Deep-Sea Life

Issue 17, July 2021

Put your feet up and enjoy reading the latest news from your deep-sea colleagues. Deep-Sea Life 17 takes us on journeys of exploration to deep-waters of South Africa, India, the Mediterranean, Cabo Verde and Gulf of Mexico, to name a few. Enjoy the stories, stunning images and videos and look out for opportunities you may be interested in. There is good news for deep-sea corals which are increasingly subject to ecological investigations and protection measures. And good news too for our new community programme, Challenger 150, which has now been endorsed by the UN Decade of Ocean Science and is up and running. I urge you to read Deep-Sea Biology Society News and especially the letter from the President on P50.

This photo of the issue was selected from a submission from our South African colleagues and is a delight! You can sense the absolute joy of discovery as MSc student Sinothando Shibe (University of KwaZulu Natal, Durban, SA) presents this wonderful specimen of a sea pen to the camera. Photograph by Kerry Sink (South African National Biodiversity Institute).

As always, Drs. Abigail Pattenden (University of Limerick, Ireland), Eva Ramirez-Llodra (REV Ocean, Norway) & Paris Stefanoudis (University of Oxford / Nekton Foundation, UK) and I all thoroughly enjoyed reading about your work during the editing process – thank you for your submissions and see you next time

Dr. Maria Baker

(University of Southampton – mb11@noc.soton.ac.uk)

A DOSI and DSBS collaborative publication.

Issue Contents

Cruise News

iMirabilis2: Deep-Sea Discovery Training at your Desktop!

Kelsey Archer Barnhill

School of Geosciences, University of Edinburgh

Contact: kelsey.barnhill@ed.ac.uk

This July, iAtlantic project scientists will embark on a six-week cruise to explore the deep sea around Cabo Verde. Sailing on the Spanish Research Vessel *Sarmiento de Gamboa*, this cruise is much more than a scientific mission: a large part of the expedition's activities will be dedicated to training and skills development for early career marine scientists.

Leg 0: Early Career Researcher Capacity Building

iAtlantic Fellows on the ship will undergo intensive training in the use of ROV technology. A small team of seabird ecologists will also use this time for hands-on training and experience in seabird surveying and census techniques.

Leg 1: Investigating Deep-Sea Ecosystems around Cabo Verde

With ROV *Luso*, Autosub6000, benthic landers and a range of other sampling gear and experimental kit on board, the team will investigate what lies in the deep Atlantic waters around Cabo Verde. Main goals include better understanding seafloor habitat distributions across the Atlantic basin, revealing past environmental conditions in the deep ocean, and understanding how trends and changes in the ocean affect ecosystems.

Everyone is invited

Capacity building is at the heart of the iMirabilis2 expedition. The ethos for this mission are to maximise opportunities to exchange knowledge, teach new skills, build capacity, and share experiences. The iMirabilis2 expedition will have a dedicated area on the iAtlantic website (https://www.iatlantic.eu/), where learning materials, explainers and videos of the work at sea will be available, along with a daily blog from the team on board the ship. You will also be able to follow all the action via our Twitter feed (https://twitter.com/iAtlanticEU).

Benthic Studies in CCZ – The Metals Company

Daniëlle S.W. de Jonge, MSc

The Lyell Centre for Earth and Marine Science and Technology, Heriot-Watt University

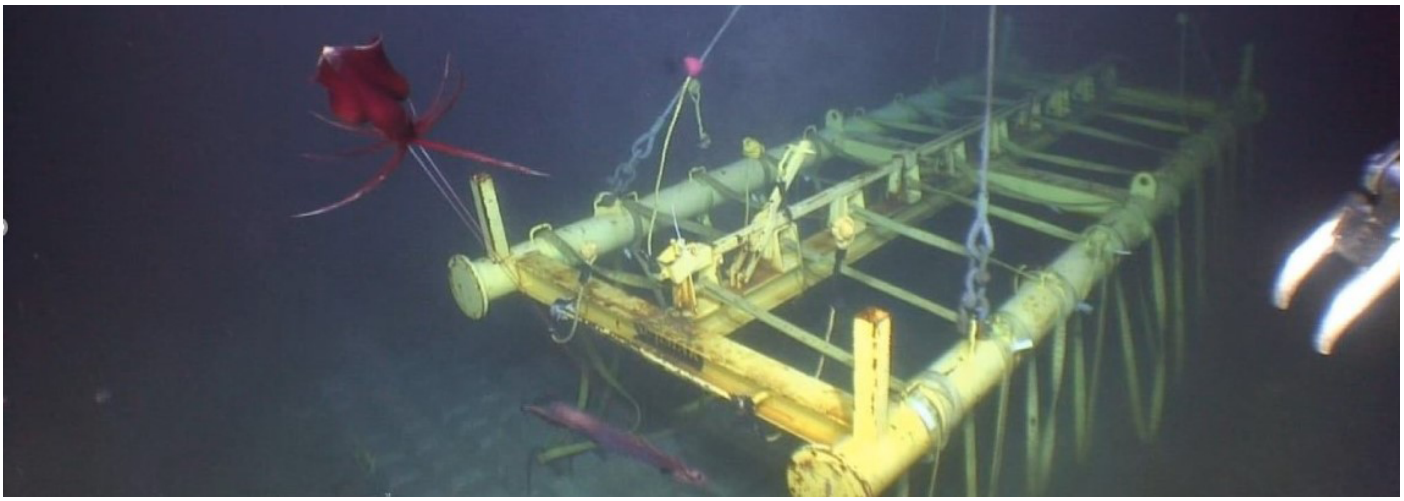
From April to June 2021, multiple independent science teams participated in a cruise to establish an environmental baseline in the NORI-D license area of the Clarion-Clipperton Zone (CCZ) (Pacific Ocean). This benthic-focused cruise (campaign 5D) is part of a larger research program sponsored by The Metals Company, who proposes deep-sea mining operations in the area. The Deep-Sea Ecology and Biogeochemistry research group from Heriot-Watt University (Edinburgh, UK) was one of the participating teams, to study baseline ecosystem functioning using three different benthic landers. A short movie regarding lander operations was published by The Metals Company on Twitter and LinkedIn.

Dinner Time in the Deep

Ami Everett

Blue Latitudes

Contact: ami@bluelatitudes.org



Offshore energy operators commonly utilize remotely operated vehicles (ROVs) to inspect the integrity of their equipment. Although recording marine life is not the primary purpose of these surveys, industry ROVs often capture more than just subsea infrastructure. While inspecting equipment in the Gulf of Mexico at 2500-foot water depth, an industry ROV stumbled upon a rare and spectacular sight – a whiplash squid at dinner time! In this photo, the whiplash

squid (family Mastigoteuthidae) is seen with its prey, likely a cusk eel, captured in its tentacles. These deep-sea creatures hunt by dangling their long whip-like tentacles equipped with microscopic suckers to trap prey as they swim by. As the ROV documented the scene, the cusk eel made a break for it and was able to free itself from the whiplash squid. In the end, the cusk eel lived to see another day and the whiplash squid disappeared back into the darkness.

Visit https://www.rig2reefexploration.org/ for more information.

Deep Forests: Amathole Lace Coral Gardens among the Sacred Places of the South African Deep-Sea

Kerry Sink[1,2], Sinothando Shibe[3] and Ryan Palmer[4,5]

[1]South African National Biodiversity Institute (SANBI); [2]Institute for Coastal and Marine Research, Nelson Mandela University; [3]University of kwaZulu Natal; [4]South African Institute for Aquatic Biodiversity; [5]African Coelacanth Ecosystem Programme

Figure 1 (top left): ACEP Deep Forests students Sinothando Shibe and Mari-lise Franken helping deploy the ROV off Cintas in South. Figure 2 (top right): Deep reef off Cintsa with an abundance of lace corals and dendrophyllid hard corals. Figure 3 (bottom left): Snowflake stylaster and scleractinian stony coral. Figure 4 (bottom right): Sinothando Shibe (ACEP Deep Forests MSc student) is studying seapens which are also indicator species of potential vulnerable marine ecosystems.

In Zulu and Xhosa culture, ancestors are considered to reside in the ocean with many people believing that the oldest and most powerful ancestors live in the deep sea. Before entering this sacred space, it is customary to present silver coins as a token of respect and remembrance and in making special requests. On the morning of 24th May, on the recent Deep Forests expedition working off East London and Gqeberha on the southeastern margin of South Africa, the team paid their respects before deploying the Remotely Operated Vehicle (ROV) into the depths. The team were amazed to descend on an exquisite field of lace coral at 220m with dense aggregations of enormous *Polyprion* wreckfish. A four-

hour dive recorded the various taxa of stylasterine and dendrophyllid corals between 220m and 120m culminating in the first collections of the violet *Stylaster*, the snowflake *stylaster*, and the dominant scleractinian stony coral. These collections represent the first collections of stylasterine corals by ROV in South Africa and open the way for integrated taxonomy and potential new work on climate vulnerability and change. The team also achieved the maximum depth for the ACEP ROV at 300m in the Gxulu Canyon and the continental slope off East London, signaling the need to expand research into deeper water. Technical constraints are a major limitation to deep-sea research efforts in developing countries. The ACEP ROV is an inspection class ROV and standardized transects cannot be conducted in the strong Agulhas current. Nevertheless, the team collected valuable imagery for the classification and mapping of benthic ecosystem types, reference images to support atlas efforts and specimens to support taxonomic work and barcoding that will be used to link reference images to accurate identities for atlasing marine invertebrates. Finally, the Deep Forest team collected new data to support the mapping and management of Vulnerable Marine Ecosystems and, together with post-doctoral researcher Otto Whitehead funded through the UKRI One Ocean Hub, released a short video in collaboration with spoken work artist Kro-Bars on World Ocean Day. The video aims to inspire fishers to help map and manage VMEs.

Watch it on youtube https://www.youtube.com/watch?v=n6kdnR2eXmg

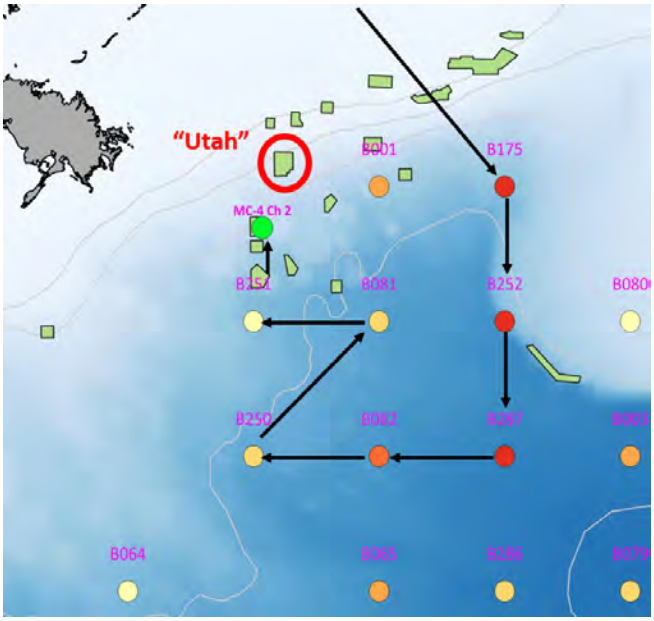
---

DEEPEND research back on track in Gulf of Mexico after COVID delays

Tracey Sutton[1] and DEEPEND team

[1]*Nova Southeastern University, Florida, USA*

We are happy to report that the DEEPEND researchconsortium(www.deependconsortium.org), whose 10+-year mission has been to further our understanding of pelagic ecosystem structure, drivers, and dynamics over time, has returned to sea after a year's delay due to COVID. The cruise was a smashing success – no gear malfunctions and the lumpy-at-times Gulf of Mexico did not prohibit any over-the-side operations. Our main objectives were like those beforehand (quantitative faunal surveys of the epi-, meso-, and bathypelagic faunae of the northern Gulf of Mexico), but we also added new components, including a detailed pelagic survey over deep-coral habitat (dubbed "Utah" in the figure below) over the continental slope (300-600 m depth). This was a departure for us, as all our previous work had been conducted in waters deeper than 1000 m. The initial results were striking – we found what looks to be evidence of a vibrant mesopelagic boundary community, with species we rarely see further offshore in extremely high numbers. We also added a semi-quantitative oceanic seabird survey to the mix, as well as sampling around a passive-acoustics monitoring (PAM) site established to survey oceanic cetacean abundance and distribution. Past findings of reduced deep-pelagic fish abundance and reduced stenellid dolphin abundance (lanternfishes are their primary prey) after *Deepwater Horizon* have been alarming and warrant further study. Among the "coolest" things we saw were a pack of oceanic sharks (mainly silky) that tracked our vessel for several days, even as we transited at high speed between stations, and, speaking of sharks, this gorgeous cookie-cutter



shark (see left) collected with a MOCNESS trawl. Overall, it was a great cruise, but more than anything, it was fantastic to be out at sea. We will provide images and a cruise report on our website for anyone interested.

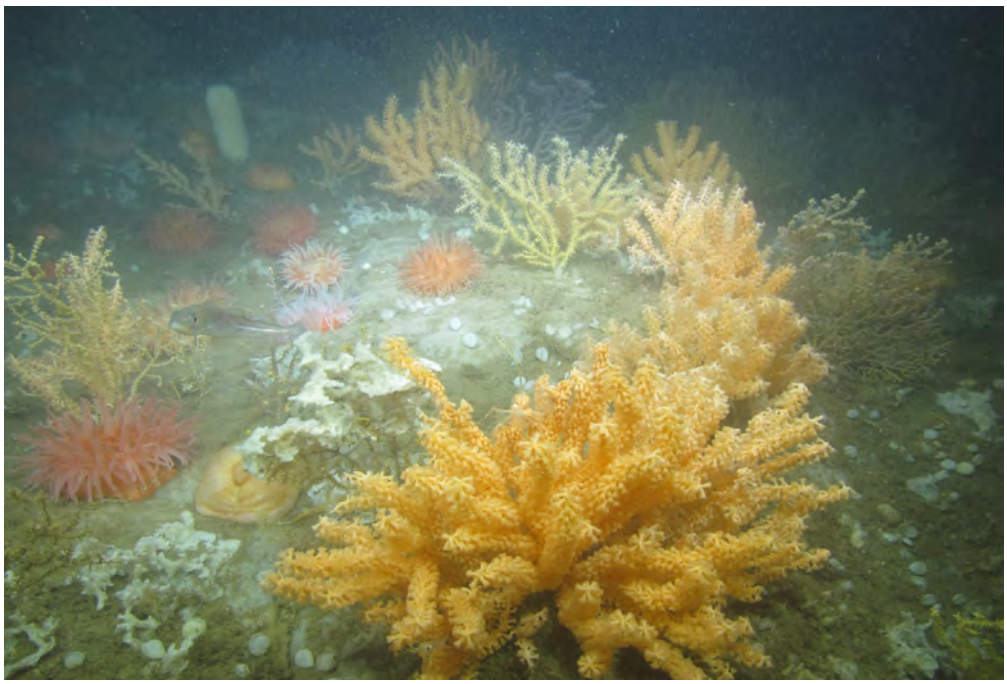
NOAA Fisheries Publishes Final Rule to Designate Protected Areas for Deep-Sea Corals in New England

Dani Weissman, Lizzie Duncan, Tom Hourigan

NOAA Deep Sea Coral Research and Technology Program

On June 25 2021, NOAA Fisheries published a final rule to designate protected areas for deep-sea corals on Georges Bank in the Gulf of Maine. The New England Fishery Management Council developed this action to reduce the impacts of fishing gear on deep-sea corals after considering long-term sustainable uses of the fishery resources in the area.

The rule establishes the Georges Bank Deep-Sea Coral Protection Area. The area is located on the outer continental shelf in New England waters deeper than 600 meters, and extends to the outer limit of the U.S. Exclusive Economic



Deep-sea coral garden habitat in Western Jordan Basin, Gulf of Maine. Image courtesy of NMFS NEFSC/UConn – NURTEC/UMaine.

Zone boundary to the east and to the north. On its southern edge, the area is bounded by the Frank R. Lautenberg Deep-Sea Coral Protection Area —established by the Mid-Atlantic Fishery Management Council in 2017. The rule prohibits bottom-tending commercial fishing gear within the Georges Bank protected area, with the exception of red crab pot gear.

The rule also designates two smaller protected areas for corals in the Gulf of Maine: the Mount Desert Rock Coral Protection Area (8-mi2), and the Outer Schoodic Ridge Coral Protection Area (31-mi2). Vessels are prohibited from fishing in these areas with bottom-tending mobile gear but may continue to fish for lobster with trap gear. The rule also creates a dedicated habitat research area in the Jordan Basin in the Gulf of Maine. Dedicated habitat research areas help scientists and resource managers to understand the impacts of fishing on ocean ecosystems.

The Council process included a high-degree of public input over several years to develop the final protection areas and associated measures. The decision to protect these areas was informed by research and modeling efforts supported by the NOAA Deep Sea Coral Research and Technology Program in collaboration with NOAA Ocean Exploration and other program partners. The final rule will go into effect on July 26, 2021.

Bring the deep-sea into your home!

OCEAN EXPLORATION TRUST

Join Ocean Exploration Trust's E/V *Nautilus* deep-sea expeditions from shore July through December 2021. Interdisciplinary scientific remotely operated vehicle dives and seafloor mapping will occur along the west coast of the United States, Canada, and within the Papahānaumokuākea Marine National Monument and Hawaiian Islands.

Register for the new Science Portal to watch low-latency ROV video, view data, chat with other scientists onboard and onshore, or make observations. You'll also receive updates from the ship and dive plans for expeditions you select. Data, video, and samples from most cruises are open-access. Interested researchers and undergraduate, graduate, and community college students are encouraged to join our Corps of Exploration. For more information please visit: https://scip.oceanexplorationtrust.org/ . Contact science@oet.org with any questions.

Join the RV *Falkor* on FK210726 Biodiverse Borderlands: Mineral-Rich Habitats of Southern California

July 26-Aug. 6, 2021

Read about the cruise at https://schmidtocean.org/cruise/biodiverse-borderlands/

View live stream of dives from https://schmidtocean.org/technology/live-from-rv-falkor/

To build the knowledge base needed for conservation and management, Drs. Lisa Levin, Paul Jensen, and Greg Rouse from Scripps, Dr. Kira Mizell from the US Geological Survey and their teams will venture to the Southern California Borderland (SCB) to investigate hardground sites where phosphorites and ferro-manganese crusts are known or expected to occur, and assess the biological communities living among the mineral substrates. The team's goal is to establish mineral and biological baselines, examine environmental conditions that may influence biodiversity and inspect the therapeutic potential of deep-sea microbes affiliated with the substrates and animals in mineral-rich areas. The knowledge gained from this expedition will inform policy, management, and stewardship of the deep sea off southern California, guide conservation efforts, and may assist in future assessment of other areas considered for deep-seabed mining development.

The ROV *SuBastian* will carry out high-resolution imaging, representative sampling of rock, fauna sediments, and water, and CTD work at eight sites. The team intends to sample invertebrates from multiple size classes (mega, macro, meio and microbial), do multiple flyovers to create 3D mosaics of specific features, recover a series of colonization experiments deployed in 2020 at sites at 700 m and 1100 m (multiple rock types, wood, bone), and characterize rock mineralogy and geochemistry. They will also briefly visit a DDT dump site off Los Angeles where tens of thousands of barrels of chemical waste have been detected.

This cruise is an early component of the Challenger 150 program (https://www.dosi-project.org/challenger-150/), a UN Decade program devoted to expanding biological sampling and ecological understanding of the deep sea and its ecosystem services.

East Pacific Rise 9°50'N cruise continues decades of research on vent community recovery and connectivity

Lauren Dykman[1,2]

On behalf of the RR2102 Ecology Team: Lauren Mullineaux (Co-Chief Scientist)[2], Susan Mills[2], Carolyn Tepolt[2], Stefan Sievert[2], Caitlin Plowman[3], Michael Meneses[4], Ian Schlegel[5], Costa Vetriani[5], Shawn Arellano[6], Daniel Fornari (Chief Scientist)[2]

[1]MIT-WHOI Joint Program in Oceanography/Applied Ocean Science & Engineering; [2]Woods Hole Oceanographic Institution; [3]University of Oregon; [4]University of California, Santa Barbara; [5]Rutgers University; [6]Western Washington University

Contact: ldykman@mit.edu

An interdisciplinary team of oceanographers and engineers led by investigators from WHOI, SIO, Rutgers University, Western Washington University, and Lehigh University returned recently from a month-long expedition on R/V *Roger Revelle* (RR2102) to hydrothermal vents at 9°50'N on the East Pacific Rise. They used deep submergence vehicles AUV *Sentry* and ROV *Jason*, paired with shipboard and field experiments, to understand the interplay between geology, microbes, and animals at these dynamic deep-sea oases.

Figure 1: Left) ROV ***Jason*** deploying settlement surfaces contained in "purses" made of fine mesh. Purses allow microbial biofilms to grow on the surfaces while excluding larval settlers. Surfaces are eventually removed from purses to compare larval settlement on surfaces with biofilm present to newly deployed surfaces with no biofilm. Photo courtesy of NDSF (c)Woods Hole Oceanographic Institution. Right) Michael Meneses, Lauren Mullineaux, and Ian Schlegel prepare a McLane pump for deployment to capture live deep-sea larvae for shipboard swimming experiments. Photo: Lauren Dykman.

