

# Deep-Sea Life

Issue 15, June 2020

Welcome to the 15<sup>th</sup> edition of Deep-Sea Life. Safety and well-being should currently be a priority for us all and I sincerely hope you are all managing well during these unprecedented times. For some of us, with less travelling and more time within our homes due to COVID-19, there is time for reflection, despite the on-going important science and related discussions. Let us all try to make improvements somehow as we move forward, to promote a better world for current and future generations. This will require a more inclusive approach, where scientific input and legislative decisions are representative of the many, not the few. We should all aim to seek diversity of input in our work, empower others to lead, give a voice to those who are rarely heard and inspire a new generation of deep-sea stewards. I know many of us strive to do this and I know we can do more.

And so to the news from the deep and our first item this issue highlights how deep-sea science skills are being used to help fight COVID-19. Love this! You can also read about deep-sea exploration in Peru canyons, the results of the extensive biodiversity survey of the deep waters off eastern Australia, long-term deep-sea observations at Station M and PAP, the inspirational GACHINKO cruise, an exiting new project exploring the NZ seabed, new resources to explore seamounts and canyons from the comfort of your home, and much more.



Photo: Javier Sellanes of Universidad Católica del Norte, Chile

Also take a look at the new papers for 2020 you may have missed, updates from the Deep-Ocean Stewardship Initiative (look out for the new working group on pollution & debris!) and from the Deep-Sea Biology Society (President's letter). Do also read and reflect on the rich lives and great contributions of two of our colleagues who are sadly no longer with us – Ron O'Dor and Paul Allen.

Finally, this stunning photo of the issue is most likely a new species of *Munida* from a seamount of the Salas y Gómez Ridge. This specimen was collected from 545 m depth during the EPIC cruise last February onboard RV *Mirai* (JAMSTEC) (as reported in DSL 14). Thanks to Javier Sellanes of Universidad Católica del Norte, Chile for sending in this beauty.

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

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## Issue Contents

News	2	Opportunities	21
Cruise News	3	Opinions	23
Project Focus	10	Hot off the Press	24
Meetings and Workshops	17	Obituaries	42
Scientist Profiles	19	Deep-Sea Biology Society News	45

# News

## Deep-Sea Biologist Responds to the COVID-19 Crisis

Teresa Amaro

*Interdisciplinary Centre of Marine and Environmental Research (CIIMAR/CIMAR), University of Porto, Portugal*



Nowadays, if one wants to survive in science, one has to be able to be reinvented several times. Therefore, along the course of these years, I have learnt to adapt to the situation several times and that is why I have acquired a broad range of skills and gained experience in using a wide variety of techniques.

On the 13<sup>th</sup> March, at the end of the day, we were advised in Portugal to go home and remain there until further notice. All of a sudden, all lab work had to stop. The Coronavirus arrived in Portugal and started to spread among people exponentially. Although I had some projects to write and some papers to finish, I could not just stay home and do nothing during this time. I had to go outside and do something to help. Thus, I started to think how I could use my deep-sea knowledge and experience to help at the hospital. After reading the few papers available, I realized that the tests that were done to diagnose if a person is positive or negative, was “simply” doing RNA extractions followed by real-time PCR. Thanks to my experience at NIOZ and at UNIVPM, I could actually help. Instead of extracting sedimentary bacteria from abyssal holothurians, I could extract the Coronavirus RNA from the samples.

I started applying for volunteer work at the hospital and after 2 weeks the pathology director from a hospital here in Porto gave me a call. All of a sudden, I was doing 200 extractions and PCR during each 12h shift. That reminded me of the scientific cruises I do to obtain the data I need.

The experience at the hospital was very different from the scientific world. They do work in a completely different way, as they need to accomplish very different objectives, and at the end of the day they are not used to being pushed to write everything down. They simply do not have the time to process the data and write it down. They have more than 1000 samples (PCRs, serology tests, historical diagnoses, etc.), but their mind is not targeted to immediately publish it. They are there to help people, us! How happy a deep-sea ecologist would be with more than 1000 data points!!!!

# Cruise News

## Deep-Sea Exploration in Peru

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Deep-sea ecosystems represent the most important and largest marine biome on the planet. However, over the last few decades, these extreme environments have garnered an increase in interest from society, which is reflected by a renewed focus on funding more multidisciplinary research (e.g. geology, physical oceanography, deep-sea habitat ecology, biodiversity, endemism studies, marine chemical compounds, alternative energies, etc.). Despite this, only ~ 1% of the world's deep ocean has been explored.



Research vessel BAP *Carrasco* during the XXVII ANTAR Campaign

Last year, we applied to the Natural Environment Research Council (NERC)-UK for funding for an international cooperation project. In a first foray in this field, the project aimed to explore benthic communities (e.g. autotrophic bacteria, protozoan and metazoan meiofauna, macrofauna), and biogeochemical processes under hypoxia in a submarine canyon off Northern Peru (~7°S). Although this project was not selected for funding, this experience served not only to

highlight our interest in studying a deep-sea ecosystem chronically affected by an intense oxygen minimum zone, but also to show the institutional effort of the Instituto del Mar del Perú in acquiring an 8-tube MUC (Ø110 mm, reaching ~ 6km depth) along with other benthic samplers for these specific objectives. Another favourable aspect for these initiatives has been the relatively recent acquisition by the Government of Peru of the RV BAP *Carrasco* (administered by the Peruvian Navy); one of the best equipped oceanographic ships in the world, with a large operational capacity, which has significantly broadened our research horizon.

Since the end of last year, we have continued in our efforts to obtain financing to conduct a cruise, ideally using the RV *Carrasco*, to explore suitable (soft sediments) sites for the deployment of benthic samplers, the collection of sediment samples and also the detection and mapping of benthic habitats (e.g. canyons, seeps) with high-resolution acoustics. Both the pandemic and the consequent lockdown produced by COVID-19 have partially slowed down all our objectives of an exploration cruise this year (most budget in national agencies is currently aiming to attend the medical emergency by funding *ad hoc* projects); meanwhile, I think this could be a good time to communicate as much as possible the current interest in Peru about these studies, the need to develop our knowledge about the ecology of our deep-sea ecosystems, the ecological services they provide, and the wish for future collaborations.



## Voyage to the Abyss

Tim O'Hara

*Museums Victoria, Australia*

In June 2017, a team of international marine biologists lead by Museums Victoria, conducted the first dedicated biodiversity survey of lower bathyal and abyssal seafloors off eastern Australia using Australia's Marine National Facility, the RV *Investigator*. Australia previously lacked the capacity to survey at these depths.

There was a lot of enthusiastic media coverage of the expedition, and it really captured the public's attention that we were exploring a completely unknown part of the planet. The excitement went international and many of you may have seen images of the faceless fish, the short-armed feeler fish, and other critters we found on the voyage.



Spiny king crab *Neolithodes bronwynae* (photo K Gowlett-Holmes/CSIRO)

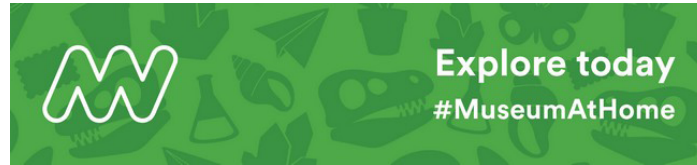
It took 2.5 years after the voyage for a small army of taxonomists to identify the specimens, and for me and others to analyse the results. But now the results are published, which (I think) are just as interesting as the spectacular imagery. The full report, including pre-prints of all papers cited below, is at <https://www.nespmarine.edu.au/document/eastern-australian-marine-parks-biodiversity-assemblage-structure-diversity-and-origin>.

The tropical-temperate transition in benthic community structure, so evident to us in shallow water (corals vs kelps), extends all the way down into the abyss (<https://doi.org/10.1016/j.dsr.2020.103283>). The animals of the tropical abyss are different from those in temperate latitudes. It is not clear what the driver for this community change would be. Temperature, salinity or oxygen are practically constant across these latitudes at these depths. Primary production at the sea surface is higher at temperate latitudes (due to phytoplankton/salp blooms). But increased productivity is typically linked to changes in diversity or abundance (<https://doi.org/10.1111/ddi.13034>), not wholesale changes in species composition. It is fun to speculate. Maybe it is due to species composition of the phytoplankton (i.e. the diet of deep-sea animals) or factors operating the larvae of deep sea animals. Or maybe it is the force of northward deep-sea currents (which can scour the lower Australian continental margin back to rock), driving a southern fauna up against their ancient tropical cousins. We have no idea.

