Deep-Sea Life

Issue 8, November 2016

Welcome to the eighth edition of Deep-Sea Life: an informal publication about current affairs in the world of deep-sea biology. Once again we have a wealth of contributions from our fellow colleagues to enjoy concerning their current projects, news, meetings, cruises, new publications and so on. The cruise news section is particularly well-endowed this issue which is wonderful to see, with voyages of exploration from four of our five oceans from the Arctic, spanning north east, west, mid and south Atlantic, the north-west Pacific, and the Indian Ocean. Just imagine when all those data are in OBIS via the new deep-sea node…! (see page 24 for more information on this).

The photo of the issue makes me smile. Angelika Brandt from the University of Hamburg, has been at sea once more with her happy-looking team! And no wonder they look so pleased with themselves; they have collected a wonderful array of life from one of the very deepest areas of our ocean in order to figure out more about the distribution of these abyssal organisms, and the factors that may limit their distribution within this region. Read more about the mission and their goals on page 5.

I always appreciate feedback regarding any aspect of the publication, so that it may be improved as we go forward. Please circulate to your colleagues and students who may have an interest in life in the deep, and have them contact me if they wish to be placed on the mailing list for this publication.

Once again, I would like to sincerely thank all those that have contributed to this issue of Deep-Sea Life. Your efforts are appreciated. Dr Abigail Pattenden (University of Limerick, Ireland) and Dr Eva Ramirez-Llodra (NIVA, Norway) have once more helped no-end in the production and editing process for this issue, and for that I am truly grateful.

Dr Maria Baker (Editor)
INDEEP Project Manager
University of Southampton

Issue Contents

Cruise News

Going Deep: Deepwater Exploration of the Marianas by the Okeanos Explorer

Dr. Diva Amon[1], Dr. Patricia Fryer[2], Dr. Deborah Glickson[3], Dr. Shirley Pomponi[4]

[1]University of Hawaii at Manoa, USA; [2]University of Hawaii at Manoa, Hawaii Institute of Geophysics and Planetology, USA; [3]NOAA Cooperative Institute for Ocean Exploration, Research, and Technology, Harbor Branch Oceanographic Institute, Florida Atlantic University, USA; [4]NOAA Cooperative Institute for Ocean Exploration, Research, and Technology, Harbor Branch Oceanographic Institute, Florida Atlantic University, USA, and Wageningen University, Netherlands

Written by: Amy Bowman, Communications and Public Relations, Collabralink, in support of NOAA Office of Ocean Exploration and Research

Figure 1. Overview map showing seafloor bathymetry, ROV dives, and CTD casts conducted during the expedition. Map courtesy of the NOAA Office of Ocean Exploration and Research.

From April to July 2016, the U.S. National Oceanic and Atmospheric Administration (NOAA) conducted a three-leg, 59-day expedition to explore unknown and poorly-known areas in and around the Marianas Trench Marine National Monument (MTMNM) and the Commonwealth of the Northern Mariana Islands (CNMI). Using NOAA's ship Okeanos Explorer, the United States' first and only federal vessel dedicated to ocean exploration, the expedition gathered data to aid in the characterization of marine geology and baseline information on deepwater habitats of the region, including the water column. Obtaining a baseline characterization expands our understanding of the diversity and distribution of benthic and pelagic habitats, as well as their inhabitants. This will help scientists and other stakeholders better manage this unique environment in the future. The expedition also worked to increase the public's knowledge of this fascinating deep-sea region.

The expedition was part of the three-year Campaign to Address Pacific monument Science, Technology, and Ocean NEeds (CAPSTONE) project. CAPSTONE is an initiative to collect deepwater baseline information in and around U.S. marine protected areas in the central and western Pacific, and provides timely, actionable information to support decision making based on sound science. It also serves as an opportunity for the nation to highlight the uniqueness and importance of these national symbols of ocean conservation.

The MTMNM encompasses the deepest trench system on the planet, as well as approximately 250,000 square kilometers of sea floor. In addition, the water column itself is a vast and undiscovered territory. Thus, the region provides an ideal location for exploration. As one of the most geologically diverse areas on the planet, it encompasses many extremes that lead to highly varied deep-ocean communities, including exotic species that can teach us about

life's exceptional adaptive ability. For example, some of the organisms living in this region deal with the most extreme pressures, temperatures, and sea-floor seep compositions in the oceans. In addition to intriguing biology and geology, the region also contains undiscovered ship and plane wrecks, as well as cultural landscapes sacred to the indigenous peoples of the Pacific. For all these reasons, this area was designated as a Marine National Monument in January 2009 through a proclamation under the authority of the Antiquities Act of 1906.

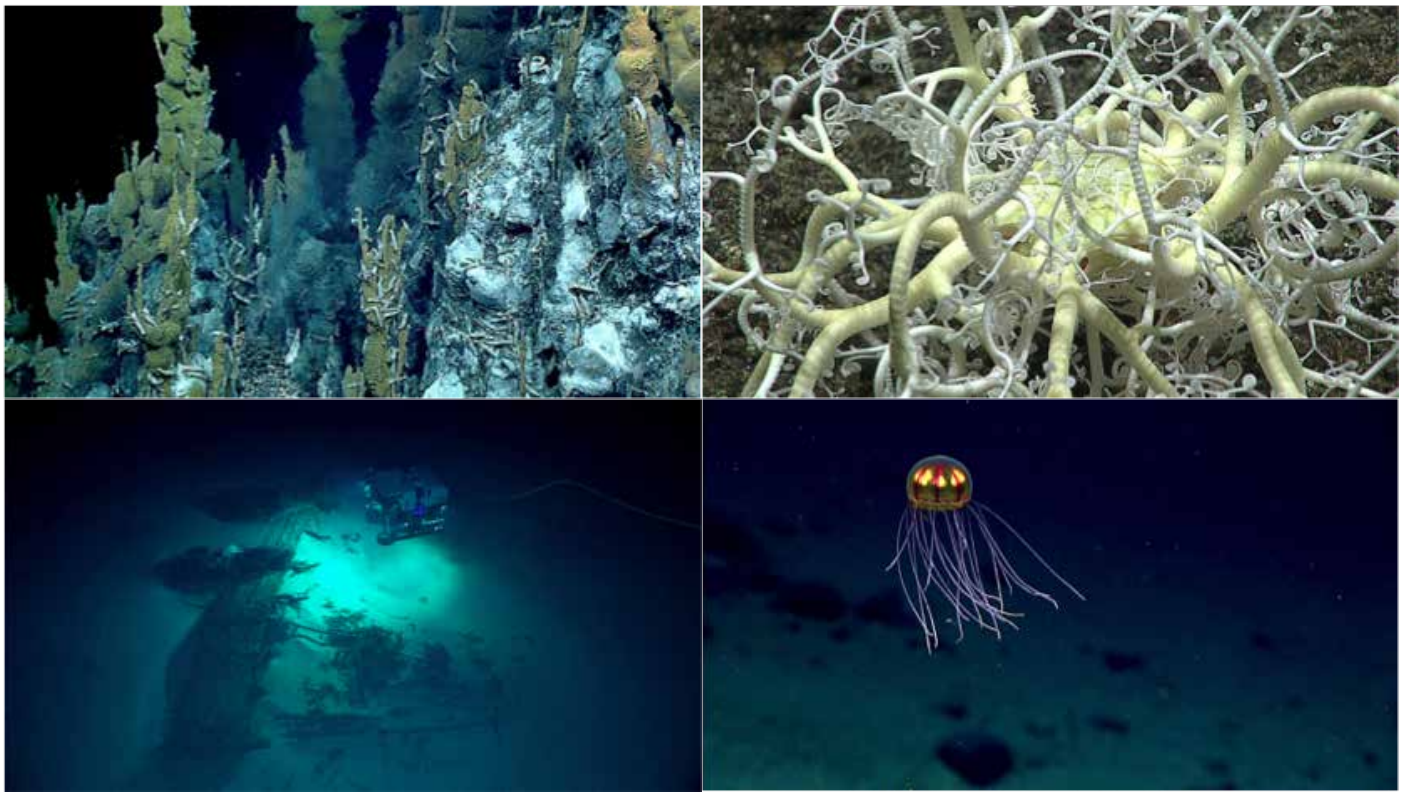


Figure 2 (top left). Hydrothermal vent chimney crawling with Chorocaris shrimp and brachyuran crabs. Image courtesy of the NOAA Office of Ocean Exploration and Research, 2016 Deepwater Exploration of the Marianas; Figure 3 (top right). . Close up of a gorgonocephalid basket star, which may be a new species. Image courtesy of the NOAA Office of Ocean Exploration and Research, 2016 Deepwater Exploration of the Marianas; Figure 4 (bottom left). ROV Deep Discoverer discovers a B-29 Superfortress resting upside-down on the seafloor. Image courtesy of the NOAA Office of Ocean Exploration and Research, 2016 Deepwater Exploration of the Marianas; Figure 5 (bottom right). This stunningly beautiful jellyfish, identified as belonging to the genus Crossota and likely a new species. Image courtesy of NOAA Office of Ocean Exploration and Research, 2016 Deepwater Exploration of the Marianas.

During 41 ROV dives that ranged from 240 to 6,000 m in depth, scientists observed hundreds of different species of animals, finding potential new species and noting several significant range extensions. Three new hydrothermal vent sites were discovered and documented, as well as several high-density coral and sponge communities, the first ever petit-spot volcano in U.S. waters, the first ever seen exposure of 80+ million year-old fossil coral sequences, previously unexplored giant submarine mud volcanoes, the first evidence of intact subducting plate seamounts burrowing into the edge of an overriding plate, and a World War II B-29 bomber. There were 58 primary biological samples (and 102 commensals – animals living on the primary specimen) collected, most of which are potentially undescribed species. 73 rock samples were also collected for age dating and geochemical composition analysis.

The team collected more than 48 terabytes of data, including video and still imagery, multibeam sonar and single beam echo sounder measurements, subbottom profiles, current profiles, CTD and dissolved oxygen measurements, and surface oceanographic and meteorological information. More than 73,800 square kilometers of seafloor was also mapped – an area larger than the Republic of Ireland. All data and samples will be made publicly available through national archives.

Expeditions aboard the Okeanos Explorer are live-streamed through telepresence technology. The Deep Discoverer ROV and the camera-sled Seirios work in tandem to provide high-resolution imagery, allowing shore-based scientists to participate in the dive, communicate directly with the ship-based team, and help direct operations. This includes determining the location and purpose of ROV dives, which samples should be considered for collection, and the choice of imagery needed to maximize observations. However, this is not just for scientists. Educators, students, and people

with an interest in exploration also have extensive opportunities to connect to the mission via these live video feeds in near-real time. This provides a front row seat to exploration activities and discoveries as they are made. All that is needed is an Internet connection.

Discovering new species and communities, previously unknown geological features, and historically and culturally significant sites reminds us why deep-sea science is important. It justifies our continued interest in deep-sea exploration and also highlights how exciting both exploration and research can be, especially when we realize how geologic processes affect natural hazards from earthquakes and tsunamis at subduction zones and how anthropogenic impacts to the ecosystem in the oceans are increasing. The next field season, CAPSTONE's final year, begins on December 1, 2016 and we invite you to join us. Please visit our website for more information.

MEDWAVES cruise (21.9.2016. Cadiz – 14.10. 2016. Ponta Delgada, Azores - 26.1.2016.Malaga)

Meri Bilan

IMAR-UAz, Azores

The MEDWAVES (MEDiterranean out flow WAter and Vulnerable EcosystemS) cruise focused on following the Mediterranean water from the Alboran Sea into the Atlantic, and its influence on the benthic communities found on seamounts and a mud volcano. The cruise started in Cádiz at the first study site: the mud volcano Gazul. The next site was Ormonde, one of the mounds of the Gorringe bank. The final site of the first leg was Formigas, a seamount in the Azores part of the complex Formigas & Dollabarat.

At each site the oceanographic team had a web of stations where the CTDs were deployed. Every water mass is basically characterized with temperature and salinity. As the Mediterranean outflow water (MOW) is warmer and more saline than the Atlantic, the water column profiles sometimes appears as a bulge in the middle, indicating the presence of MOW. Apart from water temperature and salinity, the physical and chemical oceanographic team of the MEDWAVES cruise measured currents, oxygen, pH and nutrients.

On the cruise we had three benthic teams. One was related to the ROV, a second one collected samples with a multicore, a box core or a Van Veen grab and a third taking care of the live corals in the on-board aquaria. The sediment samples from the Van Veen Grab and Multicorer were sieved, after which the benthic fauna were identified. This is quite a challenge, as the samples contained animals from the water column as well as animals that live in the sediment. From the multicores, the sediments will be characterized to DNA level, detecting species that are not visible to the human eye, and also species that may have been there and left, or that died there. The live coral specimens need to acclimatise for a while in the on-board aquaria; during the second leg, ecophysiology experiments will be conducted on these corals.

The main daily activity were the ROV dives.

The "*Liropus*" was deployed whenever weather permitted, and was controlled by experienced ROV pilots and scientists. Everyone onboard would stop by to "watch some TV"; the real time videos from *Liropus*. A group of scientists were always "watching TV" and doing live annotations with OFOP software. Coral gardens, sponge aggregations and fish communities would bring excitement to the lab, and samples collected were like Christmas presents!

All these data will feed into the ATLAS project that is dedicated to filling the knowledge gaps of the North Atlantic in order to provide better models and facts for future management plans. The connectivity between the Mediterranean and Atlantic is strong, but we still don't know how this connection influences the benthic ecosystems. Many more questions will arise during the ATLAS project, that will start off in cruises like this one.

Thank you to all the crew, technical staff from UTM and ACSM, and scientists onboard Sarmiento de Gamboa during the MEDWAVES cruise, and a special thank you for the two people that made it possible to run as smoothly as it did: María Ángeles Campos Ramos (the captain) and Covadonga Orejas (the chief scientist).

KuramBio II (SO250)

(Kuril Kamchatka Biodiversity Studies)

Angelika Brandt*, Torben Riehl, University of Hamburg, Centre of Natural History (CeNak), Zoological Museum Hamburg

**and shipboard scientific party of the SO250 expedition with RV Sonne (KuramBio II)*

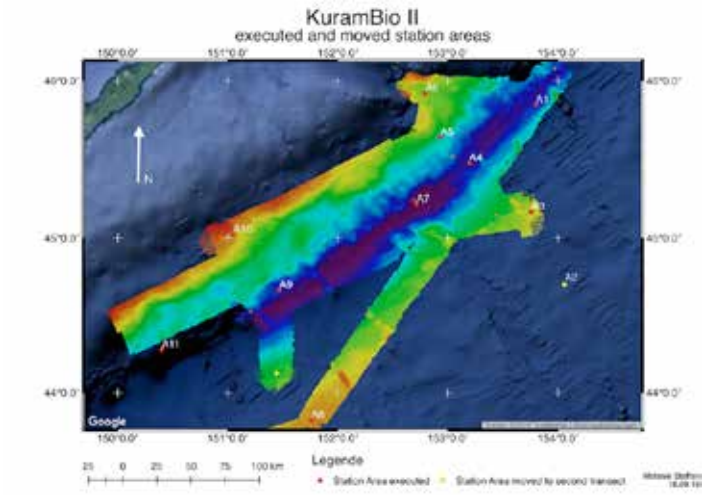


Figure 1. Stations of the KuramBio II expedition. Map: Melanie Steffen.

Figure 2. The group picture of the SO250 expedition with RV *Sonne*.

The German-Russian expedition KuramBio II (Kurile-Kamchatka Biodiversity Studies II) took place between 16th August – 26th September 2016 aboard RV *Sonne* (SO-250). The purpose of the expedition was to study the Kurile-Kamchatka Trench (KKT) region. This was the fourth expedition to the Northwest Pacific conducted as a German-Russian collaboration. The fauna of the Sea of Japan (East Sea) was initially investigated during the Russian-German SoJaBio (Sea of Japan Biodiversity study) campaign in summer 2010 on board the Russian RV *Akademik M.A. Lavrentjev*. Subsequently, in 2012, the Northwest Pacific Abyssal Plain was investigated aboard the RV Sonne in order to compare the open ocean with the semi-enclosed, marginal Sea of Japan. During this first KuramBio campaign, depths between 4700–5700 m were studied. The follow-up project SokhoBio (Sea of Okhotsk Biodiversity study) took place in summer 2015, again aboard the RV *Akademik M.A. Lavrentjev*. This marginal sea resembles the Sea of Japan depth-wise (ca. 3500–3700 m), however, its exchange with the open Pacific Ocean is stronger due to deep sills, such as the Krusenstern (1920 m) and Bussol (ca. 2500 m) Straits. The Sea of Okhotsk abyss is not only isolated from the open Pacific abyss by the Kuril Islands, but the KKT may also represent another

obstacle for migration and dispersal reaching depths of 9633 m.