Over the past three decades at this vent field, two massive seafloor eruptions have been observed and their consequences studied. On this recent cruise, the Mullineaux Benthic Ecology Lab from WHOI deployed and recovered colonization surfaces as part of a multi-decadal study on recovery after a massive deep-sea eruption in 2006, which has

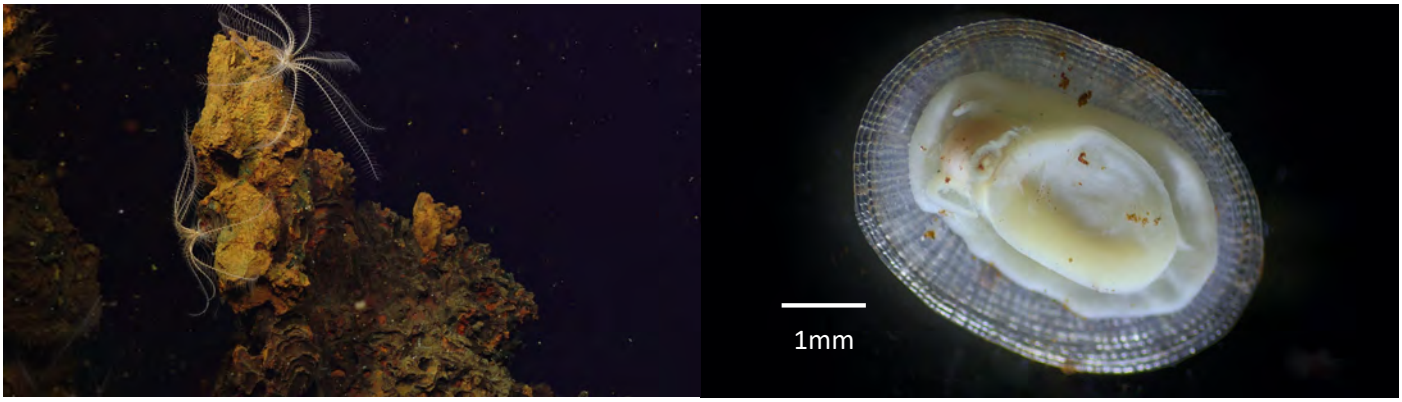
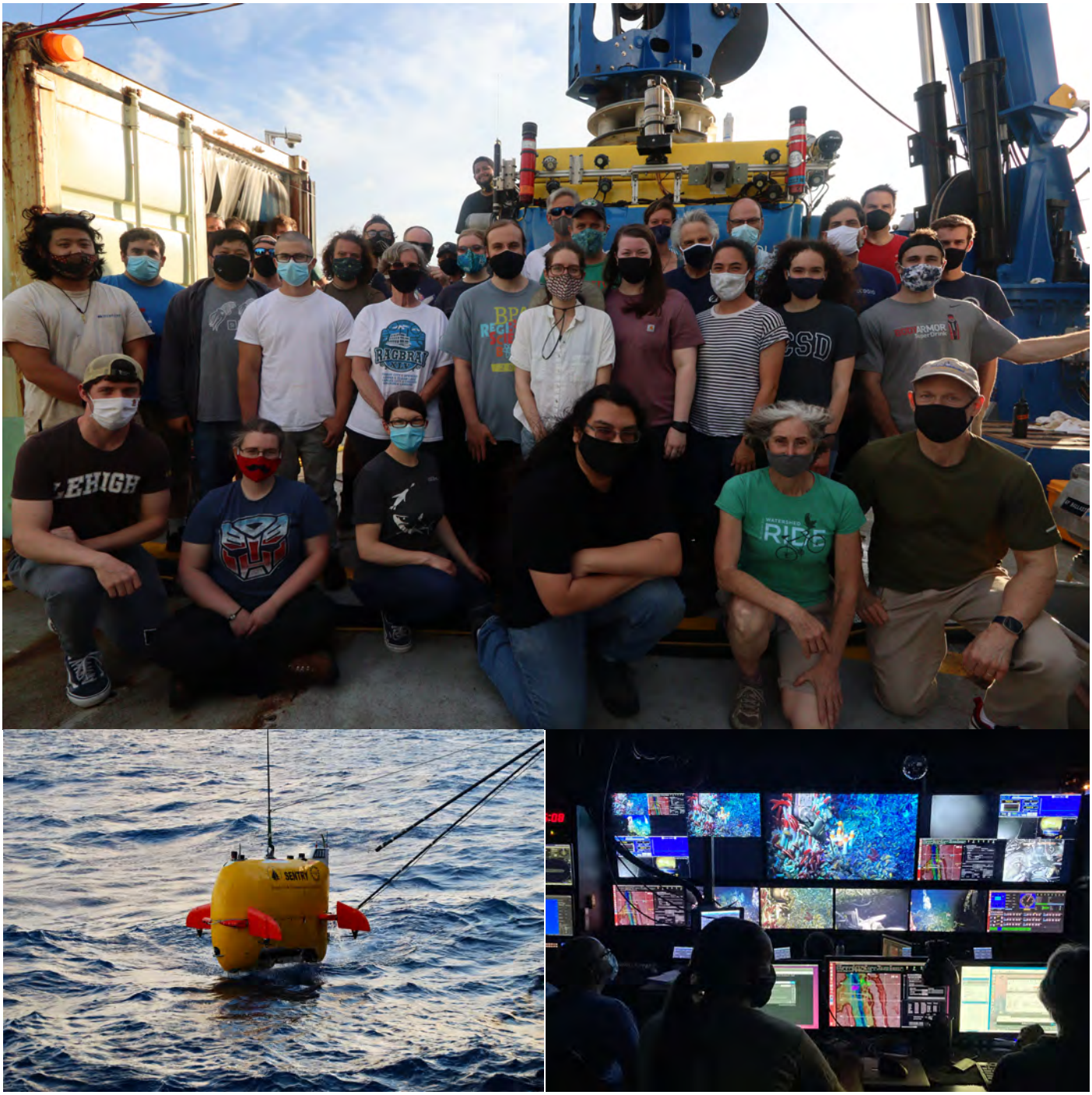


Figure 2: a) Suspension feeders such as crinoids were abundant on the off-axis inactive sulfide mounds. Photo courtesy of NDSF ©Woods Hole Oceanographic Institution. b) The limpet ***Neolepetopsis*** sp. collected from Sentry Spire. This species may graze on microbial mats. Photo: Lauren Dykman.



Top: Science and ops party of Cruise RR2102 in front of ROV *Jason* during transit back to San Diego. Photo: Connor Downing. Bottom Left: Recovery of AUV *Sentry*. Photo: Lauren Dykman. Bottom Right: Inside the ROV *Jason* control van, deploying larval traps among giant tubeworms. Photo: Lauren Dykman.

been featured in two recent publications (Mullineaux et al. 2021, Dykman et al. 2021). Data from the past eleven years of this time series have recently been published online at BCO-DMO and OBIS. Researchers also initiated experiments to understand the role of microbial biofilms in cuing larval settlement (Figure 1), including the shipboard filming of live deep-sea larvae swimming in a pressurized chamber. Combined, these experiments and long-term studies are helping us understand how vent animals disperse between patchy, ephemeral habitat, how their larvae choose where to settle, and how communities recover from massive disturbance.

A major outcome of this cruise was the documentation of inactive sulfide mounds that were discovered by AUV *Sentry* hundreds of meters away from the axial summit trough. Initial observations indicate that these sulfide mounds are home to a distinct assortment of species that may have different functions than animals at active vents or on the surrounding seabed (Figure 2a). For example, we collected limpets of the genus *Neolepetopsis* (Figure 2b) from the inactive sulfide mound Sentry Spire. This species had been found as larvae in the plankton but had not been seen as adults on active vents in the 9°50'N area. These new discoveries are critical to our understanding of how nearby yet

highly distinct deep-sea habitats contribute to regional faunal diversity and connectivity. This research was funded by NSF grants OCE-BIO-1829773, OCE-BIO-1948580, OCE-BIO-1948623, OCE-MGG-1949485, OCE-MGG-1948936, and OCE-MGG-1949938. Researchers supported by these grants will return to 9°50’N EPR on two more funded cruises in 2022 and 2023.

Project Focus

Mathematical modeling of deep-sea floor geomicrobiology data from the Central Indian Basin

Anindita Das[1*#,2#,3,4], M. B.L. Mascarenhas-Pereira[3], Maria Ana Desa[3], Sweta Mallik[4], Kunal Yadav[4], Pinki Santra[1*#,2#], Debjani Chatterjee[1*#,2#], Shreyanjali Ghosh[1*#,2], LokaBharathi P.A.[3], P.K. Dhakephalkar[4]

[1]Blue Marble Space Institute of Science (BMSIS), Seattle, USA; [2]Ramakrishna Vivekananda Mission (Secondary & Higher Secondary Schools), Barrackpore, Kolkata, India; [3]Council of Scientific and Industrial Research- National Institute of Oceanography, Goa, India; [4]Agharkar Research Institute-Maharashtra Association for the Cultivation of Science, Pune, India

* Primary affiliation; # Present affiliations

Contact: anindita@bmsis.org; lokabharathiponnapakkam@gmail.com

The Central Indian Basin (CIB) sediments at an average water depth of 5,000 m are dominantly oxic, organic C-depleted, with suboxic/anoxic mineral cycling processes (Nath *et al.* 2008; Mascarenhas-Pereira *et al*., 2010; Das *et al*, 2011a, b; Sujith *et al*., 2011; Naik *et al*., 2016; Mascarenhas-Pereira *et al*., 2016; Biche *et al*., 2017; Singh *et al*., 2019). The sediments chemoautotrophically sequester carbon by multiple synthetic processes including nitrification, metal oxidation, silicate dissolution, phosphate solubilization and thiotrophic denitrification. In addition to the above mentioned microbial communities and their associated processes, presence of methylotrophs/hydrocarbon-tolerant microbes and blue auto-fluorescent potential methanogens were detected at specific sediment depths (Das *et al*., 2011a; Das, 2011, PhD thesis; unpublished data). This prompted measurements of production rates of methane revealing enrichment of methane in particular layers of the sediment albeit at fine scales.

The peaks of methane production rates in whole sediments under dark and psychrophilic conditions (4°±2°C) ranged from 0.01 to 0.15 µM g-1 day-1, in time-course experiments. Interestingly, while this range was consistent for the cores examined, the time of incubation needed to reach this production range varied from 298-638 days of batch incubation (Das *et al*., unpublished). Diffuse hydrothermal activities and lateral flow of hydrothermal fluids are being increasingly realized as a cause of the enhanced chemosynthetic and methanogenic activities. The co-existence of hydrocarbon utilizers, methanogens and other bacteria possibly indicates rocks of mixed chemistry, deep beneath. These possibilities of deep-seated gabbroic rocks (if not olivines and serpentines) and their influence on origins and evolution of microbial life might be investigated subsequently.

Presently, we are interested in mathematical quantifications to show how the laterally spread sub-oxic or anoxic layers function along the downcore space and geochronological time. The mathematical modeling would be conducted by a team of scientists and visiting scholars based in India and affiliated to the Blue Marble Space Institute of Science (BMSIS), Seattle, USA in close association to National Institute of Oceanography Goa, India, and Agharkar Research Institute, Pune, India, where the original data/thesis were generated. Researchers from laboratories that supported these experiments would be duly credited or acknowledged.

AQUATILIS

EXPEDITION

Aquatilis Expedition reveals an affordable technique for high resolution records of mesopelagic species during blackwater diving in Mediterranean offshore islands

Alessia Dinoi[1], Alexander Semenov[2], Armando Macali[3]

[1]Stazione Zoologica Anton Dohrn, Integrated Marine Ecology Department, Marine Research Center and Advanced Infrastructures of Calabria (CRIMAC), 87071 Amendolara (CS), Italy; [2]N. A. Pertsov White Sea Biological Research Station, Department of Biology, Lomonosov Moscow State University, 119991 Moscow, Russia; [3]Department of Ecological and Biological Sciences, Ichthyogenic Experimental Marine Center (CISMAR), University of Tuscia, 01016 Tarquinia, Italy

Contact: a.macali@unitus.it

Although the mesopelagic domain represents one of the most enigmatic marine environments, field studies are still deficient. The difficulty in addressing pinpoint areas of interest, along with the expensive equipment required, is one of the major challenges in this field of research. The study of mesopelagic invertebrates also requires the use of techniques that do not disturb their natural state, as most of these organisms are extremely sensitive.

It is not uncommon for deep-water mesopelagic species to be recorded only a few meters from the surface during their nocturnal vertical migration. Blackwater diving can enable the study of mesopelagic diversity with little impact on living organisms, leading to the opportunity to record animal behavior from a privileged vantage point. Several sites worldwide have been addressed as hotspots for mesopelagic vertical migration and the offshore Mediterranean islands are one of them.

Figure 1 (left). Juvenile of the bathyal tripod fish ***Bathypterois*** sp.; Figure 2 (right). A female of the common paper nautilus ***Argonauta argo***

The *Ponza Aquatilis* Expedition was conducted at the Ponza Island shelf front (Tyrrhenian Sea) in spring 2018 and 2020, targeting the upwelling season. The exploration aimed to create a standardized recording methodology of pelagic biodiversity, with the use of inexpensive tools that are affordable for any type of diver and can provide an actionable record for the scientific communities. A total of 107 dives were conducted during the expedition: four divers, divided into two different groups, each dived for one hour after sunset, free-drifting in surface water over depths of 200-500m.

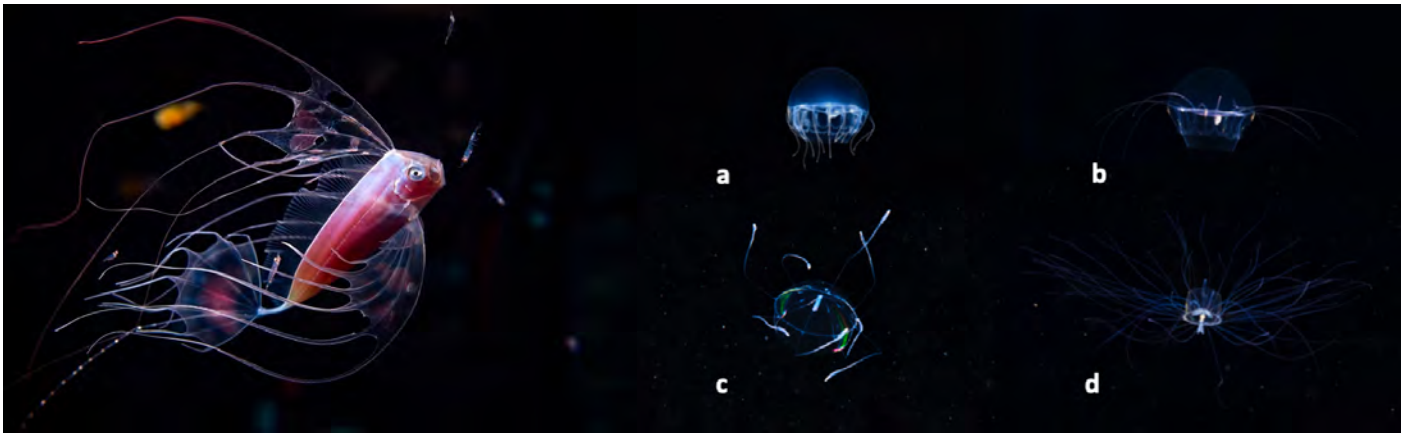


Figure 3 (left). Juvenile specimens of Mediterranean Dealfish- ***Trachipterus trachypterus*** from the central Tyrrhenian Sea.; Figure 4 (right). Deep water hydrozoan jellies: a,b and c unidentified hydrozoan species; d, ***Aglaura hemistoma***.

Dive sites were selected according to weather conditions to intercept upwelling events. Two Panasonic Lumix GH5 cameras with underwater housing and video lights were used on each dive; cameras were equipped with a 12-35mm and 50mm macro lenses to cover most useful focal lengths. To stabilize the video and photo shots in the water column, a DIY low-cost custom stabilization system was added (commercial 5l plastic box on the base plate of the housing system).

Figure 5. Trophic interaction within plankton community, observed during the surveyed period: ***Scyllaridae phyllosoma*** feeding on a salp, with detail of its peculiar interaction with jellyfish species as a floating support

The *Ponza Aquatilis* Expedition has successfully helped to shed light on the composition of mesopelagic biodiversity near an offshore Mediterranean island, with images of rare deep-water species never recorded before. The video footage allows researchers to decipher behavioral characteristics of rare mesopelagic invertebrates and fish, as well as previously unknown interspecific associations, and provides a general glimpse into the beauty and biodiversity of this unexplored world.

The high-resolution recordings obtained with the equipment used on our expedition demonstrate affordable technologies that can be used during night dives. Our simple and standardized method offers the possibility of not only obtaining high quality results, but also being replicated for citizen science projects that contribute to the collection of natural history.

The *Ponza Aquatilis* Expedition was supported by the University of Tuscia, Moscow State University, University of Siena and other international research centers, as well as by Italian Coast Guard, which allowed the expedition to be carried out despite pandemic constraints. All the expeditions have been funded by the *Aquatilis Association*.

The *Aquatilis* team is currently planning the 2022 *Ponza Aquatilis* Expedition and is looking forward to interested scientists, students and divers from all over the world to participate. Updates and news about the project will be posted on the *Aquatilis* Expedition website as it becomes available.

Impacts of Human Activities in the Azores Cold-Water Corals Physiological Resilience

Inês Martins

Okeanos-UAc, R&D Institute on Marine Sciences, University of the Azores

The Impactor project is financed by the strategic Azorean projects programme (Açores 01-0145-FEDER-000122) and aims to break through the lack of information about cold-water coral vulnerabilities and response strategies to the cumulative impacts of human activities and climate change. To achieve our goals, a series of land-based short-term experiments were set to assess cold-water coral cellular responses under acute Cu toxicity conditions generated during sea-floor polymetallic sulphides mining operations (found to be the main metal that is remobilised from polymetallic sulphide particles in solution) and predicted scenarios of ocean acidification (IPCC; 1000 µatm/pH 7.73).

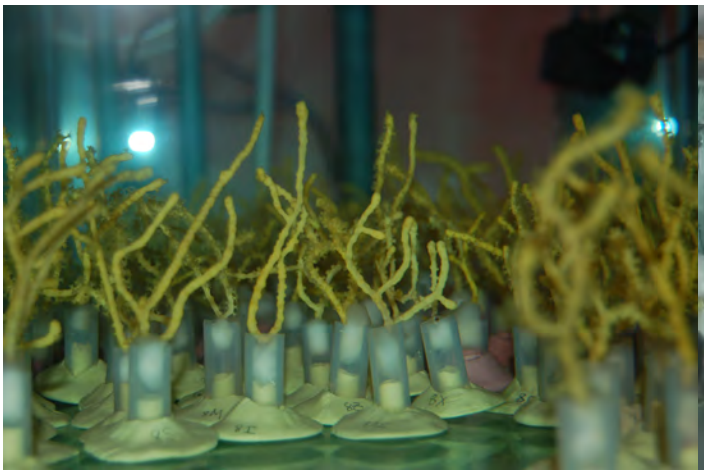


Figure 1 (left). "Dentomuricea": ***Dentomuricea aff. meteor*** fragments before the experiment. Figure 2 (right): "Viminella": ***Viminella flagellum*** during the experiment

Experiments were conducted focusing on two important components of coral communities in Azores seamounts and island slopes, the octocorals *Dentomoricea aff. meteor* and *Viminella flagellum*.

We are performing analysis of metabolic conditions, such as respiration rates and excretion of inorganic nutrients as a proxy of mucus production and metabolic stress; cell damage, calcification and oxidative stress related enzymes, genes and mRNA expression and Cu subcellular accumulation.

The first analysis seems to indicate a high sensitivity to Cu toxicity and a species-specific molecular response to overcome an interactive effect of reduced pH and Cu exposure.

We believe that this study will find potential biomarkers of cellular responses suitable to assess the adverse effects not only in cold-water coral but also in other organisms threaten by ocean acidification and human activities environmental consequences.

Current Status of Deep-Sea Squat Lobsters off Thoothukudi Coast, Gulf of Mannar, Southeast Coast of India

Vaitheeswaran Thiruvengadam

International University of East Africa, Uganda

Contact: vaitheeswaranthiruvengadam69@gmail.com

A new investigation has been carried out on the biodiversity and taxonomy of the squat lobster off the Thoothukudi coast, Gulf of Mannar, southeast coast of India. A systematic survey of the diversity of squat lobsters occurring in this region has indicated the occurrence of these squat lobsters, their preferred habitat, depth distribution, biological aspects, and possible migration to shallower depths during their peak breeding season, as in the case of other deep-sea squat lobsters such as *Munida* (Munididae), *Munidopsis* (Munidopsidae) and *Eumunida* (Eumunididae).

