacos-tracan crustaceans recorded, with Isopoda comprising 40% of all peracarids within this fraction, followed by Amphipoda with 27%, Tanaidacea with 23%, Cumacea with 9% and Mysida with 1%. At station 3–10, not a single peracarid was sampled. Isopoda dominated most of the stations, especially in the abyssal sites of the Kuril Basin. Amphipoda occurred in higher numbers in the Bussol Strait at site 8 as well as at Pacific station 9-7. In the SokhoBio area, studied macrofauna was distributed very patchily. In terms of diversity and composition the abyssal macrofauna of the Kuril Basin shows an intermediate state between the adjacent studied abyssal are-as: the semi-isolated Sea of Japan and the open abyssal plain of the Kuril-Kamchatka Trench (KKT) area.

Link to paper: https://doi.org/10.1016/j.dsr2.2018.05.022

The long and winding road: negotiating a treaty for the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction

Wright G., Rochette J., Gjerde K., Seeger I. (2018)

IDDRI (France) Study No.8/18 Aug 2018

A VAST GLOBAL COMMONS UNDER INCREASING PRESSURE

Marine areas beyond national jurisdiction (ABNJ) cover nearly half of the Earth's surface and host a significant portion of its biodiversity. The remoteness of ABNJ and a lack of knowledge previously placed them beyond the reach of human activities. In recent decades, technological and scientific advancements, coupled with growing demand for resources, have increased interest in these areas and driven exploration and exploitation.

A TREATY TO SAFEGUARD THE HEALTH OF THE GLOBAL OCEAN

The international community has become increasingly aware of the growing threats to marine biodiversity in ABNJ and been discussing options to conserve and sustainably use it. On December 24, 2017, following more than 10 years of discussions, the United Nations General Assembly decided to convene an intergovernmental conference (IGC) to negotiate an international legally binding instrument (ILBI).

A PACKAGE OF VARIED AND COMPLEX ISSUES

Negotiations will cover the 'Package Deal' of issues agreed in 2011, namely: marine genetic resources (MGRs), including questions on the sharing of benefits; area-based management tools (ABMTs), including marine protected areas (MPAs); environmental impact assessments (EIA); and capacity-building and the transfer of marine technology.

Link to free download of publication: https://www.iddri.org/en/publications-and-events/study/long-and-winding-road-negotiating-high-seas-treaty

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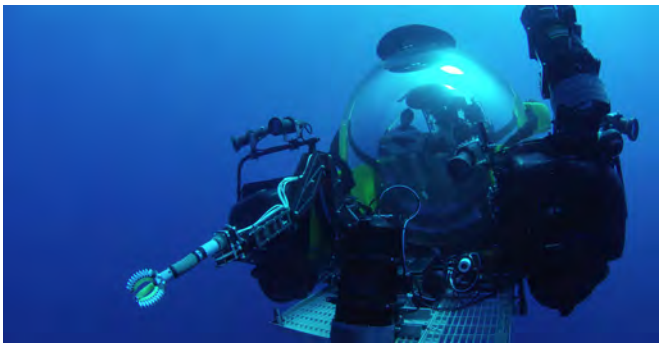
Rotary-actuated folding polyhedrons for midwater sampling

Teoh Z.E., Phillips B, Becker K., Weaver K., Gruber D., Hoberman C., Whittredge G., Wood R. (2018)

Science Robotics, 3: eaat5276



We present an origami-inspired rotary-actuated dodecahedron sampling device (the "RAD Sampler"), which is capable of rapidly encapsulating midwater organisms using a standard manipulator system. The RAD Sampler was tested in collaboration with the Monterey Bay Aquarium Research Institute, and was used to encapsulate a variety of deep-sea midwater organisms in Monterey Canyon. The device requires only a simple rotary actuator to achieve complex motion, and has numerous potential applications beyond midwater sampling.

Link to paper: http://robotics.sciencemag.org/content/3/20/eaat5276

Figure 1 (top). A soft robotic arm is tested onboard a manned submersible in the Fernando de Noronha Archipelago, Brazil. Credit: OceanX.
Figure 2 (bottom). A 3D-printed soft gripper, designed and fabricated almost entirely in the field onboard a research vessel, is used to collect a holothurian at 840m in the Phoenix Islands Protected Area. Credit: Schmidt Ocean Institute

Arcturoid isopods (Isopoda: Valvifera) from the SokhoBio expedition: First records from the abyss of the Sea of Okhotsk with description of *Neastacilla birsteini* sp. nov.

Golovan O.A., Malyutina M.V., Brandt A. (2018)

Deep Sea Research Part II: Topical Studies in Oceanography, 154: 308-319

In the samples of the expedition SokhoBio (Sea of Okhotsk Biodiversity Studies) arcturoid isopods were present at eight sites in the Kuril Basin of the Sea of Okhotsk (1685–3366 m), the Bussol Strait (2327–2358 m), and the western abyssal slope of the Kuril-Kamchatka Trench (KKT) (3371–3377 m). They were represented by eight species of three genera and two families, *Antarcturus*, *Chaetarcturus* (Antarcturidae), and *Neastacilla* (Arcturidae). Six species turned out to be new to science. The composition of fauna and distribution of arcturoids in the Kuril Basin and the adjacent regions are discussed. A list of all arcturoid species known from the Sea of Okhotsk and the adjacent waters off the Pacific coast of the Kuril Islands and the Southeastern Kamchatka at depths > 500 m is provided. In the abyss of the Sea of Okhotsk two species (*Chaetarcturus* cf. *beddardi* (Gurjanova, 1935) and *Neastacilla birsteini* sp. nov.) were found. *Neastacilla birsteini* sp. nov., the dominant species in the abyss of the Kuril Basin, is described herewith. The new species differs from all other species of the genus by the 6-articled antennae I. *N. birsteini* sp. nov. most closely resembles *N. anophthalma* (Birstein, 1963) comb. nov. nov. Both species can be distinguished from all other species of the genus by the absence of eyes and a long article 5 of antenna I which is longer than articles 1–3 together. *N. birsteini* sp. nov. differs from *N. anophthalma* in the following characters: the pleon of the new species is 1.5 times longer than pereonite 4 and has an elongated distal part with a notch at the apex; the pereopod I carpus is 3.2 times as long as wide.

Link to paper: https://doi.org/10.1016/j.dsr2.2017.11.004

Current state of fisheries for Greenland turbot *Reinhardtius hippo-glossoides matsuurae* (Pleuronectidate) in the western Bering Sea and off the eastern Kamchatka

Maznikova O.A., Novikov R.N., Datsky A.V., Novikova S.V., Orlov A.M. (2018)

Voprosy Rybolovstva. 19 (1): 42-57

The basis of this paper is the catch statistics obtained from the data of vessel daily reports from the sectoral monitoring system of the Federal Agency for Fisheries of the Russian Federa-tion for 2009-2017, in which the captures of the Greenland turbot were registered. Additional-ly, monitoring data on fishing vessels operated with longlines, trawls and Danish seines col-lected in 2009-2017 were used. The inter-annual and seasonal variability of dislocation and structure of fishing fleet, catches of Greenland turbot in the Western Bering Sea zone, Karagin-skaya and Petropavlovsko-Komandorskaya subzones were summarized and analyzed.

Link to paper: https://www.researchgate.net/publication/324703555

Xenophyophores (Rhizaria, Foraminifera) from the Eastern Clarion-Clipperton Zone (equatorial Pacific): the Genus Psammina

Gooday A., Holzmann M., Goineau A., Kamenskaya O., Melnik V., Pearce R., Weber A., Pawlowski J. (2018)

Protist 169, 6: 926-957

Xenophyophores are important megafaunal organisms in the abyssal Clarion-Clipperton Zone (CCZ; equatorial Pacific), a region hosting commercially significant deposits of polymetallic nodules. Previous studies assigned those with attached, fan-like tests to *Psammina limbata*, a species described from the central CCZ based on morphology. Here, we redescribe the holotype of *P. limbata* and then show that limbata-like morphotypes collected in the eastern CCZ include three genetically distinct species. *Psammina aff. limbata* is closest morphologically to *P. limbata*. The others are described as *P. microgranulata* sp. nov. and *P. rotunda* sp. nov. These fan-shaped species form a well-supported clade with *P. tortilis* sp. nov., a morphologically variable species exhibiting features typical of both *Psammina* and *Semipsammina*. A second clade containing *Psammina* sp. 3, and two species questionably assigned to *Galatheammina* branches at the base of this group. The genus *Psammina* includes another 9 described species for which there are no genetic data, leaving open the question of whether *Psammina* as a whole is monophyletic. Our study increases the number of xenophyophore species described from the eastern CCZ from 8 to 11, with a further 25 morphotypes currently undescribed. Many additional species of these giant foraminifera undoubtedly await discovery in abyssal settings.

Link to paper: https://doi.org/10.1016/j.protis.2018.09.003

Deep-sea anthropogenic macrodebris harbours rich and diverse communities of bacteria and archaea

Woodall L., Jungblut A., Hopkins K., Hall A., Robinson L., Gwinnett C., Paterson G. (2018)

PLoS ONE 13 (11): e0206220

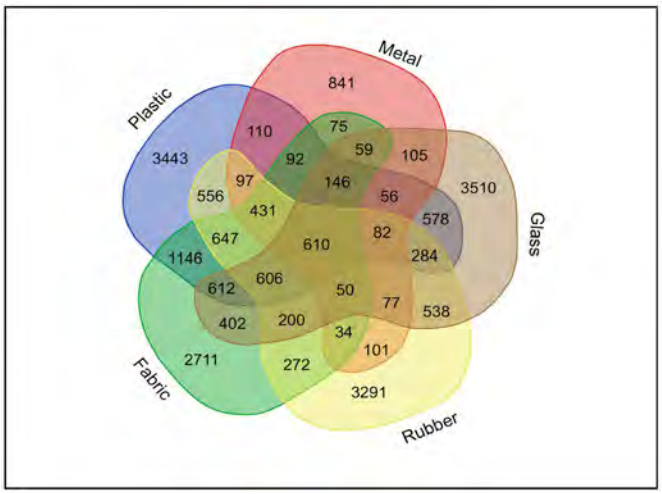


Figure 1: Venn diagram showing the number of shared OTUs between litter biofilms.

The deep sea is the largest biome on earth, and microbes dominate in biomass and abun-dance. Anthropogenic litter is now almost ubiquitous in this biome, and its deposition cre-ates new habitats and environments, including for microbial assemblages. With the ever increasing accumulation of this debris, it is timely to identify and describe the bacterial and archaeal communities that are able to form biofilms on macrodebris in the deep sea. Using 16S rRNA gene high throughput sequencing, we show for the first time the composition of bacteria and archaea on macrodebris collected from the deep sea. Our data suggest differ-ences in the microbial assemblage composition across litter of different materials including metal, rubber, glass, fabric and plastic. These results imply that anthropogenic macrodebris provide diverse habitats for bacterial and archaeal biofilms and each may harbour distinct microbial communities.

Link to paper: https://doi.org/10.1371/ journal.pone.0206220

First records of deep-sea Munnopsidae (Isopoda: Asellota) from the Kuril Basin of the Sea of Okhotsk, with description of *Gurjanopsis kurilensis* sp. nov.

Malyutina M.V., Brandt A. (2018)

Deep Sea Research Part II: Topical Studies in Oceanography, 154: 275-291.