The new abyssal material also plugged a large sampling gap for genetic analyses. For the first time, we managed to assemble a complete phylogeny of samples from shallow water to the abyss and from the tropics to Antarctica (<https://doi.org/10.1038/s41586-019-0886-z>) for an entire class of animals (brittle stars or ophiuroids). From this we could see that the tropics in general have a relatively old fauna. In fact, the most phylogenetically remote lineages (those that stick out on long phylogenetic branches all by themselves – the ophiuroid equivalents of the coelacanth or tuatara) mainly occur between 200-1000 m in the tropics. This is the sweet spot for ancient marine relics, below the disturbances of the shallows and above the re-occurring anoxia of the very deep.

The temperate and Antarctic fauna are much younger (mostly from ~40 million years ago), originating as the Earth cooled and formed new environmental niches. Antarctica appears to be in rebound and has the highest speciation rate for any biome in our study.

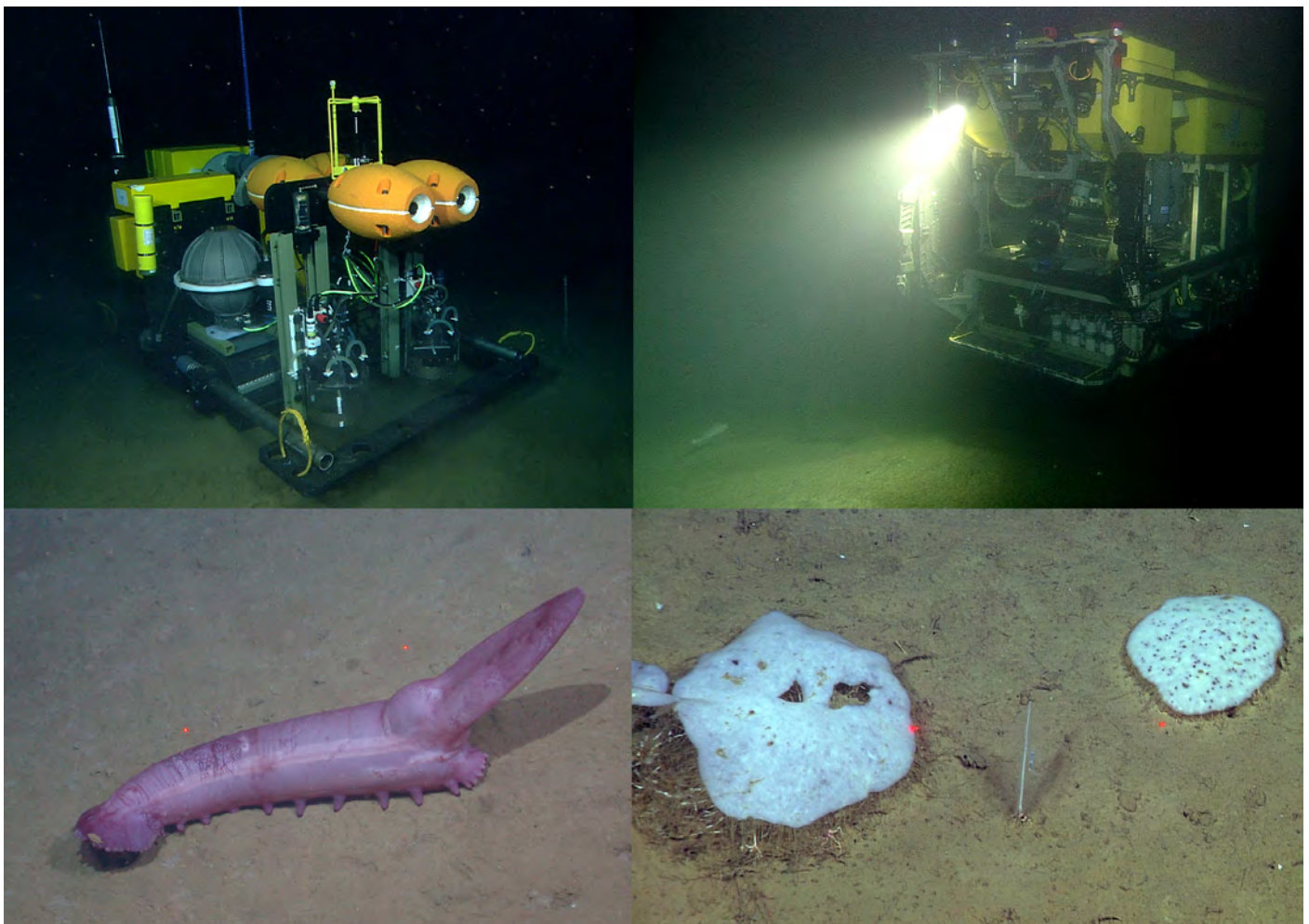
We are off again in mid-2021, this time to survey the ancient seamounts around Christmas and Cocos Keeling Islands in the eastern Indian Ocean. Another swathe of completely unexplored seafloor.



## Celebrating Three Decades of Deep-Sea Research at Station M

Henry Ruhl

MBARI, USA



In June 1989, an abyssal time-series station was established at Station M, a flat, muddy seafloor area beneath a seasonal chlorophyll-rich plume that often extends west of Point Conception over abyssal depths (about 4,000 meters). It was hypothesized that seasonal spikes in surface productivity would afford an opportunity to track this food source through the water column and identify its impact at abyssal depths. From this original plan, the study expanded to a much broader scope of monitoring inter-annual to decadal changes.

Since 1989, many research approaches have been used at Station M, including satellite imaging, water collections throughout the water column, photography and sampling of seafloor sediments and organisms, and data collection using autonomous seafloor cameras, samplers, and rovers.

When observed over time, significant changes occurred in surface water temperature and export flux of carbon at Station M. These have manifested through the water column to the seafloor. For example, between 2011 and 2018, there were pronounced increases in particulate organic carbon flux, seafloor aggregate coverage, and sediment community oxygen consumption. Changes in seafloor life and its function, from microbes to megafauna, were also studied. Such changes, along with others reported, strongly indicate a dynamic deep-sea ecosystem at Station M influenced by climate and upper ocean conditions.

- Understanding the remote influences of ocean weather on the episodic pulses of particulate organic carbon flux, H.A. Ruhl, F. Bahr, S. Henson, W.B. Hosking, B. Espinola, M. Kahru, P. Daniel, P. Drake, C.A. Edwards, <https://doi.org/10.1016/j.dsr2.2020.104741>.
- Satellite estimation of carbon export by sinking particles in the California Current calibrated with sediment trap data, M. Kahru, R. Goericke, T.B. Kelly, M.R. Stukel, <https://doi.org/10.1016/j.dsr2.2019.104639>.
- The two-component model coincidence: evaluating the validity of marine dissolved organic radiocarbon as a stable-conservative tracer at Station M, S.R. Beaupré, B.D. Walker, E.R.M. Druffel, <https://doi.org/10.1016/j.dsr2.2020.104737>
- Temporally-resolved mechanisms of deep-ocean particle flux and impact on the sea-floor carbon cycle in the Northeast Pacific, C.L. Huffard, C.A. Durkin, S.E. Wilson, P.R. McGill, R. Henthorn, K.L. Smith Jr., <https://doi.org/10.1016/j.dsr2.2020.104763>.
- DNA metabarcoding reveals organisms contributing to particulate matter flux to abyssal depths in the Northeast Pacific, C.M. Preston, C.A. Durkin, K.M. Yamahara, <https://doi.org/10.1016/j.dsr2.2019.104708>.
- Near-bottom currents at station M in the abyssal northeast Pacific, T.P. Connolly, P.R. McGill, R.G. Henthorn, D.A. Burrier, C. Michaud, <https://doi.org/10.1016/j.dsr2.2020.104743>.
- Gelatinous zooplankton abundance and benthic boundary layer currents in the abyssal Northeast Pacific: a 3-yr time series study, K.L. Smith Jr., C.L. Huffard, P.R. McGill, A.D. Sherman, T.P. Connolly, S. Von Thun, L.A. Kuhnz, <https://doi.org/10.1016/j.dsr2.2019.104654>.
- Abyssal demersal fishes recorded at Station M (34° 50'N, 123° 00'W; 4100 m depth) in the North East Pacific Ocean: an annotated check list and synthesis, I.G. Priede, J.C. Drazen, D.M. Bailey, L.A. Kuhnz, D. Fabian, <https://doi.org/10.1016/j.dsr2.2019.104648>.
- Ecological insights into abyssal benthopelagic fish at 4000 m depth using a multi-beam echosounder on a remotely operated vehicle, K.M. Dunlop, K.J. Benoit-Bird, C.M. Waluk, R.G. Henthorn, <https://doi.org/10.1016/j.dsr2.2019.104679>.
- Model study of oxygen mass transfer into persistent aggregate layers in the deep sea, T.J. Shaw, C. Boucher, K.L. Smith Jr., C.L. Huffard, <https://doi.org/10.1016/j.dsr2.2020.104760>.
- Response of deep-sea deposit-feeding rates to detrital inputs: a comparison of two abyssal time-series sites, J.M. Durden, B.J. Bett, C.L. Huffard, C. Pebody, H.A. Ruhl, K.L. Smith Jr., <https://doi.org/10.1016/j.dsr2.2019.104677>.
- Insights into the ecology of epibenthic calcareous foraminifera from a colonization study at 4000 m (Station M) in the NE Pacific Ocean, A. Burkett, A. Rathburn, R.B. Pratt, M. Holzman, <https://doi.org/10.1016/j.dsr2.2019.104709>.
- Meiobenthos from biogenic structures of the abyssal time-series station in the NE Pacific (Sta. M), M. Lampadariou, E. Syranidou, K. Sevastou, A. Tselepidis, <https://doi.org/10.1016/j.dsr2.2019.104720>.