Figure 1. From left: *Munida semoni* Ortmann, 1894; *Eumunida funambulus*; *Munida curvipes* Benedict, 1902

Taxonomical studies on the Chirostylid and Galatheid lobsters of India have been conducted by several authors, including most recently by Vaitheeswaran (2017, 2018 & 2020). The total number of squat lobsters from India has risen to 53. A total of 52 species (10 from the family Chirostylidae and 40 from the family Galatheidae) were recorded, mostly from the deeper waters of Lakshadweep sea, Arabian sea, Bay of Bengal and Andaman sea. Single galatheid lobsters of the species *Munidopsis regia, M. scobina, Eumunida funambulus, Agononida eminens*, and *Munida heteracantha, M. curvipes, M. semoni*, and *M. andamanica* have been reported from the Gulf of Mannar.

Sustainable management of fishery resources requires continuous assessment and monitoring. While examining the crustacean catches landed by larger trawlers operating in deep waters off the Thoothukudi coast, squat lobsters were collected only from by-catches. The collection and continued exploration of new offshore regions off the Thoothkudi coast, South India, at depths of 185-318 M, with the discovery of new species and genera is continuing unabated. The average depth was calculated from the minimum and maximum depths, where two depths were available in straight line curve of the southeast coast of India, otherwise the single depth record was used for the only seasonal occurrence of this species.

In order to gain as much available information as possible, different sources were used to extract geographical distributional information for the squat lobsters. This squat lobster study revealed that strict management measures need to be undertaken in order to preserve the rich biodiversity of deep-sea fauna and flora species, to avoid further exploitation of this crustacean group in the Gulf of Mannar.

Pacific Civil Society Organisations have launched a collective statement calling for a Global Ban on Deep Sea Mining (DSM).

Launched in March 2021, the statement calls on Pacific Island leaders to join the growing ranks of governments, scientific authorities, Civil Society Organisations, Churches, global leaders and indigenous groups and communities who are the forefront of the struggle across the world to join in the protection of the world's greatest ocean the Pacific Ocean.

The Pacific grouping states, "the Ocean is the living blue heart of our planet. It is our common heritage, and responsibility. Our call to ban DSM is to protect the blue heart of our planet, its life-giving functions, production of oxygen, absorption of carbon, and its currents that regulate our planet. It is home to millions of living creatures, and for Pacific people, it's our source of livelihood, our spiritual connection and wellbeing".

Malu'i e Oseni – The Deep Sea Minders of Tonga

Malu'i e Oseni – The Deep Sea Minders of Tonga

Malu'i e 'Oseni (Protect the Ocean) is a film documentary that presents voices of deep sea minders of Tonga. Highlighting the destructive nature of Deep Sea Mining (DSM), the film raises serious concerns about potential impacts on Tonga's fisheries and coastal communities. It further questions Tonga's rush to mine its ocean floor and who really stands to benefit from a destructive investment. Tonga civil society groups have continued to call for a ban on deep sea mining, continuing to stress that DSM is not wanted; not needed; not consented. These are the voices of the deep sea minders of Tonga.

VIEW FILM DOCUMENTARY: https://www.youtube.com/watch?v=3SaXVmP00QA&t=109s

Setting the Boundaries - Voices from the Last Frontier

Setting the Boundaries - Voices from the Last Frontier

Voices from The Last Frontier, is a documentary series focusing on Deep Sea Mining (DSM), a destructive and exploitative corporation led venture in the Pacific. This documentary presents the voices from Fiji around concerns of DSM explorations and a call to halt DSM in the Pacific. This film highlights the need by authorities to incorporate sufficient and stringent environmental protections, and calls into question short term economic

gains, as well as the norm of free, prior, and informed consent (FPIC) for Pacific peoples to ensure we safeguard our great ocean not just for today's needs but for future generations. DSM is not wanted; not needed; not consented. These are the voices of the guardians protecting the Last Frontier, our oceans.

VIEW FILM DOCUMENTARY: https://www.youtube.com/watch?v=dUi6bQqCCMQ

The Diversity and Ecology of Parasites at Deep-Sea Hydrothermal Vents

Lauren Dykman

MIT-WHOI Joint Program in Oceanography/Applied Ocean Science & Engineering

Contact: ldykman@mit.edu

Parasites are ubiquitous and impactful in most ecosystems, yet their diversity and ecology at deep-sea hydrothermal vents has been little studied. Few vent parasites have been discovered (de Buron and Morand 2004), which has led to the speculation that parasites may be low in diversity and abundance at vents. Many features of the vent environment, including harsh chemical and thermal conditions, habitat patchiness and ephemerality, and relatively low host diversity, may limit the success of the parasitic life strategy. Alternately, the low rate of parasite discovery could arise because we have simply not looked hard enough. Few studies have quantitatively surveyed host populations in the deep ocean (Campbell et al. 1980, Powell et al. 1999, Terlizzi et al. 2004, Ward et al. 2004), and none have investigated whole communities. The lack of quantitative, community-level parasite surveys at any one vent field makes it impossible to understand the impact of parasitism at vents or to compare between ecosystems.

Left: ROV Jason collecting samples at the 9°50'N EPR vent field. A new high-capacity suction sampler (yellow tube running aft to fore), designed by Mario Fernandez, was used to capture large fish for the vent parasite project. Photo courtesy of NDSF ©Woods Hole Oceanographic Institution. Right: MIT-WHOI Graduate Student Lauren Dykman in the main lab of R/V Roger Revelle dissecting a vent fish that was collected by the new suction sampler. Photo: Zoe Yin.

We collected potential hosts from a wide range of taxa at the 9□50'N EPR vent field in a series of two cruises, AT42-21 (2019) and RR2102 (2021) using HOV *Alvin* and ROV *Jason*. Specimens were dissected and quantitatively surveyed for any metazoan parasites. Our goals were to understand which parasite taxa are diverse and abundant at this vent field, which vent species serve as hosts, and whether any parasite taxa are scarce or missing. Ultimately, we aim to test whether parasites are truly scarce at vents or whether the observed scarcity has arisen from the previously low sample size.

We dissected over 2,000 potential hosts of 53 species and encountered most of the major taxonomic groups of metazoan parasites found in other marine ecosystems. Most invertebrate hosts were free of parasites. However, a few species

hosted parasites at high prevalences. For example, nearly 30% of squat lobsters in the genus *Munidopsis* were infected by an undescribed parasitic barnacle (Fig 1a). Vent fishes hosted trematodes (Fig 1b), acanthocephalans (Fig 1c), and nematodes. A major finding was the discovery of all life stages necessary to complete a three-host trematode life cycle in a vent ecosystem (Fig 1d-f), which will be presented as a virtual talk at the upcoming Deep Sea Biology Symposium in September 2021. Many of these new parasite species are in the process of description, and our dissection and genetic data, once complete, will be published in an open-access online repository.

Future stages of this project will compare our vent parasite database from 9°50'N EPR to datasets from other marine ecosystems that have been surveyed for parasites using similar methods. This will allow us to test, for the first time, whether vent parasites are truly low in diversity and abundance or whether we simply had not looked hard enough. If parasites prove scarce at vents, it could imply that certain harsh features of the vent environment challenge the persistence of species, such as parasites, that have highly specific habitat and nutritional requirements. If, however, vents have a comparable parasite fauna to other marine ecosystems, it would indicate that parasites are relatively resilient to the challenges of life in patchy and ephemeral habitats. This work is funded by NSF-OCE-BIO-1829773 (Mullineaux and Beaulieu), NSF-OCE-BIO-1948580 (Arellano, Vetriani & Mullineaux), and the WHOI Grassle Fund (Dykman).

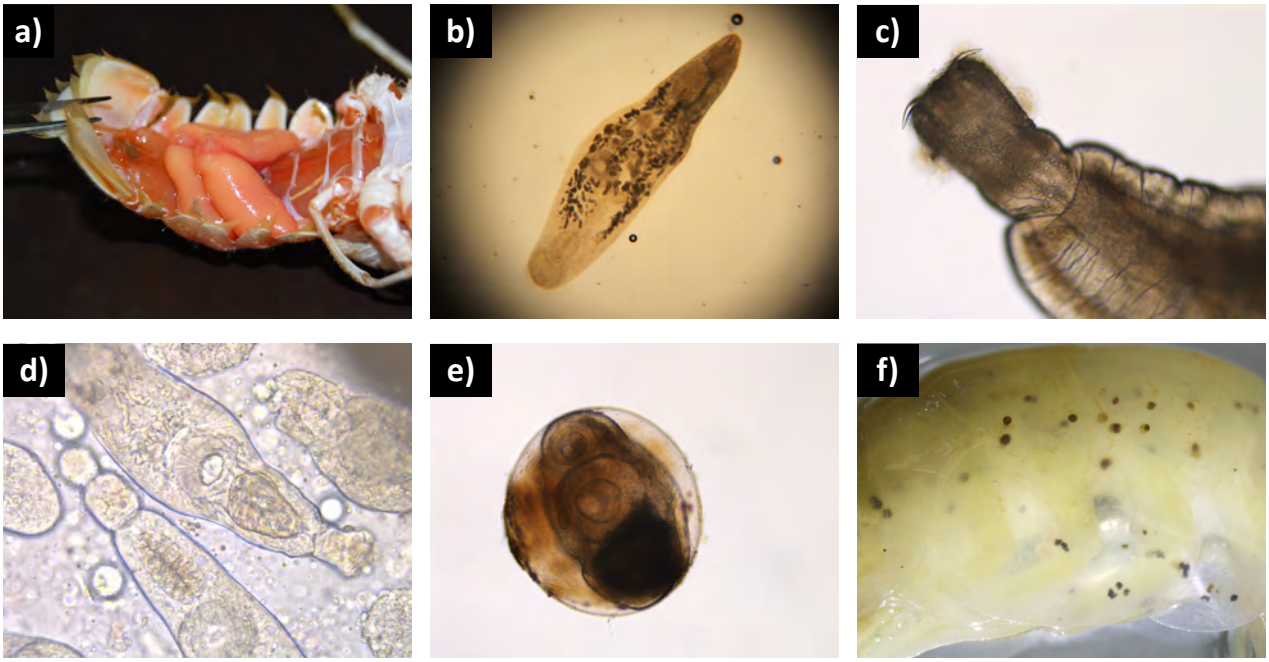


Figure 1: a) A rhizocephalan (parasitic barnacle) in the abdomen of a squat lobster. b) A trematode and c) an acanthocephalan from the intestine of a vent fish. d) The first stage of a trematode life cycle, found in a vent limpet. e) The second stage of a trematode life cycle, extracted from a vent shrimp and f) in-situ in the shrimp abdomen. Photos: Lauren Dykman.

The vent parasite project is part of the PhD thesis of graduate student Lauren Dykman (Personal website: https://www2.whoi.edu/staff/ldykman/). The Mullineaux Benthic Ecology Lab (WHOI) provided general research and logistics support, Armand Kuris (UCSB) provided parasite expertise, and Carolyn Tepolt (WHOI) helped with genetic sequencing and at-sea dissections. The crews of R/V *Atlantis* and R/V *Roger Revelle* and the technicians and pilots of ROV *Jason* and HOV *Alvin* made sample collection possible. We particularly thank Mario Fernandez, who designed and built the high-capacity suction sampler used to catch vent fish. Finally, we thank the taxonomists Charles Blend, Paola Braicovich, Rodney Bray, Henrik Glenner, and Jens Høeg for helping with species identification.

To learn more about the vent parasite project check out:

Life is Tough for Teenage Parasites – Atlantic article by science journalist Sabrian Imbler.

The Creepy, Unbelievably Inspiring World of Deep-Sea Parasites – podcast episode by Woods Hole Oceanographic Institution.

Deep Sea Corals Off Coastal Maine Get Permanent Protection

Fred Bever

Maine Public

Fisheries regulators in the Northeast are permanently putting some 25,000 square miles of seafloor off-limits to some types of commercial fishing, in an effort to protect sensitive deep-sea corals.

The National Oceanic and Atmospheric Administration issued a final rule this week that bars mobile bottom-trawling gear from vast deep-sea areas along the outer continental shelf off New England and in some smaller areas closer to Maine's coast.

"The deep-sea corals have a very fragile skeleton, and can be broken or displaced with a single pass of these nets, and they won't recover," says Gib Brogan, who directs advocacy campaigns for the international group Oceana.

Brogan says the areas in question don't see many trawlers right now - but the NOAA designations mark a proactive effort to ward off damaging fishing practices that have emerged elsewhere.

Visit https://www.mainepublic.org/environment-and-outdoors/2021-06-23/deep-sea-corals-off-coastal-maine-get-permanent-protection for more information.

Challenger 150 – A Decade to Study Deep-Sea Life

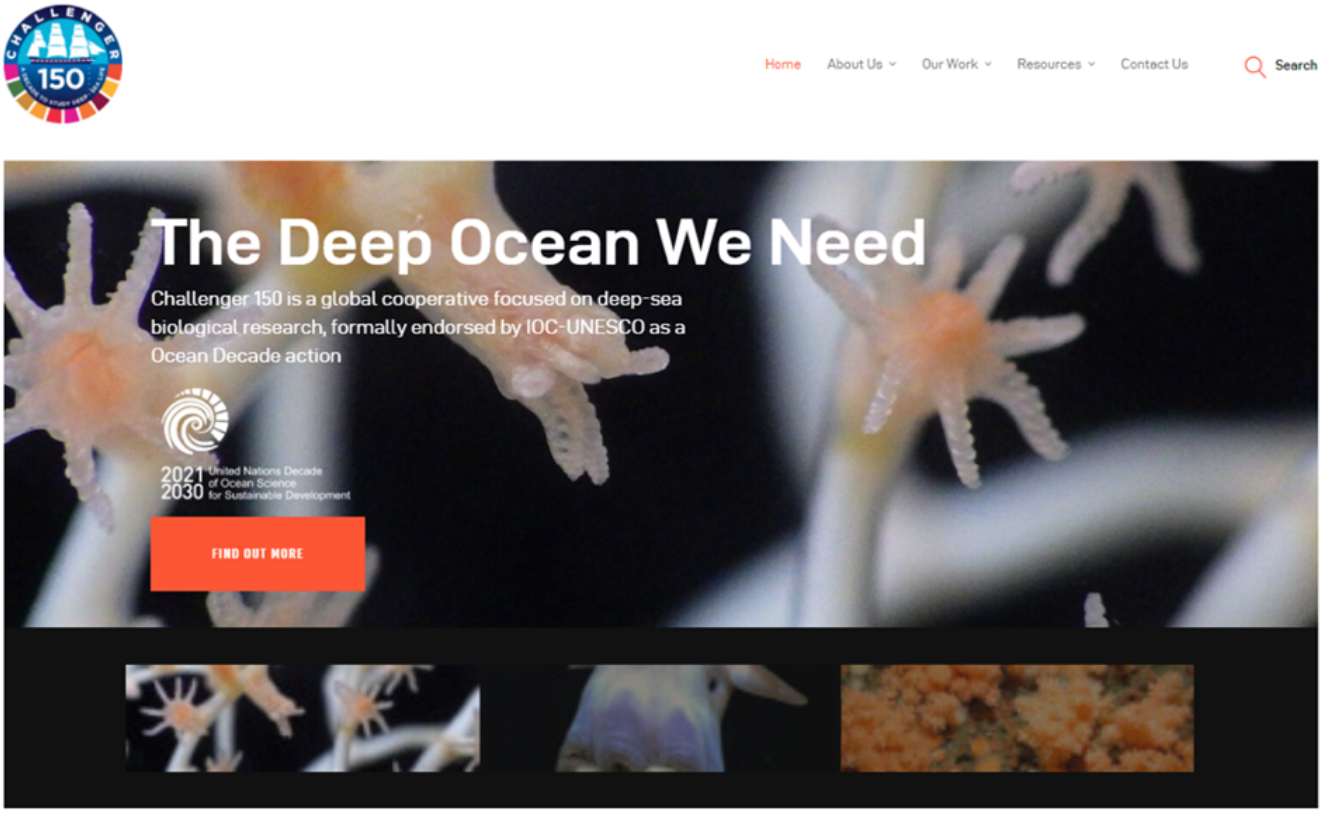
Maria Baker[1], Ana Hilario[2] and Kerry Howell[3]

[1]University of Southampton, [2]University of Aveiro, and [3]University of Plymouth

Challenger 150 has been endorsed by the Intergovernmental Oceanographic Commission as a UN Decade of Ocean Science for Sustainable Development programme. This is excellent news for deep-sea research, for our community, and for future collaborations.

The first cruise under the Challenger 150 banner is sailing - you can follow Randi Rotjan and her team on board the R/V *Falkor*, investigating deep-water microbes, corals and sponges around the Phoenix Islands Archipelago. This cruise is the first of 28 funded expeditions committed to the programme and will explore the north, central, and southern regions of the Pacific, North and South Atlantic, and the Arctic and Southern Oceans.

Challenger 150 seeks to gather people to work on a common goal to deliver science to enhance ocean health and sustainability in the long-term and to educate and inspire humankind. At heart of Challenger 150 is the development of deep-ocean expertise in order to achieve a global generation of stewards working together to maintain the integrity of deep-ocean ecosystems. Come and join us!



If you wish to learn more about this programme visit the website www.challenger150.world, and contact us if you wish to be involved. Detailed background can be found in Howell, K *et al*. (2020a). A Blueprint for an Inclusive, Global Deep-Sea Ocean Decade Field Program and Howell, K *et al*. (2020b) A decade to study deep-sea life. Further reading about Challenger 150 and other UN Decade programmes is also available in the May edition of Eco Magazine.

DEEP-OCEAN STEWARDSHIP INITIATIVE

IUCN The World Conservation Union

DOSI partners with IUCN for webinar series on Building the knowledge base for managing human activities affecting marine biodiversity beyond national jurisdiction

Kristina Gjerde[1], Karen Kienberger[2] and Aurelie Spadone[2]

[1]Senior High Seas Advisor to IUCN's Global Marine and Polar Programme, and member of the DOSI Executive; [2]IUCN

The postponement in March 2020 of the fourth United Nations Intergovernmental Conference to develop a new international agreement on the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction (BBNJ Agreement) spurred new ways to continue discussions and knowledge exchange – online. As a contribution to that effort, IUCN has been co-hosting a series of knowledge-building webinars to build a shared understanding on some of the key scientific, technical and legal aspects of the ongoing treaty discussions and related

issues.

The first webinar Marine Genetic Resources (MGRs) outlines the importance of marine genetic diversity for the ocean and people and therefore the need to conserve and preserve biodiversity in the ocean. As the use of MGRs was first not envisaged in the first draft of the BBNJ agreement and there is lack of clarity on the applicable regime relating to bioprospecting and equitable use. Examples from the Seychelles and South Africa illustrate how nations can benefit from research findings in this field as well as use of these resources.

The second webinar on Environmental Impact Assessments and Strategic Environmental Assessments explored the value of best practice environmental impact assessments (EIA) and broad-scope strategic environmental assessments (SEA) for encompassing the variety of human activities affecting BBNJ and the inherent ecological sensitivities.

The Marine Protected Areas (MPAs) and Area-based Management Tools (ABMTs) webinar offers an overview of the management tools available to regulate human activities and conserve biodiversity in ABNJ. Traditional MPAs remain necessary to achieve the conservation objectives of the BBNJ agreement. In addition, other ABMTs are needed, including industry sector-based measures to protect particularly sensitive sea areas, vulnerable marine ecosystems and other ecologically or biologically significant marine areas from the impacts of shipping, mining, deep-sea fishing, and other sectors. The webinar also explored the need to evolve and adapt ABMTs to protect migratory species and dynamic ecosystems both within and outside of MPAs.

Integrating Climate Change into Environmental Impact Assessments (EIAs). Building up on the previous EIA/SEA webinar, this webinar brought together leading experts to explore how EIAs can and should consider climate change impacts as additional impacts to other stressors and impacts in ABNJ.

Key tools to strengthen ocean resilience via the BBNJ agreement Building upon the publication from Yadav and Gjerde 2020, this webinar offers clear and specific tools on how to build ecological and institutional resilience in ABNJ via the BBNJ agreement.

Fishing in the Twilight Zone introduces science and ecology of the mesopelagic zone and explores potential governance challenges for sustainable development of new fisheries.

The mesopelagic, or "twilight" zone – the open ocean from 150-1,000 metres deep – hosts significant fish stocks. These fish are unpalatable but proposals are emerging to process them into fishmeal and nutritional supplements. As this vast midwater realm plays a role in the carbon cycle and food webs, new fisheries could have global ramifications. Yet our scientific understanding is limited, and existing governance may not be ready to effectively manage mesopelagic fisheries.

The most recent webinar entitled Raising the curtain on Deep-sea Mining focused on the wider societal questions surrounding deep-sea mining. Deep sea mining is the search for and exploitation of minerals like copper, cobalt, zinc, manganese and other valuable metals on seamounts, abyssal plain or hydrothermal vents. Unlike many activities that take place in the high seas above, the Law on the Sea Convention has deemed the seabed and its mineral resources beyond national jurisdiction (known as the Area) to be the common heritage of mankind, which requires seabed

mining to be managed in a way that benefits humankind as a whole. Hence this webinar focused on the legal, financial, institutional, and social license issues around deep-sea mining.

"Should Deep-sea Mining be….." was asked at the beginning and at the end of the webinar. The most important change of opinion occurred that most participant afterwards vote for a moratorium until further, detailed research is completed.

"Should Deep-sea Mining be…."