One of the major research questions in the KuramBio II project is whether the KKT has an isolating effect on the distribution of abyssal organisms. We are going to address this question using various taxonomic groups and size classes of organisms covering different modes of reproduction and dispersal, including brooders as well as those with free-swimming larvae. To study the depth limits of their distribution, we took samples from abyssal to full trench depths. These samples will allow us to draw conclusions about the biogeography of the whole region.

During the KuramBio I expedition we were able to increase the abyssal species count for the region from 300 that were previously known, to >1781 species. At least 50 % of these species were new to science. The richest samples, however, had been collected at the slope of the KKT. This led us to assume that the topography of the KKT might enhance food availability and habitat heterogeneity, leading to increased biodiversity.

Against this background, the KuramBio II project aims to test the following hypotheses: 1. The hadal Kuril-Islands facing slope of the KKT harbors a species diversity comparable or higher than the Northwest Pacific Basin. 2. The number of endemic species increases with increasing depth in the KKT. 3. Abyssal species are restricted in their distribution by the KKT.

During this cruise we created high-resolution maps of the seafloor topography. To collect organisms and sediment, CTDs, multi-plankton nets, multi-cores, box cores, epibenthic sledges, and Agassiz trawls were deployed at 11 areas between 5100 - 9581 m.

Preliminary analyses show that these data document a rich fauna in the Kuril-Kamchatka Trench in all groups of organisms, from protists to meio-, macro-, and megafauna. The fauna of the open Northwest Pacific differs to the fauna of Seas of Japan and Okhotsk. While some species have been identified at abyssal depths on both sides of the trench, others seem to be restricted to either side. Whether or not the percentage of endemic species in the Kuril-Kamchatka Trench increases with increasing depth will only be answered after more detailed analyses and identification of the species.

The 9583m deployment of the epibenthic sledge delivered the first ever EBS samples from such a depth, accordingly we are able to revise the maximal depth occurrence for many taxa. These include the deepest records of ostracods in (8700 m), many species of harpacticoid copepods and isopods, as well as cumaceans, polychaetes, nemertines, and many other invertebrate taxa, and the macrourid *Coryphaenoides acrolepis* (8729 m).

Deep-Sea Research Cruise in the North East Atlantic

Nicola Foster

Plymouth University, UK

In May this year, 28 scientists, including academics, post-docs, PhD students, Masters students and undergraduates embarked on a six-week, deep-sea research cruise to the northeast Atlantic aboard the RRS James Cook.

The aim of the research cruise was to collect a variety of data from a number of seamounts in the NE Atlantic, between 200 and 400 km off the west coast of Scotland. The research forms part of the Deep Links project, a NERC-funded collaborative project between Plymouth University and the University of Oxford, in partnership with the JNCC and the British Geological Survey (BGS). The three-year project (2015-2018), led by Dr Kerry Howell (Plymouth University) will investigate how patterns of population connectivity vary with depth in the deep sea, and how this influences species diversity.

Using a remotely operated vehicle (ROV), an autonomous unmanned submarine (Autosub), and an array of oceanographic equipment and moorings, the team explored some of the UK's deepest underwater ecosystems during the cruise. Physical samples of target species and high-definition video data were collected over the depth gradient, and oceanographic data were also collected. Over the next two years, state-of-the-art genetic techniques (similar to DNA fingerprinting) will be used to compare how related distant populations of the target species are, and the video footage will be used to assess the diversity and abundance of species found at different depths on the seamounts. The oceanographic data will be used to develop and improve models of current flows around the seamounts, to study how these currents may disperse larvae in the deep sea. The results of the research will help answer fundamental questions in deep-sea biology, diversity and population connectivity, and contribute to the sustainable management of the marine environment.

More details and project updates can be found using the following links: www.deeplinksproject.wordpress.com; Twitter: @_deeplinks; Facebook: www.facebook.com/deeplinksproject

Figure 2. ISIS ROV; Autosub 6000; CTD rosette (Photo credits: NERC funded Deep Links Project - Plymouth University, Oxford University, JNCC, BGS)

Deep Secrets:
Science to support the mapping and management of outer shelf and slope ecosystems of South Africa

Kerry Sink

The South African National Biodiversity Institute

The Deep Secrets Cruise (Sept. 26-Oct. 25, 2016) led by Kerry Sink of the South African National Biodiversity Institute aims to develop an understanding of shelf edge and slope ecosystems and their geological and oceanographic drivers to support improved integrated ecosystem based management in multiple sectors in this priority region. The cruise is a project of the multi-disciplinary African Coelacanth Ecosystem Programme through a joint initiative with the Oceans and Coast Branch of the Department of Environmental Affairs and the Department of Science and Technology facilitated through the Presidential Operation Phakisa Oceans Economy Laboratory. Key goals are to (1) develop oceanographic and biological offshore research capacity; (2) provide the first visual surveys of deep-water habitats in South Africa's Agulhas ecoregion, including coral mounds and possible methane seeps; (3) build a knowledge base to support

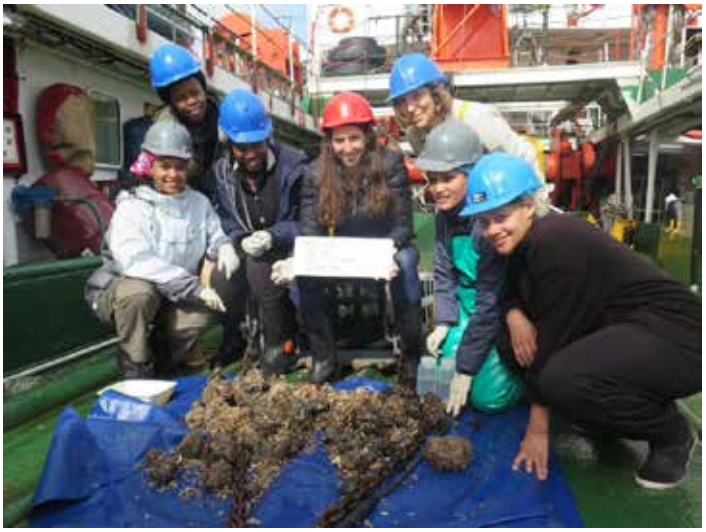


Figure 1. Scientists aboard the Research Vessel Algoa; African Women in MOcean!

management of the outer shelf and upper slope including designation and expansion of MPAs; and (4) examine seabed communities in heavily, lightly and un-trawled habitats. This cruise hosted researchers and technicians from 8 South African institutions and Scripps Institution of Oceanography, and also supported the Women in mOcean Marine Science and Management Mentoring Group. Data and sample collection are facilitated by a towed camera, drop camera and epibenthic sled, grab, CTD casts, and the 18/38 kHz echo sounder. Thus far, 29 stations sampling South Africa's south/southeast coast have revealed a suite of hard ground, coral rubble, coral mound, sandy and other ecosystems.

Highlights include:

• Documentation of South Africa's first deep-water coral habitats, with a mix of live scleractinian corals, octocorals, stylasterine corals, sponges, bryozoans and tunicates.

• Hard ground and gravel habitats to depths of 1000 m.

• High diversity of crustaceans and polychaetes in coral rubble.

• Findings of fish larvae and eggs associated with the octocoral *Thouarella* sp.

Lisa Levin has provided a series of at sea deep-sea lectures covering methane seeps, climate change, and the deep-ocean stewardship initiative (DOSI).

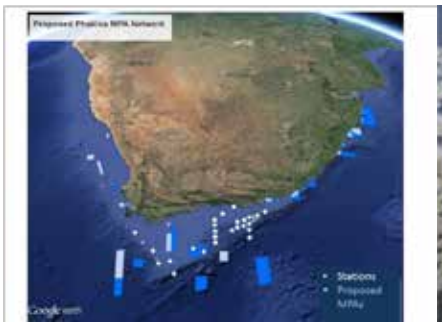


Figure 2 (above left). Map showing 29 stations covering 11 habitat types and four of the proposed new Phakisa Marine Protected Areas in South Africa; Figure 3 (above middle). Fish eggs, brittlestar and scale worm commonly found in the octocoral *Thouarella* sp.; Figure 4 (above right). Magnificent brisingid seastars and *Thouarella* octocorals at the tip of the Agulhas Bank, South Africa (515 m).

MarMine: Exploitation technologies and environmental issues for marine minerals on the extended Norwegian continental shelf

Eva Ramirez-Llodra (NIVA, Norway), Martin Ludvigsen (NTNU, Norway), Kurt Aasly (NTNU), Steinar Ellefmo (NTNU), Fredrik Søreide (NTNU), Ana Hilario (Uni. Aveiro, Portugal), Amanda Kieswetter (U. Gent, Belgium) and Emil Paulsen (NTNU).

https://www.ntnu.edu/igb/marmine

MarMine (2015-2020) is a project co-funded by the Norwegian Research Council and Norwegian industry, including oil and gas, mining and technology. The project is led by NTNU, and NIVA leads the environmental work package. The overall objectives for MarMine are to assess and develop new knowledge about exploration and exploitation technologies for seafloor massive sulphides on the Arctic Mid-Ocean Ridge (AMOR), to define the process mineralogical properties of typical seafloor marine mineral deposits along the AMOR, and to address environmental issues of a potential future mining industry in the region. Between 15 August and 5 September, MarMine researchers, on board the vessel Polar King (Figure 1), conducted geological, technological and ecological investigations in the active vent site Loki's Castle and the proposed inactive vent site Mohn's Treasure (Pedersen et al., 2010). For exploration purposes, two technologies have been brought forward for this cruise, the AUV-mounted and ROV-mounted UHI (Underwater Hyperspectral Camera) and the ROV-mounted drill system. For the mineral characterisation, rock samples were collected from Loki's Castle, packed and stored for further analyses.

The ecological studies focused on the first description and sampling of the benthic communities in Mohn's Treasure (2800-2400 m depth) using an ROV. Video and photo transects were conducted for community analyses (NIVA & NTNU, NO; Uni. Aveiro, PT). Pushcore samples were taken for analyses of metagenomics (Ifremer, FR), microbial analyses (Uni. Porto, PT), meiofauna and sediment environmental variables (Uni. Gent, BE). Scoops were used to take sediment samples for macrofauna community description (NIVA). Megafauna samples were taken with the ROV manipulator and suction sampler for barcoding (NTNU), morphological descriptions (NIVA) and stable isotope analyses (NIVA, Uni. Aveiro). The Mohn's Treasure is mostly covered with fine sediment, with scattered rocks and rocky outcrops colonised by large numbers of sponges and crinoids (Figure 2). All samples will now be analysed and the results discussed in relation to deep-sea mining technological and environmental issues.

Reference

Pedersen RB, Thorseth IH, Nygård ET, Lilley MD, Kelley DS (2010). Hydrothermal activity at the Artic Mid-Ocean Ridge. In: Rona PA, Devey CW, Dyment J, Murton BJ (eds) Diversity of hydrothermal systems on slow spreading ocean ridges. Geophysical Monograph 188. American Geophysical Union, Washington DC, pp 67-90.

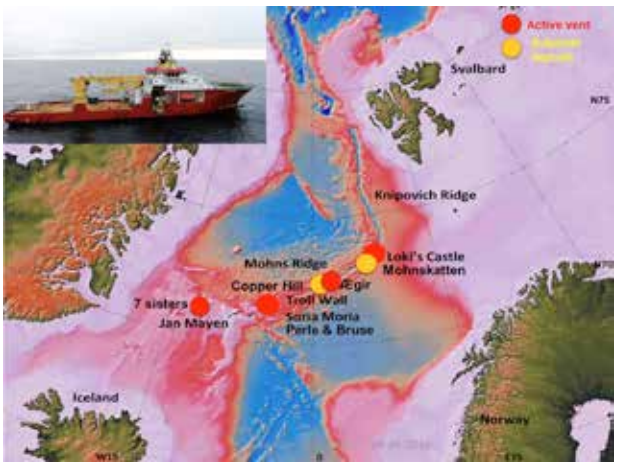


Figure 1 (above left). the Arctic Mid Ocean Ridge and the vessel Polar King. Map: GeoMapApp v. 3.6.0 (www.geomapapp.org/); Figure 2 (above right). Benthic fauna form the Mohn's Treasure. © MarMine, 2016.

Project Focus

sFDvent Working Group Meeting: A functional trait perspective on the global biodiversity of hydrothermal vent communities

Abbie Chapman & Amanda Bates, University of Southampton, UK

German Centre for Integrative Biodiversity Research (iDiv), Leipzig, Germany, 10th-13th October 2016

Hydrothermal vent communities are often defined on a global scale by distinct biogeographic provinces based on their taxonomic composition. While some species may be very similar, others may differ markedly in their morphology, behaviour, and ecology, and therefore play different roles in a community. Functional trait methods offer approaches to distinguish differences in how species interact with their environment and other species (Lefcheck et al., 2014, DOI:10.1017/S0376892914000307). Functional diversity metrics integrate the total variation in functional traits across all species within a community, providing a perspective on diversity that complements patterns identified using taxonomic diversity measures (Stuart-Smith et al., 2015, DOI: http://dx.doi.org/10.1016/j.marpol.2014.07.002).

Functional trait methods have been largely developed using plant assemblages (although presently are being more widely applied), where characteristics that define species in terms of their ecological roles and interactions are direct indicators of ecological process and function. For instance, there is a strong link between leaf traits (e.g. size, dry matter content, etc.), plant growth, and primary production through photosynthesis. In a similar way, symbiont-hosting invertebrates are dependent on access to hydrothermal vent fluids, which deliver reduced compounds, such as hydrogen sulfide or methane, used by microorganisms as an energy source for the synthesis of organic molecules. Hydrothermal vent ecosystems provide animal-analogs for analyzing functional diversity patterns in both time and space.

The sFDvent working group is developing a functional trait dataset to offer a “common currency” with which to compare vent communities comprised of different species to answer fundamental ecological questions concerning dispersal limitation, environmental filtering, and competitive exclusion, as well as a means to assess which communities might be more vulnerable to the impacts of anthropogenic disturbances, such as deep-sea mining.

The group is building an open-access functional trait database that can be updated as new species and areas of hydrothermal activity are discovered and can be extended to include additional chemosynthetic systems, such as cold seeps and whale falls.

Between 10th-13th October, a working group of hydrothermal vent ecology experts, funded by the German Centre for Integrative Biodiversity Research (iDiv), met in Leipzig, Germany, to begin building the world’s first global trait database for hydrothermal vent species. The meeting objectives were to define suitable functional traits (with sufficient knowledge and data support) to include in this database and to propose the first outputs from this new data resource.

The group members were enthusiastic and hard-working throughout the meeting, discussing functional traits and data availability at vent systems from breakfast through to dinner (and beyond!). The working group members returned to their respective institutes with clearly-defined tasks and a call for collaboration, presented in this issue of Deep-Sea Life. The sFDvent group are operating on an ‘inclusive-but-earned’ authorship policy to assemble a global functional trait database and associated paper using contributions from the deep-sea research community. As such, if you have any expertise on hydrothermal vent fauna and would like to contribute to the sFDvent project (https://www.idiv.

Figure 1 (above left). sFDvent 'Mini Meeting' held in Southampton before the working group meeting in Germany to discuss contributions that had already been made to the database, as well as potential meeting objectives for 10th-13th October. From left to right: Abbie Chapman, Dr Amanda Bates, Dr Tammy Horton, Dr Jon Copley, Dr Leigh Marsh, and Dr Maria Baker.
Figure 2 (above right). sFDvent Working Group 1 in the German Centre for Integrative Biodiversity Research (iDiv) in Leipzig. From left to right: Dr Eva Ramirez-Llodra, Dr Terue Kihara, Dr Stace Beaulieu, Dr Ana Colaço, Prof. Verena Tunnicliffe, Dr Andrey Gebruk, Dr Ana Hilário, Dr Jozée Sarrazin, Dr Amanda Bates, and Abbie Chapman.

de/?id=423), please get in touch with Amanda Bates (A.E.Bates@soton.ac.uk) and Abbie Chapman (asac1g09@soton.ac.uk).

Thanks to all working group members for their time, dedication, and expertise at this meeting and to iDiv for funding (including a second working group meeting to take place in April 2017). Thanks also to our global panel of expert contributors: Professor Loka Bharathi, Dr Rachel Boschen, Dr Malcolm Clark, Dr Daphné Cuvelier, Dr Cherisse Du Preez, Professor Charles Fisher, Dr Tammy Horton, Dr Katrin Linse, Dr Jian-Wen Qiu, Dr Tresa Remya, Dr Ashley Rowden, and Dr Elena Rybakova.

Shedding new light on deep-sea SponGES

Andrew Davies and Martyn Roberts on behalf of the SponGES consortium

School of Ocean Sciences, Bangor University, Menai Bridge, LL59 5AB

Sponge-dominated communities of the deep sea have been recognised as important ecosystems providing numerous goods and services to our planet and ultimately to humans. Yet these sponge grounds have been one of the most overlooked ecosystems in our oceans. Funded by the European Commission through the Horizon 2020 Blue Growth Programme, SponGES – Deep-sea Sponge Grounds Ecosystems of the North Atlantic: an integrated approach towards their preservation and sustainable exploitation - started in March 2016 and will run for four years, pooling together the expertise and facilities of 19 European, Canadian and American partner institutions.