- Benthic megafauna assemblage change over three decades in the abyss: variation from species to functional groups, L.A. Kuhnz, H.A. Ruhl, C.L. Huffard, K.L. Smith Jr., <https://doi.org/10.1016/j.dsr2.2020.104761>.
- Behaviors of sessile benthic animals in the abyssal Northeast Pacific Ocean, A.S Kahn, P. McGill, S. Leyes, <https://doi.org/10.1016/j.dsr2.2019.104729>.
- Using metabolic theory to assess structure and function in the deep-sea benthos, including microbial and metazoan dominance, C. Laguione Marchais, B.J. Bett, G.L.J. Paterson, K.L. Smith Jr., H.A. Ruhl, <https://doi.org/10.1016/j.dsr2.2020.104762>.

These papers provide a benchmark in research at Station M and in understanding deep-sea biogeochemistry and ecology. Going forward, research at the site is focused on disentangling the multiple ways in which changing surface conditions are driving deep dynamics. As human impacts become more pervasive, research at Station M and at other sites globally is helping to constrain mechanisms of biogeochemistry, biology and ecosystem function on the deep seafloor. For example, research at the Porcupine Abyssal Plain in the northeast Atlantic has also focused on addressing such issues. And, given the astounding adaptations of deep-sea life, we should be prepared for more surprises in the years ahead.

## The 'GACHINKO Cruise': Educating, Empowering, and Enthralling the Next Generation with Real Cruise Experience

Hiromi Kayama Watanabe<sup>1</sup>, Chong Chen<sup>1</sup>, Junichi Miyazaki<sup>1</sup>, Takashi Okubo<sup>2</sup>, Ken Takai<sup>1</sup> and YK19-10 cruise participants

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Photo by Takuma Onishi

Deep-sea research is a comprehensive (and expensive) field requiring enthusiasm from not only scientists but a wide range of stake-holders. Motivating the next generation to make career choices related to ocean research is critical to ensuring its future prosperity. To promote this, we organised the 'GACHINKO Cruise' project in JAMSTEC where undergraduate students could apply to join a research cruise to Suiyo Seamount vent field with the manned submersible *SHINKAI 6500* – and contest for a dive with scientists. 'GACHINKO' means 'serious confrontation' in Japanese, signifying our aim for the undergraduates to experience being actual members of the scientific party and candidates for limited, competitive dive opportunities in a genuine research cruise.

In August 2019, seven undergraduates from five universities, selected from 224 applications, boarded R/V *Yokosuka* after three days of pre-cruise tutorials. The students had diverse backgrounds and career interests. During the cruise, a key topic of discussion was "Do we really need manned submersibles?". Opinions were initially split with many favouring unmanned solutions in the light of limited budgets. After completing the cruise and three selected students diving to Suiyo in *SHINKAI 6500*, they agreed that diving in person is a unique experience and it is something that can only be achieved through the existence of manned submersibles, which can also act as beacons of inspiration leading people to ocean research. We are sure that the cruise has made lasting impacts on the students' future, and we hope to repeat this success with more 'GACHINKO Cruises' in the coming years.

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## Revisiting the Porcupine Abyssal Plain (in print at least)

Brian Bett, Jennifer Durden and Andrew Gates

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The 31<sup>st</sup> May 2020 was scheduled to be the departure date for the NOC deepseas team to visit their favourite place in the world - the [Porcupine Abyssal Plain Sustained Observatory \(PAP-SO\)](#). Alas, with the Covid-19 situation, we are landbound. Instead we are finalising a revisit to the site in print, with a [Special Issue of Progress in Oceanography](#). The planned 2020 cruise, onboard RRS *Discovery IV*, would have been number 38 in the 36-year history. That history that has called on several other vessels: FS *Meteor*, FS *Poseidon*, RRS *Challenger*, RRS *Charles Darwin*, RRS *Discovery III*, RRS *James Clark Ross*, RRS *James Cook*, and RV *Celtic Explorer*.

The story began with RRS *Challenger* cruise 6A/85, led by Mike Thurston (NOC Visiting Fellow), arriving at position 48° 50' N 016° 30' W, water depth 4850 m, at 22:00 UTC 22 June 1985. They collected its first successful sample – via an experimental amphipod trap system – the following morning. This early benthic work has now expanded to gathering time-series data about the surface ocean, and the fate of carbon at the site.

Broad European collaboration at the site began with FS *Meteor* cruise 6 – 7A/B, in May 1988, led by Olaf Pfannkuche (then Institut für Hydrobiologie und Fischereiwissenschaft, Universität Hamburg). This was a European (Economic) Community twinning project between the Institute of Oceanographic Sciences (now NOC), the universities of Hamburg, Belfast and Lisbon, and University College, Galway. European collaboration at the PAP-SO site has been more-or-less continuous since then: MAST I, MAST II, BENGAL, ALIPOR, MarBEF, HERMIONE, ANIMATE, FixO3, and currently EMSO-Link, iAtlantic, and contributions to European Research Infrastructure Consortia as an EMSO Regional Facility and an ICOS fixed ocean station. Another major collaboration has been with the Station M abyssal time-series site in the eastern Pacific, maintained by [MBARI](#), which has also recently celebrated a milestone with a [special issue](#) (see earlier article on page 5). Wider international collaboration at the PAP-SO site has included the Joint Global Ocean Flux Study (JGOFS), the Census of Marine Life field project on the Census of the Diversity of Abyssal Marine Life (CeDAMar),





With the PAP-SO 2020 cruise postponed, we look back fondly on 2019 (operations at the Porcupine Abyssal Plain Sustained Observatory are funded by the UK Natural Environment Research Council project "Climate Linked Atlantic Sector Science" (NE/R015953/1).

OceanSITES (worldwide system of long-term, open-ocean, reference stations), and the Partnership for Observation of the Global Ocean (POGO). Our 2020 cruise to the PAP-SO should have involved a link-up with the US EXPORT Processes in the Ocean from Remote Sensing ([EXPORTS](#)) NASA and NSF funded programme.

Many of you may have been to the PAP-SO site, as the cruises have provided training experiences to many young researchers. We were particularly sorry to have had to disappoint our [POGO](#) and [CLASS](#) Fellowship applicants this year – the next generation of Porcupine-ites. We all hope that these ventures will soon start again in the field, and for the moment we will keep going in print.

# Project Focus

## Depicting the Seep-Scape: Current Work on the Hikurangi Margin of New Zealand

Sarah Seabrook<sup>1,2\*</sup>, David Bowden<sup>1</sup>, Cliff Law<sup>1,3</sup>, Ashley Rowden<sup>1,4</sup> and the TAN1904 voyage team

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Gas hydrates are known to play important roles in sediment stability, marine ecology, and ocean chemistry. As global interest in commercial extraction of methane from hydrates intensifies there is an urgent need to understand what implications this may have for surrounding ecosystems. The Hikurangi Margin offshore of New Zealand is an area with both the geologic potential for hydrate mining and economic interest in such activity. HYDEE (Gas Hydrates: Economic Opportunities and Environmental Implications) is a multi-disciplinary research programme designed to address two main questions: (1) Would hydrocarbon production from gas hydrates significantly impact seafloor stability, ecology, or ocean biogeochemistry? And (2) What are the likely socio-economic implications of gas hydrate production in New Zealand?