The series is co-hosted by IUCN and DOSI, sponsored and supported by the Swedish Government. Thanks also go to Marviva, Duke University, and the Sargasso Sea Commission.

The International Seabed Authority joins the OBIS network

International Seabed Authority

www.isa.org.jm

On World Ocean Day, 8 June 2021, we jointly organised a webinar and celebrated the collaboration between the International Seabed Authority (ISA) and Ocean Biodiversity Information System (OBIS). The ISA is now one of the 32 OBIS nodes and publishes the biodiversity data collected by the deep-sea mining contractors to OBIS. This is an important milestone for OBIS. The ISA is also the first UN body that joins the OBIS network.

The ISA is mandated by the United Nations Convention on the Law of the Sea (UNCLOS) to regulate and control seabed mineral activities in the international seabed area, also called the Area.

At the core of this mandate is the responsibility to ensure the effective protection of the marine environment from harmful effects that may arise from such activities in the Area as well as to promote and encourage marine scientific research in the Area.

Among other activities, ISA is committed to find ways to increase the dissemination, exchange and sharing of scientific data and deep-sea research outputs. For that purpose, ISA has officially joined the International Oceanographic Data and Information Exchange (IODE) network to serve as a node for the OBIS of IOC-UNESCO.

"This collaboration is particularly significant as the Authority is the first UN body to become a node of OBIS, which clearly reflects the importance of the legal regime administered by the Authority as a mechanism for enhancing our collective understanding of deep-sea ecosystems and biodiversity. This will enable us to share more effectively the biological data and other deep-sea related information compiled in our own global repository, DeepData".

- ISA Secretary-General Mr. Michael W. Lodge

"I welcome ISA's contribution to OBIS. The ISA is adding a critical piece of information to the global knowledge base. Most of the deep sea remains unexplored and every data byte adds crucial new information about life in the ocean and assists in decision making".

- Chair of IOC-UNESCO Mr. Ariel Troisi

Increasing our understanding of the deep-sea environment and deep-sea biodiversity contributes directly towards the United Nations Decade of Ocean Science for Sustainable Development 2021-2030.

"The goals of the Decade will only be achieved if policy makers, innovators and society have the tools at their disposal to transform data and information into solutions. For this reason, the strengthening of the cooperation between ISA and OBIS […] will be key to help better understand the oceans and find ways based on solid data on biodiversity, biogeography and the seabed area".

- H.E. Ambassador del Solar Dorrego, Permanent Representative of Argentina to ISA

ISA and IOC-UNESCO signed a Memorandum of Understanding in 2000 which explicitly recognizes the importance for both organizations to cooperate in relation to the collection and exchange of data and information. By contributing its data to OBIS, ISA aims to increase access to fundamental information on samples and specimens collected in the Area over the past several decades by its contractors for environmental baseline studies while exploring the Area for mineral resources.

As of today, the ISA OBIS node contains 63 datasets from 2004 to 2019 with data on 52,057 species observations (presence records), 1,175 taxa (organisms) and 136 species.

It is expected that this will increase the scope for collaboration between the research community and ISA contractors, as well as foster collaboration among ISA contractors themselves. It will help identify potential data gaps at regional and global levels, contributing to the development and implementation of regional environmental management measures and other appropriate rules, regulations and procedures for the protection of the marine environment in the Area. It will also further support the design of targeted training programs to build capacity in the field of biodiversity data and information, including taxonomic expertise and scientific data analysis.

Coral Reefs on the High Seas Coalition launches website

Daniel Wagner

Conservation International, USA

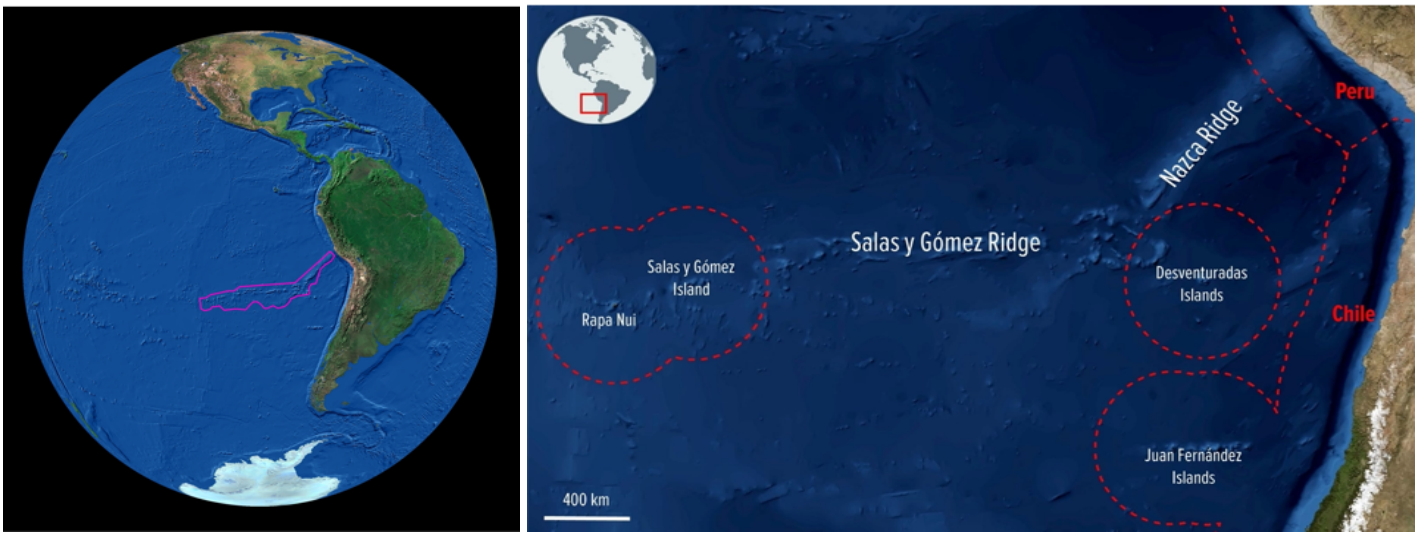


Figure 1. Location of the Salas y Gómez and Nazca ridges.

The Coral Reefs of the High Seas Coalition is pleased to announce the launch of its website with articles, videos, photos,

Figure 2. Due to its exceptional water clarity, the Salas y Gómez and Nazca ridges harbor some of the deepest light-dependent coral reefs on Earth. Photo credit: Matthias Gorny, Oceana.

and other information on coral reefs in areas beyond national jurisdiction. Coral reefs are widely regarded as one of the top conservation priorities globally, as these ecosystems harbor extraordinary biodiversity, provide many benefits, and are highly vulnerable to impacts. While most of our knowledge of these critical ecosystems is derived from studies on nearshore reefs, coral reefs have also recently been documented on the high seas in many locations around the globe.

The Coral Reefs of the High Seas Coalition is a multidisciplinary alliance of partners that aims to generate the science, strategic communication, and political support that is necessary to conserve coral reefs on the high seas. Since its inception in 2019, the coalition has regularly convened experts in ocean science, exploration, policy, law, and communications to advance its work. Specifically, the coalition conducts scientific studies to generate the knowledge needed to guide policy recommendations, and engages with organizations that regulate human activities on the high seas to better position coral reefs for increased protection.

Located off the west coast of South America, the Salas y Gómez and Nazca ridges are two seamount chains that have been identified as one of the most important places for conservation by numerous international organizations. However, over 73% of these ridges lie in areas beyond national jurisdiction, where they are unprotected and under threat from overfishing, plastic pollution, climate change, and potential deep-sea mining.

To date, the coalition has mostly focused its efforts on international waters surrounding the Salas y Gómez and Nazca ridges, two seamount chains that stretch across 2,900 kilometers in the southeastern Pacific. Isolated by the Humboldt Current and the Atacama Trench, this region is home to one of the most unique collections of marine biodiversity on Earth. For many groups of organisms, nearly half of the species are endemic to the region and found nowhere else on our planet. Not only is this region a biodiversity hotspot, it is also culturally significant as Polynesian and other seafarers have recognized its importance for centuries. The Coalition has recently published various scientific studies on the importance of this region, including the scientific rationale and policy recommendations for protecting this region, descriptions of deep benthic habitats of various seamounts on the Nazca Ridge, and the first deep-water surveys of both ends of the ridges. Additional studies focusing on various other aspects of this region are underway and will be published in the coming months. For more information visit www.coralreefshighseas.org or contact dwagner@conservation.org.

Opinions

How art can help with ocean education and conservation

Frieda Verlage

Artist and art educator

Insta: @moku.art

www.mokuartstudio.com

The UN Ocean Decade project has a goal to include the arts in its effort to engage the public in ocean education and conservation. As an artist and educator, I was thrilled! I discovered that many organizations and scientists are willing and excited to include the arts, but there is yet to be a framework on how artists (like myself) can be a part of the community.

The question I really want to ask is: I would love to know more about your work and collaborate and can we please be friends?

I started thinking of the ways in which art can help with engagement. Art can help highlight the beauty of the ocean in ways that facts and figures may not be able to. Few people will read scientific papers for fun, and even when they venture, the jargon can be confusing (I've tried).

From an art education point of view, there are different places where this focus on STEAM can take place:

1. **Museums**: Museums already have excellent education departments and the infrastructure in place to do outreach community programs. All museums should be considered for deep-sea programing. Natural history museums have the direct science connection, but many art museums have pieces inspired by the ocean and its environment. Cross disciplinary programs are ideal.

2. **Conferences**: Consider presenting at national and state art education conferences. Educators come to conferences with open minds and hoping to find novel ways of creating change inside the classroom and engaging students in meaningful projects. Presenting at conferences makes the field-classroom connection a lot more accessible. Having attended conferences myself, I can attest that when content is presented in accessible ways for educators to incorporate into our classrooms, most of us take the opportunity to do so.

3. **Community Centers**: Like museums, community centers have connections in the community and can help promote outreach programs.

4. **Schools**: Contacting schools and educators directly is also a good choice, especially in your community. Reach out to the schools in your area to see if there are educators interested in partnerships. It can be as simple as attending a science (or art!) class or presenting for career day.

5. **Artists**: Do you know an artist? Has an artist approached you? Let's work together! It can be daunting for an artist with no connection to the community to know how to properly reach out. It is an exciting time for ocean conservation efforts and spreading the word in all types of mediums is necessary.

I applaud the organizations that are starting to reach out with their education programs like the Deep Ocean Education Project. However, we all need to be more proactive in the inclusion of the arts and create more programs and opportunities (music, visual arts, theater, film, etc.).

Do you have ideas? Do you have artists in mind you can reach out to? Let's talk and come up with some programs together!

Opportunities

Seabed Minerals Authority
Runanga Takere Moana
COOK ISLANDS

Technical Director

Cook Islands

The Cook Islands Seabed Minerals Authority (Authority), located in the Cook Islands is seeking a Technical Director to support the responsible development of the Cook Islands seabed minerals sector.

The successful candidate will have:

- Tertiary (or higher) qualifications in minerals geology, marine science or other related fields
- Several years practical work experience in managing exploration or developing natural resource administration programmes and/or resource administration in related fields
- Several years post-graduate work experience in marine geology and or marine resource
- Providing both leadership and technical support and advice

Job description available online at: https://www.sbma.gov.ck/vacancies

Applicants must submit a covering letter and resume. Applications should be addressed to Ms Alex Herman, Commissioner, Cook Islands Seabed Minerals Authority, Cook Islands and emailed to eileen.macquarie@cookislands.gov.ck. Applications close on **Monday 9 August 2021** at 4pm (Cook Islands time).

Wanted

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Announcement from the clean ocean laboratory expert group

Dear Marine Community,

The "clean ocean laboratory" is approaching fast and will be held in November 2021. You can find the Laboratory-Trailer on the event website https://www.oceandecade-conference.com/en/. The application form of the 1st Call for Online Sessions for Satellite Activities can be found here: https://www.oceandecade-conference.com/en/call-for-proposals.php. For us as responsible expert group, it is important to include satellite events around the core event hosted in all time zones all around the world. It is important also to combine science and "sustainable development" as both are in the name of the decade.

We would like to encourage you to submit an application to support our core event. Some of the following questions should be addressed:

WHAT

- results would you like to see in 2030 from the Ocean Decade actions in the Clean Ocean theme? is a Clean Ocean?
- does a clean ocean mean, from a multi-level perspective, addressing this from perspectives of: A) sources (sound, debris, chemicals, human induced climate change, acidification), B) habitats (beaches, reefs, polar regions, deep-sea), C) regions (Mediterranean, South China Sea etc.)
- is the value of a Clean Ocean?

HOW

- do ECOPs plan to achieve a clean ocean by 2030?
- does science approach a Clean Ocean from a holistic perspective and offers solutions for improvement? = How can we clean the ocean?
- are industries currently equipped to understand and monitor their impact on a Clean Ocean?
- are current policies managing multi-level perspectives of a Clean Ocean and which provisions are needed for transformative approaches in safeguarding a Clean Ocean?
- can actions to address plastic pollution be leveraged to maximize the benefits across as many other ocean pollutants as possible? If plastic pollution is uniquely able to catalyze actions on solutions, how can we prioritize and design solutions to also stop the flow of other pollutants into the ocean?
- is the value stored in the ocean changing through time?
- important is the ocean to indigenous cultures?
- have the impacts in the ocean (pollution, litter, sound) and responses affected our future relationships with the ocean?
- can humanity's diverse relationships with the ocean be supported to flourish in the future, so that the ocean can make sustainable contributions to human well-being?
- Is the ocean economy being developed sustainable?

WHY

- do we need Clean Oceans and why now?

WANTED: Samples of Antipatharians (Black corals) needed

Erika Gress[1,2]

[1]ARC Centre of Excellence for Coral Reef Studies, James Cook University, Australia; [2]Nekton Foundation, UK

Contact: gresserika@gmail.com; erika@nektonmission.org

I am on the search for samples of antipatharian (black coral) branching colonies collected at 20 – 150 m depth. In particular, I am interested in samples collected in the Indian and Pacific oceans that look similar to the images below. These samples would contribute to a species delimitation project that I am currently working on as part of my PhD. I am based at James Cook University (JCU) in Australia and also associated to the Museum of Tropical Queensland (MTQ) which is a CITES registered institution that will enable the exchange.

Meetings & Workshops

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

SPONSORED BY THE Federal Ministry of Education and Research

IN PARTNERSHIP WITH United Nations Educational, Scientific and Cultural Organization; Intergovernmental Oceanographic Commission

1. Preface: First International Ocean Decade Conference

The ocean is the largest ecosystem on Earth and central to the survival of nature and humankind. But the ocean is also under massive threat. More than ever before, science and research are being called upon to join forces with policymakers, society and economic actors to protect and sustainably manage the ocean. To achieve this vision, the United Nations General Assembly proclaimed 2021 to 2030 as the United Nations Decade of Ocean Science for Sustainable Development – the "Ocean Decade".

The **First International Ocean Decade Conference** organized by the German Federal Ministry of Education and Research (BMBF) in partnership with the Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO) will take place as two interconnected segments between June 2021 and July 2022. Over the course of one year, this will offer various opportunities in terms of communications to generate awareness and catalyze action on the seven Decade Outcomes of the Ocean Decade on the path to **"Creating the Ocean We Want"**.

While the first of these segments will be the virtual High-Level Launch of the Ocean Decade on 1 June 2021, 11 am to 3 pm (CEST), the second segment will be the Ocean Decade Laboratories. Each Laboratory will address one of the Ocean Decade Outcomes, therefore, seven Laboratories will take place between July 2021 and May 2022.

CREATING THE OCEAN WE WANT

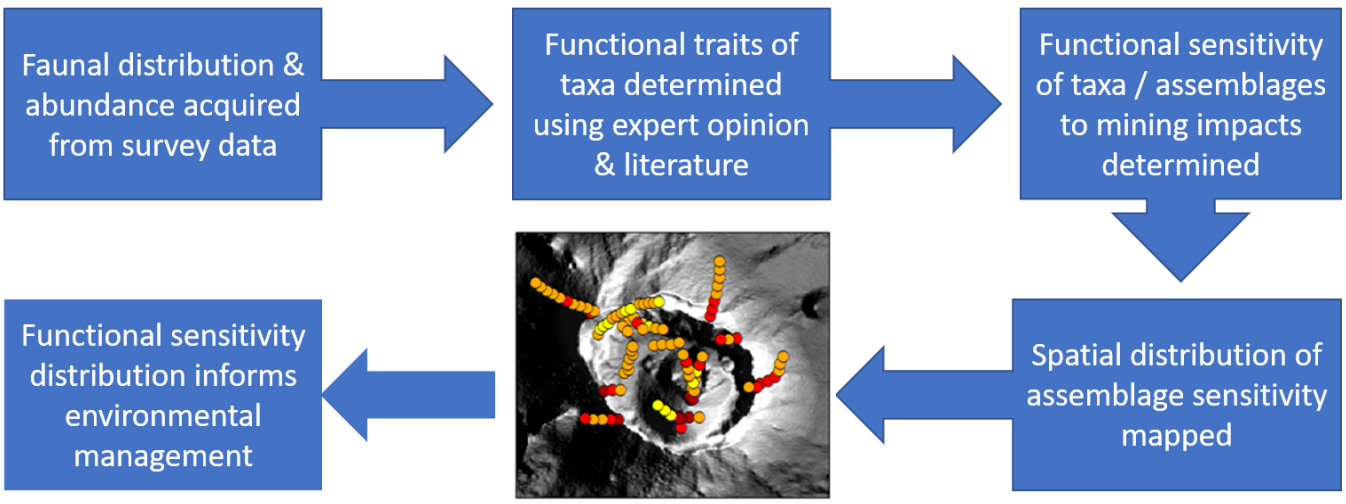
Hot off the Press

Assessing the ecological risk to deep-sea megafaunal assemblages from seafloor massive sulfide mining using a functional traits sensitivity approach

Rachel E. Boschen-Rose, Malcolm R. Clark, Ashley A. Rowden, and Jonathan P.A. Gardner (2021)

Ocean and Coastal Management, 210: 105656

Ecological sensitivity to mining of hydrothermally-formed seafloor massive sulfides (SMS) was assessed based on the functional traits of benthic megafauna. Faunal distribution and abundance data at two different spatial scales (within seamount and within site) were used from video surveys conducted at un-fished SMS deposit-hosting seamounts on the Kermadec Volcanic Arc, New Zealand. For each of the 157 taxa identified in the surveys, sensitivity was scored for six functional traits: adult size, environmental position, living habit, feeding habit, mobility, and structural fragility. Sensitivity (very low, low, intermediate, high, very high) was scored separately for three mining disturbances: passage of mining vehicles along the seafloor, sediment plumes generated by mining activity, and mineral extraction. Sensitivity to mining impacts was summed within samples and mapped to show the spatial distribution of sensitivity. At both spatial scales, the sensitivity of taxa and the sensitivity summed within each sample (assemblage) was greatest to mineral extraction, followed by plume impacts, and least sensitive to vehicle impacts. The location of most very highly sensitive assemblages coincided with the occurrence of hydrothermal vent taxa or previously mapped locations for hydrothermally active habitat. Highly sensitive assemblages occurred at hydrothermally inactive sulfide structures, such as chimneys, and other locations where assemblages were dominated by fragile, sessile, suspension-feeding taxa, such as scleractinian branching corals. This type of assessment has the potential to inform decisions on spatial management of SMS mining activities, and the suitable placement of area-based management measures, such as marine protected areas.



Link to paper: https://doi.org/10.1016/j.ocecoaman.2021.105656

Megafaunal ecology of the western Clarion Clipperton Zone

Jennifer M. Durden, Meagan Putts, Sarah R. Bingo, Astrid B. Leitner, Jeffrey C. Drazen, Andrew J. Gooday, Daniel O.B. Jones, Andrew K. Sweetman, Travis W. Washburn, Craig R. Smith (2021)

Frontiers in Marine Science

The Clarion Clipperton Zone (CCZ) is a vast area of the central Pacific Ocean where the abyssal seabed is a focus for future polymetallic nodule mining. Broad-scale environmental gradients occur east-to-west across the CCZ seabed, including organic matter supply and nodule abundance, factors that influence benthic faunal community structure and function. A network of protected areas across the CCZ, called Areas of Particular Environmental Interest (APEIs), has been designated to cover this variation. Most previous studies of the benthic environment and megafaunal communities have focussed on the eastern CCZ, leaving the impact of these large-scale gradients unexamined and the network design untested. Seamounts are a further source of heterogeneity in the region. We examined the benthic megafaunal ecology of three APEIs in the western CCZ, spanning a range of environmental conditions. We used a combination of seabed photography and direct sampling to assess the environment and megafauna on the soft sediment habitats on the abyssal plain in three APEIs, and seamounts in two of those APEIs. We found that environmental conditions on abyssal plains differed between the three APEIs in terms of water depth, nodule abundance and coverage, sediment particle size distribution, and estimated organic matter flux. Megafauna were low density and high diversity, with few common morphotypes between sites and many morphotypes being observed only once. Xenophyophores dominated the assemblages. The density and diversity of invertebrates were greater at the sites with lower organic matter inputs and greater nodule abundance. Seamounts in the same APEIs were nodule-free and had coarser sediments than on the plain. Invertebrate megafaunal diversity was lower on the seamounts than on the plains, and most morphotypes recorded on the seamounts were only found on seamounts. Low morphotype overlap also suggests little connectivity between APEIs, and between seamounts and adjacent abyssal plains. Our results provide the first evaluation of the seabed habitats and megafaunal ecology in the western CCZ, highlighting environmental gradients that influence benthic communities, and important for evaluating the design of the network of protected areas.