The deep-sea Munnopsidae Lilljeborg, 1864 of the Kuril Basin of the Sea of Okhotsk, the Bussol Strait, as well as the western abyssal slope of the Kuril-Kamchatka Trench (KKT) off the Bussol Strait were studied. The material was collected during the expedition SokhoBio (Sea of Okhotsk Biodiversity Studies) in the summer of 2015. The first data on the composition and distribution of the family Munnopsidae from the SokhoBio samples are presented. In total 2190 individuals of Munnopsidae from 53 species, 26 genera and seven subfamilies have been collected at 19 of 21 C-EBS stations at all 11 sites of the SokhoBio expedition. The most abundant subfamily in the samples was Ilyarachninae Hansen, 1916 (36%), followed by Eurycopinae Hansen, 1916 (29%). In the Kuril Basin 39 species of 20 genera and 5 subfamilies were found, the main portion of munnopsids here was represented by the *Ilyarachninae* (39%), followed by the group of genera *incertae sedis* (31%) and Eurycopinae (27%). The abyssal munnopsid fauna of the Kuril Ba-sin is an intermediate in terms of diversity and species richness between the adjacent studied abyssal areas, the Sea of Japan and the open abyssal of the KKT. Half of the collected species, 27 species (51%) are shared with the KKT area, 22 species (41.5%) are common to the Kuril Basin and the Pacific sites. About 80% of the collected species are new to science. One of the new species, *Gurjanopsis kurilensis* sp. nov. is described herein. *Gurjanopsis,* Malyutina and Brandt, 2007 is the only genus within the Munnopsidae having a posteromedial notch in the pleotelson containing tiny uropods and the anus. A similar notch in the pleotelson containing uropods within Janiroidea Kussakin, 1967 is known only in species of *Jaera* Leach, 1814 (Janiridae G.O. Sars, 1897). The male pleopods of *Gurjanopsis* which cover the pleopodal cavity of the pleotelson are unusual for the family. This “operculum” is formed by the small pleopods 1 and 2 and the enlarged exopods of pleopods 3. This is similar to the pleopodal structure found in the primitive asellote superfamilies Aselloidea Latreille, 1802 and Stenotrioidea Hansen 1905, while in Janiroidea only pleopods 1 and 2 are operculate. The new species is the third species of the rare genus *Gurjanopsis* and the first record of the genus, previously only known from the deep-sea of the Arctic and the Antarctic, for the Pacific Ocean. The finding a species of *Baeonectes* Wilson, 1982 in abyssal depths of the Kuril Basin is the deepest record of the genus.

Link to paper: https://doi.org/10.1016/j.dsr2.2017.12.006

Key role of bacteria in the short-term cycling of carbon at the abyssal seafloor in a low POC flux region of the eastern Pacific Ocean

Sweetman A.K., Smith C.R., Shulse C.N., Maillot B, Lindh M., Church M.J., Meyer K.S., van Oevelen D., Stratmann T., Gooday A.J. (2018)

Limnology and Oceanography, 1-20

The cycling of carbon (C) by benthic organisms is a key ecosystem function in the deep sea. Pulse-chase experiments are designed to quantify this process, yet few studies have been carried out using abyssal (3500-6000 m) sediments, and only a handful have been undertaken in situ. We undertook 8 in situ pulse-chase experiments in 3 abyssal strata (4050-4200 m water depth) separated by 10s to 100s of kilometres in the eastern Clarion-Clipperton Fracture Zone. These experiments demonstrated that benthic bacteria dominated the consumption of phytodetritus over short (~1.5 d) time scales, with metazoan macrofauna playing a minor role. These results contrast with the only other comparable

in situ abyssal study, where macrofauna dominated phytodetritus assimilation over short (2.5 d) time scales in the eutrophic NE Atlantic. We also demonstrated that benthic bacteria were capable of converting dissolved inorganic C into biomass, and showed that this process can occur at rates that are as high as the bacterial assimilation of algal-derived organic C. This demonstrates the potential importance of inorganic C uptake to abyssal ecosystems in this region. It also alludes to the possibility that some of the C incorporation by bacteria in our algal-addition studies may have resulted from the incorporation of labeled DIC initially respired by other unstudied organisms. Our findings reveal the key importance of benthic bacteria in the short-term cycling of C in abyssal habitats in the eastern CCFZ, and provide important information on benthic ecosystem functioning in an area targeted for commercial-scale, deep-sea mining activities.

Link to paper: https://doi.org/10.1002/lno.11069

The Ocean revealed

Euzen A., Gaill F., Lacroix D., Cury P. (2018)

The ocean covers 70% of the surface of our planet, it plays a major role in regulating the Earth's climate and is home to a multitude of species, many of which we have yet to discover. The ocean is crucial for the functioning of life on Earth. With global change, many issues have emerged, and the consequences of these in the future concern us all.

This book improves our understanding of what the ocean is, in all its breadth, depth and complexity, from both the biological and physical perspectives, including interactions and dynamics. Many innovative tools, infrastructures and approaches are developed to explore the ocean, and to obtain the data and information that are essential to expanding our knowledge. History tells us much about the evolution of the techniques and representations connecting human communities to the oceans, and the diverse ways in which we use them.

Whether we approach it in terms of its resources, its services or its territorial stakes, the ocean is not only essential, but also vulnerable. To manage the many risks associated with our seas, from submersion to pollution, we need to plan ahead in the face of increasing human activities. The ocean is often thought of as infinite and unlimited. It is seen by some as a common good, by others as a key element of geostrategic issues. This book raises the question of its future.

Collating 135 articles and drawing on the contributions of 160 researchers and specialists, this book is a reference work. It explores the issues pertaining to the ocean today, in tune with the UN Sustainable Development Goals, and with a view to understanding and proposing solutions.

Link to free download of book: http://www.cnrs.fr/inee/communication/breves/docs/The_ocean_revealed_ENG.pdf

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Human footprint in the abyss: 30 year records of deep-sea plastic debris

Chiba S., Saito H., Fletcher R., Yogi T., Kayo M., Miyagi S., Ogido M., Fujikura K. (2018)

Marine Policy, 96: 204-212

This study reports plastic debris pollution in the deep-sea based on the information from a recently developed database. The Global Oceanographic Data Center (GODAC) of the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) launched the Deep-sea Debris Database for public use in March 2017. The database archives photographs and videos of debris that have been collected since 1983 by deep-sea submersibles and remotely operated vehicles. From the 5010 dives in the database, 3425 man-made debris items were counted. More than 33% of the debris was macro-plastic, of which 89% was single-use products, and these ratios increased to 52% and 92%, respectively, in areas deeper than 6000 m. The deepest record was a plastic bag at 10898 m in the Mariana Trench. Deep-sea organisms were observed in the 17% of plastic debris images, which include entanglement of plastic bags on chemosynthetic cold seep communities. Quantitative density analysis for the subset data in the western North Pacific showed plastic density ranging from 17 to 335 items km−2 at depths of 1092–5977 m. The data show that, in addition to resource exploitation and industrial development, the influence of land-based human activities has reached the deepest parts of the ocean in areas more than 1000 km from the mainland. Establishment of international frameworks on monitoring of deep-sea plastic pollution as an Essential Ocean Variable and a data sharing protocol are the keys to delivering scientific outcomes that are useful for the effective management of plastic pollution and the conservation of deep-sea ecosystems.

Link to paper: https://doi.org/10.1016/j.marpol.2018.03.022

Link to associated article: Shopping Bags in the Abyss: Addressing the Deep-Sea Plastic Crisis (https://www.nippon.com/en/currents/d00418/)

Diversity of the CO1 Gene of Mitochondrial DNA in Representatives of Genus *Antimora* (Moridae, Gadiformes) in the World Oceans

Orlova S.Yu., Volkov A.A., Gordeev I.I., Baitaliuk A.A., Orlov A.M. (2018)

Doklady Biochemistry and Biophysics, 482: 279-283

The frequency of occurrence of the COI gene of mitochondrial DNA in the Pacific flatnose *Antimora microlepis* and blue antimora *Antimora rostrata* (Moridae, Gadiformes) was analyzed in samples collected in different areas of the World Ocean. The revealed maximum haplotype diversity of COI in the blue antimora in the North Atlantics may indicate that this species emerged in this region, from which it widely distributed in the World Ocean. The Pacific flatnose *Antimora microlepis* originated from *Antimora rostrata*. Antimora might penetrate into the North Pacific by several routes: through the Panama Strait, along the coast of Antarctica, or through the Indian Ocean along the coast of Australia.

Link to paper: https://link.springer.com/article/10.1134/S1607672918050137

Abyssal plain faunal carbon flows remain depressed 26 years after a simulated deep-sea mining disturbance

Stratmann T., Lins L., Purser A., Marcon Y., Rodrigues C.F., Ravara A., Cunha M.R., Simon-Lledó E., Jones D.O.B., Sweetman A.K., Köser K., van Oevelen D.

Biogeosciences, 15: 4131-4145

Future deep-sea mining for polymetallic nodules in abyssal plains will negatively impact the benthic ecosystem, but it

is largely unclear whether this ecosystem will be able to recover from mining disturbance and if so, to what extent and at what timescale. During the DIS-turbance and reCOLonization (DISCOL) experiment, a total of 22% of the seafloor within a 10.8km^2 circular area of the nodule-rich seafloor in the Peru Basin (SE Pacific) was ploughed in 1989 to bury nodules and mix the surface sediment. This area was revisited 0.1, 0.5, 3, 7, and 26 years after the disturbance to assess macrofauna, invertebrate megafauna and fish density and diversity. We used this unique abyssal faunal time series to develop carbon-based food web models for each point in the time series using the linear inverse modeling approach for sediments subjected to two disturbance levels: (1) outside the plough tracks; not directly disturbed by plough, but probably suffered from additional sedi-mentation; and (2) inside the plough tracks. Total faunal carbon stock was always higher outside plough tracks compared with inside plough tracks. After 26 years, the carbon stock inside the plough tracks was 54% of the carbon stock outside plough tracks. Deposit feeders were least affected by the disturbance, with modeled respiration, external predation, and excretion rates being reduced by only 2.6% inside plough tracks compared with outside plough tracks after 26 years. In contrast, the respiration rate of filter and suspension feed-ers was 79.5% lower in the plough tracks after 26 years. The total system throughput (T..), i.e., the total sum of modeled carbon flows in the food web, was higher throughout the time series outside plough tracks compared with the corresponding inside plough tracks ar-ea and was lowest inside plough tracks directly after the disturbance ($8.63 \times 10^{-3} \pm 1.58 \times 10^{-5}$ mmolCm-2d^{-1}). Even 26 years after the DISCOL disturbance, the discrepancy of T.. between outside and inside plough tracks was still 56%. Hence, C cycling within the faunal compart-ments of an abyssal plain ecosystem remains reduced 26 years after physical disturbance, and a longer period is required for the system to recover from such a small-scale sediment disturbance experiment.

Link to paper: https://doi.org/10.5194/bg-15-4131-2018

Abyssal *Rhachotropis* (Eusiroidea, Amphipoda) from the Sea of Okhotsk

Lörz A.N., Jażdżewska A.M., Brandt A. (2018)

Deep Sea Research Part II: Topical Studies in Oceanography, 154: 320-329

The genus Rhachotropis has the widest horizontal and bathymetric distribution of all amphipod genera known worldwide. Characteristic species of *Rhachotropis* were collected at 3200 m depth in the Kuril basin of the Sea of Okhotsk. Morphological investigations revealed a species new to science, which is here described in detail.

Juveniles were removed from the marsupium of the holotype; their morphological features were investigated via scanning electron microscopy and compared to the adults. The molecular barcode of the new species, *Rhachotropis* marinae, was obtained. Comparison with available *Rhachotropis* COI data revealed clear separation of the new species from all known species as well as from two other *Rhachotropis* species also collected during the SokhoBio expedition. The three *Rhachotropis* species from abyssal depths in the Sea of Okhotsk did not group together when their COI region was analysed with *Rhachotropis* sequences from other parts of the world. The number of described species of *Rhachotropis* is now increased to 62.