Through three completed voyages and two planned voyages, we have been conducting targeted exploration and experimentation to answer these questions, while also making exciting discoveries along the depths of the Hikurangi Margin. Within the marine ecosystem theme of the HYDEE project, we have coupled planned transects with opportunistic ROV sampling to characterize the biogeochemistry and ecology of methane seepage along the margin. With sampling

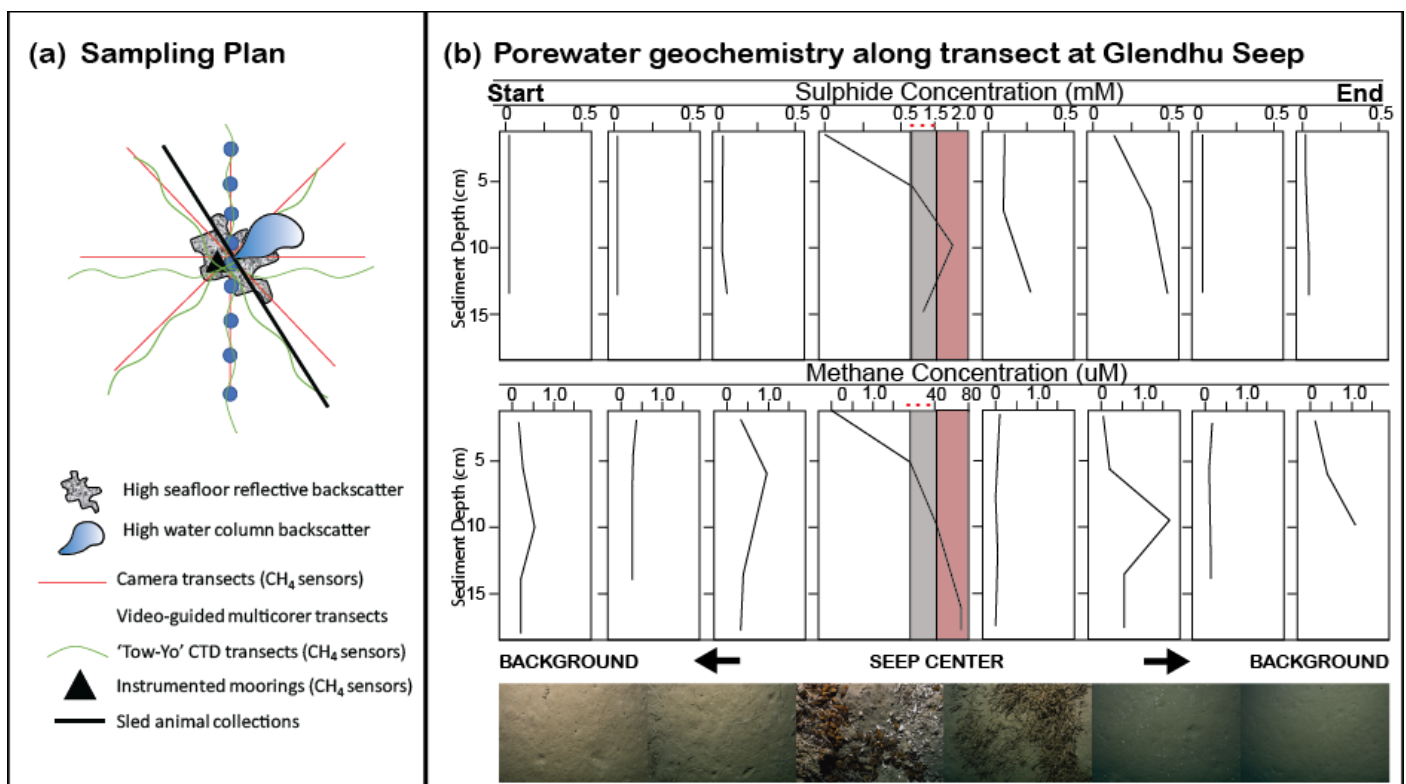


Figure 1: (a) Sampling plan that was used at the seep sites investigated in this study, (b) Vertical profiles of methane and sulphide concentrations from sediment cores collected along transects at the Glendhu seep.



following lines from the center of seep sites out to background (Figure 1a) to encompass seepage gradients, we are working to understand how seep ecosystems interact with the surrounding environment, and how these interactions may affect the future use of important ecosystem services.

As is apparent in the porewater geochemistry, as we move along the seep-scape we transition from background conditions, characterized by ambient methane and sulphide concentrations, to the center of seepage, marked with elevated concentrations (Figure 1b). From samples collected along these transect lines we will be analyzing the microbial, meio-, macro- and megafaunal communities, and various geochemical parameters to build a comprehensive picture of the seep ecotone. Preliminary analyses of the animal communities at four seep sites have revealed pronounced differences in community composition among sites. While the two shallower sites were broadly similar to others previously investigated on the margin, the deeper sites (>2,000 m) were characterized by high densities of bathymodiolin mussels and eolepadid barnacles forming close associations with upright thickets of *Lamellibrachia* tube worms (Figure 2c). Taxonomic identifications are on-going but several new species have likely been found amongst the seep sites (including shrimp and squat lobster taxa), and some new associations of known taxa with seep environments (including the eolepadid barnacles; Figure 2a,b).

As we continue our work on this project, we will be broadening our scope into mobile megafauna, including commercially important fisheries species, to investigate if there is a trophic connection between seeps and animals important to the existing New Zealand economy. We will also be digging deeper into the sediment biogeochemistry, capturing how the microbial communities may vary across these seep-scapes, and informing overall seep influence on the benthos through a broad suite of geochemical proxies.

This work is funded by the New Zealand Ministry of Business, Innovation and Employment and has benefited from collaboration with the US-funded NSF project SAFFRONZ.