Link to article: https://www.frontiersin.org/articles/10.3389/fmars.2021.671062/full

---

Genetic Divergence and Polyphyly in the Octocoral Genus *Swiftia*, including a Species Impacted by the DWH Oil Spill

Janessy Frometa, Peter J. Etnoyer, Andrea M. Quattrini, Santiago Herrera, and Thomas W. Greig (2021)

Diversity, 13, 172

Contact: Janessy.Frometa@noaa.gov

Mesophotic coral ecosystems (MCEs) are recognized around the world as diverse and ecologically important habitats. In the northern Gulf of Mexico (GoMx), MCEs are rocky reefs with abundant black corals and octocorals, including the species *Swiftia exserta*. Surveys following the *Deepwater Horizon* (DWH) oil spill in 2010 revealed significant injury to these and other species, the restoration of which requires an in-depth understanding of the biology, ecology, and genetic diversity of each species. To support a larger population connectivity study of impacted octocorals in the GoMx, this study combined sequences of *mtMutS* and nuclear 28S rDNA to confirm the identity of *Swiftia* sea fans in the GoMx, compare these markers for different polyp colors in the GoMx and Atlantic, and examine the phylogeny of the genus. Two *mtMutS* haplotypes were identified, one seemingly endemic to the northern GoMx. Compared to other

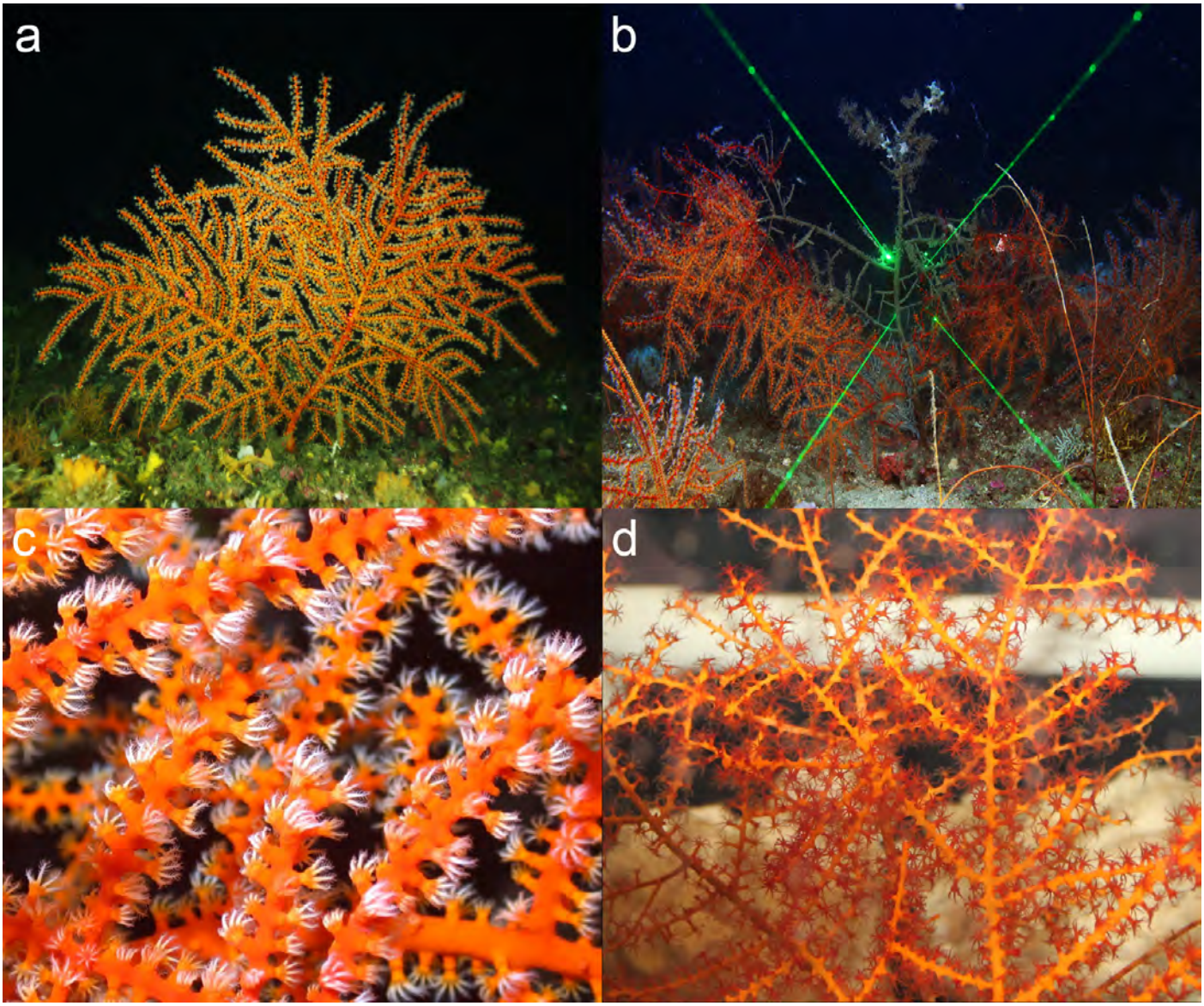


Figure 1. (a) Healthy ***Swiftia*** sp. from the northern Gulf of Mexico with white polyps. (b) Injured ***Swiftia*** sp. from the northern Gulf of Mexico. (c) Close-up of white polyps (NOAA/FGBNMS). (d) Close-up of ***Swiftia exserta*** from Riviera Beach, FL (Atlantic Ocean) with red polyps.

North Atlantic *Swiftia*, *S. exserta*, the type of the genus was found to be extremely divergent and distinct from the two other *Swiftia* at both loci, with strong evidence of polyphyly in the genus. This information refines our understanding of the geographical distribution of injured coral and highlights how little is known about MCEs. Substantial taxonomic revisions may be needed for several taxa injured by the DWH oil spill.

Link to paper: https://doi.org/10.3390/d13040172

Protect high seas biodiversity

Rebecca R. Helm, Nichola Clark, Harriet Harden-Davies, Diva Amon, Peter Girguis, Cesar Bordehore, Sylvia Earle, Mark J Gibbons, Yimnang Golbuu, Steven H. D. Haddock, Jonathan D. R. Houghton, Jamileh Javidpour, Douglas J. McCauley, Lance Morgan, David Obura, Evgeny A. Pakhomov, Kylie A. Pitt, Jorge Jimenez Ramon, Rashid Sumaila, and Jean-Baptiste Thiebot (2021)

Science, 372 (6546), 1048-1049

The high seas—marine areas beyond national jurisdiction cover nearly half of Earth's surface. The high seas support our planet in countless ways, from regulating the climate, to feeding millions of people, to supporting industries that

contribute billions of dollars to the global economy. Even so, less than 1% of the high seas are fully protected, and the current patchwork of management and lack of oversight leaves them vulnerable to abuse.

Link to full article: https://doi.org/10.1126/science.abj0581

Deep-sea plastisphere: Long-term colonization by plastic-associated bacterial and archaeal communities in the Southwest Atlantic Ocean

Luana Agostini, Julio Cezar Fornazier Moreira, Amanda Gonçalves Bendia, Maria Carolina Pezzo Kmit, Linda Gwen Waters, Marina Ferreira Mourão Santana, Paulo Yukio Gomes Sumida, Alexander Turra, Vivian Helena Pellizari (2021)

Science of The Total Environment, 793, 148335

Marine plastic pollution is a global concern because of continuous release into the oceans over the last several decades. Although recent studies have made efforts to characterize the so-called plastisphere, or microbial community inhabiting plastic substrates, it is not clear whether the plastisphere is defined as a core community or as a random attachment of microbial cells. Likewise, little is known about the influence of the deep-sea environment on the plastisphere. In our experimental study, we evaluated the microbial colonization on polypropylene pellets and two types of plastic bags: regular high-density polyethylene (HDPE) and HDPE with the oxo-biodegradable additive BDA. Gravel was used as control. Samples were deployed at three sites at 3300 m depth in the Southwest Atlantic Ocean and left for microbial colonization for 719 days. For microbial communities analysis, DNA was extracted from the biofilm on plastic and gravel substrates, and then the 16S rRNA was sequenced through the Illumina Miseq platform. Cultivation was performed to isolate strains from the plastic and gravel substrates. Substrate type strongly influenced the microbial composition and structure, while no difference between sites was detected. Although several taxa were shared among plastics, we observed some groups specific for each plastic substrate. These communities comprised taxa previously reported from both epipelagic zones and deep-sea benthic ecosystems. The core microbiome (microbial taxa shared by all plastic substrates) was exclusively composed by low abundance taxa, with some members well-described in the plastisphere and with known plastic-degradation capabilities. Additionally, we obtained bacterial strains that have been previously reported inhabiting plastic substrates and/or degrading hydrocarbon compounds, which corroborates our metabarcoding data and suggests the presence of microbial members potentially active and involved with degradation of these plastics in the deep sea.

Link to paper: https://doi.org/10.1016/j.scitotenv.2021.148335

Distribution of Vulnerable Marine Ecosystems at the South Sandwich Islands: Results From the Blue Belt Discovery Expedition 99 Deep-Water Camera Surveys

Anna-Leena Downie, Rui P. Vieira, Oliver T. Hogg and Chris Darby (2021)

Frontiers in Marine Science, 8, 652

The South Sandwich Islands (SSI) are a chain of volcanic islands located to the east of the Scotia Sea, approximately 700 km south-east of South Georgia. To date, knowledge of the SSI benthic environment remains limited. In this context,

the Blue Belt Programme conducted a scientific survey in the SSI Marine Protected Area (MPA) during February/March 2019 to examine the biodiversity and distribution of benthic communities and their potential vulnerability to licensed longline research fisheries. Here we report results from analysis of multibeam echosounder (MBES) data and drop camera imagery data collected in selected locations around the SSI. A total of eight vulnerable marine ecosystem (VME) indicator morphotaxa were mapped along the slopes of the SSI, showing a substantial variation in taxon composition and frequency of occurrence, both along bathymetric and latitudinal gradients. Our results suggest that VME indicator taxa are mostly restricted to waters shallower than 700 m. As such, based on our present understanding of the region's benthic environment the MPA, as currently established, offers effective protection for the majority of the VME indicator taxa.

Link to paper: https://www.frontiersin.org/articles/10.3389/fmars.2021.662285/full

---

Mediterranean Coral Provinces as a Sponge Diversity Reservoir: Is There a Mediterranean Cold-Water Coral Sponge Fauna?

Santín, A., Grinyó., Uriz, M.J., Lo Iacono, C., Gili, J.M. and Puig, P. (2021)

Frontiers in Marine Science, 8:662899

For the present paper, we investigated the sponge fauna associated with the recently discovered cold-water coral (CWC) in the Blanes Canyon (NW Mediterranean Sea) and, to a lesser extent, the Cabliers Coral Mound (Alboran Sea, Mediterranean Sea). Additionally, we also reviewed the current knowledge of the sponge fauna dwelling in all the Mediterranean CWC provinces. Two species, *Hamacantha (Hamacantha) hortae* and *Spongosorites cabliersi* are new to science, with many others being cryptic or rare. Additionally, at a basin scale, Mediterranean CWC appear as poriferan biodiversity hotspots, yet current diversity values on each site rather represent a small fraction of its actual fauna. Moreover, the sponge fauna thriving in Mediterranean CWC appears to be unique, and different from that of other Atlantic regions. Finally, with the current knowledge, the sponge fauna from the Mediterranean CWC is grouped in three distinguishable clusters (Alboran Sea, Western and Eastern Mediterranean), which appears to be determined by the basins water circulation, specially the Levantine Intermediate Water and the Atlantic Water following a western-eastern pattern from the Strait of Gibraltar to the Adriatic Sea.

Link to paper: https://doi:10.3389/fmars.2021.662899

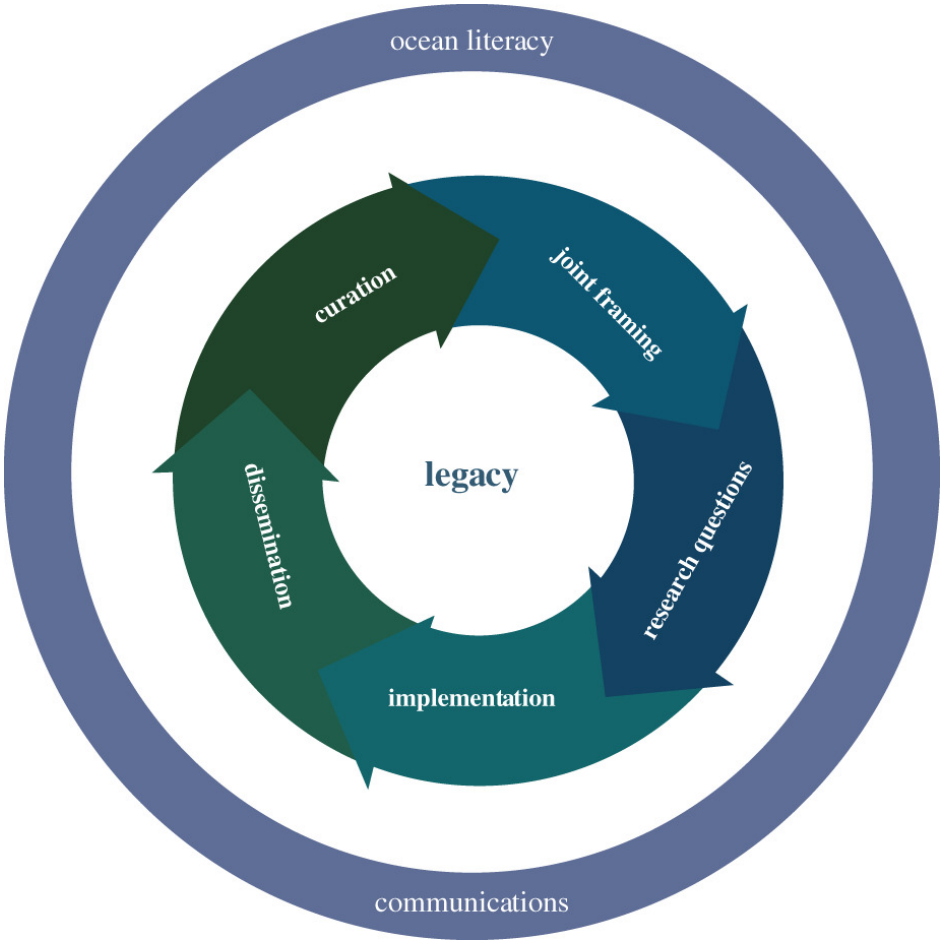
Co-development, co-production and co-dissemination of scientific research: a case study to demonstrate mutual benefits

Lucy C. Woodall, Sheena Talma, Oliver Steeds, Paris Stefanoudis, Marie-May Jeremie-Muzungaile and Alain de Comarmond (2021)

Biology letters, 17(4), p.20200699

Inadequate and inequitable distribution of research capacity and resources limits both the opportunity for leadership and participation in science. It also results in biases of effort, poor and misinterpretation of global patterns and the availability of limited usable knowledge for current challenges. Increased participation in ocean research and decision-making is needed to account for many stressors and challenges. The current intergovernmental attention on the ocean (e.g. UN Decade of Ocean Science for Sustainable Development) and the development of technologies that

permit exploration and accelerate exploitation suggest that it is timely to focus on the ocean and its stewardship. Employing the principles of co-development, co-production and co-dissemination, this paper uses a case study of a deep reef project in Seychelles to illustrate some activities that can be employed to magnify research outcomes and legacy. We provide examples that range from ministerial briefings and planning meetings to joint fieldwork, grant allocation and co-authoring outputs. These activities helped us to align priorities, promote authentic interactions and focus on equitable science. Finally, reflecting on our experiences, we acknowledge the benefits brought by respectful and long-term partnerships, the variety of activities needed to develop these and challenges of maintaining them. In the future, we also want to include more opportunities for regional peer-to-peer learning and technology transfer.



Link to Paper: https://doi.org/10.1098/rsbl.2020.0699

Journal of *Marine Science and Engineering*

an Open Access Journal by MDPI

IMPACT FACTOR 2.033

CITESCORE 2.0 SCOPUS

Deepwater Fishes

Guest Editor:

Dr. Alexei M. Orlov
P.P. Shirshov Institute of Oceanology of the Russian Academy of Sciences (IO RAS), Moscow, Russia

orlov@vniro.ru

Deadline for manuscript submissions:
10 October 2021

Message from the Guest Editor

Deepwater fishes are very diverse group of chondrichthyans and teleosts that are widely distributed in the world's oceans from the Arctic to Antarctic, inhabiting the water column and seabed of continental slopes, seamounts, and high seas at depths greater 400 m. Despite the long period of studies of deepwater fishes and commercial exploitation of some of their resources, their importance in ecosystems is still poorly understood. Our knowledge of their taxonomy, zoogeography, evolution, phylogeny, basic biological traits, and conservation needs remain scarce. The present Special Issue will provide an overview of the current status of knowledge on the variety of topics related to deepwater fishes, including their taxonomy, zoogeography, phylogeny, molecular biology, evolution, life history, role in the ecosystem, stock assessment, fisheries, and management worldwide. Additionally, the research needs and perspectives for further advancement in this field will be identified.

FREE Identification guide to the mesopelagic fishes of the central and south east Atlantic Ocean. FAO Species Identification Guide for Fishery Purposes.

Sutton, T.T., Hulley, P.A., Wienerroither, R., Zaera-Perez, D. and J.R. Paxton. 2020.

This guide to mesopelagic fishes is now available both as a free online download and in print. Downloads and hardcopy information can be accessed via the Food and Agriculture Organization of the United Nations website http://www.fao.org/documents/card/en/c/cb0365en/.

With all the emerging threats to the mesopelagic realm, both direct (intended fisheries) and indirect (e.g., oil, gas, mining activity), we need more eyes on the midwater. This book is the first to draw together all the information about an ocean basin (in this case the South Atlantic) to provide a one-stop shop for anyone to become an expert in mesopelagic fishes.

Abstract:

This identification guide includes 552 species of mesopelagic fishes (i.e. those fishes residing primarily between 200-1000 m depth during daytime) that are known to occur in the central and south east Atlantic Ocean. Fully illustrated dichotomous keys to all taxa are provided. Species are treated in detail, with accounts including the scientific name, FAO common name in English (where available), other useful characters, size, a distribution map, and one or more illustrations. To facilitate even further the identification of the taxa, captions and arrows are added to help users quickly locate their key morphological features. The guide is intended for both specialists, and non-specialists who have a working knowledge of ichthyology.

Two new papers explore the methane seep *Sphere of Influence* in hard and soft substrates off Costa Rica:

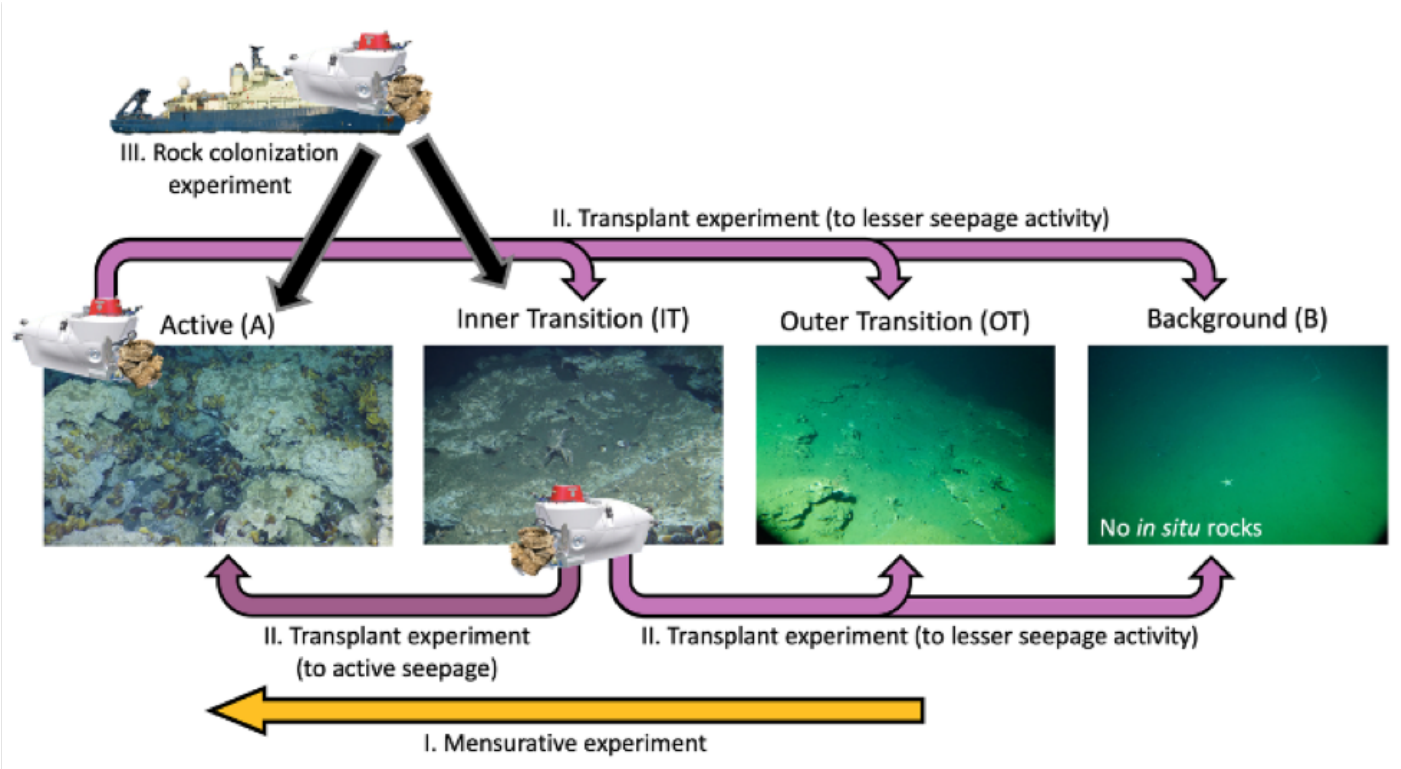
The dynamic influence of methane seepage on macrofauna inhabiting authigenic carbonates.