SponGES will use its transdisciplinary consortium and its state-of-the-art operational and technological capacity to study all of the main types of deep-sea sponge ecosystems known to occur in the North Atlantic, all the way from the Arctic southwards to the Azores archipelago, including sites from both the western and the eastern Atlantic. During the project, the consortium will address major knowledge gaps that exist about basic aspects of sponge biology and ecology, their contribution to global biogeochemical cycles, their role in supporting the economy (e.g., through fisheries and biotechnology), and the impact that human activities may have upon them. We specifically aim to:

1. Strengthen the **knowledge-base** on North Atlantic sponge ground ecosystems by investigating their distribution, diversity, biogeography, function and dynamics;

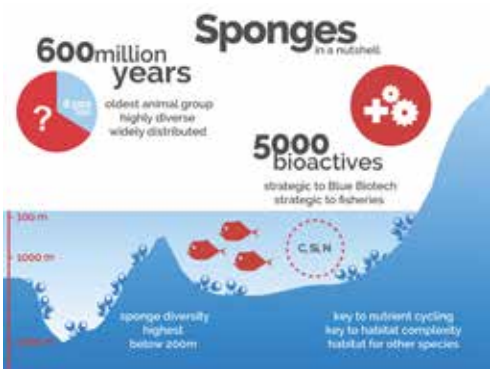
2. Improve **innovation** and **industrial application** by unlocking the biotechnological potential of these ecosystems;

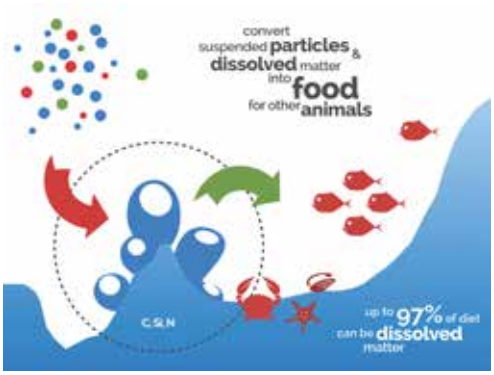
3. Improve the capacity to **model**, understand and **predict threats** and impacts and future anthropogenic and climate-driven changes to these ecosystems;

4. Advance the **science-policy** interface and develop tools for improved **resource management** and good governance of these ecosystems from regional to international levels across the North Atlantic.

As well as expanding our pool of knowledge regarding sponge ecosystems, SponGES will also contribute to the implementation of major strategic instruments such as the Marine Strategy Framework Directive (MSFD), EU Maritime Strategy for the Atlantic Ocean Area, the Galway Statement on Atlantic Ocean Cooperation, as well as international agreements established to conserve Vulnerable Marine Ecosystems (VMEs) and Ecologically or Biologically Sensitive Areas (EBSAs). If you are interested in interacting with SponGES, do not hesitate to contact the team. See our website for more details.

SponGES has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 679849.





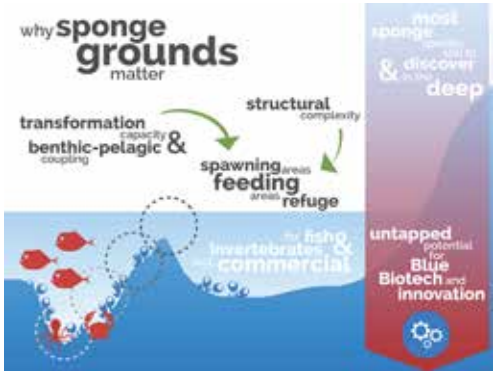


Figure 1 (left): Sponges in a nutshell, why should you care about deep-sea sponges?; Figure 2 (middle): Sponges are highly important in nutrient cycling within the ocean; Figure 3 (right): Why do sponge grounds matter in terms of ecology, bioprospecting and commercial exploitation?

Web: http://www.deepseasponges.org; Twitter: https://twitter.com/DeepSea_Sponges; Facebook: https://www.facebook.com/DeepSeaSponges/

The EU-MIDAS Project Draws to a Close

Vikki Gunn

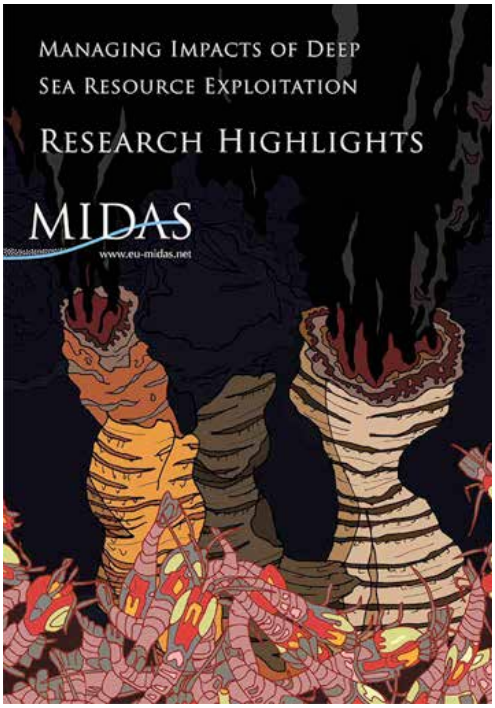
Seascape Consultants, UK

After three years of intensive research into identifying and understanding the environmental impacts of deep-sea resource exploitation, the MIDAS project has drawn to a close. Involving 32 partner institutions from academia, industry and the NGO sector, MIDAS covered a wide array of research aimed at helping the nascent deep-sea mining industry,

regulators and civil society to understand the potential impacts of mining on deep-sea ecosystems.

The project focused mainly on the potential impacts associated with extraction of manganese nodules and seafloor massive sulphides (SMS) from the deep sea, but also addressed environmental issues related to the exploitation of methane gas hydrates, and the potential of deep-sea muds in the North Atlantic as a source of Rare Earth Elements (REEs). Study areas included the mid-Atlantic Ridge (SMS), the Clarion Clipperton Zone (CCZ) in the central Pacific (nodules), and the Black Sea, Norwegian and Svalbard continental margins (gas hydrates). Additionally, the Canary Islands, Palinuro Seamount (central Mediterranean), Norwegian fjords and Portmán Bay (Spain) were used as proxy sites for various mining impact experiments. Large volumes of new data were collected via 30 research expeditions to these areas to satisfy a range of scientific questions.

MIDAS included much more than scientific research. Industry partners provided links to the commercial sector to provide information on likely mining scenarios, and to enable the determination of best practice in other sectors of offshore exploitation. The combination of new scientific data with projected mining scenarios and accepted best practice has enabled MIDAS to put forward an environmental management framework that could facilitate responsible mining whilst taking account of environmental concerns. MIDAS also identified the technology that might offer the most value in monitoring the impacts of deep-sea mining, including technology gaps where existing instrumentation requires further development.



A social dimension was incorporated through close engagement with civil society, providing them with accurate information and listening to their concerns about this emerging industry. MIDAS focused on developing practical, workable solutions with due regard of the legal aspects and worked closely with the International Seabed Authority to provide scientific input to the development of a mining code for the exploitation of deep-sea minerals. This process will continue well beyond the lifetime of MIDAS, but it will benefit from this new knowledge as well as a gap analysis of information that is of high importance but not currently available.

The MIDAS Research Highlights publication contains summary of the project's key achievements and is available to download from the MIDAS website at www.eu-midas.net.

The MIDAS project received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under Grant Agreement no. 603418.

Online submission for the Special Issue "Biodiversity and ecology of meiofauna in extreme and changing environments" is now open

Journal: Marine Biodiversity

Guest editors: Daniela Zeppilli & Daniel Leduc

In this special issue, we seek submissions on the biodiversity, ecology and physiological responses of marine meiofauna under extreme and/or changing conditions. Extreme natural environments, such as deep-sea habitats, offer unique opportunities for investigating the biological response and adaptation of organisms to harsh life conditions. Several

studies have shown that meiofaunal communities can adapt to extreme/changing environments, and the discovery of abundant and well-adapted meiofaunal communities in several extreme environments has opened new frontiers in studies of ecological interactions and biological adaptations. Better knowledge of ecological, behavioural and physiological adaptations of meiofauna to extreme conditions can give vital information on how organisms may adapt to environments impacted by human activities.

Deadline for submission: 1 February 2017

To submit your manuscript, go to the Marine Biodiversity website: https://www.editorialmanager.com/marb/default.aspx. After log-in, click on "submit your manuscript" and select "SI MeioExtreme".

Figure 1 and 2 (top left and right). *Akanthepsilonema* sp. and *Neostygarctus* sp. are two deep-sea species recently described from the Condor Seamount. Figure 3 and 4 (bottom left and right). Hydrothermal vents from the Ifremer photo collection © Ifremer.

Closures to Protect Sensitive Benthic Areas off Nova Scotia: lessons from a transboundary collaboration

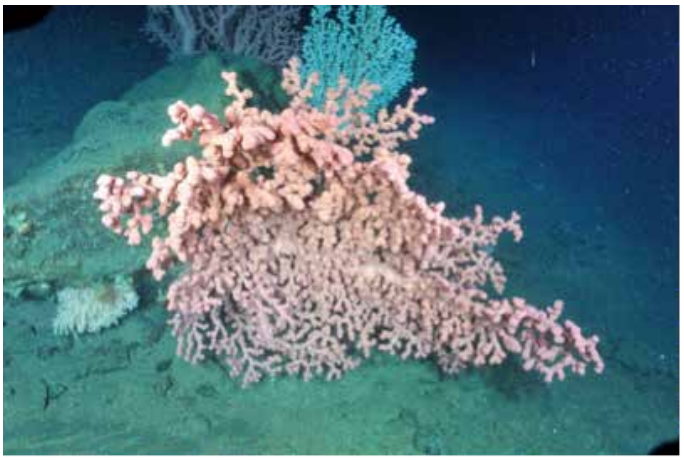
Anna Metaxas, Dalhousie University, Canada

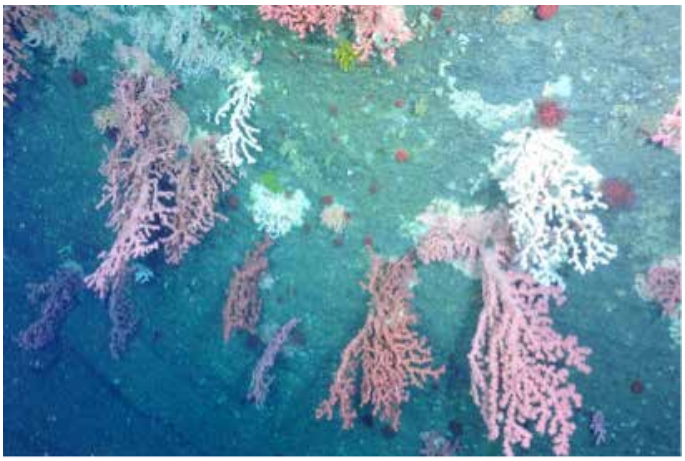
Contact: metaxas@dal.ca

In September 2016, the Canadian Minister of Fisheries and Oceans announced two closures over 9,000 km^2 of seafloor, the Eastern Jordan Basin and the Corsair and Georges Canyons, to protect deep-water corals off Nova Scotia (http://www.dfo-mpo.gc.ca/oceans/ceccsr-cerceef/backgrounder-fiche-eng.html) from bottom-contact fishing gear. This action paralleled the designation of the US Northeast Canyons and Seamounts Marine National Monument.

In 2011, I met Martha Nizinski at a NOAA workshop on Deep-Sea Coral Research Priorities. We both had been working on deep-water corals on either side of the border; and there and then, we decided that since corals do not recognize national borders, we would launch a cruise that straddled the Hague line. After three years of planning, we sailed from Woods Hole aboard the NOAA vessel Henry Bigelow with the Canadian ROV ROPOS in 2014. We explored for the first

time Nygren and Heezen canyons on the US side of the border (both of which were proposed for protection, but in the end were excluded) and Corsair Canyon on the Canadian side. We measured the highest abundances of bubble gum coral we have recorded in Canadian Atlantic waters, mostly lining vertical walls, the largest one being 3.3 m long, and likely 100s of years old. We found thickets of *Primnoa reseadaformis* on both sides of the border in Jordan Basin. Our data were used directly to support the designation of the Sensitive Benthic Areas in the Canadian Atlantic. We have been working on a repeat performance for summer 2017. Stay tuned!



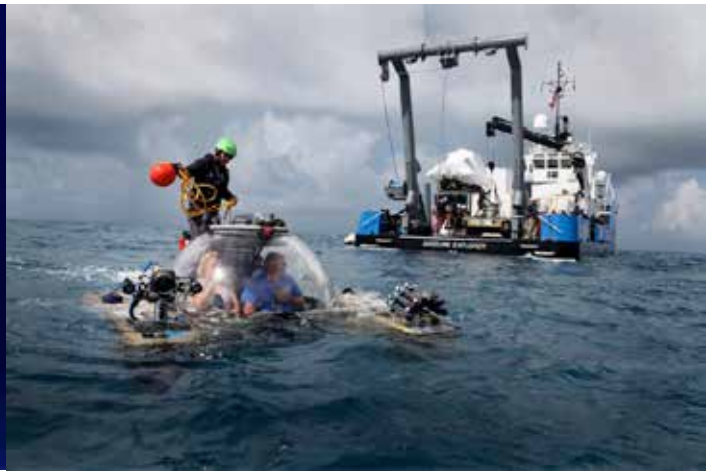


Figures 1 and 2 (above). *Primnoa reseadaformis* in the Jordan Basin.

Lucy Woodall, Catherine Head & Alex Rogers, Oxford University, UK.

Nekton is a charity launched this year which, using an alliance of global partners, delivers scientific research expeditions focusing on the function, health and resilience of the deep ocean. It carried out its first mission in the Northwest Atlantic this summer. Two ships were used to conduct the research programme. One expedition focused on the deep depths from Nova Scotia to Bermuda, and the other on the mesophotic realm (30m-300m) in Bermudan waters. The longer expedition was aboard the CCGS Hudson in collaboration with the Fisheries and Oceans Canada, and the latter was in collaboration with Project Baseline (www.projectbaseline.org) and Global Underwater Explorers (http://www.gue.com) on board the Baseline Explorer.

Aboard the CCGS Hudson, oceanographic data, ROV video, surface and pelagic nets as well as sediment samples were collected to provide data for the XL Catlin Deep Ocean Survey. The research on the Baseline Explorer concentrated on surveying the benthic habitat and demersal fish life of three outer reefs around Bermuda and two off-shore banks down a vertical gradient from 15m (where possible) to 300m. The mission made good use of the Baseline Explorer's two manned submarines and Global Underwater Explorers technical diver team. The CCGS Hudson used more traditional



research equipment such as a CTD, box corer, multibeam sonar and ROV to survey and collect biological and chemical samples in addition to physical data.

As a result, baseline biodiversity lists were increased, vulnerable marine ecosystems were documented for the first time in some locations, and topography of seamounts and banks around Bermuda was documented. More will follow as the video survey data and net/sediment samples are currently being analysed. The data will be fed into marine management programmes.

Discrete research projects were also undertaken by members of the international science team. For instance a coral population genetics project was undertaken to establish connectivity between depths and geographically with the Caribbean. The mission valued collaboration: the CCGS Hudson hosted members of the EU Sponges and ATLAS projects and deployed an ARGO float. Communicating the expedition and science undertaken is also a large focus of the mission. To learn more visit the Nekton website: www.nektonmission.org and see something of our impact here: https://youtu.be/DFsZ-YSqmYo.

Arctic Adventure: tracking deep-sea life in Canada's remote northern sphere

Anja Samardzic, Ocean Tracking Network, Canada

http://oceantrackingnetwork.org/

This summer, as part of a collaborative study between the Ocean Tracking Network (OTN), Fisheries and Oceans Canada

Figure 1. Tremblay Sound basecamp at sunset, where the team conducted the first portion of their Arctic research (Photo: Nigel Hussey)

(DFO), and the University of Windsor, principal investigator Nigel Hussey and his colleagues spent several weeks in the Canadian Arctic to continue ongoing tracking projects and fill knowledge gaps in the animal telemetry index. The data gathered on the team's six-year study of Greenland halibut, Greenland sharks, Arctic skate and more recent work focused on narwhal will provide valuable information on the movement and distribution of deep-sea fish (and of course a marine mammal) and help advise coastal community fishery development and management.

Figure 2. Nigel Hussey and John Sr. from the community of Pond Inlet tag a Greenland shark in Tremblay Sound (Photo: Nigel Hussey)

This season's collaboration involved working with the DFO marine mammal team led by Jack Orr to continue the novel tracking of Greenland sharks. This tracking approach uses combined mark report and pop-up satellite tags to generate the first horizontal tracks for the largest Arctic deep water fish predator. Over the course of the season, the team successfully tagged ten individual sharks in Tremblay Sound near the community of Pond Inlet, where they set up basecamp for a three-week period, and all the tags have successfully transmitted to date.