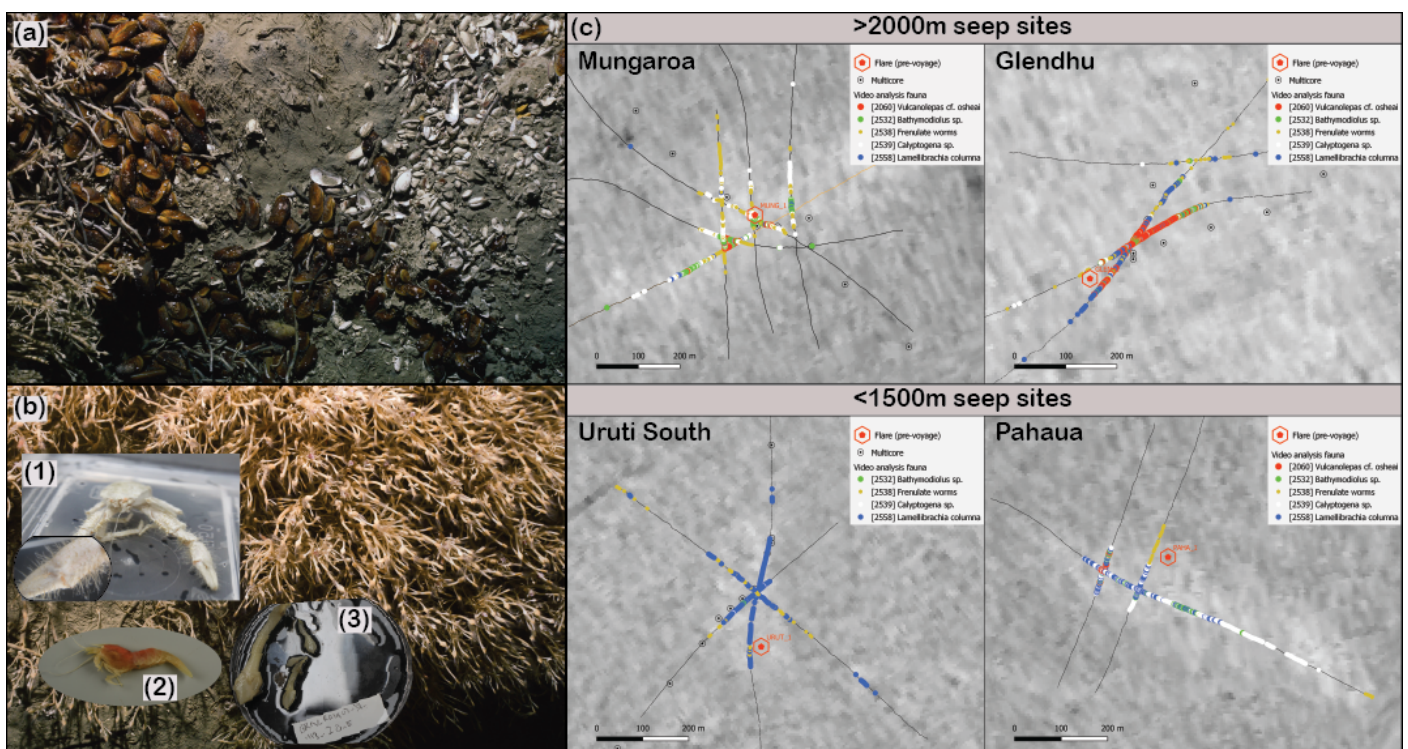


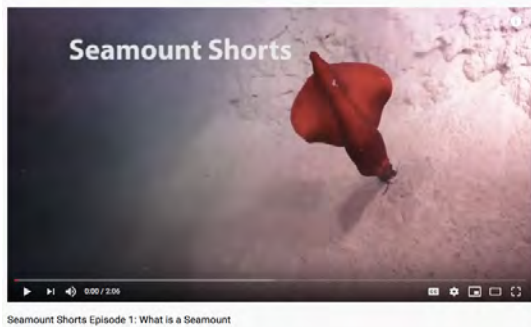
Figure 2: (a,b) Photos of mussel beds, clam beds, and tubeworm thickets that were discovered at the seep sites along the Hikurangi Margin with photos showing the squat lobsters (b1; *Munidopsis* sp.; inset shows fuzzy appendages), eolepadid barnacles (b2), and shrimps (b3) that are currently being identified. (c) Preliminary results of video analysis from the deep towed imaging system (DTIS); note site names are informal.



## Seamounts Galore!

Lance Morgan

*Marine Conservation Institute*



The Marine Conservation Institute and Mission Blue are working to develop some new and interesting content to support online engagement during the COVID-19 pandemic and we thought you may be interested to see these seamount links in relation to the California Seamounts Hope Spot on behalf of the California Seamount Coalition.

Last week we released a 'Seamount Shorts' video series narrated by Peter Coyote. You can watch the first at the link below, and don't forget to subscribe to our [YouTube Channel](#) to get updates as we release videos

in coming weeks, <https://youtu.be/dk3abbIN6Oc>.

We would also like to ask your help in protecting California's Seamounts. Please take our [Seamountaineer Pledge](#) supporting seamount conservation and asking decision makers for better and more permanent protection of these undersea treasures!



We have a number of online engagement tools that we hope you will view and share with your friends and colleagues:

- [Story Map of Seamounts](#)
- [California Seamount Coalition](#)
- [Seamount Blogs](#)
- [California Seamounts](#) on the Mission Blue Hope Spot Platform

Thanks for your help in sharing this information as widely as possible! Please feel free to reach out if you any questions, want to join the California Seamount Coalition or learn more.

Warmest regards,

Lance Morgan, PhD  
President & CEO



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## Open Public Consultation on the Deep-Sea Access Regulation

The deadline for submissions is 5 August 2020.



Photo by The New Economy

The European Commission launched a public consultation on the evaluation of the deep-sea access regulation.

The regulation aims to support the sustainability of deep-sea stocks by reducing the environmental impact of deep-sea fisheries, preventing adverse impacts on vulnerable marine ecosystems, and supporting improvements to scientific knowledge.

They are looking for feedback from as many people/organisations as possible, including the general public and those with specialist knowledge or insights. The consultation survey takes only 15 minutes to complete and is available on the [EU survey website](#). For those who

would like to give a more in-depth view, you may also upload your position paper to the consultation site.

### More information

- Deep-sea Access Regulation (ref. [\(EU\) 2016/2336](#)).
- [Public consultation on the evaluation of deep-sea access regulation](#)



## New Working Group on Deep-Sea Pollution and Debris

Lucy Woodall

*University of Oxford, UK*

### The issue:

Chemical pollution, toxic and solid residues and debris, including plastic, result from anthropogenic activities, and the ocean is often the ultimate sink. There are numerous realised and potentially harmful effects of these pollutants, which vary depending on use and material. Major types of pollution include garbage, liquid chemicals and solid residues, which make their way into the ocean through varied pathways including open dumping, spills, waste releases, natural disasters, hydroclimatological extreme events, shipping, industrial activities and from degrading debris (e.g. leaching from plastic or decomposing organic material). These direct and indirect coastal, riverine and atmospheric inputs vary from one region to another, and



Photo courtesy of Eva Ramirez-Llodra, BIOFUN, ICM-CSIC

are often greatest near the inflows. For example, nitrogen load from human activity into water ways was estimated at 32.6 MMT/yr (Mekonnen and Hoekstra 2015), and between 5 and 13 million tonnes of plastics (Jambeck *et al.* 2015). Also, between 1990 and 1999, an estimated 6.8-5000 thousand tonnes of oil entered the ocean as run-off alone (National Research Committee 2003). Assessing the impacts of these anthropogenic inputs (especially nutrient, sewage inputs from diffuse sources) and their combined effect is complicated (Jambeck *et al.* 2020), and although impacts are evident in the deep sea, few qualitative and accumulative studies are available (Ramirez-Llodra *et al.* 2011).

### References

- Jambeck, J.R., *et al.* 2015. Plastic Waste Inputs from Land into the Ocean. *Science* 347 (6223): 768–71.
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- National Research Committee. 2003. Oil in the Sea III Inputs, Fates, and Effects, National Research Council of The National Academies.
- Mekonnen, M.M. & A.Y. Hoekstra. 2015. Global Gray Water Footprint and Water Pollution Levels Related to Anthropogenic Nitrogen Loads to Fresh Water. *Environmental Science & Technology* 49 (21): 12860–68.
- Ramirez-Llodra, E., *et al.* 2011. Man and the last great wilderness: human impact on the deep sea. *PLoS one*, 6(8) e22588.

### The Working Group:

*The DOSI Pollution and Debris working group aims to:*

- Improve public understanding of, and promote research into, the patterns, impacts and relative risk of pollution and debris in the deep sea,
- Advocate for the consideration of deep-sea science in policy development and conservation initiatives, augmenting work already being done in shallow waters,
- Provide expert opinion on pollution and debris concerns through written responses, workshops, and engagement with pollution and debris-focused groups.

*Proposed initial activities:*

- Develop a list of existing groups working on marine plastic pollution with which to engage, with the aim of adding the deep-sea perspective.
- Develop a press pack, providing a unified expert opinion on the impacts of pollution and debris.
- Develop a reference listing of benthic and pelagic studies about plastic/debris/pollution in the deep-sea.
- Discuss the differing methods of assessing plastic in the marine environment, with the aim of developing a community best practise (or an evaluation of the pros and cons of each, or an inter-calibration between them).
- Develop a matrix to help inform communities of relative risk of different deep-sea threats, along with other WGs.

**Self-nominations for working group co-lead and working group members are welcomed.** Please contact Lucy on: [lucy.woodall@zoo.ox.ac.uk](mailto:lucy.woodall@zoo.ox.ac.uk)





## Deep-Sea Policy Briefs

DOSI policy briefs have been co-authored by numerous working group members (from Minerals, BBNJ and Climate working groups) and circulated during high-level meetings relating to deep-ocean regulation development. The subject matter often transcends policy processes and is hence useful for multiple fora. They summarise and highlight some of the main issues for consideration in the future management of our deep oceans. Dive in! (Click to Link to full brief)

**DOSI**

### Digital Sequence Information – Clarifying Concepts

**POLICYBRIEF**

**Why is Digital Sequence Information (DSI) important?**

DSI is the digital information generated from sequencing biological samples. It is a key component of the data generated by the sequencing process. DSI is a key component of the data generated by the sequencing process. DSI is a key component of the data generated by the sequencing process.

**DOSI**

### Ecological Connectivity: Implications for Ocean Governance

**POLICYBRIEF**

**What is Ecological Connectivity?**

Ecological connectivity is the degree to which different parts of an ecosystem are connected. It is a key component of the data generated by the sequencing process. DSI is a key component of the data generated by the sequencing process.

**DOSI**

### Ocean Deoxygenation: A Hidden Threat to Biodiversity beyond national jurisdiction

**POLICYBRIEF**

**Why is Ocean Deoxygenation a threat to biodiversity?**

Ocean deoxygenation is the loss of oxygen in the water column. It is a key component of the data generated by the sequencing process. DSI is a key component of the data generated by the sequencing process.