Link to paper: https://doi.org/10.1016/j.dsr2.2017.09.020

Bacterial Diversity and the Geochemical Landscape in the South-western Gulf of Mexico

Godoy-Lozano E.E., Escobar-Zepeda A., Raggi L., Merino E., Gutierrez-Rios R.M., Juarez K., Segovia L., Licea-Navarro A.F., Gracia A., Sanchez-Flores A., Pardo-Lopez L. (2018)

Frontiers in Marine Science, 9: 2528

Marine sediments are an example of one of the most complex microbial habitats. These bacterial communities play an important role in several biogeochemical cycles in the ma-rine ecosystem. In particular, the Gulf of Mexico has a ubiquitous concentration of hydro-carbons in its sediments, representing a very interesting niche to explore. Additionally, the Mexican government has opened its oil industry, offering several exploration and production blocks in shallow and deep water in the southwestern Gulf of Mexico (swGoM), from which there are no public results of conducted studies. Given the higher risk of large-scale oil spills, the design of contingency plans and mitigation activities before oil exploitation is of growing concern. Therefore, a bacterial taxonomic baseline profile is crucial to understand-ing the impact of any eventual oil spill. Here, we show a genus level taxonomic profile to elucidate the bacterial baseline, pointing out richness and relative abundance, as well as relationships with 79 abiotic parameters, in an area encompassing approx. 150,000 km^2, including a region where the exploitation of new oil wells has already been authorized. Our results describe for the first time the bacterial landscape of the swGoM, establishing a bacterial baseline “core” of 450 genera for marine sediments in this region. We can also differenti-ate bacterial populations from shallow and deep zones of the swGoM based on their com-munity structure. Shallow sediments have been chronically exposed to aromatic hydrocar-bons, unlike deep zones. Our results reveal that the bacterial community structure is partic-ularly enriched with hydrocarbon-degrading bacteria in the shallow zone, where a greater aromatic hydrocarbon concentration was determined. Differences in the bacterial commu-nities in the swGoM were also observed through a comprehensive comparative analysis relative to various marine sediment sequencing projects, including sampled sites from the Deep Water Horizon oil spill. This study in the swGoM provides clues to the bacterial popu-lation adaptation to the ubiquitous presence of hydrocarbons and reveals organisms such as *Thioprofundum* bacteria with potential applications in ecological surveillance. This resource will allow us to differentiate between natural conditions and alterations generated by oil extraction activities, which, in turn, enables us to assess the environmental impact of such activities.

Link to paper: https://doi.org/10.3389/fmicb.2018.02528

A dexterous, glove-based teleoperable low-power soft robotic arm for delicate deep-sea biological exploration.

Phillips B., Becker K., Kurumaya S., Galloway K., Whittredge G., Vogt D., Teeple C., Rosen M., Pieribone V., Gruber D., Wood R. (2018)

Scientific Reports, 8: 14779

This paper describes a complete soft robotic manipulator system that has been successfully tested to 2300 m. The manipulator is operated using a wireless glove interface, which drives a novel hydraulic system that uses seawater and requires minimal power to operate. This is the latest in a series of efforts to create delicate, minimally-intrusive sampling devices for deep sea biological exploration.

Link to paper: https://www.nature.com/articles/s41598-018-33138-y

Microsatellite loci obtained by next generation sequencing on the sablefish (*Anoplopoma fimbria*)

Orozco-Ruiz A.M., Galvan-Tirado C.,· Orlova S.Yu., Orlov A.M., Garcia-De Leon F.J.(2018)

Molecular Biology Reports, 45 (5): 1523-1526

Eleven microsatellite loci were developed and characterized for the sablefish, *Anoplopoma fimbria*. The markers were identified from sequences obtained by next generation sequenc-ing. Thirty samples from Aleutians Islands were genotyped. The amplifications were per-formed with three different annealing temperature and amplification products were visual-ized in ABI 3500 Genetic Analyzer. No evidence for scoring errors was detected by stutter-ing or due large allele dropout and neither of the loci presented a high null allele frequency (> 0.2). The number means of alleles per locus was of 12.21 and mean of observed and ex-pected heterozygosity were of 0.60 and 0.75 respectively. The sablefish represents a re-source of high commercial value on the coasts of Japan, Russia, Canada and west coast of the United States and these new primers could be useful to future diversity and structure population studies.

Link to paper: https://doi.org/10.1007/s11033-018-4226-4

Implications of population connectivity studies for the design of marine protected areas in the deep sea: An example of a demosponge from the Clarion-Clipperton Zone

Taboada S., Riesgo A., Wiklund H., Paterson G.L.J., Koutsouveli V., Santodomingo N., Dale A.C., Smith C.R., Jones D.O.B., Dahlgren T.G., Glover A.G. (2018)

Molecular Ecology, 1-23

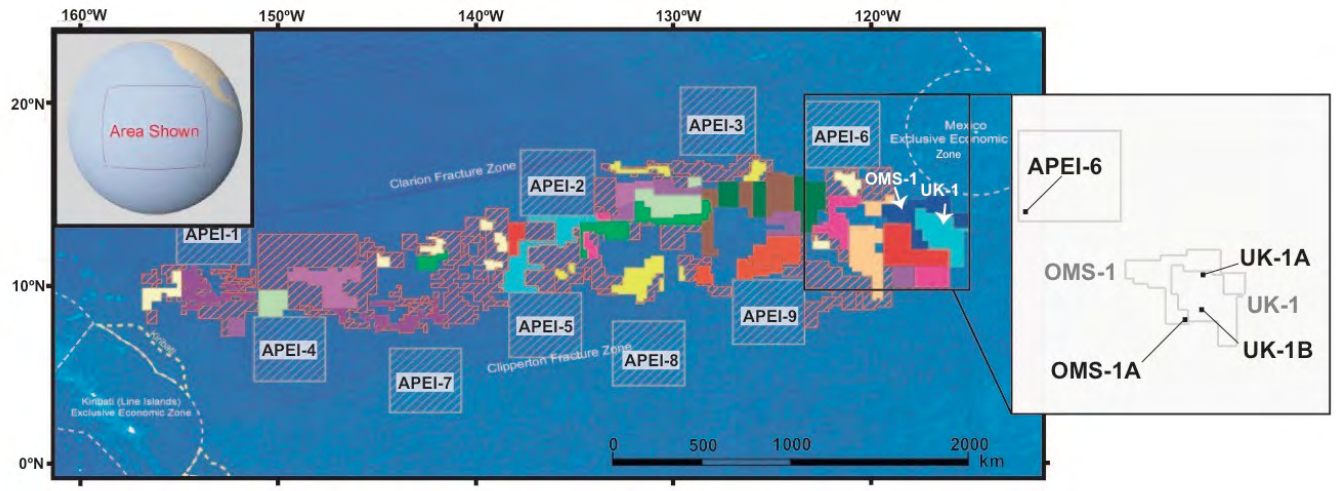

Figure 1: Map of the CCZ with the mining exploration areas and the network of APEIs. Inset showing the approximate position of the four different areas studied (APEI-6, UK- 1A, UK-1B and OMS-1A).

We have just published a paper on the molecular connectivity of a abyssal demosponge (Plenaster craigi) inhabiting the Clarion-Clipperton Fracture Zone (CCZ) in the NE Pacific. The CCZ is a region with abundant seafloor polymetallic nodules with a potential interest for mining. Our main aim was to assess the effectiveness of Areas of Particular Environmental Interest (set aside regions of the CCZ) as a po-tential genetic reservoir for the exploration areas once

they are exploited. Our study suggests that although APEI-6 does serve a conservation role, containing high values of genetic diversity, it is on its own inadequate as a migrant source for P. craigi for the entire eastern portion of the CCZ, indicating that after exploitation, recovery through migration from APEI-6 would be strongly unlikely. Our findings are highly significant because they provide solid information (integrating both molecular data with oceanographic models) for redesigning APEIs in the eastern CCZ.

Link to paper: https://doi.org/10.1111/mec.14888

Related press release: http://www.nhm.ac.uk/discover/news/2018/october/the-tiny-sponge-that-could-help-preserve-our-deep-oceans.html

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Geomorphological evidence of large vertebrates interacting with the seafloor at abyssal depths in a region designated for deep-sea mining

Marsh L., Huvenne V.A.I., Jones D.O.B. (2018)

Royal Society Open Science, 5: 180286

Exploration licences for seafloor mineral deposits have been granted across large areas of the world's oceans, with the abyssal Pacific Ocean being the primary target for polymetallic nodules—a potentially valuable source of minerals. These nodule-bearing areas support a large diversity of deep-sea life and although studies have begun to characterize the benthic fauna within the region, the ecological interactions between large bathypelagic vertebrates of the open ocean and the abyssal seafloor remain largely unknown. Here we report sea-floor geomorphological alterations observed by an autonomous underwater vehicle that suggest large vertebrates could have interacted with the seafloor to a maximum depth of 4258 m in the recent geological past. Patterns of disturbance on the seafloor are broadly comparable to those recorded in other regions of the world's oceans attributed to beaked whales. These observations have important implications for baseline ecological assess-ments and the environmental management of potential future mining activities within this region of the Pacific.

Link to paper: https://doi.org/10.1098/rsos.180286

Mineralogy of Deep-Sea Coral Aragonites as a Function of Aragonite Saturation State

Farfan G.A., Cordes E.E., Waller R.G., DeCarlo T.M., Hansel C.M. (2018)

Frontiers in Marine Science, 5: 473

In an ocean with rapidly changing chemistry, studies have assessed coral skeletal health under projected ocean acidification (OA) scenarios by characterizing morphological distor-tions in skeletal architecture and measuring bulk properties, such as net calcification and dissolution. Few studies offer more detailed information on skeletal mineralogy. Since aragonite crystallography will at least partially govern the material properties of coral skeletons, such as solubility and strength, it is important to understand how it is influenced by environmental stressors. Here, we take a mineralogical approach using micro X-ray diffraction (XRD) and whole pattern Rietveld refinement analysis to track crystallographic shifts in deep-sea coral Lophelia pertusa samples collected along a natural seawater aragonite satu-ration state gradient (Ω_{sw} = 1.15–1.44) in the Gulf of Mexico. Our results reveal statistically significant linear

relationships between rising Ωsw and increasing unit cell volume driven by an anisotropic lengthening along the b-axis. These structural changes are similarly observed in synthetic aragonites precipitated under various saturation states, indicating that these changes are inherent to the crystallography of aragonite. Increased crystallographic disorder via widening of the full width at half maximum of the main (111) XRD peaks trend with in-creased Ba substitutions for Ca, however, trace substitutions by Ba, Sr, and Mg do not trend with crystal lattice parameters in our samples. Instead, we observe a significant trend of increasing calcite content as a function of both decreasing unit cell parameters as well as decreasing Ωsw. This may make calcite incorporation an important factor to consider in coral crystallography, especially under varying aragonite saturation states (Ω_{Ar}). Finally, by defining crystallography-based linear relationships between Ω_{Ar} of synthetic aragonite analogs and lattice parameters, we predict internal calcifying fluid saturation state (Ω_{cf} = 11.1–17.3 calculated from b-axis lengths; 15.2–25.2 calculated from unit cell volumes) for *L. pertusa*, which may allow this species to calcify despite the local seawater conditions. This study will ideally pave the way for future studies to utilize quantitative XRD in exploring the impact of physical and chemical stressors on biominerals.

Link to paper: https://doi.org/10.3389/fmars.2018.00473

Unravelling the versatile feeding and metabolic strategies of the cold-water ecosystem engineer Spongosorites coralliophaga (Stephens, 1915)

Kazanidis G., van Oevelen D., Veuger B., Witte U.F.M. (2018)

Deep Sea Research Part I: Oceanographic Research Papers, 141: 71-82

Sponges are often major players in the functioning of shallow-water ecosystems through their high biomass and high capacity in filter feeding. In comparison, little is known about the feeding and met-abolic strategies of deep-sea sponges, although they can also form dense aggregations with high biomass. This situation hinders our understanding about how some sponge species thrive under the often food-limited conditions of the deep sea. In the present study we examined the feeding and metabolic strategies of 1) the massive demosponge *Spongosorites coralliophaga*, which was recently described as an important ecosystem engineer in cold-water coral reefs (CWCRs) and 2) the anthozoan *Parazoanthus anguicomus* and the ophiuroid *Ophiura ophiura*, i.e. two dominant epibionts on *S. coralliophaga*. All three benthic species have high density at CWCRs of the North-East Atlantic and knowing their feeding strategies facilitates future studies on carbon (C) and nitrogen (N) cycling at CWCRs. The on-board feeding experiments examined the processing of four isotopically-labelled food sources, namely ^{15}N-ammonium chloride, ^{13}C-glucose, ^{13}C/^{15}N-labelled microalgae, ^{13}C/^{15}N-labelled bacteria by *S. coralliophaga* and its symbiotic bacteria and the epibionts *P. anguicomus* and *O. ophiura* from the Mingulay reef complex and the Logachev mound (North-East Atlantic). There were no significant differences among the three species in terms of biomass-specific C and N assimilation rates; however, there were differences among *S. coralliophaga, P. anguicomus* and *O. ophiura* in how they processed the food sources and this maybe is linked to interspecific variability in metabolic needs. *S. coralliophaga* preferentially assimilated particulate organic N (PON) over particulate organ-ic C (POC) while this was not the case for *P. anguicomus* and *O. ophiura*. We did not detect the ^{15}N tracer in the bacterial biomarker D-Alanine suggesting that the preferential assimilation of N over C in *S. coralliophaga* was mediated by sponge cells instead of the bacterial symbionts. *S. coralliophaga* assimilated C and N from all four food sources and this versatile feeding strategy was accompanied by an ability for de novo synthesis of essential and non-essential hydrolysable amino acids (HAAs). We suggest that the recorded feeding and metabolic flexibility of *S. coralliophaga* plays an important role in the survival of this massive sponge under food-limited conditions in the deep sea.