Olivia Pereira, Jennifer Gonzalez, Guillermo Mendoza, Jennifer Le, Connor Coscino, Ray Lee, Jorge Cortes, Erik Cordes, and Lisa A. Levin.

Ecosphere (in press)

Methane seeps are highly productive deep-sea ecosystems reliant on chemosynthetic primary production. They are increasingly affected by direct human activities that threaten key ecosystem services. Methane seepage often generates

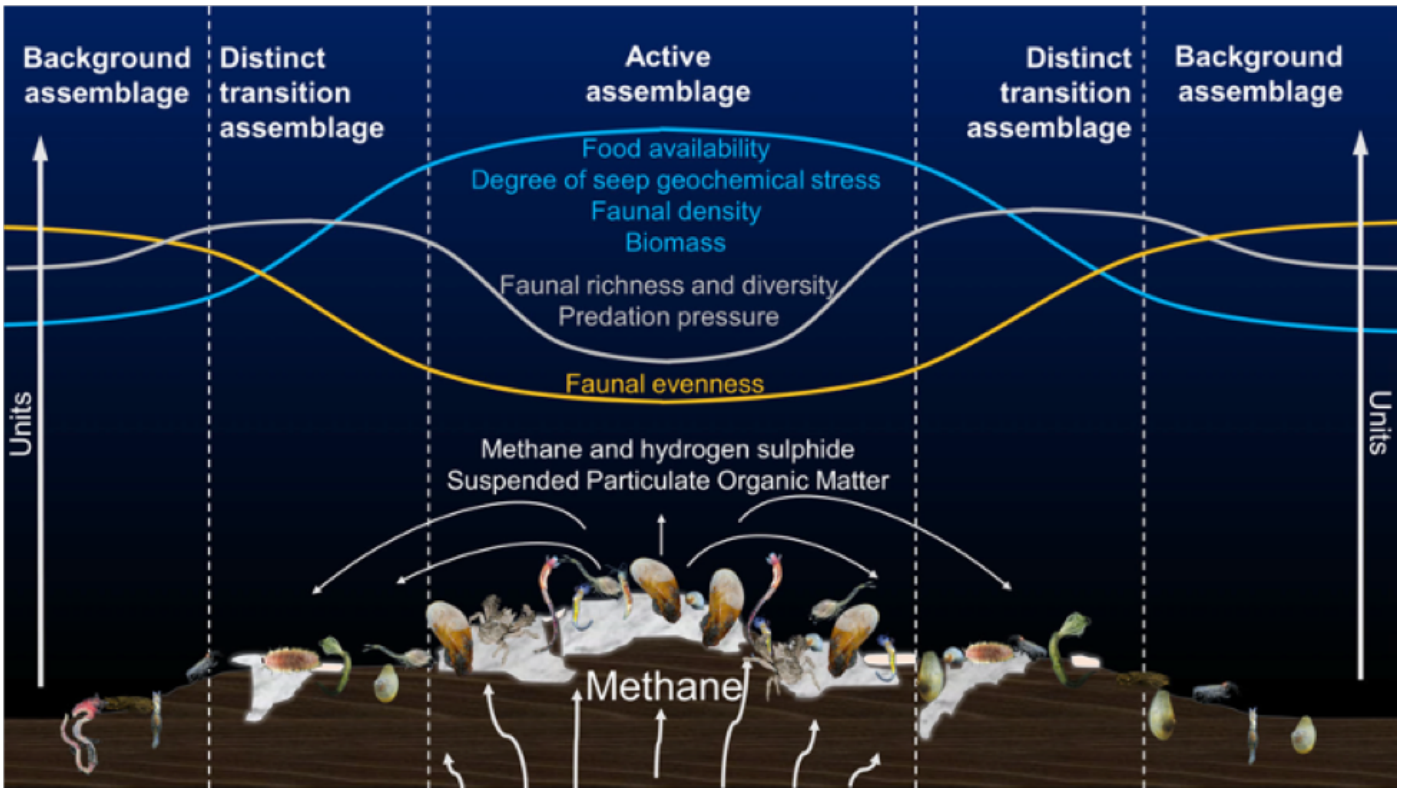
precipitation of authigenic carbonate rocks, which host diverse microbes, and a dynamic invertebrate community. By providing hard substrate, even after seepage ceases, these rocks may promote a long-lasting ecological interaction between seep and background communities. We analyzed community composition, density and trophic structure of invertebrates on authigenic carbonates at Mound 12, a seep on the Pacific margin of Costa Rica, using one mensurative and two manipulative experiments. We asked whether carbonate macrofaunal communities are able to survive, adapt, and recover from changes in environmental factors (i.e. seepage activity, chemosynthetic production, food availability), and we hypothesized a key role for seepage activity in defining these communities and responses. Communities on in situ carbonates under different seepage activities showed declining density with increasing distance from the seep and a shift in composition from gastropod dominance in areas of active seepage to more annelids and peracarid crustaceans that are less dependent on chemosynthetic production. Response to changing environmental context was evident from altered community composition following (i) a natural decline in seepage over successive years, (ii) transplanting of carbonates to different seepage conditions for 17 months, and (iii) defaunated carbonate deployments under different seepage regimes over 7.4 years. Seep faunas on transplants to lesser seepage emerge and recover faster than transition fauna (characterized by native seep and background faunas, respectively) and are able to persist by adapting their diets or by retaining their symbiotic bacteria. The macrofaunal community colonizing defaunated carbonates deployed for 7.4 years developed communities in a similar successional stage as in situ rocks, although trophic structure was not fully recovered. Thus, macrofaunal successional dynamics are affected by habitat complexity and the availability of microbial chemosynthetic productivity. This multi-experiment study highlights the interaction between biotic and abiotic factors at methane seeps at different time scales along a spatial gradient connecting seep and surrounding deep-sea communities, and offers insight on the resilience of deep-sea macrofaunal communities.



A chemosynthetic ecotone -“chemotone” -in the sediments surrounding deep-sea methane seeps

Oliver S. Ashford, Shuzhe Guan, Dante Capone, Katherine Rigney,Katelynn Rowley, Victoria Orphan , Sean W. Mullin, Kat S. Dawson, Jorge Cortes, Greg W. Rouse, Guillermo F. Mendoza, Raymond W. Lee, Erik E. Cordes, Lisa A. Levin (2021)

Limnology and Oceanography, 66



Ecotones have been described as “biodiversity hotspots” from myriad environments, yet have not been studied extensively in the deep ocean. While physiologically challenging, deep-water methane seeps host highly productive communities fueled predominantly by chemosynthetic pathways. We hypothesized that the biological and geochemical influence of methane seeps extends into background habitats, resulting in the formation of a “chemotone” where chemosynthesis-based and photosynthesis-based communities overlap. To investigate this, we analyzed the macrofaunal assemblages and geochemical properties of sediments collected from “active,” “transition” (potential chemotone), and “background” habitats surrounding five Costa Rican methane seeps (depth range 377–1908 m). Sediment geochemistry demonstrated a clear distinction between active and transition habitats, but not between transition and background habitats. In contrast, biological variables confirmed the presence of a chemotone, characterized by intermediate biomass, a distinct species composition (including habitat endemics and species from both active and background habitats), and enhanced variability in species composition among samples. However, chemotone assemblages were not distinct from active and/or background assemblages in terms of faunal density, biological trait composition, or diversity. Biomass and faunal stable isotope data suggest that chemotones are driven by a gradient in food delivery, receiving supplements from chemosynthetic production in addition to available photosynthetic-based resources. Sediment geochemistry suggests that chemosynthetic food supplements are delivered across the chemotone at least in part through the water column, as opposed to reflecting exclusively in situ chemosynthetic production in sediments. Management efforts should be cognisant of the ecological attributes and spatial extent of the chemotone that surrounds deep-sea chemosynthetic environments.

Link to paper: https://aslopubs.onlinelibrary.wiley.com/doi/full/10.1002/lno.11713

Eukaryotic Biodiversity and Spatial Patterns in the Clarion-Clipperton Zone and Other Abyssal Regions: Insights from Sediment DNA and RNA Metabarcoding

Lejzerowicz F, Gooday AJ, Barrenechea Angeles I, Cordier T, Morard R, Apothéloz-Perret-Gentil L, Lins L, Menot L, Brandt A, Levin LA, Martinez Arbizu P, Smith CR and Pawlowski J (2021)

Frontiers in Marine Science

The abyssal seafloor is a mosaic of highly diverse habitats that represent the least known marine ecosystems on Earth. Some regions enriched in natural resources, such as polymetallic nodules in the Clarion-Clipperton Zone (CCZ), attract much interest because of their huge commercial potential. Since nodule mining will be destructive, baseline data are necessary to measure its impact on benthic communities. Hence, we conducted an environmental DNA and RNA metabarcoding survey of CCZ biodiversity targeting microbial and meiofaunal eukaryotes that are the least known component of the deep-sea benthos. We analyzed two 18S rRNA gene regions targeting eukaryotes with a focus on Foraminifera (37F) and metazoans (V1V2), sequenced from 310 surface-sediment samples from the CCZ and other abyssal regions. Our results confirm huge unknown deep-sea biodiversity. Over 60% of benthic foraminiferal and almost a third of eukaryotic operational taxonomic units (OTUs) could not be assigned to a known taxon. Benthic Foraminifera are more common in CCZ samples than metazoans and dominated by clades that are only known from environmental surveys. The most striking results are the uniqueness of CCZ areas, both datasets being characterized by a high number of OTUs exclusive to the CCZ, as well as greater beta diversity compared to other abyssal regions. The alpha diversity in the CCZ is high and correlated with water depth and terrain complexity. Topography was important at a local scale, with communities at CCZ stations located in depressions more diverse and heterogeneous than those located on slopes. This could result from eDNA accumulation, justifying the interim use of eRNA for more accurate biomonitoring surveys. Our descriptions not only support previous findings and consolidate our general understanding of deep-sea ecosystems, but also provide a data resource inviting further taxon-specific and large-scale modeling studies. We foresee that metabarcoding will be useful for deep-sea biomonitoring efforts to consider the diversity of small taxa, but it must be validated based on ground truthing data or experimental studies.

Link to paper: https://www.frontiersin.org/articles/10.3389/fmars.2021.671033/full

---

The Biodiversity and Distribution of Abyssal Benthic Foraminifera and Their Possible Ecological Roles: A Synthesis Across the Clarion-Clipperton Zone

Gooday A, Lejzerowicz F, Goineau A, Holzmann M, Kamenskaya O, Kitazoto H, Lim S-C, Pawlowski J, Radziejewska T, Stachowska Z & Wawrzyniak-Wydrowska B. (2021)

Frontiers in Marine Science

Benthic foraminiferal research in the North Pacific has a long history, with works published over a century ago providing important information about the taxonomy and distribution of morphospecies. These studies focused mainly on areas outside the Clarion-Clipperton Zone (CCZ). Our knowledge of foraminiferal faunas within the CCZ originates largely from recent baseline investigations related to likely future seabed mining of the polymetallic nodule deposits. These have revealed highly diverse assemblages of sediment-dwelling morphospecies among the meiofauna and macrofauna, as well as megafaunal xenophyophores and nodule-attached fauna. Morphological analyses have been complemented by metabarcoding studies that yielded even higher numbers of molecular species (Operational Taxonomic Units - OTUs). Monothalamids, the vast majority undescribed, constitute a substantial proportion of both morphological and molecular

datasets, with multichambered agglutinated and calcareous foraminifera being less common. Their importance in this abyssal (>4,000 m depth) habitat likely reflects food limitation combined with carbonate dissolution close to and below the carbonate compensation depth. Literature records, supported in a few cases by genetic data, suggest that many morphospecies found in the CCZ have wide geographical distributions across the Pacific abyss and in other oceans. At smaller spatial scales (several 100s of kilometers) there is a general uniformity in assemblage composition. Nevertheless, many morphospecies are too rare to conclude anything about their geographical distributions. Similarly, the part played by benthic foraminifera in CCZ ecosystems is largely a matter of speculation, although their abundance across different size classes suggests that it is significant. Meiofauna-sized taxa that consume freshly-deposited organic detritus may be important in carbon cycling, particularly at the shallower, more eutrophic eastern end of the CCZ. Megafaunal xenophyophores can provide habitat structure for other organisms, potentially enhancing benthic biodiversity. Foraminifera of all sizes could be among the earliest recolonisers of disturbed or redeposited sediments. Their potential contributions in terms of both ecology and biodiversity make these protists significant members of benthic communities in the CCZ.

Link to paper: https://www.frontiersin.org/articles/10.3389/fmars.2021.634726/full

---

Application of scientific criteria for identifying hydrothermal ecosystems in need of protection

Gollner S, Colaço A, Gebruk A, Halpin P.N., Higgs N, Menini E, Mestre N.C., Qian P-Y, Sarrazin J, Szafranski K, Van Dover C.L. (2021)

Marine Policy, 132

Deep-sea hydrothermal vent fields are globally rare (abundant in numbers, but extremely small in area) and are rich in extraordinary life based on chemosynthesis rather than photosynthesis. Vent fields are also sources of polymetallic sulfides rich in copper and other metals. Mineral resources of the international seabed beyond national jurisdictions (referred to as the “Area”) are administered by the International Seabed Authority (ISA), which has the mandate to organize and control mineral resource-related activities and to ensure effective protection of the marine environment from harmful effects which may arise from such activities. To date, the ISA has approved 3 contracts for mineral exploration on the northern Mid-Atlantic Ridge (nMAR) and is developing a Regional Environmental Management Plan (REMPs) for polymetallic sulfide resources in the Area of northern MAR, including the application of area-based management tools to address the potential impacts of mining activities. Several intergovernmental organizations have developed suites of criteria to identify vulnerable, sensitive, and ecologically or biologically significant ecosystems in need of protection. In this case study, we combine criteria developed by FAO for VMEs (Vulnerable Marine Ecosystems), by CBD for EBSAs (Ecologically or Biologically Significant Areas), and by IMO for PSSAs (Particularly Sensitive Sea Areas) to assess whether the 11 confirmed vent fields on the nMAR may meet these criteria. Our assessment indicates that all vent fields meet multiple criteria for vulnerability, sensitivity, and ecological or biological significance, and 10 of 11 vent fields meet all criteria for ecosystems in need of protection.

Link to paper: https://authors.elsevier.com/sd/article/S0308-597X(21)00252-9

Obituaries

In Memoriam Dr. Mary Esther Rice - Past President of the SICB

August 3, 1926 – April 29, 2021

Look to the sea -

That's where I will be.

Look to the sky

And the birds that fly.

See the fields and the trees,

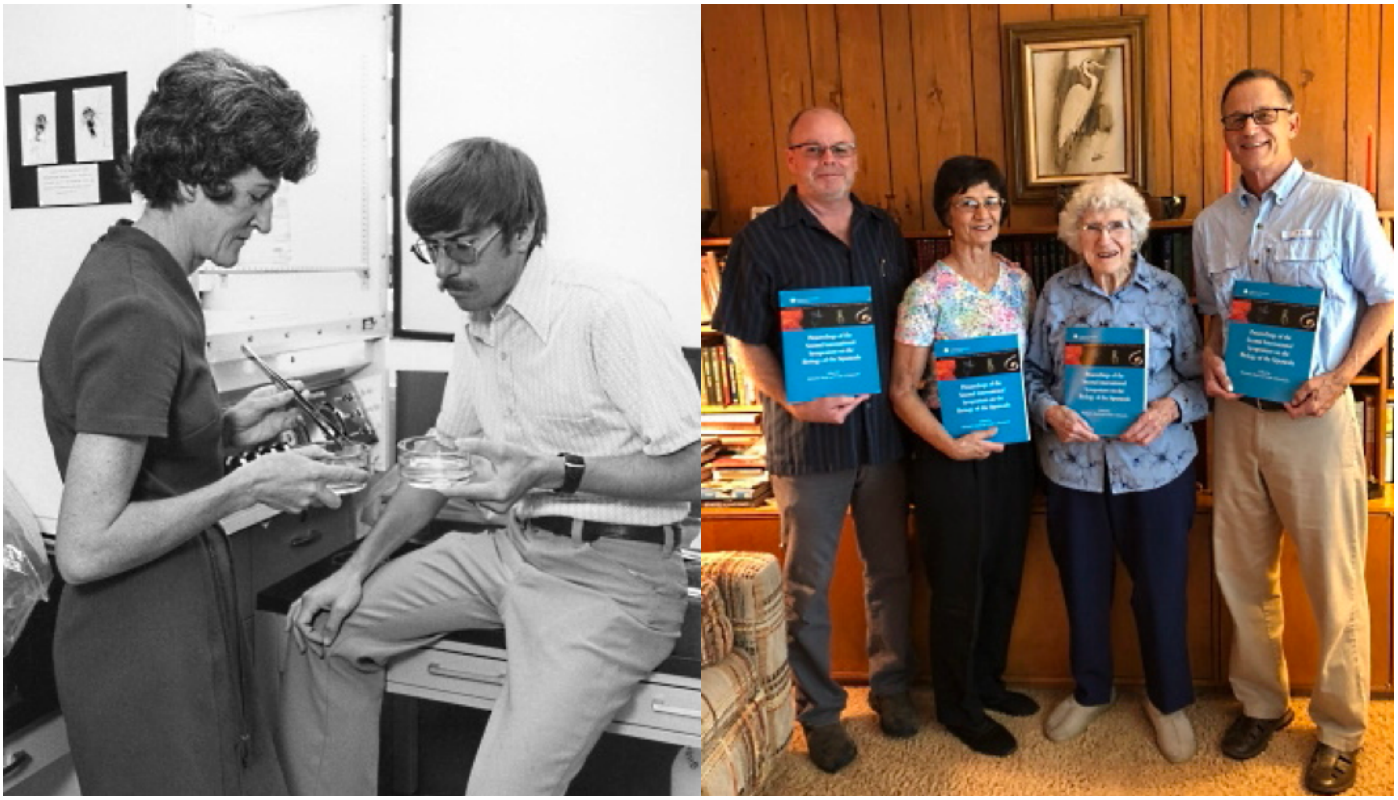
Feel the soft, cool breeze.

Know that I have become

With all of them - One.

Mary Esther Rice - Scientist, Mentor and Friend

Dr. Mary E. Rice was the first Director of the Smithsonian Marine Station (SMS) in Fort Pierce, Florida, a tropical branch of the Smithsonian Institution. She was a remarkable woman and the pillar of many scientific careers, through her Life Histories Research Program at SMS. She was also a brilliant and fiercely independent woman, scientist, person. Her specialty was the marine invertebrate Sipunculans, and she would capture larvae from the biodiverse Gulf Stream and culture them through metamorphosis to match the larvae with their adult form. Kevin Eckelbarger was hired right out of graduate school as a Research Scientist by Florida- based Harbor Branch Oceanographic Institution (HBOI) in 1973 and was a close colleague of Mary's for eighteen years. He arrived just as Dr. Rice started the Life Histories Program at SMS (see photo). Mary's first postdoctoral fellows were Ed Ruppert and John Pilger, and she mentored a number of postdocs, graduate students and faculty who went to SMS to do research. Mary embraced molecular biology as a tool and added a Molecular Lab at SMS for visiting scientists to use when they visited, as well as the resident scientists. Her last few postdoctoral fellows continued on her sipunculan research with biocoding and sequencing larvae and adults.



Left: Mary and Kevin Eckelbarger. Right: Michael Boyle, Julie Piraino, Mary Rice and Hugh Reichardt.

Mary's last Postdoctoral Fellow, Dr. Michael Boyle will carry on the Life Histories Research Program at SMS (see photo).

Mary Rice was born on a farm in Maryland to Daniel and Florence (Pyles) Rice and was a precocious child. She had one younger sister, Frances, and an older brother named Daniel. She had a pet crow named Pete who learned to talk and tease visitors from the tree above. She also told me of her love of cats and that she would send stray kittens from Drew College in Maryland back to the farm if she couldn't find an owner. She loved Biology and majored in it to receive her Bachelor of Science at Drew College. There were only three Biology majors then. She had a mentor who went to the Marine Biology Laboratory (MBL) at Woods Hole, MA in the summertime and she went several summers to do research there.