The collaborative team then achieved a first by attaching a Bluetooth-linked VMT (mini receivers that listen for tagged fish) to a SMRU satellite tag on a narwhal. This will help them determine the viability of using narwhal as "animal oceanographers" or "bio-probes" to monitor sustainable fisheries across the Arctic. A team at Dalhousie University has already developed the bio-probe technology for use on grey seals. While marine autonomous vehicles (robo-probes) are also used in the collection of oceanographic and animal data, bio-probes will collect information where robo-probes can't go, due to their limited range of movement and ability to navigate the oceans.

In the second phase of the field season in Baffin Bay, high resolution daily diary loggers with cameras were attached to Greenland sharks to assist understanding of post-release survival from fisheries and to examine their ecology (predator-prey interactions are one example of this). The team was joined by expert Yuuki Watanabe from the Polar Tokyo Institute to do this work. High-resolution accelerometers were also attached to Greenland halibut for bioenergetics works, while deep-water baited cameras were deployed in Scott Inlet to examine species diversity and undertake population assessments in conjunction with scientists from Memorial University.

Figure 3. PI Nigel Hussey outfits a Greenland shark with an accelerometer and camera in Scott Inlet, Baffin Bay (Photo: Yuuki Watanabe)

The team also worked closely with commercial fisheries in Baffin Bay, who have been incredibly open in sharing their data, allowing the team to gather valuable information to determine suitable locations for moorings that don't compromise either fishing or research activities. A total of 43 new moorings were situated offshore in Baffin Bay, mainly along the shelf edge on the drop off to deep water and where most fishing is concentrated. The edge may serve as a "conveyor belt", building predictable seasonal movements of Greenland halibut. Around 200 Greenland halibut were acoustically tagged at various sites along the shelf edge for this study.

"It was a fabulous trip: for the first time ever, we caught Greenland sharks in less than five meters of water. Satellite tags on these animals will provide us with the first ever data on the horizontal movements of this little-known deep water species for the next two years," said Hussey. "We were also able to attach six cameras and accelerometer tags on the sharks, five of which we were able to physically recover, providing unique insights in to both their ecology and post-release survival and behavior."

Thus, the team had a very successful summer of Arctic research, and they look forward to sharing the results and


Figures 4 and 5. The team attaches accelerometer tags onto Greenland Halibut in Scott Inlet, near the community of Clyde River. (Photo: Amanda Barkley)

footage with the science community and beyond. This work would only have been possible through the support of the local communities, the Government of Nunavut, CanNor, DFO and the crews of the Nuliajuk and Kiviuq.

Nigel Hussey is an Assistant Professor in Biological Sciences at the University of Windsor. His research focuses on understanding the movements and trophic interactions of aquatic organisms and how these structure global food webs in the context of climate change.

The Ocean Tracking Network (OTN) is a global research, technology development and partnership platform headquartered at Dalhousie University in Halifax, N.S., Canada. OTN's mission is to generate knowledge on the behaviour, movement and distribution of aquatic animals to advance the conservation and sustainable use of marine and freshwater species. OTN has deployed electronic tagging systems (primarily acoustic tags and receivers, but also includes data loggers, satellite tags, and radio-tracking gear) and oceanographic monitoring equipment in key ocean locations and in collaboration with partners in 20 countries. OTN is tracking over 100 keystone, commercially important and endangered species, including marine mammals, sea turtles, squid, benthic crustaceans (lobsters, crabs) and fish, including sharks, sturgeon, eels, tuna, salmonids and cod.

Figure 6. Principal investigator Nigel Hussey from the University of Windsor and Yuuki Watanabe from the Polar Tokyo Institute in Baffin Bay (Photo: Amanda Barkley)

ATLAS - «A Trans-Atlantic assessment and deep-water ecosystem-based spatial management plan for Europe»

Contact: Katherine.simpson@ed.ac.uk

Website: www.eu-atlas.org https://medwavesblog.wordpress.com/ *Facebook:Eu-ATLAS Twitter:eu_atlas*

ATLAS is a new EU Horizon2020 project launched in May 2016, bringing together a unique group of scientists, policy-makers, NGOs, SMEs, and the industries engaged in the exploitation of deep ocean resources. ATLAS's 25 partners from across Europe, Canada, and the USA are collecting new information on ocean circulation, sensitive Atlantic ecosystems (e.g., VMEs and EBSAs) and deep-sea fish populations to produce a step-change in our understanding of their functioning, diversity, connectivity, and ecosystem services now, and under future climate change and human activity scenarios. Using the North Atlantic's substantial coverage of oceanographic arrays as the foundations of its science, ATLAS will scale-up our capacity to monitor and predict the functioning, biodiversity and genetic connectivity of fish stocks and ecosystems such as cold-water coral reefs, coral gardens, sponge grounds, hydrothermal vents and cold seeps. By scaling up this science, ATLAS can then scenario-test science-led, cost-effective adaptive management strategies that stimulate Blue Growth and protect sensitive ecosystems and populations at spatial scales relevant to management and industry. An intensive schedule of 25 research cruises is planned, with 12 trans-Atlantic case studies offering opportunities for more in-depth analyses and roll-out of new spatial management plans.

Our most recent cruise is MEDWAVES, organised by Covadonga Orejas (Instituto Español de Oceanografía), which took place from 21st September - 26th October 2016. Please see page 4 for short report on MEDWAVES.

The data-driven science in ATLAS will provide the foundation for socioeconomic analysis and marine spatial planning for Blue Growth scenarios in the deep Atlantic. This will provide international policy makers with the best data, tools, and understanding needed for sound adaptive management of the deep ocean as patterns of marine resource exploitation change.

Figure 1. One of the fantastic seascapes MEDWAVES visited in Ormonde at around 1,500 meters depth!

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 678760 (ATLAS). This output reflects only the author's view and the European Union cannot be held responsible for any use that may be made of the information contained therein.

New NOAA four-year research initiative to study deep-sea coral and sponge ecosystems in the Southeast United States

National Oceanic and Atmospheric Administration (NOAA)

Contact: daniel.wagner@noaa.gov

This past summer, the National Oceanic and Atmospheric Administration (NOAA) launched a new four-year research initiative to study deep-sea coral and sponge ecosystems across the southeastern U.S., a region including federal waters in the U.S. South Atlantic, the Caribbean Sea and the Gulf of Mexico. The initiative is led by a multidisciplinary science team from multiple NOAA line offices, including National Ocean Service, National Marine Fisheries Service and Office of Oceanic and Atmospheric Research. The team will work in collaboration with partners from federal and academic institutions to generate scientific information needed to improve the management, conservation and protection of deep-sea coral ecosystems. The initiative will provide ~$2.5M to fund federal research activities in 2016-2019, through NOAA's Deep Sea Coral Research and Technology Program (DSCRTP).

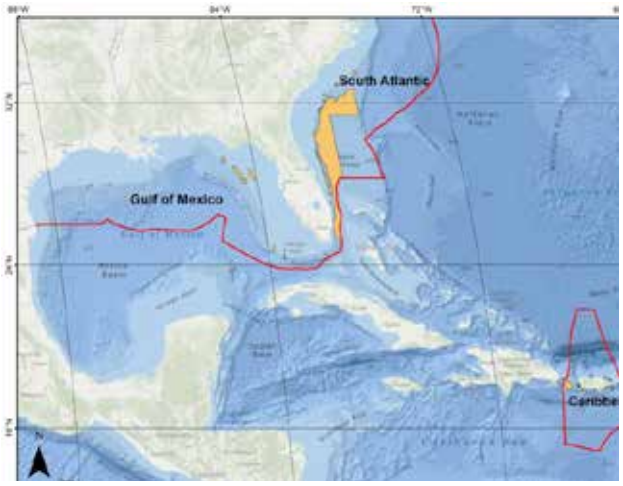


Figure 1. Map showing geographic areas in which the DSCRTP Southeast Initiative will operate in 2016-2019. Areas where deep-sea ecosystems are currently protected are shown in orange (credit: NOAA).

Research priorities identified in a recently released NOAA report for this initiative include benthic habitat characterization and mapping, as well as improving our understanding of climate change impacts, fishery impacts, taxonomy and population connectivity of deep-sea coral ecosystems.

Fieldwork for this initiative commenced in August 2016 with two expeditions aboard NOAA vessels, including (1) a five-day expedition aboard R/V *Manta* to survey deep-water (50-150 m) banks in the Northwestern Gulf of Mexico by the Flower Garden Banks National Marine Sanctuary using ROV *Mohawk*, and (2) a 15-day expedition aboard NOAA Ship *Pisces* that surveyed deep-sea canyons off North Carolina using AUV *Sentry*. The expedition conducted by the Flower Garden Banks aimed to collect information needed to evaluate sanctuary expansion proposals, and included the collection of over 2,800 seafloor images, including of some species which are likely new to science. The expedition to the North Carolina canyons supported regional characterizations of canyon ecosystems, and surveyed over 70 km of seafloor through the collection of 59,000 images. Future expeditions are planned in the U.S. South Atlantic, the Caribbean and the Gulf of Mexico as part of this initiative in 2017-2019.

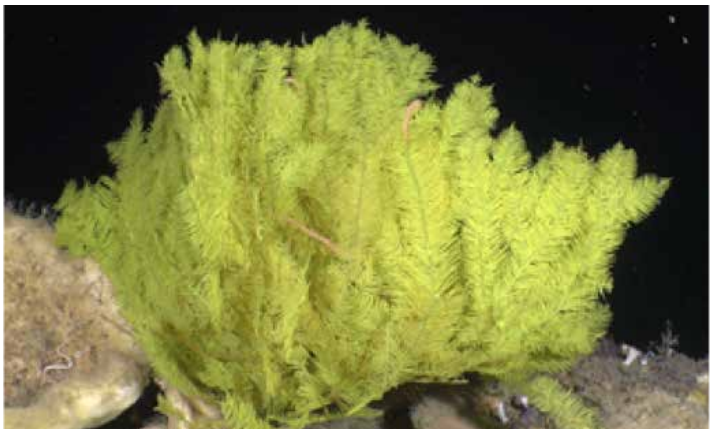


Figure 2 (left): Black coral colony photographed by ROV Mohawk during the 2016 expedition that surveyed deep-water coral ecosystems in and around the Flower Garden Banks National Marine Sanctuary. This species is likely new to science and will be verified through pending analyses (credit: NOAA/UNCW-UVP). Figure 3 (right): Hatteras Canyon wall photographed by the AUV *Sentry* during the 2016 expedition that surveyed deep-sea canyons off North Carolina (credit: NOAA-OER-NMFS/WHOI).

News

NOAA Deep Sea Coral Research & Technology Program's 2016 Report to Congress

Heather Coleman, NOAA, USA

Deep-sea coral and sponge habitats support the richest and most complex biological communities in the deep sea. NOAA's Deep Sea Coral Research and Technology Program is providing the first systematic effort to discover and understand these ecosystems, combining science and information-sharing to help ocean managers conserve valuable habitats. The Program proudly announces its 2016 Report to Congress, highlighting exciting scientific research conducted over the past two-year period and historic conservation measures that have been proposed and enacted based on our Program's results. The report spans the globe, from the remote Johnston Atoll in the middle of the Pacific Ocean to previously unknown coral gardens teeming with redfish only 25 miles off the coast of Maine. The Deep Sea Coral Research and Technology Program's website also provides fieldwork reports and a searchable map in the nation's most comprehensive online database of deep-sea corals and sponges. Armed with such information, the Mid-Atlantic Fishery Management Council is the most recent council to propose measures to protect deep-sea coral habitat from impacts of fishing. The Gulf of Maine also earns a spotlight because its deep-sea coral gardens are a major discovery – in addition to reading the report, take a virtual dive into this offshore habitat!

International Association of Biological Oceanography (IABO) – MARINE-B Email List

Adrian Glover

Natural History Museum, London, UK

As one of the 'deep-sea' representatives on the executive committee for the International Association of Biological Oceanography (IABO) I would like to draw your attention to the marine-b email list which is now the official communication channel of IABO. IABO have recently been making efforts to update the list. As well as communication related to marine biodiversity research, this email list will also announce updates on the next IABO meeting, which is the World Conference on Marine Biodiversity (http://www.wcmb2018.org) and follows the meetings held in Valencia, Aberdeen and Qingdao.

To join send a message entitled "SUBSCRIBE MARINE-B firstname surname" to listserv@listserv.heanet.ie. Omit your signature and anything else you may normally add. You will receive an automated response.

Ocean Highlights from the IUCN World Conservation Congress

This webinar originally aired on 4 October and features speakers: Lauren Wenzel, Director of the NOAA National Marine Protected Areas Center; Carl Gustaf Lundin, Director of the IUCN Global Marine and Polar Programme; and Dan Laffoley, IUCN Principal Advisor, Marine Science and Conservation for the Global Marine and Polar Programme, and Marine Vice-Chair for the World Commission on Protected Areas.

Webinar co-sponsored by the NOAA National MPA Center, MPA News, and

the EBM Tools Network (co-coordinated by NatureServe and OpenChannels.org).

Click here to download a copy of this webinar from Vimeo page

Click here to watch this video on YouTube

MOOC (includes deep-sea module)

One Planet – One Ocean: From Science to Solutions.

Introduced by Martin Visbeck, GEOMAR

The Ocean encircles the globe, forming the largest interconnected ecosystem on earth. It provides a huge range of services on which we rely; food, energy, transportation, environmental resilience, but also immaterial benefits such as beauty, cultural identity and recreation that enhance our sense of well-being. The pivotal role of the ocean in stabilizing climate, enabling a just distribution of economic prosperity and allowing for sustainable management and good governance of human activities is recognized in Goal 14 of the United Nations Sustainable Development Goals that focuses on the Ocean.

Our Massive Open Online Course provides you a knowledge base that brings to you the science and fascination of the ocean. Marine scientists team with economists, lawyers and philosophers to bring you a holistic view of how the ocean functions, how human interactions with the ocean can be understood, and what solutions are available to support both sustainable use and stewardship of our blue planet.

We address you – learners around the world who want to share our nuggets of insight and include these in your knowledge space. Whether you are looking to upgrade your education, are professionally involved in ocean issues or seek to know more about your local coastline, the fish you eat or the climate that the ocean regulates; we invite you to join us on this voyage of discovery.

As Arthur C. Clarke put it: “How inappropriate to call this planet Earth when it is quite clearly Ocean”

The MOOC is not currently online, but you can access all the videos, links to reference material and additional links that were provided by participants of the course. It may be run again in 2017.

Link to media: http://www.oceanmooc.org/en/index.php

Upcoming Webinar:

Progress on establishing protected areas in the Southern Ocean: the Ross Sea region MPA by Mi Ae Kim of NOAA

Thursday, December 1st, 1 pm US EST/10 am US PST/6 pm UTC

Register at: https://attendee.gotowebinar.com/register/3252815366896112130

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) has been working to establish marine protected areas in the Southern Ocean, which would contribute to its objective – the conservation of Antarctic marine living resources. On October 28, 2016, CCAMLR agreed to the establishment of the Ross Sea region MPA, an

area of exceptional ecological value and scientific importance. An overview of CCAMLR's MPA efforts will be provided during the webinar, including details about the recently adopted MPA in the Ross Sea.

This webinar is co-sponsored by the NOAA National MPA Center, MPA News, and the EBM Tools Network (co-coordinated by NatureServe and OpenChannels.org).

Meetings & Workshops

The revival of the deep sea in OBIS

Ward Appeltans*, Pieter Provoost, Greg Reed, Leen Vandepitte, Maria Baker, Nicholas Higgs, Timothy O'Hara, Franziska Althaus, Diva Amon, Meri Bilan, Magdalena Blazewicz, Catherine Borremans, Jill Bourque, Stefan Brager, Abbie Chapman, Amber Cobley, Marina Cunha, Thomas Dahlgren, Andrew Davies, Fabio De Leo, Matt Dornback, Tammy Horton, Jeroen Ingels, Severine Martini, Doreen Mcveigh, Christopher Olson, Andrea Polanco, Ana Ramos, Etienne Rastoin, Ascensão Ravara, Torben Riehl, Christopher Roterman, Sidi Mohamed Mohamed Moctar

*Contact: w.appeltans@unesco.org

Follow us on Twitter: @OBISNetwork Catch up with the workshop: #deepseadata

33 participants from 16 countries (Australia, Belgium, Canada, Colombia, Ecuador, France, Germany, Jamaica, Mauritania, Norway, Poland, Portugal, Spain, Trinidad and Tobago, United Kingdom and United States) attended the first International OBIS-INDEEP training workshop on 25-28 October 2016 at the UNESCO-IOC project office for IODE in Oostende (Belgium). The participants represented 20 different deep-sea programmes and data systems (see list below).

Figure 1. Group picture, including Tammy Horton on Skype.