Link to paper: https://doi.org/10.1016/j.dsr.2018.07.009

Distribution of Meiofauna in Bathyal Sediments Influenced by the Oxygen Minimum Zone Off Costa Rica

Neira C., Ingels J., Mendoza G., Hernandez-Lopez E., Levin L.A. (2018)

Frontiers in Marine Science, 5: 448

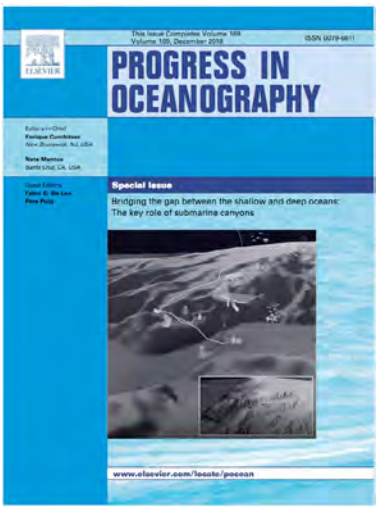
Ocean deoxygenation has become a topic of increasing concern because of its po-tential impacts on marine ecosystems, including oxygen minimum zone (OMZ) ex-pansion and subsequent benthic effects. We investigated the influence of oxygen concentration and organic matter (OM) availability on metazoan meiofauna within and below an OMZ in bathyal sediments off Costa Rica, testing the hypothesis that oxygen and OM levels are reflected in meiofaunal community structures and distri-bution. Mean total densities in our sampling cores (400–1800 m water depth) were highest with 3688 ind. 10 cm−2 at the OMZ core at 400 m water depth, decreasing rapidly downslope. Nematodes were overall dominant, with a maximum of 99.9% in the OMZ core, followed by copepods (13%), nauplii (4.8%), and polychaetes (3%). Relative copepod and nauplii abundance increased consistently with depth and in-creasing bottom-water O2. Meiofaunal composition was significantly different among sites, with lower taxonomic diversity at OMZ sites relative to deeper, oxy-genated sites. Vertical distribution patterns within sediments showed that in strong-ly oxygen-depleted sites less meiofauna was concentrated in the surface sediment than at deeper slope sites. Highest meiofaunal abundance and lowest diversity oc-curred under lowest oxygen and highest pigment levels, whereas highest diversity occurred under highest oxygen-concentrations and low pigments, as well as high quality of sedimentary pigment (chl *a*/phaeo) and organic carbon (C/N). The lower meiofaunal diversity, and lower structural and trophic complexity, at oxygen-depleted sites raises concerns about changes in the structure and function of benthic marine ecosystems in the face of OMZ expansions.

Link to paper: https://doi.org/10.3389/fmars.2018.00448

Special Issue on submarine canyons

De Leo F.C.[1,2], Puig P.[3]

[1]Ocean Networks Canada, University of Victoria, Canada; [2]Department of Biology, University of Victoria, Canada; [3]Department of Marine Geosciences, Marine Sciences Insti-tute (ICM-CSIC), Barcelona, Spain



Fresh out of the oven is the special issue in Progress in Oceanography, “Bridging the gap between the shallow and deep oceans: the key role of submarine canyons”, with 16 contributions presented during the 3rd INCISE International Submarine Canyon Symposium, in Victoria, Canada, in July of 2016. Available online since last August, the volume was finalized on the planned schedule and just prior to the 4th edition of the INCISE Symposium, hosted by the Southern University of Science and Technology (SUSTech), in Shenzhen, China, early in November (read more about yet another successful INCISE Symposium in this Deep Sea Life issue). The guest editors are very happy to share with the entire INDEEP research community, new insightful data and results on physical, geological and biological processes in submarine canyons. As our current knowledge builds up, it becomes more evident that canyons not only play a key role as major pathways between coastal and deep-sea environments, but in doing so also act as catalysts for a more rapid expansion of the human footprint into the deep-sea. Enjoy the read!

Link to Special Issue: https://www.sciencedirect.com/journal/progress-in-oceanography/vol/169/suppl/C

Bryozoa (Cyclostomata and Ctenostomata) from polymetallic nodules in the Russian exploration area, Clarion–Clipperton Fracture Zone, eastern Pacific Ocean—taxon novelty and implications of mining

Grichenko A.V., Gordon D.P., Melnik V.P. (2018)

Zootaxa, 4484 (1): 001-091

This work describes Bryozoa of the orders Cyclostomata and Ctenostomata found associat-ed with polymetallic nodules collected by box-coring in the eastern part of the Russian ex-ploration area of the Clarion-Clipperton Fracture Zone (CCFZ) under contract to Yuzhmorgeologiya. Scanning electron microscopic study of 358 cyclostome colonies and 14 ctenostome colonies from 4510–5280 m depth has resulted in the recognition of two new species of Ctenostomata, and 14 new species, nine new genera and two new families of Cyclostomata; three additional species of Cyclostomata are left in open nomenclature pending the discovery of missing reproductive characters. The taxonomic novelty is thus notable. One of the new Ctenostomata represents the first living example of the previously monotypic Late Cretaceous genus *Pierrella*. Twelve of the new cyclostome taxa have well-developed gonozooids, indicating that embryonic cloning (polyembryony) is normal in this deep-sea environment. On the other hand, one indeterminate tubuliporine and two rectangulates have dimorphic peristomes. In the latter two cases, enough mature colonies were found to suggest that this feature is normal, and that the dimorphic zooids are possibly female—in other words, capacious incubation chambers are apparently lacking, and therefore polyembryony would also be lacking or reduced. In one of these species, evidence is pre-sented to suggest that the ancestrular zooid can reproduce precociously. Of the species re-ported here, only one has previously been found outside the exploration area, highlighting both the limited knowledge we have of bryozoans in the deep Pacific and/or a fauna that is largely endemic to the nodule environment. An additional 31 species of Cheilostomata have also been discovered that will be described in a subsequent publication. Most bryozoans are macrofaunal-sized, so are both inadequately determinable and overlooked in images obtained by remotely operated vehicles; yet, with 50 species, Bryozoa is the most speciose sessile macrofaunal phylum on the nodules. Nodules constitute hard substrata in an area otherwise mostly inhospitable for Bryozoa, hence mining would lead to loss of critical habitat. Further, as suspension-feeders, bryozoans are highly susceptible to smothering by sus-pended sediment, and non-mined areas closely adjacent to extraction zones would likely also be affected and their associated bryozoan fauna obliterated. More data are required on the distribution of the CCFZ bryozoan species elsewhere in the east Central Pacific to determine if mining would lead to local taxon extirpation or global extinction at both low and high taxonomic levels.

Link to paper: http://dx.doi.org/10.11646/zootaxa.4484.1.1

Factors affecting trophic compositions of offshore benthic invertebrates at a sub-Antarctic archipelago

Puccinelli E., McQuaid C., Ansorge I.J. (2018)

Limnology and Oceanography 63 (5): 2206-2228

Food availability is a key regulator of the distribution, metabolism, and success of benthic populations. In deep sea

ecosystems, hydrodynamics and depth play fundamental roles in determining benthic food resources. Recent studies suggest that the Southern Ocean sub-Antarctic front is shifting southward, with implications for pri-mary production and food availability around the sub-Antarctic Islands embedded in the Antarctic Circumpolar Current. We used fatty acid (FA) and stable isotope (SI) analyses to investigate the trophic pattern of benthic invertebrates and suspended particulate matter (SPM) at three Depths (shallow: 100 m, middle: 300 m, and deep: 600 m) in three hydrographic regions with different flow and productivity regimes around the Prince Edward Islands. Both region and depth affected the SI values of SPM, while feeding guild was the key factor influencing consumer trophic values. Depth affected the $\delta^{15}N$ of all trophic groups and the FA compositions of suspension feeders. Deeper samples had a higher $\delta^{15}N$ and showed a greater proportion of mono- and saturated fatty acids, reflecting greater remineralization of SPM and of food reaching the seafloor. Region affected the $\delta^{13}C$ and FA values of SPM, suspen-sion feeders and deposit feeder/scavengers, with differences between the inter-island and open ocean regions. This was probably linked to the retention of nutrients and phytoplankton between the islands. Critically, the effects of depth and hydro-graphic region were taxon specific, indicating that long-term responses to environ-mental change may have complex consequences for the feeding ecology and viabil-ity of benthic populations, with implications for the higher trophic levels that these populations support.

Link to paper: https://doi.org/10.1002/lno.10934

Mercury concentrations in muscles and liver tissues of Cape monkfish (*Lophius vomerinus*) from the Northern Benguela, Namibia

Erasmus V.N., Hamutenya S., Ilitembu J.A., Gamatham J.C.

Marine Pollution Bulletin, 135: 1101:1106

Cape monkfish (*Lophius vomerinus*) is one of the long-lived species and top predators in the northern Benguela region. Studies on bioaccumulation of mercury (Hg) in cape monkfish are limited. This study compared the total Hg concentration between monkfish muscle and liver tissue; and related the monkfish total Hg concentrations to fish body size and capture locations (depth and latitude). Monkfish specimens (n = 529) were collected from 2016 to 2018. The mean total Hg concentration was 0.126 ± 0.005 mg/kg in muscle tissues and 0.106 ± 0.005 mg/kg in liver tissues. No significant differences were observed between to-tal Hg concentrations of muscles and liver tissues. Differences in Hg concentrations be-tween monkfish length classes were observed. No significant correlation was found be-tween total Hg concentrations and latitude. A significant increase of total Hg concentration with the depth was observed. The concentrations of Hg were below the World Health Or-ganization (WHO limits for fish (0.5 mg/kg).

Link to paper: https://doi.org/10.1016/j.marpolbul.2018.08.037

Quantifying the transfer of terrestrial organic matter into two contrasting New Zealand submarine canyon systems using bulk and compound-specific stable isotopes

Leduc D., Gibbs M., Swales A., Kingston A., Nodder S., Rowden A., De Leo F., Smith C., Mountjoy J., Graham B., Pallentin A. (2018)

We used bulk stable isotope and compound-specific isotope analyses to determine the sources of organic matter

in sediments of two contrasting canyon systems on either side of the active plate boundary and associated uplifted mountain divide of the South Island off New Zealand (Southwest Pacific): Kaikoura Canyon, a steep canyon close to the shore on the eastern seaboard, and Hokitika Canyon, a narrow and lower gradient canyon further from the coast on the western side of the island. Sediments from locations offshore from each canyons provided the marine end-member samples, and sediments collected from the mouth of rivers located up current from each canyon provided terrestrial end-member samples. We analysed archived (frozen) sediment samples collected along the axis of both canyons from 200 to 2000 m depth. These data enable us to determine the origins of canyon sediments by using simple mixing models with marine and terrestrial end members (Isosource and MixSIAR). Carbon isotope signatures of fatty acids have proved useful in determining the origins of sediments in estuaries. Here, we use this technique to determine the origins of deep-sea sediment organic matter for the first time.

Link to poster:

https://www.researchgate.net/publication/329104572_Quantifying_the_transfer_of_terrestrial_organic_matter_into_two_contrasting_New_Zealand_submarine_canyon_systems_using_bulk_and_compound-specific_stable_isotopes

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Tragedy of Abyssal Commodity: Deep Sea Mining and Corals

George R. (2017)

Deep-Sea floor was once a receptacle for military waste in the sixties, as revealed in the MIZAR cruises in the DWD Dumpsite off New Jersey where this author photographed with US Navy's FISH (Fully Instrumented Sonar Housing) vast patches of dead sea urchin Echinus affinis on sea floor where a 'Liberty ship' was sunk with nerve gas cylinders in caskets. After the 1972 "London Convention" for "prevention of marine pollution of dumping wastes and other material", deep-sea dumping was made illegal (Hollis, 2012) although marine debris is still an ongoing problem on ocean floor at abyssal depths.