Mary felt that she finally found her calling while taking the Embryology course at the Marine Biological Laboratory (MBL) in Woods Hole, MA in 1945. Mary fell in love with embryos and larvae during the course and decided to make it her research topic. World War II was raging then and there were few men in school or applying for summer courses, and Mary felt that helped her get accepted to the Embryology Course. The course Director at the time was Victor Hamburger, who was known to take the students out for a sail on his sailboat from time to time. Another faculty member in the Embryology course was Jane Oppenheimer, who also later became the first female President of the Society for Integrative and Comparative Biology (SICB). Dr. Mary E. Rice was the third female President of SICB, which was then called the American Society of Zoology (ASZ) and she also served as President of the American Microscopical Society. She was a regular at the meetings for years, attending talks, going to dinner and exchanging Christmas gifts with friends. She was also a fellow of the American Association for the Advancement of Science. She was lifelong supporter of women in science, but she denied ever being treated differently because she was female.

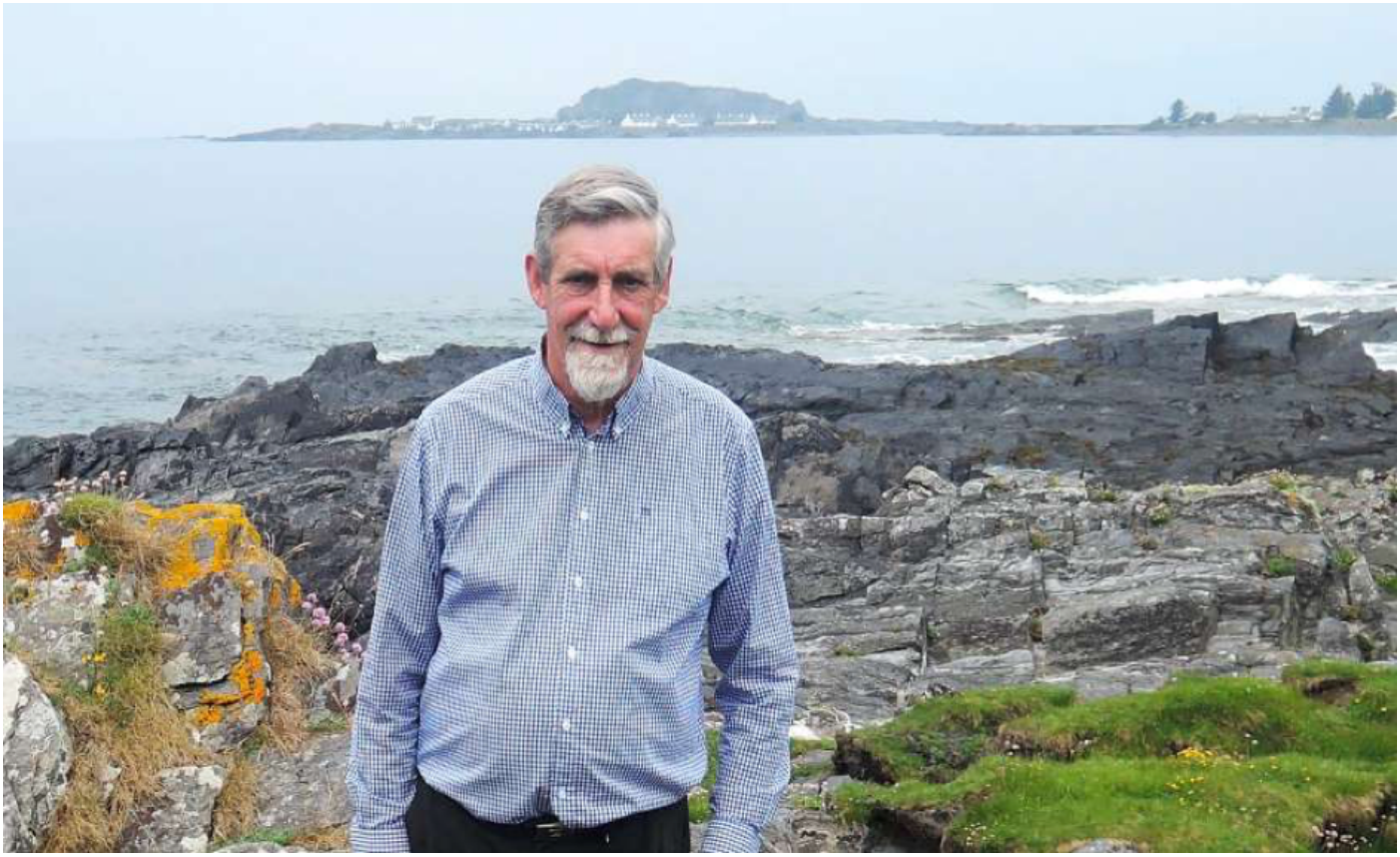
In 1961, Mary moved to the University of Washington to do graduate work on invertebrate development. She was a student of Dr. Robert Fernald, along with Fu-Shiang Chia, Colin Hermans, and Russel Zimmer. Mike Hadfield was also a UW graduate student at this time and they all became life-long friends and colleagues. Dr. Fernald told them each to pick an invertebrate group, and Mary chose Sipunculans. Mary finished her PhD in 1966 and went to the Smithsonian Institution to become a curator in the Department of Invertebrate Zoology. In 1981, she became the Director of the Smithsonian Marine Station until she retired in 2002. In 2019, Dr. Mary E. Rice won the A.O. Kovalevsky Medal from

the St. Petersburg Society of Naturalists for her work in Comparative Embryology, Development and Evolution of sipunculans.

Mary spent summers on San Juan Island, continuing to work on sipunculans and winters at Fort Pierce in Florida. She retained a love for the Friday Harbor Labs at the University of Washington where she had done her graduate work and continued to foster the Embryology Course by starting the Robert Fernald fund to support students taking the course. She would continue to work at getting the sipunculans to spawn and was always up for a spontaneous dissection and description of their internal anatomy to students. Everyone who met Mary was impressed by her intelligence, her grace and poise. She will be missed by many students, collaborators and friends.

Professor Billie J. Swalla

Dr John Gordon OBE



Dr John Gordon received his OBE in 2016

Tributes have been paid to the internationally renowned deep sea scientist Dr John Gordon OBE, who has died after a short illness.

An expert on Atlantic fisheries, Dr Gordon became one of the world's foremost researchers in deep sea ecology and remained a SAMS Fellow until his death on June 3.

Born in Edinburgh, Dr Gordon lived in Easdale, Isle of Seil, and spent his whole research career at SAMS – previously the Scottish Marine Biological Association (SMBA) – after completing a PhD at Edinburgh University.

Dr Gordon began his research in the shallow waters of the Firth of Lorn but, with the commissioning of the RRS Challenger in 1974, he moved into deeper waters (500 to 1,500 metres) to the west of Scotland's continental slope, working on the biology of the bottom-living fish, which were later commercially fished. His work over the next decade in particular contributed greatly to our knowledge of food chains in the deep sea and how commercial trawling affects fish populations in deeper water.

From 1975 to 1985 he comprehensively sampled the deep-sea demersal fish populations of the Rockall Tough and adjacent areas in the NE Atlantic before the onset of any commercial fishing activity. In so doing, John generously offered ship time on RRS Challenger to Nigel Merrett, then of the Institute of Oceanographic Services (IOS). This began an intense series of 11 joint sampling cruises over a six-year period, studying both the Rockall Trough and the adjacent Porcupine Seabight areas with the SMBA Granton trawl to 1,250m depth and the IOS semi-balloon trawl to 4,000m.

Dr Merrett said John's warm and amicable leadership through fair weather and foul - mostly foul - typically knit together the small team involved and ensured the success of this fruitful collaboration well into the future. This period of sampling led to Dr Gordon's unique description of the distribution, abundance, age, growth, diet and reproduction

of 70 species of fishes in their pristine state before human exploitation. In no other fishing ground in the world, shallow or deep, are such pre-fishery baseline data available against which to measure impacts of man and climate change.

Commercial deep-sea fisheries began in the Rockall Trough in 1989 and by 1993, the most valuable fish species, the Orange Roughy, had been fished close to extinction and other species were being depleted. In 2003 Dr Gordon wrote that "The Rockall Trough is probably one of the best studied deep-water ecosystems … is now being subjected to Unsustainable Fish Activity". Since then, Dr Gordon worked tirelessly contributing to reports, working groups, national and international bodies to implement effective regulation of deep-water fisheries. His early data have repeatedly been used in assessments of long-term changes in deep-water fish populations in the North-East Atlantic.

Former colleague Prof Monty Priede said: "John sampled in all seasons of the year including heroic mid-winter trawling when the small ship had to hide from storms behind Hebridean islands and head out to grab fishing opportunities in rough seas between weather fronts. John seemed unperturbed by such working conditions, carefully measuring, counting, and sorting specimens as the ship tossed and turned around him. "He became a master of the art of scientific deep-water trawling obtaining consistent calibrated samples of numbers of fish per unit area of sea floor, techniques which he later passed on to new generations of fishery scientists. John's pre-1989 data set stands as a stark reminder of what we have lost in the uncontrolled rush to exploit the deep-sea. Now we have also lost John Gordon himself, the staunchest advocate for sound science-based fishery management. I have known John for 47 years and he was always there as a source of advice on anything to do with deep-sea fishes. As a shipmate, colleague and friend I shall greatly miss him."

In 1994 Dr Gordon was named Buckland Professor, which involved giving public lectures on deep water fisheries at venues throughout the UK. In 1995 he was appointed chairman of the International Council for the Exploration of the Sea (ICES) Study Group on the Biology and Assessment of Deep-sea Fishery Resources, a post he held until 2000. He also provided advice and evidence to organisations such as the European Commission, the North East Atlantic Fisheries Commission (NEAFC); the Scottish Government and the House of Lords Select Committee on Science and Technology.

Dr Gordon retired in 2002 as Principal Scientific Officer at SAMS but remained an Honorary Research Fellow. On his retirement, his international reputation kept him busy as a keynote speaker and with several consultancies. In 2016, his contribution to marine science was recognised with an OBE in the Queen's Birthday Honours.

Dr Gordon spent considerable time outside the UK as visiting scientist and consultant. During visits to Norway he contributed to significant discoveries of early life stages of deep-sea fish. He also spent considerable time in Mallorca, Spain, where he contributed to Mediterranean deep-sea fish studies. Norwegian scientist Dr Odd Aksel Bergstad, with whom Dr Gordon collaborated on international projects, said: "Dr Gordon was a highly valued and inspirational colleague who will be remembered for his competence, production and leadership. His contribution to deep-sea science stands as a great legacy.

"To those who met him and worked with him, across Europe and well beyond, he will also be remembered as a very good mentor and friend. He was insightful and authoritative but informal and always willing to share. His friends and colleagues will be happy to know that he spent his final days enjoying his splendid view of the sea in Easdale, probably looking back at fond memories of his past sea-going years."

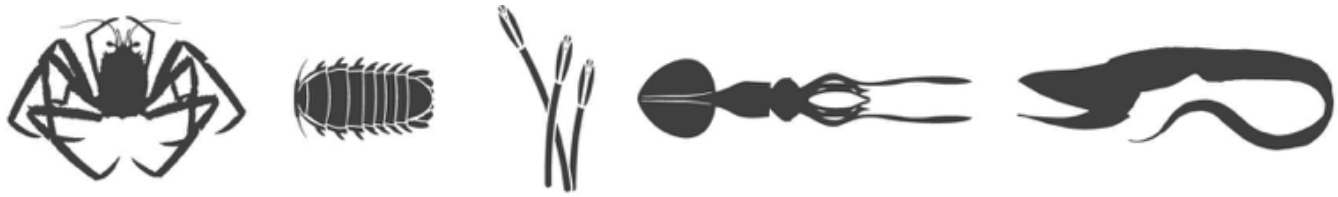
SAMS Director, Prof Nicholas Owens, said: "Dr John Gordon's name is as synonymous with SAMS and its predecessor the Scottish Marine Biological Association (SMBA), as the laboratories' names themselves. John spent his entire professional career working at the SMBA/SAMS as a marine ecologist, eventually specialising and becoming a world-leading expert in the deep-sea and fisheries. John had retired by the time I arrived at SAMS but I know all who worked with him had the most tremendous affection for him. I had the pleasure of making his acquaintance as a neighbour on the Island of Seil, where he was a pillar of the community council. John was a very gentle gentleman, who was a

pleasure to spend time with. Our communities are poorer for his absence but they have been enriched by him having been part of them."

Dr Gordon is survived by his wife, Kathleen and two sons Hamish and Colin.

From Scottish Association of Marine Science (SAMS) - By Euan Paterson

Deep-Sea Biology Society News



DEEP-SEA BIOLOGY SOCIETY

President's Letter, July 2021

Dear Deep-Sea Biology Colleagues,

It is with great pleasure, and perhaps a little bit of relief, that I write my 10th and final President's Letter to you all, and I hope you can forgive a slightly longer one than usual. After 5 years in the role (and to my great delight and perhaps greatest achievement, outlasting President Trump), I will step down at our next Annual General Meeting (AGM) which will be held during the 16th Deep-Sea Biology Symposium (16DSBS) in September. All of the positions as 'Trustees' of the Society will be open for new nominations and as usual it is likely that several of our existing Trustees will not nominate themselves to the same or other roles within the Society while others may run again. In our constitution, the outgoing President continues in a non-executive role for a further year to aid the new President, so you will not be completely done with me just yet. We will soon open a call via email and the website for nominations for the open positions, and I strongly encourage anyone interested to apply. The positions are fun, rewarding, challenging and offer fantastic networking as well as free 'on-the-job' training in managing an organisation that no training course can ever provide.

And it is a proper organisation that the Society has become. Thanks to the tireless work of all the Trustees, both in the executive and non-executive roles, our membership has grown from ~150 in 2016 to ~700 today. We have a professional membership system, official charitable and non-profit status, an updated official constitution that meets the requirements for charitable-organisation status, a working financial system able to receive and distribute large amounts of funding with full transparency and independent accounting, annual meetings for all members where votes can take place, regulation by a state body, code of ethics, a diversity officer and draft diversity action plan, data protection policy and procedures, a key role in regulating and advising the triennial DSBS symposia as well as the deep-sea coral and chemosynthesis meetings, a wide range of Society awards including free online attendance at the forthcoming 16DSBS for anyone that needs it, an early-career mentoring programme, student event and networking programmes, a website filled with news and information, 6,340 followers on twitter, a public Slack workspace with 556 members, biennial updates from the Society in the Deep-Sea Life newsletter, the ability to underwrite and take on the financial risk for conference hosting (e.g., the 2019 deep-sea coral meeting) and the ability to host online conferences (e.g., the eDSBS in 2020, attended by 357 people). There is one thing we don't have, any salaried staff, and if there is anything I take from my time helping the Society it is the remarkable achievements that our (100% volunteer) Trustees have realized mostly in their spare time and at personal and professional cost. I thank them, and all of the members and tireless committee-servers that have helped get us to this point.

But with growth comes responsibility. There is no doubt that as both our community and the size of our formal Society grows, we must take on greater responsibility and look not only at our strengths but also at our weaknesses and work

harder to deliver a more diverse, more equal and more inclusive community. We are just a small scientific society with tiny resources, but that does not excuse us from acknowledging our inequalities and listening to those that feel under-represented. We live in a world that has, and continues to be, ravaged by a pandemic that has exposed both the frailty of our existing networks and the awful biases in access to resources and health care that continue to define modern society.

In the small part of the world that is our community, we can look at the next Symposium (16DSBS) as an example of the challenges to achieve equity and justice. Myself and all the Society Trustees continue to support IFREMER and the Local Organising Committee (LOC) in the amazing efforts they have gone to make this meeting as accessible as it can be, with IFREMER contributing both large amounts of funding and taking on financial risk to host the meeting both entirely in-person and online, in what we now call the 'hybrid' format. Supporting the idea of a hybrid meeting is the data from the LOC that of the ~500 so far registered for the meeting, 200 plan to attend in-person. More abstracts have been received for 16DSBS than were received for 15DSBS. The Society has given out to date a remarkable 130 awards to help online and in-person participation in the meeting, and we can still offer more if anyone needs help. As I explained to the members in our Annual General Meeting (AGM) last year, the Trustees support the hybrid approach as it delivers some degree of accessibility to all in the time of a pandemic, and more access than any previous DSBS meeting. But we must acknowledge the inequality it creates.

Although it seemed the correct and democratic choice to offer the 16DSBS meeting to the runner-up bid (IFREMER) after the original host (JAMSTEC/Shizuoka City) withdrew, I regret that we did not hold an additional poll at the 2020 AGM on what sort of a meeting the members wanted in 2021. We are now hoping to rectify that by hosting an extensive online poll and questionnaire on what sort of meeting our Society wants for 17DSBS (in 2024) and going forward. It's also about time we polled members on other potential changes. For example, the last few years the Symposia have been heavily oversubscribed and with only 2 parallel sessions in which it's only possible to fit about 60% of submitted talk abstracts. A big change would be, for example, a 3rd parallel session that would come at the cost of smaller audiences per session and likely greater hosting expense. We need your input on these thoughts and any other thoughts and views you have on future symposia. Please fill out the poll (https://forms.gle/c5tN8SXbdS1QTfnJ6) by 9 July 2021 if you have not already done so.

What have we done and what more can we do to increase the diversity of our community and make it fairer and more inclusive? Our Diversity Officer, Raissa Hogan, outlined in a recent email to you all the actions we have taken so far, including the creation of a code of conduct, the creation of a Diversity Officer, a Diversity Fund and expanding hugely our funding to improve access to 16DSBS. Raissa has created several spaces going forward where we want to receive feedback, ideas and hopefully volunteering of time to help. These spaces include a round-table discussion at 16DSBS on 13 September 2021, a series of webinars, a channel on our public Slack where anyone can post comments, an email address and an anonymous form. I believe everyone is united in a desire to see change, but to get there we need both good ideas and volunteers to action them. With that in mind, we will soon be putting out a call for members to serve on a new Diversity Committee and we encourage anyone to apply for those positions.

One of the most important things the Society does is make sure that the symposia happen, and with that in mind I want to remind all of you that bids for hosting 17DSBS in 2024 will soon open, with online voting on the bids to open at our 2021 AGM at 16DSBS. Our meeting has only once been held outside of western Europe or the USA, never in Asia, and never in a developing nation. We would like to encourage bids from a more diverse range of hosts and in more diverse formats, and the Society is here to help. In 2019 we trialled for the first time hosting the Deep-Sea Coral meeting with complete financial risk and payment systems handled by the Society, reducing burdens on the host institutes, with great success. This system is something that will now be a possibility for all our meetings going forward, subject to approval of a financial plan from the Trustees. However, we will also maintain the option of the traditional model

where the host institute retains complete financial control of the meeting if that remains popular.

It must be said that myself, and the Trustees, have communicated to the membership rather little of the simply vast and wide-ranging discussions we have had on the challenges of improving diversity in our community and the complexities and issues involved in trying to make a conference experience work both online and in-person. We are certainly not alone, almost every other academic and professional society I know of is in the middle of the same discussion. There are a few things I am certain of: criticism is more useful than praise, so long as it's of the constructive form, and there is nothing worse than simply no feedback at all. Unfortunately, for many years, the Society has received little feedback, with low response rate to most polls and low attendance at AGMs. We are now getting more feedback from members, which I am very happy about as it shows that the Society has grown enough that people really care about how it moves forward. I challenge all of you to take up your slack/teams/zoom/twitter/email finger and attend the AGM in September to share and discuss ideas that will help the new set of Trustees take the Society forward.

We remain a long way from the end of this awful pandemic. But we must look forward and continue to plan and hope. The pandemic has forced us to rethink how we communicate, network and build partnerships and with that in mind, we can hope that our future symposia will be built on a more equitable footing for all.

There will be time I hope at our AGM in September to thank all of the outgoing Trustees that have served but I take this opportunity to do that again. And I thank you all for your support to me personally in this job that I have enjoyed so much over the last 5 years.