**DOSI**

### Strategic Environmental Goals and Objectives for Seabed Mining

**POLICYBRIEF**

**What are the Strategic Environmental Goals and Objectives for Seabed Mining?**

The Strategic Environmental Goals and Objectives for Seabed Mining are a set of goals and objectives that guide the development of seabed mining. DSI is a key component of the data generated by the sequencing process.

**DOSI**

### Diving deep into diversity: The importance of biodiversity assessment and monitoring for deep-seabed mining impacts

**POLICYBRIEF**

**Why is biodiversity assessment and monitoring important for deep-seabed mining?**

Biodiversity assessment and monitoring are key components of the data generated by the sequencing process. DSI is a key component of the data generated by the sequencing process.

**DOSI**

### The Full Value of Marine Genetic Resources (MGR)

**POLICYBRIEF**

**What is the Full Value of Marine Genetic Resources (MGR)?**

The Full Value of Marine Genetic Resources (MGR) is the value of genetic resources that are not currently being used. DSI is a key component of the data generated by the sequencing process.

**DOSI**

### Accessing and Sharing Benefits from Marine Genetic Resources from Areas Beyond National Jurisdiction: Building on Best Practices in the Scientific Community

**POLICYBRIEF**

**How can we access and share benefits from marine genetic resources?**

Accessing and sharing benefits from marine genetic resources is a key component of the data generated by the sequencing process. DSI is a key component of the data generated by the sequencing process.

**DOSI**

### Climate Change Considerations are Fundamental to Sustainable Management of Deep-Seabed Mining

**POLICYBRIEF**

**Why are climate change considerations fundamental to sustainable management of deep-seabed mining?**

Climate change considerations are fundamental to sustainable management of deep-seabed mining. DSI is a key component of the data generated by the sequencing process.

**DOSI**

### Sustaining Biodiversity Beyond National Jurisdictions: The Major Science Challenges

**POLICYBRIEF**

**What are the major science challenges for sustaining biodiversity beyond national jurisdictions?**

The major science challenges for sustaining biodiversity beyond national jurisdictions are a key component of the data generated by the sequencing process. DSI is a key component of the data generated by the sequencing process.

**DOSI**

### Strategic Environmental Assessment (SEA). Envisioning its Application to Marine Areas beyond National Jurisdiction (ABNJ)

**POLICYBRIEF**

**What is Strategic Environmental Assessment (SEA)?**

Strategic Environmental Assessment (SEA) is a key component of the data generated by the sequencing process. DSI is a key component of the data generated by the sequencing process.

**DOSI**

### Climate and Biodiversity Beyond the Limits of National Jurisdiction

**POLICYBRIEF**

**How are climate and biodiversity related in areas beyond national jurisdiction?**

Climate and biodiversity are related in areas beyond national jurisdiction. DSI is a key component of the data generated by the sequencing process.

**DOSI**

### Deep-Sea Fundamentals

**POLICYBRIEF**

**What are the fundamentals of deep-sea ecosystems?**

The fundamentals of deep-sea ecosystems are a key component of the data generated by the sequencing process. DSI is a key component of the data generated by the sequencing process.

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# DOSI on Social Media

**DOSI** @DeepStewardsh... · 15/04/2020  
"DOSI Paper of the Week": Ophiuroid material from the #CCZ mining zone was collected & examined by @Magdalena\_Chris et al. from 5 exploration areas, 1 protected area & the DISCOL area. Their paper in @EGU\_BioGeo reveals unexpected high abyssal diversity: [buff.ly/2K3ZrTu](https://doi.org/10.1002/2019EGU11911)



Paper of the Week

**DOSI** @DeepStewardsh... · 30/04/2020  
Our inaugural \*DOSI #SciPol Paper of the Week\*: @oceanpanel's #BluePaper on the #OceanGenome, which raises awareness of the critical importance of the conservation and the fair, equitable and sustainable use of marine genetic resources. Read it here: [buff.ly/2Yc9k9R](https://doi.org/10.1002/2019EGU11911)



Deep-Sea News

**DOSI** @DeepStewardship · 21/04/2020  
#GoodNewsTues in #deepsea science is the discovery of 30 new species & a siphonophore around 150ft long. The findings of the @SchmidtOcean & @wamuseum cruise to #NigalooCanyons continue to expand our limited knowledge of earth's final frontier [buff.ly/2Vlcd6d](https://doi.org/10.1002/2019EGU11911)



**DOSI** @DeepStewardsh... · 23/04/2020  
The value of time-series: 34 year-long #deepsea study @PAP\_observatory reveals significant shifts in composition of scavenging amphipod communities that mirrors surface ocean changes due to Atlantic Multi-decadal Oscillation [buff.ly/2VwVwVD](https://doi.org/10.1002/2019EGU11911) @tammy\_horton @NOCnews




Showcasing Your Work

**DOSI** @DeepStewardsh... · 02/05/2020  
What is the role of thermohaline circulation in the distribution and concentration of microplastics on the seafloor? And might deep-sea biodiversity hotspots also be microplastic hotspots? Find out in this new @ScienceMagazine paper by @SedLogic & team [buff.ly/3fakjXm](https://doi.org/10.1002/2019EGU11911)


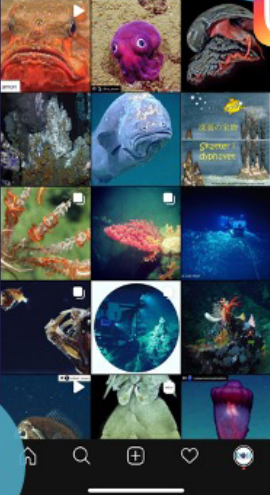


**DOSI** @DeepStewardship · 2d  
Webinars to start the week Mon 6pm BST: "New camera observations of biodiversity in shallow & deep ocean habitat" [buff.ly/2LEHgV6](https://doi.org/10.1002/2019EGU11911) Tue 1pm ET: "Options for adaptation, risk management, & resilience building in a changing climate: Q&A on IPCC Report"



Event Notification

Curated deep-sea visuals





# Meetings & Workshops

## NOAA Plans Next Deep-Sea Coral Research Initiative in Alaskan Waters

Heather Coleman

*NOAA Deep Sea Coral Research and Technology Program*

From May 12-15, 2020, the National Oceanic and Atmospheric Administration's (NOAA) Deep Sea Coral Research and Technology Program (DSCRTP) and Alaska Fisheries Science Center hosted a virtual workshop to determine priorities for their new research initiative. The DSCRTP supports rotating four-year research initiatives around the country, and the next initiative focuses on deep-sea coral and sponge research in Alaskan waters from 2021-2022. Workshop breakout sessions focused on shared priorities for coral and sponge distribution, population dynamics, genetics, effects of climate change and human activities, mapping, and data mining. The workshop gave DSCRTP and partners a better understanding of resources available to facilitate deep-sea research, known coral and sponge habitats in the region, and potential pathways for sharing the knowledge and information to be acquired from the initiative. Sixty participants represented multiple NOAA offices, the Bureau of Ocean Energy and Management, Alaskan tribal governments, the North Pacific Research Board, universities, fishing industries, and environmental NGOs. The Alaska Deep-Sea Coral Initiative plans to support research activities in 2021 and 2022, and to focus on data analysis in 2023.

Contact: [heather.coleman@noaa.gov](mailto:heather.coleman@noaa.gov)



Image caption: Red tree coral with a school of juvenile Pacific cod. Image courtesy of the Deepwater Exploration of Glacier Bay National Park expedition and University of Connecticut Northeast Underwater Research, Technology & Education Center.



## Marine Biodiversity Dialogues

Webinar: Tuesday, June 23<sup>rd</sup> at 7:00pm ET/4:00pm PT

Emily Knight

*Manager, Lenfest Ocean Program*

Global marine biodiversity plays a vital role in maintaining essential ecosystem functions, including primary productivity, food provision, and shelter. In the United States, marine sanctuaries and other strategically placed habitat protections can safeguard biodiversity hotspots, enhancing ecosystem resilience and sustaining ecosystem services upon which human communities depend. Join us on **Tuesday, June 23<sup>rd</sup> at 7:00pm ET/4:00pm PT** for a seminar featuring Dr. J. Emmett Duffy, Smithsonian Institution, and Dr. Daniel Dunn, University of Queensland, on their work convening teams of experts to develop a technical framework that will enable managers and scientists to:

- holistically assess the adequacy of marine biodiversity protections;
- target areas most in need of management action; and
- facilitate adaptation to changing ocean conditions.