CONTENTS

Chapter 1. Abuse of the Abyss: Anthropogenic Threats To Deep-Sea Ecosystem Integrity and Biodiversity with focus on Ocean Acidification and Co9balt Mining. Chapter 2. Executive Summary: Third In-ternational Deep-Sea Coral Symposium in Miami.

Link to book: https://www.amazon.co.uk/Tragedy-Abyssal-Commodity-Mining-Corals/dp/3330322527

Remarkable fish: Low oxygen extremophiles in the Gulf of California

Gallo N.D., Levin L.A., Beckwith M., Barry J.P. (2018)

Ecology, 1-4

All aerobic animals need oxygen to breathe, and fish are no exception; they extract dissolved oxygen from the water with their gills and use it to fuel their metabolism. Most fish are intolerant of hypoxic (low oxygen) conditions, however, a new study, published in the journal Ecology, and titled, "Home sweet suboxic home: remarkable hypoxia tolerance in two demersal fish species in the Gulf of California," describes the catshark, *Cephalurus cephalus*, and the cusk eel, *Cherublemma emmelas*, living under nearly anoxic (oxygen-free) conditions. Using MBARI's remotely operated vehicle

Figure 1 (above). The cusk eel, *Cherublemma emmelas* (upper panel), and the catshark, *Cephalurus cephalus* (lower panel), were observed living under nearly anoxic conditions in the Gulf of California, suggesting that fish have higher potential for hypoxia tolerance than previously thought. Red lasers are 29 cm apart and are used for scale.

(ROV) Doc Ricketts, in March of 2015, researchers surveyed deep seafloor communities in the Gulf of California oxygen minimum zone and were surprised to find high numbers of fish living under suboxic conditions, which were expected to exclude fish. *Cephalurus cephalus* and *Cherublemma emmelas* were commonly observed in suboxic areas and were absent from better oxygenated areas, suggesting a preference for a low oxygen habitat. Under nearly anoxic conditions, these two fishes were observed swimming over areas resembling bare, depauperate moonscapes. The described habitat of these fishes suggests that they are the most hypoxia tolerant fish species known, however the exact mechanisms that allow them to thrive under these extreme conditions remain a mystery. In the study, the authors propose the term “ligooxyphile”, to refer to animals that are specialists of low oxygen environments. Understanding the tolerance ranges of species to hypoxia takes on new relevance as the world’s low oxygen zones expand with climate change.

Link to paper: https://doi.org/10.1002/ecy.2539

Environmental considerations for impact and preservation reference zones for deep-sea polymetallic nodule mining

Jones D.O.B., Ardron J.A., Colaço A., Durden J.M. (2018)

Marine Policy, 1-9

Without effective monitoring of deep-sea mining the consequences of this industry on the environment will be unknown. However, monitoring in the deep sea is challenging and may not be able to identify even large changes to the environment if it is not done carefully. The developing legal regime for deep-sea mining is likely to focus on monitoring the impacts of mining at impact reference zones and comparing this to control sites at preservation refer-ence zones. Although specific plans will need to be tailored to the environment being im-pacted, many recommendations can be made to support the development of environmental monitoring plans that will improve the robustness of results and the ability to detect change. The new open access paper in Marine Policy outlines some important evidence-based recommendations for monitoring of deep-sea mining.

Link to paper: https://doi.org/10.1016/j.marpol.2018.10.025

Slope-shelf faunal link and unreported diversity off Nova Scotia: Evidence from polychaete data

Neal L., Taboada S., Woodall L.C. (2018)

Deep-Sea Research Part I, 138: 72–84

Deep-water sedimentary habitats off Nova Scotia have only rarely been explored. The topographically and oceanographically complex shelf of Nova Scotia harbours two interesting topographic features, Emerald Basin, a sedimentary habitat reaching greater depths (max of 270 m) than the surrounding shelf and the Gully, the largest canyon in NW Atlantic. Em-erald Basin is exposed to upwellings of slope water and harbours predominantly deep-sea hexactinellid sponges. Such distributional pattern resembles “deep-water emergence”. In this study an abundant benthic group, the polychaetes, were selected to test for such deep-water faunal link. Qualitative boxcores were collected from Emerald Basin (180m depth, N=5) and the adjacent Gully Canyon (1600 m, N=3). At species level, there was no overlap in distribution between Emerald Basin (N=73, S=29) and Gully Canyon (N=351, S = 60) fauna based on morphological assessment of all specimens and molecular analysis (COI and 16S markers) of selected morphotypes. In an alternative approach, Multivariate analysis (nMDS, Cluster Analysis) of incidence data for polychaete genera (N=179) from 24 Atlantic sites (5–1600 m) was carried out. These results showed a greater similarity of Emerald Basin polychaetes to bathyal sites (400–1000 m), particularly the 680m site off Nova Scotia rather than shelf sites (5–80 m), including those on the Nova Scotia shelf. Thus, at 1600 m, the Gully Canyon samples were likely “too deep” for our comparative purposes and depths of< 1000m should be targeted in the future. Our data also provide the first published as-sessment of polychaete diversity from the Gully Canyon, suggesting the presence of a diverse assemblage (S = 60). Unusually for a deep-sea site, the Gully Canyon polychaetes are mostly known taxa with wider distribution across bathyal NW Atlantic. Additionally, our molecular data provide an interesting insights into the distribution of several polychaete species commonly found in deepsea (e.g *Aurospio dibranchiata Maciolek*, 1981; *Ophelina abranchiata Støp-Bowitz*, 1948) suggesting wide geographical distribution for some but re-vealing species complexes for others.

Link to paper: https://doi.org/10.1016/j.dsr.2018.07.003

Deep sea mining’s future effects on Fiji’s tourism industry: A contingent behaviour study

Folkersen M.V., Fleming C.M., Hasan S. (2018)

Marine Policy, 96: 81-89

Pristine coral reefs possess a tremendous potential for contributing to tourism and economic development. This is especially important for Fiji given their tourism economy’s reliance on diving and coastal activities. Understanding divers’ perceptions of coral reefs and environmental issues is, therefore, paramount to sustaining the tourism industry. Despite the importance of coral reefs to the Fijian tourism sector, the Fijian Government has granted exploration licenses to mining companies to assess the viability of deep sea mining (DSM) activities in Fiji’s seas. There is concern that DSM may negatively impact reef-related tourism due to tourists’ perception that DSM activities degrades Fiji’s coral reefs. This study conducts a contingent behaviour survey to explore how tourists’ expectations of DSM will affect their future travel decisions and subsequently influence overall tourism demand in Fiji. Our findings show that divers and snorkelers demonstrate a high willingness to return to Fiji in the future, based on their previous travel experience, but that they would significantly reduce their future visits if DSM was to take place in Fiji. These results contribute to our understanding of the potential trade-offs between DSM and reef-related tourism and give some preliminary estimates of the potential economic consequences of the Fijian Government allowing DSM within their territorial waters.

Link to paper: https://doi.org/10.1016/j.marpol.2018.08.001

Deep-sea mining: Interdisciplinary research on potential environmental, legal, economic, and societal implications

Koschinsky A., Heinrich L., Boehnke K., Cohrs C.J., Markus T., Shani M., Singh P., Stegen K.S., and Werner W.(2018)

Integrated Environmental Assessment and Management, 14 (6): 672-691

Deep-sea mining refers to the retrieval of marine mineral resources such as Mn nodules, FeMn crusts, and seafloor massive sulfide deposits, which contain a variety of metals that serve as crucial raw materials for a range of applications, from electronic devices to renewable energy technologies to construction materials. With the intent of decreasing dependence on imports, supporting the economy, and potentially even overcoming the environmental problems related to conventional terrestrial mining, a number of public and private institutions have rediscovered their interest in exploring the prospects of deep-sea mining, which had been deemed economically and technically unfeasible in the early 1980s. To date, many national and international research projects are grappling to understand the economic environmental, social, and legal implications of potential commercial deep-sea mining operations: a challenging endeavor due to the complexity of direct impacts and spillover effects. In this paper, we present a comprehensive overview of the current state of knowledge in the aforementioned fields as well as a comparison of the impacts associated with conventional terrestrial mining. Furthermore, we identify knowledge gaps that should be urgently addressed to ensure that the world at large benefits from safe, efficient, and environmentally sound mining procedures. We conclude by highlighting the need for interdisciplinary research and international cooperation.

Link to paper: https://doi.org/10.1002/ieam.4071

Shipboard design and fabrication of custom 3D-printed soft robotic manipulators for the investigation of delicate deep-sea organisms

Vogt D., Becker K., Phillips B., Graule M., Rotjan R., Shank T., Cordes E., Wood R., Gruber D. (2018)

PLOS One, 13 (8): 0200386

3D printers were taken aboard the R/V *Falkor* during a recent expedition, to rapidly advance the design of soft underwater grippers on-the-fly and in the field. These designs were deployed on the ROV *SuBastian* on a series of dives exploring the biodiversity of the Phoenix Islands Protected Area.

Link to paper: https://doi.org/10.1371/journal.pone.0200386

Comparative morphological analysis of the morid cods (*Antimora* spp., Moridae, Gadiformes) from ichthyological collections

Orlov A.M., Grigorov I.V., Lazareva N.I. (2018)

Zoologicheskie Issledovania, 20: 98–111

An analysis of 24 morphometric and 10 meristic characters in 174 individuals of Pacific flatnose *Antimora microlepis* Bean, 1890 and 102 blue hake A. rostrata Gűnther, 1878 oroginated from different parts of the species ranges and kept

in the collections of Russian, USA and Canadian museums was performed. Previously, a revision of the genus *Antimora* with the allocation of two valid species (Small, 1981) was carried out on the basis of analy-sis of 8 morphometric and 5 meristic characters, which showed that these species differ from each other only in head length, length and number of gill filaments on the first gill arc. The data obtained by us show statistically significant differences between the studied species in a number of both morphometric and meristic features, the strongest of which are head length, post-orbital distance, length of anal fin base, number and length of gill filaments on the first gill arc and some others. Along with the previously revealed differences (Small, 1981), those we found can serve as good characters for distinguishing the species under consideration. The results of morphological studies, along with the study of the shape and structure of otoliths, osteological studies and genetic analysis indicate in favor of the validity of the two *Antimora* species.

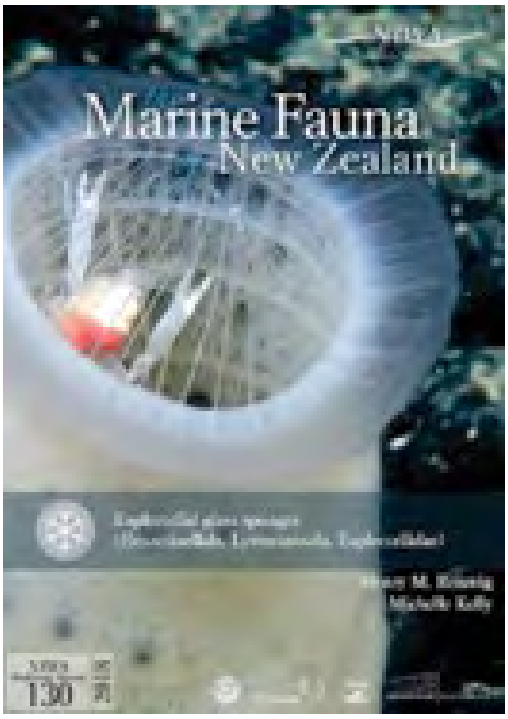
Link to paper: https://www.researchgate.net/publication/329034696

The NIWA Biodiversity Memoirs

Comprehensive, definitive, illustrated reference works that capture the rigorous, peer-reviewed scientific study of New Zealand's marine fauna and flora.

https://www.niwa.co.nz/coasts-and-oceans/niwa-biodiversity-memoirs

The information in these monographs provides the foundation upon which marine biological and ecological research sits. These important publications are indispensable references for academic researchers and postgraduate students interested in marine systematics and the conservation of New Zealand's unique aquatic biodiversity, much of which is found nowhere else in the world.