The meeting brought together deep-sea biologists and data managers and created the momentum to build an international alliance of young scientists with a common vision to provide open access to deep-sea biodiversity data and enhance our understanding of the deep-ocean ecosystem in order to better inform ocean governance and management.

The group called for:

- The establishment of a data-sharing platform, built on the Ocean Biogeographic Information System (OBIS; www.iobis.org), with the aim to provide a single integrated access point to high-quality data and information on the

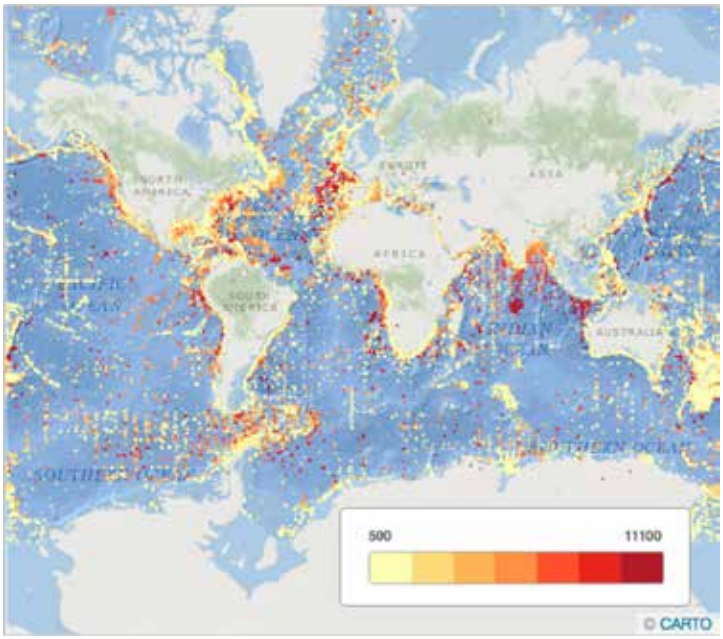
diversity, abundance and distribution of all deep-sea organisms and their ecosystem properties, including habitat and environmental characteristics.

- The promotion of guidelines and best practices in data management and to make these principles common practice through training the next generation of deep-sea scientists.
- The deposition of all primary biodiversity data in open-access archives and data integrators such as OBIS as a mandatory condition for publicly funded research, which should also apply for scientific publications, as is common practice for DNA sequences in GenBank.

In order to ensure the highest quality of data, the group recommended that each dataset be reviewed by an expert before it is put in the public domain and published through OBIS. An automatically generated dataset report providing summary statistics on data quality could assist this process.

The participants were trained in OBIS data standards and best practices in quality assurance (e.g. WoRMS and LifeWatch tools) and data publishing as well as in data access and analytical and visualization tools using the R OBIS package and GIS software (see http://iobis.org/manual). All the training material, including video presentations, are available on Ocean Teacher: http://bit.ly/2eFr06r.

The further development of a deep-sea OBIS node and data portal is a shared responsibility of this group and the wider deep-sea scientific community. The success will depend on the dedication of a few people, backed with extra resources such as a full-time data manager. The sharing of new data will be encouraged through a biennial review paper on the status of deep-sea data in OBIS and all new data contributors will be invited to join this effort.



As a baseline this map shows all 158,000 unique positions with species occurrence records currently in OBIS between 500 and 10897m depth. Online at http://bit.ly/2eG4BWU

The participants represented the following data systems and programmes:

- Southern Tasmanian seamounts surveys and the Western Australian Voyages of Discovery in Australia (CSIRO)
- Abyssal fauna from the the Clarion-Clipperton Zone (CCZ) via the ABYSSLINE (ABYSSal baseLINE) project
- Data from European Horizon 2020 projects such as [SponGES](http://www.deepseasponges.org/) and [ATLAS](http://www.eu-atlas.org/)
- Benthic invertebrates of Icelandic waters from the international [BIOICE and IceAGE projects](http://www.iceage-project.org)
- Nematode genera abundance from Portuguese canyons from [HERMES](http://www.eu-hermes.net/) and [HERMIONE](http://www.eu-hermione.net/) EU projects

- Deep-Sea Benthic Ecological Database managed by [SISMER](http://en.data.ifremer.fr/) of IFREMER
- Benthic macrofaunal communities associated with cold-water coral and seep habitats in the Gulf of Mexico and western Atlantic from [USGS DISCOVRE](https://www.usgs.gov/centers/wetland-and-aquatic-research-center-warc/science-topics/discovre)
- National Database of Deep-Sea Corals and Sponges of [NOAA's Deep Sea Coral Research and Technology Program](http://www.habitat.noaa.gov/protection/corals/deepseacorals.html)
- Hydrothermal vent data from the [sFDvent functional trait database](https://www.idiv.de/?id=423) and ChEssbase, including recent hydrothermal vent expeditions from the East Scotia Ridge.
- Deep-sea biodiversity data from the Atlantic and Mediterranean European margin, deposited in the Biological Research Collection of Universidade de Aveiro
- Ocean Networks Canada (ONC)'s regional observatory, formerly called [NEPTUNE observatory](http://www.oceannetworks.ca/installations/observatories/neptune-ne-pacific).
- Data from [MBARI's video annotation and reference (VAR) system](http://www.mbari.org/products/research-software/video-annotation-and-reference-system-vars/)
- SYNDEEP and [SeaMountsOnline](http://seamounts.sdsc.edu/) from the Scripps Institution of Oceanography
- Deep-sea fishes from the Caribbean region (INVEMAR)
- Mega- and macrobenthos from Northwest Africa of the [EcoAfrik database](http://www.ecoafrik.es/) of the Instituto Espanol de Oceanografia
- Selection of deep-sea sponges and echinoderms from the Galapagos Islands. Charles Darwin Foundation (http://www.darwinfoundation.org/datazone/) and Ocean Exploration Trust (http://www.oceanexplorationtrust.org/) 2015 joint expedition.
- Oceanographic and biological data from the Gulf of Mexico and Western Atlantic Margin Seep Connectivity ([SEEP-C](https://cmast.ncsu.edu/seepc/)) Project and recent expedition in the North Atlantic Continental Margin off the coast of New England.
- Macrostylidae of the KuramBio and Vema-TRANSIT project at the Centre for Natural History, University of Hamburg
- Benthic biodiversity of the continental shelf and slope of Mauritania
- Deep-sea benthic biodiversity data from the modern Discovery Collections at the National Oceanography Centre, Southampton.

Robert Ballard, Jesse Ausubel and around 100 other leading figures in marine science met in October to compare thoughts on the future of marine exploration at the 2016 National Ocean Exploration Forum, "Beyond the Ships: 2020-2025," hosted in New York by The Rockefeller University in partnership with Monmouth University. The Forum

was also supported by the Monmouth-Rockefeller Marine Science and Policy Initiative, NOAA, the Schmidt Ocean Institute, and James A. Austin, Jr. Ocean exploration has arrived at a historic hinge, Forum organizers say, with profound transformation underway thanks to new technologies.

For further information about the National Ocean Exploration Forum, visit: http://phe.rockefeller.edu/noef/

There are also a series of interesting (and thought-provoking) discussion papers of interest to the deep-sea community including:

Emerging technologies for biological sampling in the ocean: http://phe.rockefeller.edu/noef/Pomponi%20NOEF%20Biological%20Sampling%20.pdf

Ocean Exploration – The Mineral Resource Perspective:

http://phe.rockefeller.edu/noef/National_Ocean_Exploration_Forum_Discussion_Paper.pdf

Positioning Ocean Exploration in a Chaotic Sea of Changing Media:

http://phe.rockefeller.edu/noef/docs/NOEF%202016%20Schubel%20draft%20discussion%20paper%20re%20media.pdf

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BLUE PLANET
Oceans and Society

THE ROLE OF THE OCEANS IN EARTH'S LIFE-SUPPORT SYSTEM

Announcing the 3rd Blue Planet Symposium

We are pleased to inform you that the 3nd Symposium will be held in College Park, MD, USA, May 31-June 2, 2017. The Symposium will serve as a forum for discussion of societal information needs resulting from the important role the oceans play in Earth's life-support system and the challenge of minimizing the impacts of human activities on the oceans while utilizing the resources of the oceans to meet our needs. The symposium will also be a platform for the participating communities to exchange information on their activities and identify potential pilot and prototype projects for Blue Planet to focus on in the coming years. The Symposium will address four subthemes:

- The changing oceans
- Threats from pollution, warming and acidification
- Processes and life at the interfaces with the oceans

- Sustainable use of ocean resources

http://symposium.geoblueplanet.com/

Participation

The symposium is open to scientists, researchers, and students from academia, industry and government, users of ocean observation data and information, and other stakeholders engaged in monitoring, understanding and managing the oceans.

Registration will open in January 2017.

Spread the word

We will be sending out updates about the Symposium through this email list, please forward this email to colleagues who may be interested in attending the Symposium.

Community Input

We will be seeking community input prior to the Symposium - details to follow.

Visit the Blue Planet Symposium website regularly for all the latest information.

info@geoblueplanet.com

Panel Discussion Event: "Deep-Sea Mining, UK: Current Status of our National Policy and Regulatory Framework".

Amber Cobley

Contact: a.cobley@nhm.ac.uk

Panel Organiser: Amber Cobley (Natural History Museum, London (NHM) & University of Southampton (UoS)), Chair: Adrian Glover (NHM)

See Storify of what people were talking about at: https://storify.com/cobbers_ocean/deep-sea-mining-uk-national-frameworks

Deep-sea mining (DSM) is potentially close on the horizon, and despite financial uncertainties, pioneer projects could commence full-scale extraction as early as 2017.

This panel session was convened as part of the Challenger Society UK Deep-sea Ecosystems Special Interest Group (SIG), on 9th September 2016, with over 40 attendees. Chairing the event, Dr. Adrian Glover (NHM) introduced the scope of the session: to focus at a national level on strengthening the UK's DSM network. By bringing together policy-makers and industry representatives, the event aimed to bridge the gaps between science, policy and industry to promote future discussions.

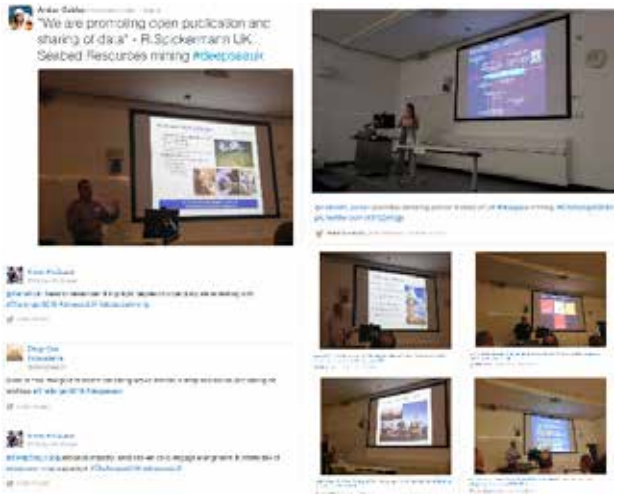

Figure 1. Tweets from the Deep-Sea Mining, UK panel event, 9/09/2016

Event organiser Amber Cobley (NHM & UOS) gave an overview of her work on the international and national history of DSM. From the discovery of nodules by HMS Challenger in the 19th century, to their commercialisation and governance development, the presentation provided a potted history to the academic community to contextualise the following panel members:

Gavin Watson - Head of Overseas Territories and Maritime Team in Legal Directorate, Foreign and Commonwealth Office (FCO).

- UK Government committed to development and implementation of International Seabed Authority's Mining Code. A clear red line for the UK is that this code includes adequate environmental protection, whilst providing a certainty for commercial activity to be conducted within a level playing field.
- DSM is on the agenda for the UK government, with specific interest from Secretary of State for International Trade.

Andrew Birchenough - (Principal Marine Advisor, CEFAS)

- CEFAS' representation on multiple conventions lead to a memorandum of understanding (MOU) with ISA to share experience.
- FCO are the lead on DSM, but DEFRA provide environmental impact information to FCO from CEFAS. Deep Sea Ecosystems, UK is a good base for expertise in future license and regulatory consultations.

Ralph Spickermann - (Chief Engineer, UK Seabed Resources LTD, UKSRL)

- Baseline environmental data is vital for responsible Chief Engineer to do their job.
- UKSRL committed to transparency and encourage publications and sharing of data. They hope other contractors will do the same to create a cohesive plan for the Clarion-Clipperton Zone (CCZ).
- UKSRL ABYSSLINE project has developed a data processing pipeline using modern taxonomic methodologies and open access archiving.

Stef Kapusniak - (Business Development Manager – Mining, Soil Machine Dynamics, SMD)

- SMD recently commissioned by Nautilus Minerals for DSM equipment and EU project VAMOS (Viable Alternative Mining Operating System) to develop technologies for inland submerged deposits, which are proving useful for testing technologies they expect to use in DSM.
- 3 machines– Auxiliary and Bulk cutters flatten "spikey seabed". A collecting machine consolidates ore to go up a riser pipe to be dewatered. Water and material goes back down pipes to the place of origin at the seabed. Particle size and turbidity cannot be known until test mining has taken place.

Henry Green – (Government Office for Science, Foresight Report).

- GO Science take a single issue in science and technology where there is a long-term challenge or issue of interest to the UK.
- Foresight projects are forward looking on issues of decadal scales – next project is on the Future of the Sea, with a deep-seabed mining component as an emerging technology.

The output was a submission from the group to the FCO reviewing the ISA exploitation regulations zero draft. We are grateful to the panel for their extremely informative presentations, and illuminating Deep-sea Ecosystems SIG about how they can provide scientific advice to create a modern DSM regulatory framework.

The London Workshop on the Biogeography and Connectivity of the Clarion-Clipperton Zone

Adrian Glover, Thomas G Dahlgren, Sergio Taboada, Gordon Paterson, Helena Wiklund, Andrea Waeschenbach, Amber Cobley, Pedro Martínez, Stefanie Kaiser, Sarah Schnurr, Sahar Khodami, Uwe Raschka, Daniel Kersken, Heiko Stuckas, Lenaick Menot, Paulo Bonifacio, Ann Vanreusel, Lara Macheriotou, Marina Cunha, Ana Hilário, Clara Rodrigues, Ana Colaço, Pedro Ribeiro, Magdalena Błażewicz, Andrew J Gooday, Daniel OB Jones, David SM Billett, Aurélie Goineau, Diva J Amon, Craig R Smith, Tasnim Patel, Kirsty McQuaid, Ralph Spickermann, Stefan Brager

Background

Recent years have seen a rapid increase in survey and sampling expeditions to the Clarion-Clipperton Zone (CCZ) abyssal plain, a vast area of the central Pacific that is currently being actively explored for deep-sea minerals (ISA, 2016). Critical to the development of evidence-based environmental policy in the CCZ are data on the biogeography and connectivity of species at a CCZ-regional level.

New information

The London Workshop on the Biogeography and Connectivity of the CCZ was convened to support the integration and synthesis of data from European Union (EU) CCZ projects, supported by the EU Managing Impacts of Deep-Sea Resource Exploitation (MIDAS) and EU Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI Oceans) projects. The London Workshop had three clear goals: (1) To explore, review and synthesise the latest molecular biogeography and connectivity data from across recent CCZ cruises from both contractor and academia-funded projects; (2) To develop complementary and collaborative institutional and program-based academic publication plans to avoid duplication of effort and ensure maximum collaborative impact; (3) To plan a joint synthetic data publication highlighting key results from a range of planned molecular biogeography/connectivity publications. Thirty-two participants attended the workshop at the Natural History Museum in London from 10-12 May 2016. Presentations and discussions were given covering (1) overviews of current CCZ environmental projects, (2) policy and industry perspectives, (3) synthesis of DNA taxonomy and biogeography studies, (4) summaries of the latest population genetic studies, (5) summaries of the latest broader morphological context, (6) an overview of publication and proposal plans to maximise collaborative opportunities and finally (7), a series of workshop recommendations.

Figure 1. The London Workshop on the Biogeography and Connectivity of the Clarion-Clipperton Zone on the main steps of the Natural History Museum below the bust of Charles Darwin. Workshop participants: Back row, left to right: Ralph Spickermann, Stefan Brager. Second from back row, left to right: Pedro Ribeiro, Sergi Taboada, Lara Macheriotou, Ann Vanreusel, Magda Blazewicz, Sarah Schnurr, Helena Wiklund. Third from back row, left to right: Andrew Gooday, Daniel Jones, Lenaick Menot, Pedro Martinez, Steffi Kaiser, Ana Colaço, Sahar Khodami, Marina Cunha, Ana Hilario. Third from back row, left to right: Adrian Glover, Paulo Bonifacio, Kirsty McQuaid, Aurélie Goineau, Heiko Stuckas, Thomas Dahlgren. Front row, left to right: Daniel Kersken, Uwe Raschka, Tasnim Patel, Clara Rodrigues, Gordon Paterson, Amber Cobley. Not present for photo: Andrea Waeschenbach and David Billett. Image credit: T Cruise.

Marine Imaging Workshop 2017 – Registration Open!