**Register for the seminar [here](#).** Learn more about the project and download the fact sheet on our [webpage](#).

This work is being supported by the Lenfest Ocean Program and the National Marine Sanctuary Foundation. The seminar will be recorded and please do invite your networks.

# Scientist Profiles

## Carlos Sanchis

Master in Oceanography Student

*Universidad de Valparaíso, Chile*

Email: [carlos.sanchis@alumnos.uv.cl](mailto:carlos.sanchis@alumnos.uv.cl)



I am a Marine Biologist and am studying for a Master in Oceanography in a joint academic programme between the Universidad de Valparaíso and the Pontificia Universidad Católica de Valparaíso in Chile. Dr Eulogio Soto (UV) and Dr Eduardo Quiroga (PUCV) are mentoring my studies, which are related to macrofaunal assemblages inhabiting the surficial sediments of the Atacama trench (7742 metres), and seamounts (2895-4114 metres) in the Southeast Pacific Ocean. The data were collected during a recent oceanographic cruise onboard RV *MIRAI* organized by JAMSTEC. The main goals of this research are to investigate biodiversity, standing-stock and biogeography of these assemblages, as well as the associated seafloor biogeochemistry. I am currently examining the sediment samples from this expedition to find macrofaunal organisms, in order to assess composition, abundance and diversity. I am very pleased to be providing biological information from one of the most unknown regions in the world, especially as these areas are Ecologically and Biologically Significant Areas and Marine Protected Areas (Nazca-Desventuradas and Salas y Gómez seamounts chain and Easter island).

I enjoy studying benthic ecology, data processing and the management of statistical software. When I finish my Master studies I would like to continue deep-sea research, and aim to undertake a PhD in Chile to increase my skillset and my experience of oceanographic cruises.

## Larissa Macedo C. de Oliveira

MSc candidate

*University College Cork, Ireland*

Email: [larissa.oliveira@ucc.ie](mailto:larissa.oliveira@ucc.ie)

I am a second-year MSc research student at University College Cork, School of Biological, Earth and Environmental Science (BEES) and member of the [UCC Marine Geology Research Group](#). My research is part of the Science Foundation of Ireland (SFI) funded project MMMonkey\_Pro (Mapping, Modelling and Monitoring Key Processes and Controls of Cold-water Coral Habitats in Submarine Canyons under the coordination of Dr Aaron Lim and Prof Andy Wheeler). I am investigating new techniques for seabed image classification from 3D models derived from ROV video photogrammetry. Through applying different classification techniques, I am analysing which methodology is more appropriate for cold-water corals and submarine canyons, and which features can be analysed from 3D data as opposed to 2D. I am passionate about seabed mapping and new technologies. I am also looking for PhD opportunities in seabed habitat mapping and 3D data analysis.



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Twitter: [@LarissaMacedoC1](https://twitter.com/LarissaMacedoC1)

LinkedIn: [www.linkedin.com/in/larissa-macêdo-50a023101](https://www.linkedin.com/in/larissa-macêdo-50a023101)



# Opportunities

## Available Position: JAMSTEC is Recruiting One Position as a Researcher (II).

**Recruiting Department:** Marine Plastics Research Group (M-Plastics), Marine Biodiversity and Environmental Assessment Research Center (BioEnv), Research Institute for Global Change (RIGC)

**Job Description:** We seek a researcher who will conduct marine plastic research at the Marine Plastics Research Group (M-Plastics) of the [Marine Biodiversity and Environmental Assessment Research Center](#) (BioEnv. Director: Katsunori Fujikura).

Our group is studying the extent of marine plastic pollution from the sea surface to the deep-sea in the North Pacific, and assessing its impact on marine ecosystems using multiple approaches, including ship-board observations, laboratory experiments, and the development of innovative sampling and measurement methods/systems. Given that marine plastic pollution is currently an urgent environmental topic facing the global community, scientists are urged to provide credible evidence on the composition, distribution, and density of marine plastics by analyzing numerous samples collected by intensive ocean monitoring, efficiently and quantitatively. In close collaboration with other group members, the successful applicant will be responsible for conducting research on microplastics distribution and dynamics, and produce high-quality scientific outcomes. She/he will also be involved in various outreach activities, such as public lectures, which is the duty of any scientists working on socio-economic issues such as marine plastic pollution.

**Website:** <http://www.jamstec.go.jp/ocean-plastic/e/>

**Application Deadline: 31 July 2020**

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## FY21 Federal Funding Opportunity – Deadline Extension

In light of the challenging times facing the world, the NOAA Office of Ocean Exploration and Research has decided to extend the FY21 Federal Funding Opportunity pre-proposal deadline to **July 8, 2020** to allow the broadest participation in the funding opportunity. While the fall deadline for full submissions remains **October 22, 2020** for now, we will re-evaluate the appropriateness of this deadline later.

The full announcement for this opportunity may be found online at <https://oceanexplorer.noaa.gov/about/funding-ops/welcome.html>.

A webinar about the OER FFO was held on May 6, 2020 at 1:00 pm EDT. A recording of the webinar is available on the [OER website](#). Additional questions may be directed to [oer.fo2021@noaa.gov](mailto:oer.fo2021@noaa.gov).



ASSOCIATION OF EUROPEAN MARINE BIOLOGICAL LABORATORIES EXPANDED

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ASSEMBLE Plus offers access to over **30 marine stations and institutes** in 15 countries across Europe and overseas for basic and applied research in the marine science field (see overleaf).

Researchers from both industry and academia can apply for **on-site and remote access**. Sponsorship includes travel and subsistence for two persons (one return trip per person, up to 30 days). Successful applicants will be able to carry out their project **free-of-charge** (subject to some limitations).

Please check for updates on available services, call dates, application procedures and any further information on current and upcoming calls for access on: [www.assembleplus.eu](http://www.assembleplus.eu)

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement no. 730984 (ASSEMBLE Plus). This output reflects the views only of the author(s), and the European Union cannot be held responsible for any use which may be made of the information contained therein.

# Opinions

## Automatic Seabed Image Classification: Where Are We Going With It?

Larissa M. Oliveira

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The amount of data coming from research expeditions has increased substantially over the past decade. Data collected with state-of-the-art equipment and software has provided high-quality and high-resolution data to map and understand the seabed. Thanks to the integration of different processing platforms, marine scientists can now analyse marine environments with acoustic and photogrammetric data and beyond. Analysing terabytes of data can be time-consuming and it is not cost-effective. For example, it could take several months to analyse one dataset. Ideally, analysis of these large datasets should be fast and precise. This is where automatic seabed classification can benefit us. Training an algorithm to detect and classify seabed features from images so we can identify broad-scale environmental patterns is what a few scientists are attempting to do recently. Although automatic classification methods have progressed for image pattern recognition in Medicine and Engineering, a method that can provide reliable results for seabed classification has yet to be consolidated. When it comes to 3D point clouds derived from photogrammetric reconstructions of benthic habitats, this is even more evident. Marine scientists have teamed up with computer scientists to find methods that are able to consider the particularities of deep-sea features (e.g. identification of our sponges and corals). The requirement for precise feature analysis leads to the need for “diving” into the deepest dimensions of Computer Vision techniques (e.g. Machine and Deep Learning). With a bit of creativity, sagacity, and data analyses these tools can produce accurate results. Sounds great, doesn't it? The only thing we have yet to think about is how to make these methods accessible for non-computer scientists. Although having programming skills is becoming a requirement in any field of science, it is necessary to consider accessibility and repeatability of methods within experts of diverse backgrounds. While these methods are not accessible for a broader audience yet, there is a group of scientists who are studying how to use and adapt off-the-shelf image analysis software to analyse the seabed. This requires considerable cross-platform analyses, but the results have provided high-quality information from 3D photogrammetry data, bathymetry, and backscatter. Whilst combining different techniques, these scientists are comparing how different sources of information and methods can provide a better understanding of our seabed. Meanwhile, they are also moving from the user interface to the command line, by applying customised algorithms into their data and understanding how the results compare to application embedded in the software. Soon enough, the term “data scientist” will be carried around with marine scientists together with an ocean of new classification methods and possibilities. Stay tuned!