Front cover of the latest NIWA Biodiversity Memoir: Reiswig, Henry Michael; Kelly, Michelle 2018. The Marine Fauna of New Zealand. Euplectellid glass sponges (Hexactinellida, Lyssacinosida, Euplectellidae). Wellington, New Zealand: National Institute of Water and Atmospheric Research (NIWA). (NIWA Biodiversity Memoir; 130)

Many marine invertebrates such as sponges and corals form 'gardens' or biological habitats that support other animals, including commercially important fish species. These habitats can be vulnerable to damage by human activities such as fishing and seabed mining, thus knowledge of their biodiversity is critical for understanding the function of deep-sea and seamount ecosystems in order to improve their management.

The series

The NIWA Marine Biodiversity Memoir series began in 1955 as the New Zealand Oceanographic Institute Memoirs (volume 1–107). Topics covered by these earlier monographs include New Zealand oceanography, hydrology, microbiology, bathymetry, sedimentation, submarine geology and geomorphology, and also included contributions on the Ross Sea. Most of the NIWA Biodiversity Memoir volumes are authored by our NIWA taxonomists funded by our Coasts and Oceans Research Programme 2 Marine Biological Resources: Discovery and definition of the marine biota of New Zealand, but many are authored by overseas specialists if expertise is lacking in New Zealand.

In 2016 we released the first of our revitalised editions in the NIWA Biodiversity Memoir series, including colour in-situ

imagery of the New Zealand fauna and a new-look front and inside cover design.

MBARI Media Management

The Monterey Bay Aquarium Research Institute's (MBARI) Video Annotation and Reference System (VARS) has been used for creating and managing video and image annotations for over fourteen years. The central tenants of VARS–using a controlled vocabulary and a centralized archive of annotations–have proven extremely effective for generating quantitative and qualitative information from images and video. Over 400 peer-reviewed publications have been written using data from VARS. MBARI is currently transitioning from videotape recordings to file-based formats. As part of this transition, we have developed a new software stack designed around a microservice architecture that communicates via standard web protocols. Each component is relatively small and independently deployable. This type of design allows for the evolution or replacement of individual services over time and gives researchers tremendous flexibility in developing special-purpose annotation and video applications. MBARI is releasing these tools as open-source for external researchers and organizations for managing their own video assets and to facilitate the development of new, custom video analysis applications.

Link to poster: https://drive.google.com/file/d/1B9Gmxj2MEzlDIAmVQxONYzW5i2D3MaPl/view?usp=sharing

Deep-Sea Biology Society Business

President's Letter, December 2018

With snow falling in parts of Europe, and even a light frost in London, it gives me great pleasure to write another letter to the members of the Deep-Sea Biology Society, and to wish you all a very happy holiday season. It seems like a lot has happened since the hot European summer of 2018, where for the Trustees, significant parts of it were spent huddled around video-conferences on our laptops — at strange times of night and day — helping to plan the 15th Deep-Sea Biology Symposium in Monterey.

It was an astonishing achievement for the team, and in particular our local hosts at the Monterey Bay Aquarium Research Institute, who hosted the largest DSBS ever held (405 participants) despite competition with quite a range of other major marine meetings the same week. As with the meeting in Aveiro three years ago, it felt like another leap forward in the growth of our community and the openness of our discipline. Over 300 abstracts were submitted to the meeting, with 172 oral talks (42 by students), 59 lightning talks, and 195 posters (44 by students). Participants hailed from at least 34 countries around the world. The meeting was reported in a range of media, including Nature and The Economist magazines as well as through a very active twitter hashtag #DSBS2018 - where you can still relive the memories if you so desire. You can of course also download the full program and abstracts from our website.

We must thank the leadership of Steve Haddock, George Matsumoto and Mariah Salisbury, with the support of all the local organising committee and the society Trustees for this incredible success.

Figure 1. Conference Group Photo.

It is a good joke that the most important thing to do at any meeting is to decide the venue of the next meeting. And this year, we did things slightly differently, and we hope, slightly more openly to allow as many members as possible to have a say. At our Annual General Meeting (AGM) that the Society hosted on the Wednesday evening, we invited prospective bidders to put forward their proposals for the 16th DSBS (to occur in 2021). These bids were also circulated in the form of 2-page proposals to all members, and voting was opened until Friday, including online voting for any members not present at Monterey. We were delighted to announce at the closing ceremony that the winner of this process was the bid led by JAMSTEC in Japan. The runner-up was a strong bid from IFREMER in France. We are all extremely excited to support the 2021 16th Deep-Sea Biology Symposium in Japan - the first time the meeting will have been held in Asia.

One thing the Society is very aware of is the rising cost of attending our international symposia. In the last 6 years, attendance at the main triennial DSBS meeting has almost doubled in size, and we will expect perhaps 500 delegates in 2021. This places increasing burdens on the local organising committees and often a requirement to utilise professional conference facilities, with increased costs. The Society is committed to making the symposia as open as possible to all, and one of the main ways we can do this is through raising sponsorship for travel grants to enable people to attend the meeting. We were able to do this in 2018 for a record 13 participants at the 15th DSBS, and we want to build on this for the next meeting. We are also committed to helping push online participation in the meetings through social media. We would be interested to hear from the membership on other ideas for increasing access to the meeting for those with limited travel funds.

Figure 2. Student/Early career BBQ event at Hopkins Marine Station.

Next year, the Annual General Meeting of the Society will be held in conjunction with the 7th International Symposium on Deep-Sea Corals (ISDSC) which will be held in Cartegena, Colombia from 29 July - 2 August 2019. You can already visit the website and propose sessions: https://www.deepseacoral2019.org and we encourage anyone with an interest in deep-sea corals to register. The Society will be sponsoring the meeting with travel awards, student events, the AGM, and discounts for members.

Since my last letter in June, there have been some changes to the oversight of the Society as all of the Trustee positions, including President, were up for re-election at our last AGM in Monterey. I would like to take this opportunity to thank our departing Trustees Holly Bik, Diva Amon, Paul Snelgrove and Rachel Boschen for all of their work over the years.

Re-joining the Trustees in a new role is Moriaki Yasuhara, formerly in a non-executive role, but now as our new Trustee for Conferences supported by the lead of the Local Organising Committee for the 16th DSBS in Japan, Katsunori Fujikura. Also in a new role are Paris Stefanoudis (formerly student lead) who is now in charge of our Communications portfolio, and Erin Easton (formerly non-executive) who is our new Secretary. Our new Student officer is Zoleka Filander and we have now created two new positions in Development (Julia Sigwart) and Early-Career officer (Andrea Quattrini). Moving from the epic job of leading the 15th DSBS in our Conferences position, we are delighted that Steve Haddock now joins our Trustees in a non-executive oversight role, and we are joined by two new non-executive Trustees, Chong Chen and Leigh Marsh.

Staying in the same role are myself as President, Rachel Jeffreys in Awards, Chris Yesson as Treasurer, Santiago Herrera in Membership, and Craig McClain and Malcolm Clark in non-executive Trustee roles. I feel confident that we have an excellent new board of Trustees to serve the membership over the next three years.

As this is now a period of settling in and development of new ideas for our Trustees, I will wait until 2019 to report on the new plans in our various core areas. However, in January we will announce our list of awards and funding opportunities for the 2019 calendar year - so please keep an eye for those on our twitter feed, slack team (join at j.mp/deep-slack), mailing list and website.

Wishing you a very happy holiday,

Adrian Glover, President
a.glover@nhm.ac.uk

Landmark Paper Award

The Deep-Sea Biology Society seeks to acknowledge major advancements in deep-sea research through our triennial Landmark Paper Award. This award honours current and major advancements in research that either reveal key information, challenge our current notions, or generally bolster the field of deep-sea biology.

The winner of the Landmark Paper in Deep-Sea Biology Research for 2018 is "Sinking particles promote vertical connectivity in the ocean microbiome" by Mireia Mestre, Clara Ruiz-González, Ramiro Logares, Carlos M. Duarte, Josep M. Gasol and M. Montserrat Sala (Institut de Ciències del Mar, Consejo Superior de Investigaciones Científicas, Barcelona, Spain).

Sinking organic particles constitute the main pathway for carbon export to the deep ocean and form the main source of energy for most deep-sea communities. Sinking organic particles are formed in the sunlit surface ocean from photosynthesising phytoplankton and play a globally important role in the biological carbon pump. To date attention has been mainly focused on characterising and quantifying (1) flux of organic particles through the deep ocean to the seafloor[1,2], and (2) the role of organic particles i.e. as a source of food in promoting species diversity in the deep-sea[3]. In contrast, few studies have identified sinking particles as microbial biodiversity hotspots in their own right.

Sinking particles are rapidly colonized by prokaryotes[4] and particle attached communities constitute microbial communities different than the free-living counterparts[5]. In their paper Mestre et al. (2018) tested three hypotheses: (1) sinking particles represent a dispersal vector of prokaryotes into the deep ocean, (2) prokaryotic communities attached to large particles have strong vertical connectivity to surface communities, and (3) deep ocean biogeographic patterns of prokaryotic diversity resemble those of surface particle attached communities. In order to test these hypotheses Mestre and co-authors used Illumina sequencing of 16S rRNA genes from 155 samples across eight stations globally in the Atlantic, Pacific and Indian Oceans. Their results show that the global ocean prokaryotic microbiome has strong vertical connectivity throughout the water column, demonstrating that sinking particles act as a dispersal vector for prokaryotes. They show that the majority of prokaryotic species in the deep-sea are also present in surface waters and so the biogeography of deep-sea prokaryotic communities is influenced by particle colonization of prokaryotes in the surface waters, providing a viable diversity of life to the deep ocean layers. Finally, Mestre et al. (2018) state that their work 'unveils the importance of particle-driven dispersion' and suggest implications and research questions for other areas of deep-sea research including how endemic communities colonize geographically and isolated habitats e.g. hydrothermal vents. This paper provides convincing evidence that marine particles originating from the surface ocean act as seed bank of viable taxa for the deep ocean.

Author Information

Mireia Mestre is a microbial ecologist and is currently a postdoctoral researcher at Centro FONDAP de Investigación en Dinámica de Ecosistemas Marinos de Atlas Latitudes in Chile. She completed her PhD at the Institut de Cièncеis del Mar (Barcelona) in conjunction with Universidad de Las Palmas de Gran Canaria. Her PhD work has been recognised as a major advancement in the field of deep-sea biology and awarded the Deep-Sea Biology Society triennial landmark paper award.

Landmark Paper Citation

Mestre, M. et al. Sinking particles promote vertical connectivity in the ocean microbiome. P Natl Acad Sci USA 115, E6799–E6807 (2018).

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1. *Smith, K. L., et al. Episodic organic carbon fluxes from surface ocean to abyssal depths during long-term monitoring in NE Pacific. P Natl Acad Sci USA 115, 12235–12240 (2018).*
2. *Lampitt, R. S. et al. Long-term variability of downward particle flux in the deep Northeast Atlantic: Causes and trends. Deep-Sea Res II 57, 1346–1361 (2010).*
3. *Woolley, S. N. C. et al. Deep-sea diversity patterns are shaped by energy availability. Nature 533, 393–396 (2016).*
4. *Grossart, H. P., et al. Bacterial Colonization of Particles: Growth and Interactions. Appl Environ Microb 69, 3500–3509 (2003).*
5. *DeLong, E. F., et al. Phylogenetic diversity of aggregate-attached vs. free-living marine bacterial assemblages. Limnol Oceanogr 38, 924–934 (1993).*

15th Deep-Sea Biology Symposium Awards

Travel Awards were sponsored by the Deep-Sea Biology Society, by the journal Frontiers in Marine Science, and by the International Seabed Authority.