We are happy to announce that the registration and abstract submission for the upcoming Marine Imaging Workshop is now open.

The Marine Imaging Workshop 2017 follows on from a successful 2014 workshop held at the NOCS, UK. We invite anyone using visual imagery in the marine realm: scientists, engineers, researchers, regulators, and industrial partners. The focus will be on developments and challenges in methods of marine optical imaging: imagery acquisition, processing and manipulation, annotation, segmentation and automated strategies, data management, application to scientific aims, and outlook and future developments.

The abstract submission deadline is the 8th of November. Please see the workshop website for details: www.marine-imaging-workshop.com

We are looking forward to your contributions and to meeting you in Kiel!

The Local and Scientific Organising Committees

Save the date!

IMBER will hold its fifth IMBIZO (the Zulu word for a gathering) at the Woods Hole Oceanographic Institution, Woods Hole, MA, USA from 2-6 October 2017 (yes, it is more than a year away, but you don´t want to miss it!)

The theme of IMBIZO V will be: Marine biosphere research for a sustainable ocean: Linking ecosystems, future states and resource management

We will follow the usual IMBIZO format of three concurrent but interacting workshops. The three workshops are:

1. Critical constraints on future projections of marine systems (co-Chairs: Laurent Bopp and Eric Galbraith)
2. Metabolic diversity and ecosystem processes in a changing ocean (co-Chairs: Gerhard Herndl and Tatiana Rynearson)
3. Management Strategy Evaluation: Achieving Transparency in Natural Resource Management by Quantitatively Bridging Social and Natural Science Uncertainties" (co-Chairs: Ingrid van Putten and Cisco Werner)

Abstract submission will open in February 2017.

Please spread the news widely - http://www.imber.info/events/imbizos/marine-biosphere-research-for-a-sustainable-ocean-linking-ecosystems_-future-states-and-resource-management

The 10th Indo-Pacific Fish Conference

(Tahiti, French Polynesia, 2-6 October 2017)

Session: Primitive Fishes: Scientific, Cultural, and Commercial Importance

Organizers: Alexei M. Orlov & Marcelo R. de Carvalho

Affiliations: Russian Federal Research Institute of Fisheries and Oceanography (VNIRO), Moscow, Russia / Departamento de Zoologia, Universidade de São Paulo, Brazil

Lead contact: Alexei M. Orlov - orlov@vniro.ru

Description: Non-teleost fishes that are the living representatives of ancient lineages are considered to be “primitive” or “living fossils”. More derived fishes, such as cichlids, sunfishes, and perches, are generally considered to be “modern”. These terms (primitive versus modern) are not entirely accurate in terms of vertebrate evolution. According to modern concept, primitive fishes include hagfishes (Myxini), lampreys (Petromyzonti), sharks and skates/rays (Elasmobranchii), ratfishes/chimaeras (Holocephali), coelacanths (Coelacanthi), lungfishes and tetrapods (Dipneusti), bichirs/reedfishes (Cladistii), sturgeons (Acipenseridae) and paddlefishes (Polyodontidae), gars (Lepisosteidae), bowfins (Amiidae) and some others. The main purpose of this symposium is to provide an overview of the current status of knowledge on the variety of topics related to primitive fishes, including (but not limited by):

- Evolution, phylogeny, phylogeography, and molecular biology;
- Taxonomy and zoogeography;
- Ecology and life history;
- Harvesting, stock assessment, and fisheries management;
- Artificial propagation and aquaculture;
- Conservation and stock rebuilding.

Expected Audience: We expected broad target audience from around the globe represented by interdisciplinary scientists dealing with evolution, phylogeny, phylogeography, molecular biology, taxonomy, zoogeography, ecology, and life history traits of primitive fishes with special focus on issues related to harvesting, stock assessment, fisheries management, artificial propagation, aquaculture conservation and stock rebuilding of these diverse and species-rich group of fishes.

Link to description of the session:

https://ipfc10.criobe.pf/primitive-fishes-scientific-cultural-and-commercial-importance/

CBE6
AUG 27 – SEP 1 2017
Woods Hole, Mass. USA

The 6th International Symposium on Chemosynthesis-Based Ecosystems takes place in Woods Hole on beautiful Cape Cod, MA, USA, August 27 - September 1, 2017

Please join us in Woods Hole as we celebrate the 40th anniversary of the discovery of deep-sea hydrothermal vents at the Galapagos Spreading Center in 1977. This has forever changed our perception of life on Earth and has sparked a new line of research to investigate the role of chemosynthesis in various ecosystems, from cold seeps and organic falls to the extensive oxygen deficient zones of the oceanic water column. The discovery of deep-sea hydrothermal vents 40 years ago has thrust the process of chemosynthesis into the limelight. However, it is only more recently that chemosynthesis has been identified to be an important driver for many environmentally relevant processes on a global scale.

CBE6 represents the 6th iteration of a successful symposium series that started back in Funchal, Madeira, Portugal in 1997 and has since been held in Brest, France (2001), San Diego, USA (2005), Okinawa, Japan (2009), and most recently in Victoria, BC, Canada (2013), ever broadening in scope from an initial focus on the biology of deep-sea hydrothermal vents.

We look forward to hosting an exciting meeting that will highlight the newest discoveries and developments in studying chemosynthesis-based ecosystems and their societal relevance, while at the same time also evoking the early days of deep-sea vent discovery - in a way connecting the past with the present, with a glimpse into the future!

We look forward to seeing you in Woods Hole!

Please visit http://cbe2017.org for further information and send inquiries to cbe2017@whoi.edu

Please also note that on 26th August, the Deep Ocean Stewardship Initiative (DOSI) will host a 1-day community engagement and vent protection meeting to which you are all invited. Please save this date if you are interested in attending.

Scientist Profiles

Sook-Jin Jang

Interdisciplinary Program of EcoCreative, The Graduate School, Ewha Womans University, South Korea

Contact: mingjuee@gmail.com

I am a third year PhD student at Ewha Womans University in South Korea focusing on the analysis of whole genome sequences of chemosynthetic symbiotic bacteria in gill tissues of the vent mussel, *Bathymodiolus thermophilus*. Also, I am conducting comparative genomics analysis among symbionts of mussels, clams, and tubeworms from hydrothermal vents and seeps, as well as closely related environmental, free-living bacteria from vents and shallower Oxygen Minimum Zones. Genomic data provides information about the evolutionary history of symbionts, such as how changes in metabolic pathways, cellular processes, and environmental response genes result from adaptations to specific environments. The purpose of my study is to trace this evolutionary process by comparing the genome sequences of bacteria from these different environments.

My research also involves population genetics, which I previously studied during my Masters degree. Recently, I co-authored a paper on population subdivision of the hydrothermal vent Alvinellid polychaete, *Alvinella pompejana*, across geographical boundaries on the East Pacific Rise using a multi-locus approach, including mtCOI and nuclear genes, (Jang et al., 2016; http://rdcu.be/l55D). I am also in the process of studying the genetic population structure of endosymbionts of *Ridgeia piscesae* in the Northeast Pacific Ridge System and of the fresh water fish species, *Iksookimia pacifica* found in South Korea.

I am particularly interested in the evolutionary history of vent organisms and how they have adapted to these extreme environments, and I am looking forward to providing new results from my ongoing comparative genomics studies in collaboration with my colleagues at Monterey Bay Aquarium Research Institute and The National Oceanography Centre, Southampton.

Patrick Nason

Columbia University, Department of Anthropology

Ph.D. Candidate

Contact: Pfn2104@columbia.edu www.patricknason.com

As an environmental anthropologist I am concerned with the preservation of biological and cultural diversity in areas most vulnerable to anthropogenic change. For the past year I have lived in a small village in the Bismarck Archipelago of Papua New Guinea (PNG), the only place in the world where sharks are caught by hand using materials from the forest and knowledge passed down through the generations. There, I have been working with indigenous fishermen and their families to develop novel ways of sensing ecological change in spaces that are practically or economically out of reach.

This work began with an initial visit to New Ireland in 2013, just as Nautilus Minerals' Solwara 1 project was securing approval from the provincial and national governments of PNG. In local meetings and on social media, communities on the island expressed concern that the sound and sediment from the proposed mining operation would affect their fisheries, and thus, their means of social and physical reproduction. Yet, it was unclear how these local stakeholders would sense and record changes to the marine environment without the sophisticated equipment essential to modern oceanography. To answer this complex question, I realized we needed to look deeper into local interactions with the land and the sea: to the unique practice of "shark-calling," but also to conventions of land and sea tenure and the elaborate mortuary rites through which these conventions are invoked, recognized, and amended. Funding from The Wenner-Gren Foundation, The Explorer's Club, and Columbia University has enabled this ongoing fieldwork.

Now back in the United States, I am working across disciplines to render this experience into a new method of remote sensing in which ecological change at sea can be identified in the realm of the everyday. Simply put, if the sea is in us, then changes to it can be observed through us: in the ways we relate to each other and the freedoms and constraints that structure those relations. With the deep Pacific as its research site, this work necessarily involves collaboration with biological and physical oceanographers, deep-sea ecologists, historians, and those working to develop conservation policy in areas beyond national jurisdiction and surveillance. I am excited to meet the readers of Deep Sea Life and welcome any opportunity to speak more about Papua New Guinea, the intrepid Shark Callers, and the importance of indigenous knowledge for the conservation of deep spaces.

Opportunities

FACULTY POSITION AT SCRIPPS INSTITUTION OF OCEANOGRAPHY, UCSD – Biological Oceanography/Marine Ecology
Scripps Institution of Oceanography (SIO) at the University of California San Diego (http://scripps.ucsd.edu) invites faculty applications for the position listed below. We seek a motivated, broad-thinking scientist-educator to establish a vigorous research program and provide intellectual leadership in his or her field while complementing existing expertise at Scripps and other UCSD departments. SIO is a world renowned center of marine research with approximately 200 principal investigators leading research programs on all aspects of earth, ocean, biological and atmospheric sciences. We are committed to academic excellence and diversity within the faculty, staff, and student body. The department is interested in candidates who have demonstrated commitment to excellence by providing leadership in teaching, research, and service towards building an equitable and diverse scholarly environment.

Biological Oceanography/Marine Ecology: We seek an outstanding candidate with interests in **marine ecosystem, population, or organismal response to global change**, with strong preference for a sea-going scientist. Research areas of interest could include but are not limited to experimental pelagic ecology, pelagic or benthic deep-sea biology, population and evolutionary genetics, fisheries oceanography, biogeochemistry, or marine physiology and biochemistry. The successful candidate will have the opportunity to interact with large scale interdisciplinary SIO field research programs, including the California Current Ecosystem-LTER, the California Cooperative Oceanic Fisheries Investigations (CalCOFI), and others. The candidate will develop a vigorous extramurally-supported research program, be committed to active teaching and mentoring of graduate students, and will teach in the new marine biology undergraduate major.

The position requires a PhD or equivalent degree in a relevant field, a competitive record of publication and service, as well as evidence of ability or strong potential to secure extramural funding and conduct an active research program. Our strong preference is for hiring at the level of Assistant Professor, but appointments at the Associate level will be considered. Rank, level of appointment (Assistant, Associate, Acting Associate) and salary will be consistent with the applicant's qualifications and experience and with University of California pay scales.

For full consideration, please apply by the 11/20/16 deadline.

Assistant Professor at: https://apol-recruit.ucsd.edu/apply/JPF01234
Associate/Full Professor at: https://apol-recruit.ucsd.edu/apply/JPF01241
(Current Assistant level candidates with a strong record of research and teaching are encouraged to submit materials through both links.)
The University of California San Diego is an Equal Opportunity/Affirmative Action Employer. All qualified applicants will

receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, disability, age or protected veteran status. For applicants with interest in spousal/partner employment, please also see http://academicaffairs.ucsd.edu/aps/partneropp/index.html for the UCSD Partner Opportunities Program.

RESEARCH INTERNS, NEKTON FOUNDATION, UK.

Full Time, Fixed Term, Start immediately

£13,065 pa

Oxford

Opportunity to assist in science and logistics delivery for Nekton's global deep ocean research missions

Background

Nekton's mission is to explore and protect the last great frontier on our planet – the deep ocean. Today we have better maps of Mars and the Moon, than we do of our own seabed. Containing over 95% of our biosphere, an average depth of 2.3 miles (full ocean depth is 7 miles down), with only 0.0001% biologically sampled, the deep ocean is the least known part of our planet. It is also the most important, as it plays a critical role in our planet's life support system. Worryingly, it's undergoing its most severe disruption in at least 250 million years and no one really knows how the changes will affect us. Simply, we need to go deep.

About Nekton

A UK-registered charity based in Oxford, London and New York, Nekton has just completed its first major expedition into the deep ocean around Bermuda and west Atlantic, using the latest submersibles and deep sea technology to carry out a health check on the ocean. Our Missions provide the scientific data and media content to amplify ocean prioritisation, accelerate ocean literacy and inform and catalyse marine protection. Through our expeditions, technology development, ground-breaking research, published discoveries, broadcast films and high-profile communications and events, we aim to help revolutionise ocean science and conservation.

Role of Laboratory Technician

Nekton is seeking two laboratory technicians to assist in the delivery of the Nekton science program. They will be expected to take responsibility sorting pelagic and benthic samples and assist with species identification. They may be requirement to assist with logistical tasks.

Responsibilities

- Sorting samples under binocular microscope
- Undertake identification of pelagic and benthic macrofauna
- Photograph specimens
- Report progress to senior laboratory technician
- Update specimen database
- Provide support for other Nekton science activities
- Provide assistance with day-to-day running of the laboratory

About you

We are looking for someone who is self-motivated and efficient, ideally with skills in marine taxonomy. As public communication is an important aspect of the Nekton philosophy, you will be happy to take part in filming and other communications activities.

Required Qualifications

- BSc Science related subject- Marine Science preferred
- Proven light microscopy skills, preferable with photographic experience

- Computer literate
- Strong attention to detail
- Organised

Time commitment & remuneration

We are currently looking to recruit two interns. This is currently a three month position. Extension is possible subject to funding.

How to apply

Please send your CV and a cover letter detailing your interest, skills and qualifications to Belinda Bramley at belinda@nektonmission.org

SENIOR LABORATORY TECHNICIAN, NEKTON FOUNDATION, UK.

Full Time, Fixed Term, Start immediately

£30,000 pa

Oxford

Opportunity to assist in science and logistics delivery for Nekton's global deep ocean research missions

Background

Nekton's mission is to explore and protect the last great frontier on our planet – the deep ocean. Today we have better maps of Mars and the Moon, than we do of our own seabed. Containing over 95% of our biosphere, an average depth of 2.3 miles (full ocean depth is 7 miles down), with only 0.0001% biologically sampled, the deep ocean is the least known part of our planet. It is also the most important, as it plays a critical role in our planet's life support system. Worryingly, it's undergoing its most severe disruption in at least 250 million years and no one really knows how the changes will affect us. Simply, we need to go deep.

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Role of Senor Laboratory Technician

Nekton is seeking a senior laboratory technician to assist in setting up a new laboratory and managing interns and technicians. They will be expected to take responsibility for all health and safety aspects of science activities and management of the lab including ordering and servicing of equipment, assist with species identification and support all logistical requirements of the research group.

Responsibilities

- Health and Safety management of the laboratory
- Servicing of all laboratory equipment
- Stocktake and maintenance of scientific gear and consumables stored or used in Oxford
- Management of laboratory team
- Responsible for day-to-day laboratory tasks
- Teaching basic microscope skills
- Training of team in identification of common pelagic and benthic macrofauna

- Sorting samples under binocular microscopes.
- Identifying pelagic specimens to morphospecies
- Provide regular updates on project progress
- Responsible for maintaining specimen database
- Provide support for Nekton science activities

About you

We are looking for someone who is self-motivated and efficient, with skills in marine taxonomy (Zooplankton- especially useful) and with experience in a laboratory management/ supervision. As public communication is an important aspect of the Nekton philosophy, you will be happy to take part in filming and other communications activities.

Required Qualifications

- BSc Science related subject- Marine Science preferred
- Experience with laboratory Health and Safety and all aspects of laboratory management
- Proven light microscopy skills, preferable with photographic experience
- Specific skills in identification of marine pelagic fauna
- Ability to support all areas of administration for science research
- Computer literate
- Able to communicate scientific concepts to non-science audience

Time commitment & remuneration

This is currently a six-month position. Extension is possible subject to funding. There may be an opportunity to spend up to 2 months on expeditions at sea in the future for which you will be required to pass an ENG1 medical. The position will be based in Oxford and you will be present in the laboratory each working day and be able to respond to emergencies out of hours.

How to apply

Please send your CV and a cover letter detailing your interest, skills and qualifications to Belinda Bramley at belinda@nektonmission.org

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SCHMIDT OCEAN INSTITUTE

Call for Expressions of Interest

Dear Colleague:

We are pleased to announce that Schmidt Ocean Institute has opened its annual call for Expressions of Interest in collaborative oceanographic research and technology development. Further details and submission guidelines are available at the following link: Schmidt Ocean Institute - Expressions of Interest in collaborative research cruises on R/V Falkor in 2019

Submissions will be accepted through December 4, 2016. Should you have any questions about the SOI proposal process, kindly email your question to proposals@schmidtocean.org. Please feel free to forward this information to

any your interested colleagues.