I wish you all the very best in your deep-sea research,

Adrian Glover
President, Deep-Sea Biology Society
president@dsbsoc.org

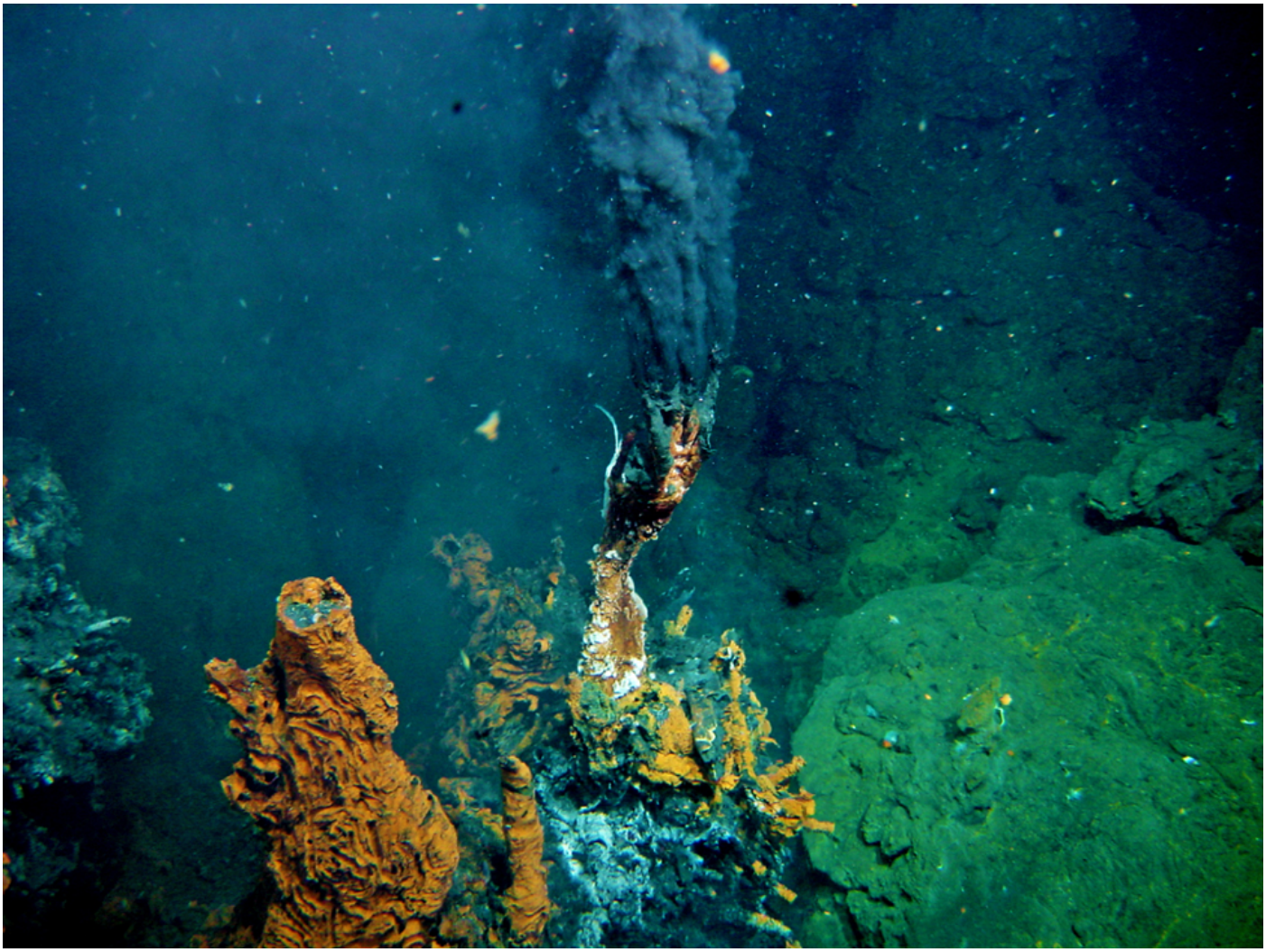
16th Deep-Sea Biology Symposium

Daniela Zeppilli

Conferences Officer

Contact: conferences@dsbsoc.org

The 16th Deep-Sea Biology Symposium will take place between 12 and 17 September 2021!



Conference format

The 16th DSBS conference will be organized as a hybrid meeting, combining an onsite meeting for delegates who can travel (up to 350 persons), with full access online for those who cannot, while aiming to promote as much interactions as possible between the two types of delegates.

We are looking forward to having an onsite meeting in Brest. However, due to the global pandemic situation, we must ensure the safety of delegates traveling and meeting at the conference and also consider the engaged catering costs.

In consequence, if the meeting should switch to a full online meeting, delegates will be proposed to change their registration from onsite to online. In this case, the difference in the registration fee will be reimbursed.

For those that are currently not sure if they can travel, it is possible to register now either for onsite or online meeting. For those that register now for online, they may later 'upgrade' their registration to onsite (up to 25 July). For those that register now for onsite meeting, they may later 'downgrade' their attendance to online only and be reimbursed

fully (up to 4 June include), less a 30 EUR administration fee (up to 20 June), and up to 25 July they can get 50% of the registration back, less the cost of online participation. Delegates that 'downgrade' after that date, may attend online but will not be reimbursed.

To stay informed about the symposium, please do not hesitate to check the latest news and follow us on twitter (@16dsbs, #16DSBS).

Registration and Financial Aid

Over 500 have registered already! Registration deadline for onsite registration is 25 July 2021, and online registration 29 August 2021. To register for the conference visit HERE.

The Deep-Sea Biology Society offers fee waivers for anyone wishing to attend online but cannot afford to, regardless of whether or not you are presenting or simply attending, listening, or actively participating. Ifremer offers five training opportunities to candidates from developing States Members of ISA to attend the 16th edition of the Deep-Sea Biology Symposium (inscription fees and travel expenses fully covered).

You can apply here if you are attending online and presenting: https://docs.google.com/forms/d/e/1FAIpQLSeLrWbd6AEJ7ZQSbdOuV4IbWNID7pwEL8-wI8aMsL-VKsqw1g/viewform and here if you just want to attend, listen in and engage with exciting deep-sea science: https://forms.gle/ZDGpiBWQLQAYK85r6

Registration for onsite attendance in Brest includes:

- Access to the conference
- Icebreaking reception on 12 September 2021
- Coffee breaks and lunches from 13 to 17 September, 2021
- Attendance at all conference onsite sessions as well as online live sessions
- Attendance at all poster sessions (with refreshments) and exhibition areas
- Access (until 30 September) to all recorded presentations and e-posters
- Connection with all online and onsite delegates (chat or video) for Q&A or private meetings
- Participation to online group chats
- Attendance to social activities on 15 September, 2021 (additional fees will apply)

Registration for online attendance includes:

- Access (until 30 September) to all presentations and e-posters recorded at the conference
- Upload of your e-presentation or e-poster on the website
- Access to live streamed sessions from the Oceanopolis Centre
- Online/remote presentation of your talk in one of the streamed sessions, if selected by the convener
- Access to online live sessions
- Connection with all online and onsite delegates (chat or video) for Q&A or private meetings
- Participation in online group chats
- Social online events for remote participants of different time zones

Student workshop

A workshop for introduction to infaunal benthic communities and the latest methods for studying them using a combination of imaging and computational methods of AI and Deep Learning.

Main organizers D. Zeppilli/Ifremer, A. Benzinou/ENIB, V. Foulon/ENIB and C. Borremans/Ifremer

"In person" and virtual session – **both limited in places.**

The registration to the workshop is free.

We offer a limited number of travel grants for students (Masters and PhD) to attend our Workshops: Those from France 200 €, from the EU 400 €, and International 800 €. In case of withdrawal the grant should be refunded.

Please complete the application form and attach a cover letter. PhD applicants should include a letter of support from their supervisor.

Applications by candidates should be received no later than **11 July 2021**.

https://wwz.ifremer.fr/bluerevolution/Events/Training-Workshop-September-19-23-2021

Awards and Prizes

Rachel Jeffreys

Awards Officer

Contact: awards@dsbsoc.org

I would like to thank the deep-sea community for giving me the opportunity to serve as your Trustee for awards over the last 8 or so years. It has been an absolute privilege and a joy. I have made some great friends whilst serving and had the opportunity to work collaboratively in a team during this time with some amazing people. Together as a Society and group of Trustees we have achieved some fantastic things. Thank you all.

Thanks to the continued support of our membership and the generosity of our sponsors we enabled the participation of 20 deep-sea scientists at the 7th International Symposium on Deep-Sea Corals (ISDSC7), Cartagena, Colombia 2019. This year, to date we have enabled the online participation of 121 deep-sea scientists and 9 deep-sea scientists to attend the 16th Deep-Sea Biology Symposium in person, in Brest, France, September 2021. We strongly believe that in these unprecedented times, all Deep-Sea Scientists should be able to attend the 16th Deep-Sea Biology Symposium and we encourage all our members to make use of the funding we have secured for any Deep-Sea Scientist to attend the symposium online free of charge, regardless of whether or not you are presenting or simply attending, listening, actively participating. Our sincere thanks go to the continued support of DSBSoc members, The Pew Charitable Trusts, Richard Lounsbery Foundation and International Seabed Authority. This funding stream will remain open until all funds are exhausted.

Join us here, if you are presenting: https://docs.google.com/forms/d/e/1FAIpQLSeLrWbd6AEJ7ZQSbdOuV4IbWNID7pwEL8-wI8aMsL-VKsqw1g/viewform and here if you just want to attend, listen in and engage with exciting deep-sea science: https://forms.gle/ZDGpiBWQLQAYK85r6

We have recognised the outstanding contributions and work of deep-sea scientists through our conference presentation awards and outstanding research article awards.

Our Dive Deeper Research Bursary, has enabled us to support the professional development of 4 early career deep-sea scientists, with further awardees to be announced later this month.

Finally, our new award, the Cruise Bursary award has enabled two early career deep-sea scientists to participate in research cruises this year.

We have supported deep-sea scientists from across the world and for a list of previous awardees please see here: https://dsbsoc.org/grants-awards/previous-society-award-recipients/

Thank you Society members, without your continued support, and active engagement, nominations for awards, this would not be possible. I would also like to extend a big thanks to my fellow Trustees, this year has been difficult and challenging for all and we have worked tirelessly alongside each other in an open and supportive way. The role of Trustee for Awards is hard work but extremely rewarding and I am happy to answer any questions from those that are interested in putting themselves forward for this position, please get in touch here: awards@dsbsoc.org

Finally, we look forward to announcing the best PhD-Thesis paper, Paper of the Year and Landmark Paper Awards at the 16th Deep-Sea Biology Symposium, where we will also be announcing the awards for best oral and poster presentations for students and early-career researchers. More information about these awards can be found here: https://dsbsoc.org/grants-awards/society-awards/

Communications

Paris Stefanoudis

Communications Officer

Contact: communications@dsbsoc.org

It has been a real privilege to be able to serve the deep-sea biology community for the last 6 years, first as the Student Officer (2015-2018) and currently as the Communications Officer (2018-2021). It has been a truly enriching experience, and has equipped me with several practical skills that I would not have dreamt of before applying to become a Society Trustee back in the 2015 Aveiro DSBS meeting.

With that, I would like to briefly summarise some key achievements over the last three years:

Social media. There has been a continuous growth of our social media presence, with the Society Twitter account currently counting >6,300 followers, more than 3 times to where it was in June 2018 (~2,100). This result is a testament to our growing community, the several new initiatives spearheaded by Society Trustees that have increased the Society's exposure including but not limited to "Meet the next generation of deep-sea researchers", the Mentoring Scheme, Early-Career webinars, the variety of awards, the Society's involvement in other deep-sea themed conferences such the 2019 ISDSC7, and of course the collaboration with DOSI in producing the Deep-Sea Life Issues.

Deep-Sea Life: It is now the 7th Issue that the Society has co-produced with DOSI (Deep-Sea Life Vol. 11-17). Most of the content is then prepared as separate blog posts hosted in the Society website and individually promoted on Twitter, which helps increase website traffic and engagement around each article story. So far, there have been ~100 blog posts which you can access here.

Society website. The Society website has been enriched over the years. You can now find all past Annual General Meetings minutes here, student profiles here, past awardees and their reports here, past Symposia books of abstracts (although still incomplete!) here, and deep-sea resources here. It has also been used very successfully for eDSBS in 2020. Plans that are still on the horizon, but likely to be completed by the next set of Trustees, include featuring a History of the Society and past Symposia, and a dedicated section on Mentoring.

Public Slack. This workspace has been set up during the 15DSBS in Monterey, and ever since it has been a hub for informal discussion, exchange of ideas, announcement of opportunities, and a parallel communications tool for conferences (e.g. eDSBS). With >550 registered members, it's a great way to connect with your peers on an informal basis, set up channels with specific themes, or create private chat groups (e.g. for working group discussions or mentoring groups). Use http://j.mp/dsbs_slack to join, and if you are already connected you can visit it via https://dsbsoc.slack.com.

There are many more things that can be done to enhance communication and engagement between the Society and its membership, therefore, I would strongly encourage those of you who have the ideas and the time to implement them, to step forward and nominate yourselves for the position of the Communications Officer. If you are considering applying or not sure if you want to yet, please do not hesitate to contact me, and I would be more than happy to explain what the position entails. Even if you are not considering running for a position, you can always contact the Officers via email or by using the public Slack to discuss potential ideas / issues.

Diversity

Raissa Hogan

Diversity Officer

Contact: diversity@dsbsoc.org

In this short time I have served as a DSBS diversity officer, it has been an honour to work towards Diversity, Equity, Inclusion and Antiracism (DEIA) (that I care so dearly in my heart) applied in the deep-sea field (which I love so much). I would like to deeply thank the deep-sea community for all the support, feedback, and discussions. Your participation is invaluable, and without it, it will be difficult, if not impossible, to grow as a community. I would also like to express my gratitude to all the Trustees for their amazing work and vulnerability in this incredibly intense, hard and beautiful moment.

An extended update of the DEIA work and plans was sent a few weeks ago by email to the membership. I am leaving

here again some of the links of spaces and contacts. We appreciate any suggestions, feedback, and comments.

- Roundtable “Decolonizing deep-sea science” - 13 September 2021 - 19:00 (GMT+2).
- From July, we are organising a series of Webinars to have different DEIA themes and researchers from different career stages. (Please, feel free to send any suggestions).
- In our public Deep-Sea Biology Society Slack workspace (use http://j.mp/dsbs_slack, and if you are already connected you can visit it via https://dsbsoc.slack.com), we have opened a new Diversity channel where we all can share materials, ideas, experiences and give suggestions. To join this channel, type #diversity on the search box on the top of the main page.
- You may also send suggestions and concerns to diversity@dsbsoc.org or through an anonymous form (https://forms.gle/6NA521WQzat354dZ7).

Early-Career Support

Andrea Quattrini

Early Career Officer

Contact: early_career@dsbsoc.org

It is with great pleasure to have served as the Early Career Officer over the past three years. Through feedback from our community, we held several webinars focused on professional development (e.g., outreach, academic job applications, proposal writing) for our newest members of our deep-sea community. We also recognized the need to establish a Cruise Bursary award and have since supported several researchers to participate in research cruises. Although many of the in-person activities that I had planned were put on hold due to the pandemic, there were some really inspiring and informative virtual events that occurred. One of the highlights of my tenure was the eDSBS and the pre-meeting event on “Global Research Cruise Opportunities: Enhancing opportunities for early-career scientists.” I look forward to sharing my knowledge and other ideas with the next Early Career Officer, so that we can better build a global community of early-career researchers.

Since the last letter, we hosted a fun and informative event: ”How to be an Effective Chief Scientist on a Research Cruise”. This webinar generated interesting discussion on the Society’s public Slack and even a paper in preparation regarding some guidelines and recommendations for participating in research cruises. Thanks to Louise Allocck, Amanda Demopolous, Santiago Herrera, and Tracey Sutton for their words of wisdom for the 50 people who attended the webinar. The last webinar of the year will be about leadership. A professional leadership consultant will guide us in discovery of our leadership philosophy. Details to follow soon.

It truly has been wonderful to have met so many of you, and learn about your aspirations and challenges. I am grateful to have worked with a dedicated team of Trustees who all care deeply about our Society and the future and accessibility of deep-sea research.

Students

Ily Iglesias

Student Officer

Contact: students@dsbsoc.org

First and foremost, I am honored and humbled to have been able to represent student interests to the DSBS as the Student Officer. I joined as a relative newcomer to the world of deep-sea science and am departing with a profound sense of awe for the diversity of research topics, events and members represented by this growing community. I have been proud of the steps taken to promote diversity and equity in the deep-sea sciences and hope that the next Student Officer is able to continue this important work well into the future. If anyone is interested in serving as the next Student Officer, please don't hesitate to reach out with any questions to students@dsbsoc.org. While the intangibles of participating in this community don't come in bullet-point form, the following is a brief list of some of the activities I have taken on during my time as student trustee:

- Planned an online event as part of the upcoming 16th DSBS symposia entitled "Creating impactful graphics and figures to showcase your science." During this event we will cover hands-on training in how to create meaningful graphics for communication and publication. I hope to see everyone there!
- Hosted two successful student-panel events (representing different time zones) during eDSBS, where more established researchers provided advice and lessons learned about life beyond graduate school in the world of deep-sea science. (Panelists hailed from France, South Africa, Mexico, New Zealand, UK and Hawaii).
- In addition to continued communication to our student members, I have been working collaboratively to highlight the research and personal journey of individual students and early career scientists through the creation of student profiles for the Society website. We have already highlighted some important research and unique stories in amazing profiles, and we are keen to keep these coming. If you are interested, or would like to nominate someone to be profiled, please do not hesitate to contact students@dsbsoc.org for more information.
- Helped maintain the mentoring network to connect early career and student members with more established scientists in the deep-sea field (see following section),
- Helped review various grant applications for students and early-career researchers.
- Communicated with the International Seabed Authority on a proposed initiative to increase the participation by women, especially those from developing countries, in the deep-sea sciences.

Mentoring

Rachel Jeffreys, Andrea Quattrini & Ily Iglesias

The 2021 mentoring network has been quite successful. We currently have 10 mentoring groups with ~70 mentees and mentors. The groups meet every 4-8 weeks via an online platform and discuss a variety of topics, including but not limited to: paper writing, work-life balance, job applications and career progression. A recent check in with mentors and mentees revealed that this program is in fact beneficial to mentees, and perhaps could serve as a model for other societies.

If you are interested in joining the network please do contact mentoring@dsbsoc.org. Similarly, if you already participate in the network and have any suggestions or ideas please let us know.

Development

Julia Sigwart

Development Officer

Contact: development@dsbsoc.org

Over the last three years the Society has focussed on supporting our research community, and especially early-career researchers, by holding webinars (see Student and Early-Career sections above) and by organising virtual meetings such as eDSBS. We have sought and also managed to secure funding from Gordon and Betty Moore Foundation, Richard Lounsbery Foundation, The Pew Charitable Trusts, and The International Seabed Authority, which along with the invaluable support from the Society membership, allowed us to widen participation during the 7th International Symposium on Deep-Sea Corals (ISDSC7) in 2019, eDSBS in 2020, and the 16th Deep-Sea Biology Symposium in 2021.

We are also thinking a lot about ways to both diversify participation in deep sea biology at all career stages, and how to support under-represented groups. These are the main foci of our ongoing fundraising work, and during the next three-year term (2021-2024) we will be actively seeking ways to increase support for these efforts through donations to the Society.

Donations to the Society can be received here: https://dsbsoc.wildapricot.org/Donate

---

Membership

Santiago Herrera

Membership Officer

Contact: membership@dsbsoc.org

When I took over the role of Membership and Data Protection Officer in 2015 the society had barely over 150 members and a basic mechanism to enroll and manage members. Much has changed since. I have truly enjoyed working with the other Trustees and our members to build a larger and more diverse community. Through my tenure, I oversaw the migration of the membership management to a professional platform (WildApricot), developed a data protection plan, and executed initiatives to increase the representation of our members.

Most recently, when comparing the periods leading up to 15DSBS in 2018 and 16DSBS in 2021, the Society's membership has grown from 410 to 650 active members. The composition of the society has also changed significantly in this period of time. Women now make up 61% of the membership (up from 57% in 2018), and students 40% (up from 31% in 2018). Remarkably, the proportion of members from developing countries has almost tripled, from 3% in 2018 to 8% in 2021. This increase can be attributed to a number of actions, including the introduction of membership waivers to researchers from developing countries and in difficult financial situations in 2020, and hosting of the Society-backed 7th International Symposium on Deep-Sea Corals in Cartagena, Colombia in 2019. The society now has members representing 48 countries (covering all continents), including 18 developing nations. Most recently, we migrated the membership payment system from PayPal to the Stripe platform. This switch should facilitate Credit Card payments to places of the world where PayPal was not effective.

I leave my Trustee role with a sense of accomplishment and gratitude. Thank you all for your patience and understanding throughout this process. I believe that the Society is in a much better position now to carry out its mission and I look forward to our continued growth as a united community.

Finances

Chris Yesson

Treasurer

Contact: treasurer@dsbsoc.org

Since the 15th DSBS, the society has filed two sets of financial accounts with the UK charity commission. Our 2019 accounts were endorsed at the 2020 AGM and have been submitted and approved by the UK charity commission. The accounts and our annual report are publicly available on the charity commission website. Membership payments have been greatly facilitated by the introduction of the WildApricot platform. Also, in 2021 DSBS registered our charity on Amazon Smile allowing donations to be made by UK residents to DSBS when making Amazon purchases (https://smile.amazon.co.uk/ch/1173699-0).

Despite event cancellations and the general effect of the pandemic, 2020 ended up as a solid year for the Society's finances. Membership remains our main income stream, and the boost from eDSBS saw our membership income keep pace with previous years, exceeding our budget expectations for a non-symposium year. Our expenditure was lower than budgeted, due to no uptake for travel and field related awards due to COVID19 restrictions. All unspent awards will be redirected to future awards. We also secured funding from Gordon and Betty Moore Foundation to support eDSBS and the postponed CBE meeting (which will be carried forward). We are currently preparing our 2020 annual accounts and we will circulate these to the membership before the 2021 AGM.