Deep-Sea Biology Society Awards & Frontiers in Marine Science Awards

Yi Yang, Hong Kong University of Science and Technology, Hong Kong
Craig Robertson, University of Wales Bangor, UK
Elisabeth Myers, Massey University, New Zealand
Poppy Best, Plymouth University, UK
Raissa Hogan, National University of Ireland Galway, Ireland
Lissette Victorero, National Oceanography Centre, Southampton, UK
Sven Laming, Ifremer, France
Beatriz Mejia Mercado, Florida State University, USA

International Seabed Authority Awards

Ana Luna Cruz, Universidad Nacional Autonoma de Mexico
Eleonora Puccinelli, University of Cape Town, South Africa
Diana Salcedo, Universidad Nacional Autonoma de Mexico
Marina Fernandez, University of São Paulo, Brazil
Pamela Rivadeneira, Museo Argentino de Ciencias Naturales, Argentina

Student Presentation Awards

Best Student Talk

Kate Thomas, Duke University, USA
Now you see me, now you don't: Cephalopod visual ranges and implications for deep-sea visual ecology.

Highly Commended Student Talks

Karin Steffen, Uppsala University, Sweden
Investigating sponge microbiome and metabolome along a depth gradient.

Franziska Bergmeier, LMU, Munich, Germany.
Bathyal slope to hadal trench: diversity and biogeography of Solenogastres (Mollusca) in the Northwest Pacific.

Best Student Poster

Richard Jones, Florida Atlantic University, USA
Ecology of the barracudinas (Paralepididae) in the Gulf of Mexico.

Highly Commended Student Posters

Abigail von Hagel, University of Washington, USA.
Depth-related Skeletal Reduction in Snailfishes (Liparidae).

Ben Burford, Stanford University, USA.
Visual signalling by a group-forming squid in the deep sea.

Reports to the International Seabed Authority

Diana Salcedo

Universidad Nacional Autonoma de Mexico

Attending the 15th Deep Sea Biology Symposium co-hosted by MBARI (Monterey Bay Aquarium Research Institute) and the Monterey Bay Aquarium was a remarkable and productive experience. I had attended other international scientific meetings before, but never one that big, and this allowed me to connect with students and scientists from all around the world who are involved in similar topics to that of my PhD project.

I´m a Mexican student enrolled in the PhD program of the Institute of Ocean Sciences and Limnology, UNAM, Mexico City. Considering the scopes of this type of meetings I was very interested in attending the 15th DSBS, but at the same time I was concerned because the registration fees and the travel costs were very high considering the exchange rate. How-ever, months ago I applied to request a travel award, and it was very exciting to know that I had been selected to be recipient of an award granted by the Deep-Sea Biology So-ciety and the International Seabed Authority, which allowed me to attend this meeting.

I presented my PhD project in a poster session, and I was able to give a lightning talk before. Although it lasted only two minutes, I loved the experience. It was challenging to speak in front of such a large audience in a different language, to summarize my project in two minutes and to capture the attention of the attendees to learn more about my pro-ject, but I enjoyed it immensely. I was not nervous at all, which made me realize that I`m ready for future scientific talks, and it was even better when I received very good com-ments from some colleagues. My poster was not in a very visible area inside the exposi-tions room, but many people showed interest in my project and stopped by to ask ques-tions. It was a very pleasant and enriching experience to be able to explain my project in a different language, to answer all kind of questions and to discuss my results with other researchers, hence improving my scientific communications skills.

During the meeting, I could hear many interesting talks about deep-sea topics that I was not aware of. I learned a lot about new deep-sea exploration and study technologies and about priority issues. It was very nice to meet most of the deep-sea community, the in-teresting projects they are conducting all around the world, and to feel the warm wel-come to young scientists.

Attending this meeting was also an amazing experience because I met some colleagues that I had met before in other scientific events such as international courses, oceano-graphic expeditions, etc. It was great seeing them again and catching up. In addition, I had the opportunity to meet many other students and researchers. These interactions al-lowed me to solve important doubts that I had about the interpretation of the data of my project, which will allow me to improve it. This also allowed me to meet researchers with whom I could establish future collaborations according to my scientific interests. Addi-tionally, I could meet some MBARI colleagues with whom I currently collaborate and could establish new and promising collaborations, which includes the joint publication of scientific articles, obtaining data, obtaining samples for new projects, etc.

This was a truly unique and amazing experience that will surely have a remarkable influ-ence on my academic and scientific career. I am very satisfied, happy and proud of all that I could achieve during this meeting. I feel very grateful to the DSBS, the ISA, and all the people involved in granting me this award, without their support, this could not have been possible.

Eleonora Puccinelli

University of Cape Town, South Africa

Email: eleonorapuccinelli@gmail.com
Website: www.eleonorapuccinelli-naturalview.com

The Deep-sea Biology Symposium and the Deep Ocean Stewardship Initiative (DOSI) work-shop were very interesting meetings that I had the possibility to attend in Monterey (CA) between the 9 - 14 of September 2018. I have been working on deep-sea ecology in South Africa since 2015, however, this was the first time that I have had the opportunity

to attend similar meetings.

Even if intense, the symposium was well organized, and all different aspects related to the deep-sea were discussed. Of particular interest to me were the Biodiversity and Ecosystem Functioning, and the Trophic Ecology sessions. The plenary talks were also very inspiring. It was fascinating to hear from Julie Packard how the Monterey Bay Aquarium and MBARI started, and to have such a compressive lecture on trophic ecology from an upcoming young female scientist Dr Anela Choy. Most of the keynote speakers were female, and many es-tablished female researchers attended the conference. As an early-career female research-er, it was extremely inspiring and important to see female researchers in these marine fields cover such roles.

The highlight of the conference was definitely having the opportunity to present my work in front of an international audience. I felt very privileged to be able to show the results of a project that I have been working on for the last couple of years. I am working on trophic ecology of deep-sea benthos at the Southern Ocean Prince Edward Islands (PEI), looking at how variability in oceanographic conditions around the islands can influence the pattern of food distribution and the trophic ecology of deep-sea benthos. The PEI currently represent the sole South African offshore marine protected area (established in 2013). Understanding patterns of variability is thus fundamentally important for an effective protection of this MPA. It was extremely stimulating to present my results in front of an audience who work on similar topics. I have presented similar results at other meetings, however I had difficul-ty finding people that fully understood what I am working on, the problems that I usually encounter and most of all to have a constructive discussion and share ideas. Additionally, in my current lab I am the only one working on such topics and it was very useful to talk and listen to researchers knowledgeable in this field.

During the conference I had the chance to meet with a collaborator from SCRIPPS with whom I have been working since 2016. The project is looking at the isotopic composition of benthic specimens collected on the South Africa south coast in collaboration with other South African researchers. I strongly believe that a fundamental way forward in research is to collaborate, and conferences are the place where most of the collaborative projects start.

At the conference I learnt from the top-experts in the field about new technology used to sample the deep-sea. Although South Africa has probably the best facility to study the deep-sea in Africa, we are still behind compared to other countries. I have learned about different strategies that researchers have developed to study for instance larvae of benthos in the abyss, or economical camera systems to investigate the seafloor, some of which could be used in the near future in South Africa.

Before the meeting I had been asked to give an early career lighting talk for the students attending the conference, together with four other early career researchers. It was really stimulating to share my experience of working in an African country, the difficulties that I encountered but most of all, the beauty to work in such an environment. At the conference I had the chance to chat with students and young researchers from other universities, to dis-cuss future career plans, job opportunities, day to day difficulties etc. We have reciprocally started to follow each other on major social media such as Twitter and ResearchGate. Likewise, I had the chance to have scientific conversations with some of the top-experts in the field, with whom I hope to start collaborative projects. Conferences and international meetings are the starting point to meet other scientists, but it is fundamental to connect and engage with them once the meeting is over. Definitely several talks made me think about possible future projects which I am hoping to develop.

On this line, I have decided to join the DOSI community and to actively be involved in a working group. This will not only keep me informed of new developments in the field, but I am aiming to share the knowledge acquired during the DOSI meeting across the South Afri-can marine science community. With another colleague from South Africa who attended the conference, we are planning to host a talk through the network SANCOR, which regular-ly hosts talks in Marine Science, to inform the community about DOSI and its initiatives.

I was one of the three people from the entire African continent attending the conference in Monterey, and I am really grateful for the financial support provided by ISA and by the Deep-Sea Biology Society. It has been a great experience and I am hoping that this will lead to future collaborations and further interesting and meaningful projects in the deep-sea, making South Africa an internationally recognized country for top-class deep-sea research.

Pamela Rivadeneira

Museo Argentino de Ciencias Naturales, Argentina

Deep-Ocean Stewardship Initiative workshop

During this meeting I had the opportunity to know and understand the general problems in deep waters around the world, some that I had not thought of before and others well known by our working group. Particularly in the pollution group of which I participated, we defined what we consider to be contaminants and which of these are the most relevant in each case (in addition to plastics), as well as their origin and need to monitor the most affected areas. The most important points for me were to recognize the need to work with people from other disciplines and to know what effect this has on organisms that live in deep waters. Without this it is difficult to communicate to people the importance of becoming aware of our actions and the consequences they have. It is not minor because we as researchers have an obligation to communicate about the problems we generate as a society and offer tools to improve the situation. The exchange of opinions, ideas and experiences with people from different parts of the world and with such diverse works during the workshop seemed to me the most enriching part of the meeting. This meeting also gave me new tools to tackle problems as well as ideas to look for the best possible way of collaborating. This is very important not only for me but also for my working group, since in Argentina there are no other groups that work in deep waters and this type of networking can hopefully continue in the future.

Conference - 15th Deep-Sea Biology Symposium

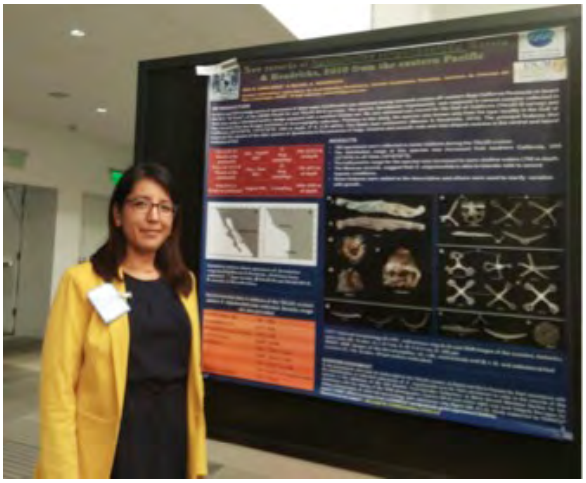
This conference gave me the opportunity to know what is being studied around the world in deep waters, to know what are the new technologies used for sampling, the most recommended methods and analysis, as well as the most innovative studies. The fact that it is a conference that covers all types of biological studies in this particular environment is very satisfying as it allows "assembling the pieces of the puzzle" to have a broader picture of how this ecosystem functions. This is very important for us as an undeveloped country since we do not have the possibility of using cameras or ROVs, we only have an idea of how this environment can be based solely on what we obtain from the samplings. The presentations (oral and poster sessions) gave me new ideas for our work as well as contacts of people with whom a joint work is possible. During my poster presentation it was very interesting to be approached by several people - most of which I already knew by name having read their papers in the past - and exchange ideas about my work. I also took advantage of the coffee breaks and social events (e.g. student/early career BBQ, banquet) to meet as many people as possible and generate contacts in other parts of the world, perhaps allowing me, in a year, to have the possibility of doing a postdoc in another country.

Figures: (top) Picture of all DOSI-workshop participants; (bottom) From left to right: Maria Baker (DOSI co-lead), Marina Fernandez (ISA awardee), Pamela Rivadeneira (ISA awardee), Eleonora Puccinelli (ISA awardee), Ana Luna Cruz (ISA awardee), Diana Salcedo (ISA awardee), and Rachel Jeffreys (DSBS officer for Awards).

Ana Karina Luna Cruz

Universidad Nacional Autonoma de Mexico

When I was notified that had been selected to receive one of the five prizes awarded by the Deep Ocean Stewardship Initiative with the Endowment Fund of the International Seabed Authority to attend the 15th DSBS and the DOSI day, I could not believe it! I had to read the email a second time to make sure it was correct! So it took me a short time, before I could recognize that it was a great opportunity for me. In the following weeks, I started planning everything for that trip.



I was very excited about the idea of being able to present part of the research that I had been doing for a year and half as a master student at Universidad Nacional Autónoma de México. It would be the first time that I would attend an event of this size, that would cover a range of science topics. Also, that would be the first time that I would travel outside of Mexico.