Thank you.

Schmidt Ocean Institute

2017 SCOR Visiting Scholars Program

SCOR has issued a call for applications for the 2017 SCOR Visiting Scholars Program. The announcement can be found at http://www.scor-int.org/SCOR_CB/Call_for_2017_SCOR_Visiting_Scholars.pdf.

Applications are due by **30 November 2016**. SCOR will support three Visiting Scholars in 2017. Applications are welcomed from potential Visiting Scholars as well as institutions wishing to host a Visiting Scholar.

The purpose of the program is to encourage ocean scientists to share their expertise through teaching and mentoring in developing countries.

Please contact SCOR Executive Director Ed Urban at ed.urban@scor-int.org with any questions about the program.

Funded PhD Position

Understanding the functional roles of shallow and deep water sponge assemblages using Remotely Operated Vehicles and SCUBA

Supervisor: Associate Professor James J. Bell, Victoria University of Wellington, New Zealand.

Project overview: Despite sponges being widespread and abundant throughout New Zealand little is known about their ecology or threat status. Importantly, we have very limited information on the sponge fauna between 50-200 m, where sponges dominate rocky environments as algal populations decline. This project will use SCUBA and a remotely operated vehicle (ROV) to investigate shallow and deep water sponge ecology in New Zealand. Recent research at VUW in shallow water (<20 m), where sponge abundance is less than 10% cover, has shown that sponges pump vast quantities of water through their bodies, and in doing so can remove >90% of the available plankton in the water column. This simple action of feeding means sponges are exerting a major influence on the water column, and therefore are likely to be very important in coastal ecosystems. However, in deeper water, from 50-200 m, sponges are even more abundant and cover can often exceed 50% of the rock surface. In these environments sponges are likely to have even more important functional roles through their feeding activities that may have implications for shallower water communities, especially if mobile species like fish are moving between these habitats. In addition, recent studies overseas have shown that sponges assimilate other potential food sources, particularly dissolved organic carbon (DOC), which they likely transform to different carbon sources that can become available to other marine organisms and support entire local ecosystems. This may be an even more significant impact of sponges than feeding on picoplankton, especially in deeper waters where plankton is less abundant; this requires further investigation to fully understand the functional roles of sponges in temperate coastal ecosystems. The work will be based at Victoria of University in Wellington with fieldwork in the Taranaki region, which supports some magnificent sponge 'gardens', particularly in Paraninihi Marine Reserve. Unusually, these sponge assemblages, where rock coverage can exceed 50%, occur in very shallow water (5 m) and the assemblages are more typical of deeper water ecosystems. This project will focus on these sponge gardens and determine how these reefs function compared to shallow water sponge assemblages elsewhere, and also to deeper water sponge assemblages. The overall aim of this project is investigate the functional roles of shallow compared to deeper water sponges assemblages focusing on feeding, competition and habitat provisioning. This project might include fieldwork/studies, feeding experiments and ecological modeling.

Other information: The successful candidate will need SCUBA experience and ideally have experience of temperate ecosystems and working in remote locations. Applicants would be expected to have already completed an MSc or equivalent. The project is fully funded by the George Mason Trust to include a 3-year scholarship (stipend and fees worth NZ$35,000 per year) and travel and consumable costs. IMPORTANT: In the first instance please send a full CV, copies of academic transcripts and names of two referees who we can contact to support your application to Associate Professor James Bell (james.bell@vuw.ac.nz). We will be considering applications as they arrive as we need to fill this position quickly, with a final closing date of 18/11/16.

For further information about Victoria University of Wellington, about the city of Wellington and life in New Zealand, please refer to the VUW website – (www.victoria.ac.nz). This PhD opportunity is open to individuals of all nationalities. If English is not your first language, then please note the English language requirements - http://www.victoria.ac.nz/fgr/prospective-phds/qualifications-required. Please note postgraduate fees for PhD in New Zealand are the same for both domestic and international students, therefore this opportunity is open to students from all countries. Minimum requirement for admission to our 3 year PhD programme is a Bachelor of Science with honours (or equivalent) degree from a university (or equivalent) that is recognised by Victoria University of Wellington.

Please contact Associate Professor James Bell for further details (james.bell@vuw.ac.nz)
http://www.victoria.ac.nz/sbs/research/marine-biology-research/sponge-marine-ecology/

Hot off the Press

The Whittard Canyon – A case study of submarine canyon processes

Amaro T, Huvenne V, Allock A *et al.* (2016)

Progress in Oceanography 146: 38–57

Submarine canyons are large geomorphological features that incise continental shelves and slopes around the world. They are often suggested to be biodiversity and biomass hotspots, although there is no consensus about this in the literature. Nevertheless, many canyons do host diverse faunal communities but owing to our lack of understanding of the processes shaping and driving this diversity, appropriate management strategies have yet to be developed. Here, we integrate all the current knowledge of one single system, the Whittard Canyon (Celtic Margin, NE Atlantic), including the latest research on its geology, sedimentology, geomorphology, oceanography, ecology, and biodiversity in order to address this issue. The Whittard Canyon is an active system in terms of sediment transport. The net suspended sediment transport is mainly up-canyon causing sedimentary overflow in some upper canyon areas. Occasionally sediment gravity flow events do occur, some possibly the result of anthropogenic activity. However, the role of these intermittent gravity flows in transferring labile organic matter to the deeper regions of the canyon appears to be limited. More likely, any labile organic matter flushed downslope in this way becomes strongly diluted with bulk material and is therefore of little food value for benthic fauna. Instead, the fresh organic matter found in the Whittard Channel mainly arrives through vertical deposition and lateral transport of phytoplankton blooms that occur in the area during spring and summer. The response of the Whittard Canyon fauna to these processes is different in different groups. Foraminiferal abundances are higher in the upper parts of the canyon and on the slope than in the lower canyon. Meiofaunal abundances in the upper and middle part of the canyon are higher than on adjacent slopes, but lower in the deepest part. Mega- and macrofauna abundances are higher in the canyon compared with the adjacent slope and are higher in the eastern than the western branch. These faunal patterns reflect the fact that the Whittard Canyon encompasses considerable environmental heterogeneity, related to a combination of organic matter trapping, current regimes (due to focused internal tides) and different substrates. We conclude that coordinated observations of processes driving faunal patterns are needed at a fine scale in order to understand the functioning of communities in this and other submarine canyons.

Link to article: http://www.sciencedirect.com/science/article/pii/S0079661115300549

Insights into the abundance and diversity of abyssal megafauna in a polymetallic-nodule region in the eastern Clarion-Clipperton Zone

Amon D, Ziegler A, Dahlgren T *et al.* (2016)

Scientific Reports 6, Article number: 30492, doi:10.1038/srep30492

There is growing interest in mining polymetallic nodules in the abyssal Clarion-Clipperton Zone (CCZ) in the Pacific. Nonetheless, benthic communities in this region remain poorly known. The ABYSSLINE Project is conducting benthic biological baseline surveys for the UK Seabed Resources Ltd. exploration contract area (UK-1) in the CCZ. Using a Remotely Operated Vehicle, we surveyed megafauna at four sites within a 900 km^2 stratum in the UK-1 contract area,

and at a site ~250 km east of the UK-1 area, allowing us to make the first estimates of abundance and diversity. We distinguished 170 morphotypes within the UK-1 contract area but species-richness estimators suggest this could be as high as 229. Megafaunal abundance averaged 1.48 ind. m^{-2}. Seven of 12 collected metazoan species were new to science, and four belonged to new genera. Approximately half of the morphotypes occurred only on polymetallic nodules. There were weak, but statistically significant, positive correlations between megafaunal and nodule abundance. Eastern-CCZ megafaunal diversity is high relative to two abyssal datasets from other regions, however comparisons with CCZ and DISCOL datasets are problematic given the lack of standardised methods and taxonomy. We postulate that CCZ megafaunal diversity is driven in part by habitat heterogeneity.

Link to article: http://www.nature.com/articles/srep30492

Abyssal fauna of the UK-1 polymetallic nodule exploration area, Clarion-Clipperton Zone, central Pacific Ocean: Cnidaria

Dahlgren T, Wiklund H, Rabone M, *et al.* (2016)

Biodiversity Data Journal 4: doi: 10.3897/BDJ.4.e9277

We present data from a DNA taxonomy register of the abyssal Cnidaria collected as part of the Abyssal Baseline (ABYSSLINE) environmental survey cruise 'AB01' to the UK Seabed Resources Ltd (UKSRL) polymetallic-nodule exploration area 'UK-1' in the eastern Clarion-Clipperton Zone (CCZ), central Pacific Ocean abyssal plain. This is the second paper in a series to provide regional taxonomic data for a region that is undergoing intense deep-sea mineral exploration for high-grade polymetallic nodules. Data were collected from the UK-1 exploration area following the methods described in Glover et al. (2015b).

Morphological and genetic data are presented for 10 species and 18 records identified by a combination of morphological and genetic data, including molecular phylogenetic analyses. These included two primnoid octocorals, two isidid octocorals, one anemone, four hydroids (including two pelagic siphonophores accidentally caught) and a scyphozoan jellyfish (in the benthic stage of the life cycle). Two taxa matched previously published genetic sequences (pelagic siphonophores), two taxa matched published morphological descriptions (abyssal primnoids described from the same locality in 2015) and the remaining six taxa are potentially new species, for which we make the raw data, imagery and vouchers available for future taxonomic study. We have used a precautionary approach in taxon assignments to avoid over-estimating species ranges. The Clarion-Clipperton Zone is a region undergoing intense exploration for potential deep-sea mineral extraction. We present these data to facilitate future taxonomic and environmental impact study by making both data and voucher materials available through curated and accessible biological collections. For some of the specimens we also provide image data collected at the seabed by ROV, which may facilitate more accurate taxon designation in coming ROV or AUV surveys.

Link to article: http://bdj.pensoft.net/articles.php?id=9277

The Structure and Distribution of Benthic Communities on a Shallow Seamount (Cobb Seamount, Northeast Pacific Ocean)

Du Preez C, Curtis R, & Clarke E (2016)

PLoS ONE 11(10): e0165513. doi:10.1371/journal.pone.0165513

Partially owing to their isolation and remote distribution, research on seamounts is still in its infancy, with few comprehensive datasets and empirical evidence supporting or refuting prevailing ecological paradigms. As anthropogenic activity in the high seas increases, so does the need for better understanding of seamount ecosystems and factors that influence the distribution of sensitive benthic communities. This study used quantitative community analyses to detail the structure, diversity, and distribution of benthic mega-epifauna communities on Cobb Seamount, a shallow seamount in the northeast Pacific Ocean. Underwater vehicles were used to visually survey the benthos and seafloor in ~1600 images (~5m^2 in size) between 34 and 1154 m depth. The analyses of 74 taxa from 11 phyla resulted in the identification of nine communities. Each community was typified by taxa considered to provide biological structure and/or be a primary producer. The majority of the community-defining taxa were either cold-water corals, sponges, or algae. Communities were generally distributed as bands encircling the seamount, and depth was consistently shown to be the strongest environmental proxy of the community-structuring processes. The remaining variability in community structure was partially explained by substrate type, rugosity, and slope. The study used environmental metrics, derived from ship-based multibeam bathymetry, to model the distribution of communities on the seamount. This model was successfully applied to map the distribution of communities on a 220 km^2 region of Cobb Seamount. The results of the study support the paradigms that seamounts are diversity 'hotspots', that the majority of seamount communities are at risk to disturbance from bottom fishing, and that seamounts are refuges for biota, while refuting the idea that seamounts have high endemism.

Link to paper: http://dx.doi.org/10.1371/journal.pone.0165513

Comparison of image annotation data generated by multiple investigators for benthic ecology

Durden J, Bett B, Schoening T *et al.* (2016)

Marine Ecology Progress Series, 552:61-70

Multiple investigators often generate data from seabed images within a single image set to reduce the time burden, particularly with the large photographic surveys now available to ecological studies. These data (annotations) are known to vary as a result of differences in investigator opinion on specimen classification and of human factors such as fatigue and cognition. These variations are rarely recorded or quantified, nor are their impacts on derived ecological metrics (density, diversity, composition). We compared the annotations of three investigators of 73 megafaunal morphotypes in ~28,000 images, including 650 common images. Successful annotation was defined as both detecting and correctly classifying a specimen. Estimated specimen detection success was 77%, and classification success was 95%, giving an annotation success rate of 73%. Specimen detection success varied substantially by morphotype (12-100%). Variation in the detection of common taxa resulted in significant differences in apparent faunal density and community composition among investigators. Such bias has the potential to produce spurious ecological interpretations if not appropriately controlled or accounted for. We recommend that photographic studies document the use of multiple annotators and quantify potential inter-investigator bias. Randomisation of the sampling unit (photograph or video

clip) is clearly critical to the effective removal of human annotation bias in multiple annotator studies (and indeed single annotator works).

Link to article: http://www.int-res.com/abstracts/meps/v552/p61-70/

Why might dwarfism have appeared in the males of a deep-sea wood-borer population?

Gaudron S, Haga T, Wang H, *et al.* (2016)

Marine Biology, 163: 213. DOI 10.1007/s00227-016-2988-6

While studying a population of *Xylophaga atlantica* collected from colonization devices deployed for one year at 2300 metres depth on the Mid-Atlantic Ridge, the discovery of tiny specimens settled on the dorsal shell surfaces of larger conspecifics came as little surprise. Such patterns had been documented before in other wood-boring species, often presumed to be settling post-larvae. No adult dissoconch shells were observed in the tiny individuals collected in our study, with only the prodissoconch II present, the larval shell built during the dispersal phase. This appeared to support a post-larval origin. However in reality their nature was far more intriguing. Using both histology and scanning electron microscopy we confirmed that these specimens, considerably smaller in size and lacking the wood-boring ornamentation of the individuals on which they settled, were in fact dwarf males already producing mature sperm! More intriguing still was that cohort analyses of this population of *X. atlantica* revealed that not all male specimens were dwarves. The first cohorts of the *X. atlantica* population were obligate wood-borers and gonochoristic. The last cohort by contrast was exclusively comprised of dwarf males, each thought to be filter-feeding on the Particulate Organic Matter possibly generated as a by-product of the feeding activity of the larger, xylophagous primary-consumer "hosts". We therefore hypothesized this male paedomorphism and alternative diet to have been triggered by the reduction of spatial and trophic niches. It is thought that this might depend upon as-yet-undetermined environmental epigenetic factors acting to control the sex and the size of these bivalves.

See article:. Plasticity in reproduction and nutrition in wood-boring bivalves (*Xylophaga atlantica*) from the Mid-Atlantic Ridge.

Link to article: http://link.springer.com/article/10.1007/s00227-016-2988-6

UK's oldest deep-water Marine Protected Area successfully protects coral reefs

Huvenne V, Bett B, Masson D *et al.* (2016)

Biological Conservation 200: 60–69. doi:10.1016/j.biocon.2016.05.030

A unique study recently published by scientists from the National Oceanography Centre and University College Cork shows that deep, cold-water corals are very slow to recover from damage. Therefore deep-water Marine Protected Areas (MPAs) protect vulnerable marine ecosystems most effectively when they are put in place before that damage occurs.

This study used data from deep-water robots to compare a section of the northern Rockall Trough, off North West Scotland, before and after an MPA was set up. The coral populations remained stable in areas that had not been

Figure 1. Healthy cold-water coral colonies in the Darwin Mounds MPA. © NOC,

impacted by trawling before the area was closed to all bottom contact fisheries. However, the amount of live coral dropped dramatically in the parts of the MPA that had sustained previous damage, with hardly any live coral being found during the follow-up survey. Despite eight years of protection there were very few indications of new coral growth. Some deep-sea species grow slowly and do not recover from impacts quickly or easily.

Dr Veerle Huvenne from the NOC, the lead author of this research paper, said "These findings are a really good example of how the NOC's technology and scientific expertise can help inform the management of marine protected areas to get the best possible outcome."

Unlike their tropical cousins, cold-water corals do not need sunlight because they do not live in symbiosis with micro-algae. Instead, they capture their food from the water as it passes by. This means they can live in much colder and deeper waters. In 1998 NOC scientists discovered the first UK cold-water coral reefs one thousand metres deep, and named the area the 'Darwin Mounds' after their research ship RRS Charles Darwin. Cold-water corals build reefs that are important habitats for a wide range of other species, including commercially important fish. The reefs are fragile, and can easily be damaged by the heavy gear of deep-sea bottom trawlers.

Co-author Dr Brian Bett from the NOC recalls seeing the first images of the corals back in 1998; "It was a surprise – we were expecting mud volcanoes. The little mounds on the seabed were topped with live coral colonies. Our initial observations, made with towed video cameras and echo-sounders, also showed that extensive damage to the corals had already been caused by bottom trawling."