My stay during the symposium resulted in a great academic, cultural and personal learning. The opportunity to meet and interact with scientists from others parts of the world whose work in deep ocean research I have been following over the past couple of years, was very rewarding for me. Listening to to the plenary speakers was like receiving a direct class from someone who had indirectly motivated the emergence of new scientific questions throughout the course of my project. My enthusiasm stemmed not only by meeting and listening to them, but also by realizing their true dedication and passion for their work.

Most of the trips that a person can make outside of their home country are already a sea of cultural knowledge, which becomes even greater with the dialogue with other people. I met and spoke with other attendees from different regions of the world with interests similar to mine, some of them at early career stages, but all with great enthusiasm about deep-sea work, which was very inspiring to me. Now I have some friends in different regions of the world such as USA, Japan, Argentina and Brazil! In the near future we are will probably bump into each other again in a different meeting and likely to remember with gratitude the moment we first met in a deep-sea biology symposium.

One of the moments that I really enjoyed during the symposium, was when three young researchers were invited to give a brief overview of their career, where they shared with us their successes but also the challenges presented to them. What was motivating to me was to know how they grew in their professional career overcoming difficulties and limitations.

Another event that I like the most was when Steven Haddock, at the end of his extraordinary talk in bioluminescence, let us all know that the motivation of his work and personal support of what had involved summoning a large number of scientists, had been his family. This made me realize that the achievements of a scientist' work is not only because of themselves or their team, but also due to the support of people behind the scenes that accompany us and share with us the satisfaction.

On the other hand, the DOSI meeting impressed me. Previously I had not had the opportunity to participate in a real manner to implement everything we know about the ecological challenges in the world that we are facing. There is currently a thought in some science groups that the role of scientists is to report a phenomenon, then question it, try to explain it, understand it and generate information. But how can all the information we generate have impact? I think the true scope happens until collectively we manage to find solutions to a problem. Attending the DOSI workshop made me understand that there is important part of the deep-sea community working together to bring a positive change to all the threats our oceans are currently facing. The scientists not only write papers to generate information; options and possible answers are being proposed and now the work of the science goes committed beyond laboratory tests.

Mexico is not a country that has opted to invest widely in scientific research; the opportunities and financial support that we can access are limited. However, I think we are working hard and can confront the difficulties to develop high quality work.

Having had this experience made me recognize two personal things: 1.- I have given the first step to start in what will be a long, arduous, but very rewarding career; 2.- in the future, I would like to become the person that motivates generations of younger scientist.

Marina Fernandez

University of São Paulo, Brazil

Since I started studying deep-sea hydroids for my PhD, back in 2013, and started learning about the wonders of the deep sea, with its fascinating animals and environments, one my greatest wishes was to be able to attend the Deep-Sea Biology Symposium to meet other people with the shared amazement by this habitat. Unfortunately, I was not able to attend the meeting in Aveiro in 2015, and since then I was hoping to go to the next Symposium. The time arrived, but traveling from Brazil was very expensive and I couldn't afford it. Thankfully, I was selected to receive the generous ISA travel award that covered all my expenses, giving me the opportunity to attend the DSBS 2018 and present my research.

Figure 1 (top). Visiting the Monterey Bay Aquarium; Figure 2 (middle). ISA awardees before the banquet. From left to right: Diana Salcedo, Pamela Rivadeneira, Ana Luna Cruz, and Marina Fernandez; Figure 3 (bottom). During the the BBQ event at Hopkins Marine Station.

The meeting was very productive. Going by myself, with no colleagues from Brazil, was not a problem, since from the first day at the meeting I started meeting very kind people, those amazing researchers of whom I had been reading their nice work and others that I was just starting to learn about. Also it was very gratifying to realize that they were quite interested in my research. I learned how warming and collaborative the deep-sea biology community was, and started feeling part of it.

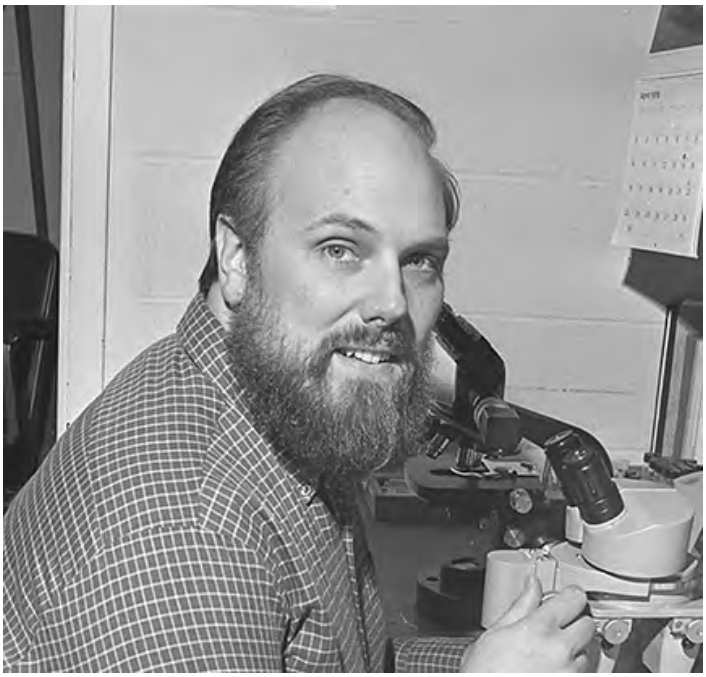
I'm sure that all the activities during those days in Monterey will have a big impact in my career as a deep-sea researcher. Attending the DOSI Day gave me the opportunity to realize what is currently being done, how people are joining efforts to make a positive difference in the future of our oceans, and that I could be part of this initiative as well. I was very much impressed by the high quality of the research presented in the talks during the symposium and their amazing findings in such a difficult environment to access, which demands cutting-edge technology, infrastructure, and abundant resources to be explored. I was also very pleased to give a talk about my research on the distribution patterns of hydroids in the deep Atlantic Ocean, which helped to disseminate my work and get feedback from my peers. The Lightning talks were amazing and I had a lot of fun watching people sell their research in such an effective way. This series of short presentations gave a good perspective on a large array of research and helped a lot in choosing posters to visit later. The poster session itself was a great opportunity to learn about details and the various research methods currently being used, plus it was the perfect moment to meet the people doing it. Also, I had a great experience judging the students posters.

Besides the formal research presentations, the many occasions for social gatherings, such as the opening reception, coffee breaks, the student barbecue at Hopkins Marine Station and the banquet at the Aquarium, were great opportunities for networking.

I feel extremely grateful for the ISA assistance, which was crucial for me attending the 15th Deep-Sea Biology Symposium in Monterey and presenting my research. I feel now very much inspired, with new ideas and different perspectives for my career, and further involved with the community.

Obituaries

In Memoriam: Fred Grassle



(Taken from the WHOI website, July 12, 2018)

The Woods Hole Oceanographic Institution announces with great sorrow the death of former employee Fred Grassle on July 6 2018, New Jersey. He was 78. Son of the late John K. Grassle and Norah I. (Fleck) Grassle, Fred was born in Cleveland, Ohio, and raised in Bay Village, Ohio. He graduated from Bay Village High School in 1957.

Fred received a degree in zoology from Yale University in 1961. During his studies, he spent a summer as an intern at the WHOI. Fred earned his PhD from Duke University in 1967 and then completed a Fulbright Fellowship at the University of Queensland in Australia, studying succession on the reef crest at Heron Island on the Great Barrier Reef

After his fellowship, Fred joined WHOI as a full-time assistant scientist in 1969. He was granted tenure in 1977 and in 1983, was promoted to senior scientist. Fred's research at WHOI focused on deep-sea biodiversity and included pioneering work on hydrothermal vent ecosystems. The National Geographic Society documented one of the early expeditions to the hydrothermal vents discovered in 1977 at the Galapagos Rift—of which Fred was one of the chief scientists—in "Dive to the Edge of Creation."

In 1989, Fred joined the faculty at Rutgers University's Cook College to establish the Institute of Marine and Coastal Sciences. He helped to raise funds for a new building to house the institute while expanding the research and teaching faculty and conducting his own research. This included an analysis of ocean dumping that led to the end of sludge disposal in US waters. He later helped establish one of the first ocean observing stations off the coast of New Jersey and was one of the founders of the Census of Marine Life, which led to the creation of Ocean Biogeographic Information System to provide a searchable database of data on distribution of marine life.

Fred retired in 2012 after 23 years at Rutgers University. Among other honors, he was awarded the Japan Prize in 2013, the Benjamin Franklin Medal in 2009, the Grand Prix des Sciences de la Mer Albert de Monaco, and the ASLO A.C. Redfield Lifetime Achievement Award in 2011.

Fred has had six species and one genus of polychaetes, three species of mollusks, and three species of crustaceans

named after him.

He was the husband of Judith H. (Payne) Grassle for 53 years. In addition to his wife, he leaves his son, John Thomas Grassle; and his sister, Norah Jean Bunts.

(Information for this obituary is from The Falmouth Enterprise)

Some remembrances of Fred from his former colleagues:

Fred Grassle and I met about 1990 when he was a faculty member at WHOI and I began working summers in the Marine Policy Center. While Fred moved to Rutgers in 1993 to found the Institute of Marine and Coastal Sciences, we would get together during the summer, because Fred retained his home on School Street and liked to spend as much time in the village as possible. Fred chaired the National Research Council committee that authored the 1995 report Understanding Marine Biodiversity. On July 2nd 1996, Fred and I were chatting upstairs in Swift House. He was frustrated that the US government had failed to respond to the recommendations in the report, which it had invited and paid for. During that conversation, we decided we needed to enlarge rather than shrink the ambitions of the report and came up with the idea of a global "Census of the Fishes." In fact, the idea was always to span most all marine life, but I thought Census of the Fishes had a good ring to it. We vetted the idea with John Steele, Mike Sissenwine, and several other experts in WHOI, MBL, and the NOAA Northeast Fisheries Science Center. In short, everyone said we were crazy but no one said do not try. So, we tried, and succeeded. The Census of Marine Life formally launched in 2000 and concluded in 2010 after 540 expeditions, countless discoveries included 5000 new species, and an expenditure of $650 million, the largest program in the history of marine biology. Fred served as founding chair and brought deep knowledge and wide networks. At the outset, he remarked that he was "comfortable with ambiguity", and that spirit allowed the organic growth of the program. Many of the formative ideas for the program came from the WHOI community, often grown in Fred's yard on School Street.

-Jesse H. Ausubel, Adjunct Scientist, WHOI

I first met Fred in the summer of 1986, when I drove to Woods Hole from Montreal to meet with him as a potential advisor. I had no idea what he would be like – this was pre-internet days – so I did not even know what he looked like. I found him in his office in the basement of Redfield, I big bear of a man who beamed with a smile and stood to offer me the gentlest handshake I had ever encountered. "Please have a seat" he said, and my career path was set. We spoke for an hour or two, went to the Kidd for lunch, and I knew Fred's lab at WHOI was the place for me. My mother called me that winter to say someone from WHOI had called to say I had been accepted in the Joint Program. I called Fred, excited to tell him. He chuckled and said that it was he who had called and spoken to my mother. When I came back to begin in the Joint Program the next year he sent me to Bermuda as an advance party for the cruise. The ship's Chief Engineer assured me everything was on schedule for a PISCES launch system. I called Fred and told him as much, though I had my doubts, and Fred flew down. The launch system was not ready, not even close, and Fred knew it the minute he saw it. But he shrugged it off and we spent the next week waiting in Bermuda. We played pool, we played Pigmania, and we waited. His patience was endless. When the cruise finally left and started to get samples, but on one dive one of the ALVIN box corers washed off the sub. I looked at Fred who grimaced briefly and then smiled and shrugged. We would figure something out (and actually found the corer on a subsequent dive). That gentle patience – and never an unkind word - has been a constant influence in my life, and I have tried to emulate it with my own staff and students. Fred was the essence of a scholar, mentor, and friend. The ocean has lost a great friend and so have we, but we are fortunate to have his tremendous science legacy and many great memories.

I write these recollections from my cabin 150 km offshore on a Canadian research ship. Fittingly, we are out here chasing mud. Fred would be pleased.

-Dr. Paul Snelgrove, Network Director, NSERC Canadian Healthy Oceans Network II