The comparison that forms the basis of this study was made by returning to the MPA, eight years after it was set up in 2003, using some of the newest marine survey technology, including NOC's robot-sub, Autosub6000, to map the area, and a Remotely Operated Vehicle to collect high-definition video footage.

Link to article: http://www.sciencedirect.com/science/article/pii/S0006320716302117

Figure 2 (above left). Broken coral fragments in areas that were damaged before the Darwin Mounds MPA was put in place
Figure 3 (above right). Small amounts of live coral next to broken fragments in the Eastern Darwin Mounds, which were heavily affected by bottom trawling before the MPA was put in place.. Images © NOC, UK

Phylogeny and origins of chemosynthetic vesicomyid clams

Johnson S, Krylova E, Audzijonyte A *et al.* (In Press)

Systematics and Biodiversity

Chemosynthetic vesicomyid clams commonly found at hydrocarbon seeps and hydrothermal vents worldwide are notoriously difficult to distinguish and classify taxonomically. DNA sequences from nuclear and mitochondrial genes were used to construct a phylogeny involving 61 named and presently undescribed species. Correspondence with shell characteristics and soft anatomy was used to create a foundation for revising their genus-level taxonomy. A molecular clock, calibrated with fossil data was used to estimate the evolutionary history of the subfamily Pliocardiinae. In contrast to most deep-sea taxa that evolved from shallow water ancestors, the pliocardiins probably have evolved from deep-water ancestors.

Article online soon.

Substantial role of macroalgae in marine carbon sequestration in the deep ocean

Krause-Jensen D & Duarte C (2016)

Nature Geoscience 9: 737-742, doi:10.1038/ngeo2790

Vegetated coastal habitats have been identified as important carbon sinks. In contrast to angiosperm-based habitats such as seagrass meadows, salt marshes and mangroves, marine macroalgae have largely been excluded from discussions of marine carbon sinks. Macroalgae are the dominant primary producers in the coastal zone, but they typically do not grow in habitats that are considered to accumulate large stocks of organic carbon. However, the presence of macroalgal carbon in the deep sea and sediments, where it is effectively sequestered from the atmosphere, has been reported. A synthesis of these data suggests that macroalgae could represent an important source of the carbon sequestered in marine sediments and the deep ocean. We propose two main modes for the transport of macroalgae to the deep ocean and sediments: macroalgal material drifting through submarine canyons, and the sinking of negatively buoyant macroalgal detritus. A rough estimate suggests that macroalgae could sequester about 173 TgC yr^{-1} (with a range of 61–268 TgC yr^{-1}) globally. About 90% of this sequestration occurs through export to the deep sea, and the rest through burial in coastal sediments. This estimate exceeds that for carbon sequestered in angiosperm-based coastal habitats.

Link to paper: http://www.nature.com/ngeo/journal/v9/n10/full/ngeo2790.html

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Exploring the “Sharkcano”: Biogeochemical observations of the Kavachi submarine volcano, Solomon Islands

Brennan T. Phillips, Matthew Dunbabin, Brad Henning *et al.* (2016)

Oceanography 29(4): doi:10.5670/oceanog.2016.85

An expedition to the Kavachi submarine volcano (Solomon Islands) in January 2015 was serendipitously timed with a rare lull in volcanic activity, permitting access to the inside of Kavachi’s active crater and its flanks. The isolated location of Kavachi and its explosive behavior normally restricts scientific access to the volcano’s summit, limiting previous observational efforts to surface imagery and peripheral water-column data. Here we present medium-resolution

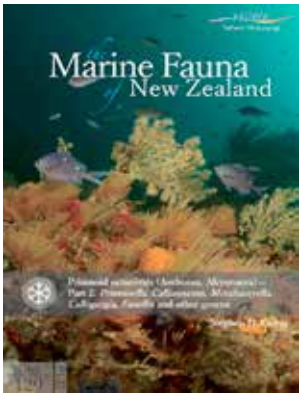
Figure 1. Screen captures of a scalloped hammerhead shark, taken from an autonomous camera system dropped into the active crater of Kavachi at a depth of 50 m. Silky sharks, bluefin trevally, snapper, and gelatinous larvaceans were also observed in the same video. Note the orange-colored plume water, which was measured at >42° C, depressed pH, and contained elevated levels of particulates.

bathymetry of the main peak paired with benthic imagery, biological observations of multiple trophic levels living inside the active crater, petrological and geochemical analysis of samples from the crater rim, measurements of water temperature and gas flux over the summit, and descriptions of the hydrothermal plume structure. A second peak was identified to the southwest of the main summit and displayed evidence of diffuse-flow venting. Microbial samples collected from the summit indicate chemosynthetic populations dominated by sulfur-reducing ε-proteobacteria. Populations of gelatinous animals, small fish, and sharks were observed inside the active crater, raising new questions about the ecology of active submarine volcanoes and the extreme environments in which large marine animals can exist.

Link to article: http://dx.doi.org/ doi:10.5670/oceanog.2016.85

New NIWA Biodiversity Memoir on the diverse primnoid corals of New Zealand

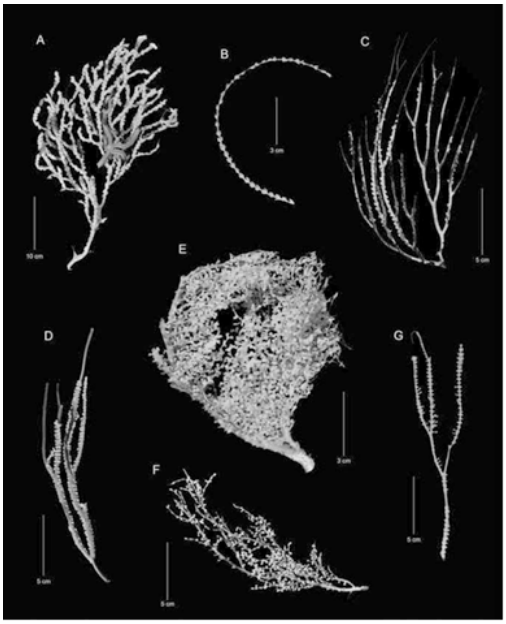
Primnoid corals are among the most diverse and species-rich group in the octocorals, and are deemed important habitat formers, providing refuge and shelter for small fishes and other invertebrate species. The family is characteristic of the deep sea, occurring down to 6400 metres, although there are some shallow water species known from the New Zealand (NZ) region that occur at depths as shallow as 13 metres.



Above: Front cover of new-look NIWA Biodiversity memoir series: Cairns, Stephen D. 2016. The Marine Fauna of New Zealand: Primnoid octocorals (Anthozoa: Alcyonacea) – Part 2. Primnoella, Callozostron, Metafannyella, Fanellia and other genera. Wellington, New Zealand: National Institute of Water and Atmospheric Research (NIWA). (NIWA Biodiversity Memoir; 129) 131 pages. Front cover image by Crispin Middleton, NIWA.

NIWA has recently published the 131-page NIWA Biodiversity Memoir on the primnoid family, which is an initiative of the US/NZ Joint Commission Meeting Marine and Ocean Theme, and is supported by funding from the NZ Ministry for Business Innovation and Employment. The memoir is the second in a multi-part series authored by Dr. Stephen D. Cairns, research zoologist and Curator of Corals at the Smithsonian Institution in Washington, DC. Part I was released in 2012. Both memoirs include full descriptions, distribution maps, light photography of overall colony morphology, SEM imagery of polyps, plus tabular and dichotomous keys for the NZ species. Prior to these works, only

26 species in the family Primnoidae were known in the NZ. Following an examination of hundreds of specimens in the NIWA Invertebrate Collection, this memoir has added 32 more species, including two new genera, 11 new species and 14 new records for the NZ region. The total known NZ Primnoidae fauna currently now stands at 62 living species from 23 genera, including those that are yet to be described in future works. For the size of its Exclusive Economic Zone, NZ has a disproportionately high number of species, with over 21 % of the species diversity of the family, and 52 % of the generic diversity occurring here.



A summary of ecological information for the New Zealand Primnoidae fauna is provided in the memoir by Dianne Tracey from NIWA's Deepwater Group.

The NIWA Biodiversity Memoir series of faunal monographs, originating in the 1950s, are technical works that aim to describe NZ's marine life, such as sponges, corals, worms, molluscs, crustaceans, sea stars and lesser-known marine invertebrate groups. The Memoirs are comprehensive, definitive, illustrated reference works that capture the rigorous, peer-reviewed scientific study of NZ's distinctive marine fauna and flora.

The website address for ordering NIWA Biodiversity memoirs is: https://www.niwa.co.nz/coasts-and-oceans/niwa-biodiversity-memoirs

Figure 1 (above). Examples of whole colony morphology, including the new species honouring Dianne Tracey of NIWA (see B). Taken from a figure (Figure 46) in the new NBM 129: A. *Primnoa notialis* Cairns & Bayer, 2005; *B. Narelloides traceyae* Cairns, 2016, holotype; C. *Paracalyptrophora mariae* (Versluys, 1906); D. *Paracalyptrophora hawaiiensis* Cairns, 2009; E. *Parastenella spinosa* Wright & Studer, 1889; F. *Parastenella pacifica* Cairns, 2007; G. *Candidella helminthophora* (Nutting, 1908).

Food-Web Complexity in Guaymas Basin Hydrothermal Vents and Cold Seeps

Portail M, Olu K, Dubois SF *et al.* (2016)

PLoS ONE 11(9): e0162263. doi:10.1371/journal.pone.0162263

In the Guaymas Basin, the presence of cold seeps and hydrothermal vents in close proximity, similar sedimentary settings and comparable depths, offers a unique opportunity to assess and compare the functioning of these deep-sea chemosynthetic ecosystems. The food webs of five seep and four vent assemblages were studied using stable carbon and nitrogen isotope analyses. Although the two ecosystems shared similar potential basal sources, their food webs differed: seeps relied predominantly on methanotrophy and thiotrophy via the Calvin-Benson-Bassham (CBB) cycle and vents on petroleum-derived organic matter and thiotrophy via the CBB and reductive tricarboxylic acid (rTCA) cycles. In contrast to symbiotic species, the heterotrophic fauna exhibited high trophic flexibility among assemblages, suggesting weak trophic links to the metabolic diversity of chemosynthetic primary producers. At both ecosystems, food webs did not appear to be organised through predator-prey links but rather through weak trophic relationships among co-occurring species. Examples of trophic or spatial niche differentiation highlighted the importance of species-sorting processes within chemosynthetic ecosystems. Variability in food web structure, addressed through Bayesian metrics, revealed consistent trends across ecosystems. Food-web complexity significantly decreased with increasing methane concentrations, a common proxy for the intensity of seep and vent fluid fluxes. Although high fluid-fluxes have the potential to enhance primary productivity, they generate environmental constraints that may limit microbial diversity, colonisation of consumers and the structuring role of competitive interactions, leading to an overall reduction of food-web complexity and an increase in trophic redundancy. Heterogeneity provided by foundation species was

identified as an additional structuring factor. According to their biological activities, foundation species may have the potential to partly release the competitive pressure within communities of low fluid-flux habitats. Finally, ecosystem functioning in vents and seeps was highly similar despite environmental differences (e.g. physico-chemistry, dominant basal sources) suggesting that ecological niches are not specifically linked to the nature of fluids. This comparison of seep and vent functioning in the Guaymas basin thus provides further supports to the hypothesis of continuity among deep-sea chemosynthetic ecosystems.

Link to article: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0162263

Population subdivision of hydrothermal vent polychaete *Alvinella pompejana* across equatorial and Easter Microplate boundaries

Sook-Jin Jang, Park E, Lee W, *et al.* (2016)

BMC Evolutionary Biology 16:235 , DOI 10.1186/s12862-016-0807-9

Background: The Equator and Easter Microplate regions of the eastern Pacific Ocean exhibit geomorphological and hydrological features that create barriers to dispersal for a number of animals associated with deep-sea hydrothermal vent habitats. This study examined effects of these boundaries on geographical subdivision of the vent polychaete *Alvinella pompejana*. DNA sequences from one mitochondrial and eleven nuclear genes were examined in samples collected from ten vent localities that comprise the species' known range from 23°N latitude on the East Pacific Rise to 38°S latitude on the Pacific Antarctic Ridge.

Results: Multi-locus genotypes inferred fro m these sequences clustered the individual worms into three meta population segments — the northern East Pacific Rise (NEP R), southern East Pacific Rise (SEPR), and northeastern Pacific Antarctic Ridge (PAR) — separated by the Equator and Easter Microplate boundaries. Genetic diversity estimators were negatively correlated with tectonic spreading rates. Application of the isolation-with-migration (IM a2) model provided in formation about divergence times and demographic parameters. The PAR and NEPR meta population segments were estimated to have split roughly 4.20 million years ago (M ya) (2.42–33 .42 Mya, 95 % highest posterior density , (HPD)), followed by splitting of the SEPR and NEPR segments about 0.79 Mya (0.07–6.67 Mya, 95 % HPD). Estimates of gene flow between the neighboring regions were mostly low (2 Nm < 1). Estimates of effective population size decreased with southern latitudes: NEPR > SEPR > PAR.

Conclusions: Highly effective dispersal capabilities allow *A. pompejana* to overcome the temporal instability and intermittent distribution of active hydrothermal vents in the eastern Pacific Ocean. Consequently, the species exhibits very high levels of genetic diversity compared with many co-distributed vent annelids and mollusks. Nonetheless, its levels of genetic diversity in partially isolated populations are inversely correlated with tectonic spreading rates. As for many other vent taxa, this pioneering colonizer is similarly affected by local rates of habitat turnover and by major dispersal filters associated with the Equator and the Easter Microplate region.

Link to article: https://bmcevolbiol.biomedcentral.com/articles/10.1186/s12862-016-0807-9

Biodiversity response to natural gradients of multiple stressors on continental margins

Sperling E, Frieder C, Levin L (2016)

Proceedings Royal Society B: 283 (1829), DOI: 10.1098/rspb.2016.0637

Sharp increases in atmospheric CO2 are resulting in ocean warming, acidification and deoxygenation that threaten marine organisms, their ecological functions, and resulting vital ecosystem services on continental margins. The relative influence of these stressors on biodiversity remains unclear though, as well as the threshold levels for change and when secondary stressors become important. One strategy to interpret adaptation potential and predict future faunal change is to examine ecological shifts along natural gradients in the modern ocean. Here, we assess the explanatory power of temperature, oxygen and the carbonate system for macrofaunal diversity and evenness at bathyal depths along continental upwelling margins using variance partitioning techniques. Oxygen levels have the strongest explanatory capacity for variation in species diversity. Sharp drops in diversity are seen as O2 levels decline through the 0.5 – 0.15 ml/l (~22 – 6 µM; ~21 – 5 matm) range, and as temperature increases through the 7-10°C range. pCO2 is the best explanatory variable in the Arabian Sea but explains little of the variance in diversity in the Eastern Pacific Ocean. In contrast, very little variation in evenness is explained by these three global change variables. The identification of sharp thresholds in ecological response are used here to predict areas of the seafloor where diversity is most at risk to future marine global change, noting that the existence of clear regional differences cautions against applying global thresholds.

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Abyssal hills: influence of topography on benthic foraminiferal assemblages

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Figure 1. Organisms encrusting a pebble-sized dropstone collected on top of an abyssal hill at the Porcupine Abyssal Plain, NE Atlantic (3,900 m water depth). Metazoans: polychaete tube (middle); bryozoan? (top). Foraminifera (-like): orange agglutinated spheres (several); orange tubular network (centre left, next to the polychaete tube); light brown mat-like formations (several).

Abyssal plains, often thought of as vast flat areas, encompass a variety of terrains including abyssal hills, features that constitute the single largest landscape type on Earth. The potential influence on deep-sea benthic faunas of mesoscale habitat complexity arising from the presence of abyssal hills is still poorly understood. To address this issue we focus on benthic foraminifera (testate protists) in the >150-µm fraction of Megacorer samples (0-1 cm layer) collected at five different sites in the area of the Porcupine Abyssal Plain Sustained Observatory (NE Atlantic, 4,850 m water depth). Three sites are located on the tops of small abyssal hills (200–500 m elevation) and two on the adjacent abyssal plain. We examined benthic foraminiferal assemblage characteristics (standing stock, diversity, composition) in relation to seafloor topography (hills vs. plain). Density and rarefied diversity were not significantly different between the hills and the plain. Nevertheless, hills do support a higher species density (i.e. species per unit area), a distinct fauna, and act to increase the regional species pool. Topographically enhanced bottom-water flows that influence food availability and sediment type are suggested as the most likely mechanisms responsible for these differences. Our findings highlight the potential importance of mesoscale heterogeneity introduced by relatively modest topography in regulating abyssal foraminiferal diversity. Given the predominance of abyssal hill terrain in the global ocean, we suggest the need to include faunal data from abyssal hills in assessments of abyssal ecology.

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