# Hot off the Press

## **Phospholipid Fatty Acids are Correlated with Critical Thermal Tolerance but not with Critical Pressure Tolerance in the Shallow-Water Shrimp *Palaemon Varians* During Sustained Exposure to Low Temperature**

Alastair Brown, Sven Thatje, David Pond & Andrew Oliphant (2020)

*Journal of Experimental Marine Biology and Ecology*, 529, 151394

Some extant deep-sea shrimp are known to be descended from shallow-water ancestors that adapted to environmental conditions (constant low temperature and high hydrostatic pressure) in the deep sea. During acclimation to low temperature and high hydrostatic pressure representative of the deep-sea, critical thermal tolerance decreases and critical pressure tolerance increases in the shallow-water shrimp *Palaemon varians*. It has been suggested that these shifts may depend in part on adjustments to phospholipid fatty acid composition and/or metabolic adjustments. Here, we present evidence that metabolic rate does not change during sustained exposure to low temperature (5°C) in the shallow-water shrimp *Palaemon varians*, and that metabolic rate and acute environmental tolerances are not correlated during sustained exposure to low temperature, suggesting that standard metabolic rate does not affect acute environmental tolerances. In contrast, we present evidence that phospholipid fatty acid composition does shift during sustained exposure to low temperature. Desaturation of fatty acids during sustained exposure to low temperature supports the suggestion that cell lipid bilayer homeoviscous modifications are important in low temperature acclimation. Shifts in several individual phospholipid fatty acids during sustained low temperature exposure are correlated with critical thermal tolerance. Exploring the greater complexity apparent in the responses of these phospholipid fatty acids to sustained low temperature exposures suggests a potential homeostatic impact moderating adverse impacts on nervous system function. However, shifts in phospholipid fatty acids are not correlated with critical pressure tolerance during exposure to low temperature, suggesting that shifts in critical pressure tolerance are related to modifications other than cell lipid bilayer composition.

Link to paper: <https://doi.org/10.1016/j.jembe.2020.151394>

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## **Intraspecific Variability in Larval Development in the Lithodine crab *Lithodes maja***

Alastair Brown, Sven Thatje, Kathryn E. Smith & Andrew Oliphant (2019)

*Journal of Sea Research*, 155, 101813

Interspecific comparison of larval duration in lecithotrophic deep-water lineage lithodine king crabs suggests that faster development at a given temperature is associated with greater energetic reserve utilisation. Similarly, intraspecific comparison using data from two different studies has suggested that faster development at a given temperature is associated with greater energetic reserve utilisation in the deep-water-lineage lithodine *Lithodes maja*. To assess intraspecific covariation in duration of larval development and energetic resource utilisation more robustly, we examined larval development parameters (survival, duration of development, and energetic reserve utilisation) in broods from three different captive-mated females of the northern stone crab *L. maja* incubated and maintained under identical

conditions at 6°C. Larval survival was similar among broods but duration of development differed. Energetic reserve utilisation also differed among broods with the depletion of C mass and N mass appearing greater in faster developing larvae. The greater energetic cost of more rapid development may contribute to selection pressure for increased per-offspring investment during adaptation to low temperature and high hydrostatic pressure in lithodid species. Although the limited number of broods examined prevents definitive conclusions, results presented here suggest potential links between duration of development and energetic reserve utilisation, warranting further exploration of this relationship.

Link to paper: <https://doi.org/10.1016/j.seares.2019.101813>

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## Deep-Sea Debris in the Central and Western Pacific Ocean

Diva J. Amon, Brian R. C. Kennedy, Kasey Cantwell, Kelley Suhre, Deborah Glickson,  
Timothy M. Shank and Randi D. Rotjan (2020)

*Frontiers in Marine Science*

Marine debris is a growing problem in the world's deep ocean. The naturally slow biological and chemical processes operating at depth, coupled with the types of materials that are used commercially, suggest that debris is likely to persist in the deep ocean for long periods of time, ranging from hundreds to thousands of years. However, the realized scale of marine debris accumulation in the deep ocean is unknown due to the logistical, technological, and financial constraints related to deep-ocean exploration. Coordinated deep-water exploration from 2015 to 2017 enabled new insights into the status of deep-sea marine debris throughout the central and western Pacific Basin via ROV expeditions conducted onboard NOAA Ship *Okeanos Explorer* and RV *Falkor*. These expeditions included sites in United States protected areas and monuments, other Exclusive Economic Zones, international protected areas, and areas beyond national jurisdiction. Metal, glass, plastic, rubber, cloth, fishing gear, and other marine debris were encountered during 17.5% of the 188 dives from 150 to 6,000 m depth. Correlations were observed between deep-sea debris densities and depth, geological features, and distance from human-settled land. The highest densities occurred off American Samoa and the main Hawaiian Islands. Debris, mostly consisting of fishing gear and plastic, were also observed in most of the large-scale marine protected areas, adding to the growing body of evidence that even deep, remote areas of the ocean are not immune from human impacts. Interactions with and impacts on biological communities were noted, though further study is required to understand the full extent of these impacts. We also discuss potential sources and long-term implications of this debris.

Link to paper: <https://doi.org/10.3389/fmars.2020.00369>

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## True Size Matters for Conservation: A Robust Method to Determine the Size of Deep-Sea Coral Reefs Shows They Are Typically Small on Seamounts in the Southwest Pacific Ocean

Alan Williams, Franziska Althaus, Mark Green, Kylie Maguire, Candice Untiedt, Nick Mortimer, Chris J. Jackett, Malcolm Clark, Nicholas Bax, Roland Pitcher and Thomas Schlacher (2020)

*Frontiers in Marine Science*

Protection of vulnerable marine ecosystems (VME) is a critical goal for marine conservation. Yet, in many deep-sea

settings, where quantitative data are typically sparse, it is challenging to correctly identify the location and size of VMEs. Here we assess the sensitivity of a method to identify coral reef VMEs based on bottom cover and abundance of the stony coral *Solenosmilia variabilis* on deep seamounts, using image data from a survey off Tasmania, Australia, in 2018. Whilst there was some detectable influence from varying coral cover and the abundance of live coral heads, the distribution of coral reef VMEs was not substantially shifted by changing these criteria or altering the attributes of a moving window used to spatially aggregate coral patches. Whilst applying stricter criteria for classifying VMEs predictably produced smaller areas of coral reef VME, these differences were not sizeable and were often negligible. Coral reef VMEs formed large contiguous “blankets,” mainly on the peaks and flanks of seamounts, but were absent from the continental slope where *S. variabilis* occurred at low abundance (cover) and/or had no living colonies. The true size of the Tasmanian coral reef VMEs ranged from 0.02 to 1.16 km<sup>2</sup>; this was relatively large compared to reefs of *S. variabilis* mapped on New Zealand seamounts, but is small compared to the scales used for regional model predictions of suitable habitat (typically 1 km<sup>2</sup> grid cell), and much smaller than the smallest units of management interest (100s–1000s km<sup>2</sup>). A model prediction of the area of suitable habitat for coral reef in the Tasmanian area was much greater than the area of coral reef estimated in this study. That the method to estimate VME size is not overly sensitive to the choice of criteria is highly encouraging in the context of designing spatial conservation measures that are robust, although its broader application, including to other VME indicator taxa, needs to be substantiated by scenario testing in different environments. Importantly, these results should give confidence for stakeholder uptake and form the basis for better predictive VME models at larger spatial scales and beyond single taxa.

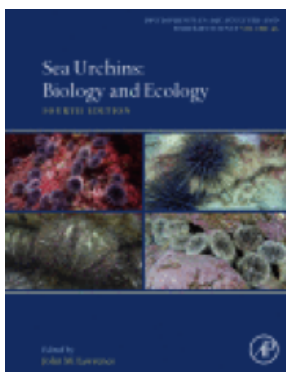
Link to paper: <https://doi.org/10.3389/fmars.2020.00187>

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## Chapter 14 - Deep-Sea Sea Urchins

Angela Stevenson & Andreas Kroh (2020)

*Developments in Aquaculture and Fisheries Science, Volume 43, Pages 237-254*



Extreme morphologies are often found in extreme conditions. Many commonalities exist in the morphology of deep and shallow-water sea urchins, but different evolutionary histories and adaptations to living at great depths have created peculiar and divergent morphologies within deep-sea sea urchins. These are highlighted alongside a list of families prevalent and charismatic in the deep sea. Following this brief introduction, life-history traits (growth and reproduction) and nutrition, including food sources, trophic positioning, nutrient partitioning, seasonal dietary shifts, and bioerosion of deep-sea corals are discussed in detail. The majority of deep-sea sea urchins appears to be deposit feeders and scavengers, but some exceptions indicate more sophisticated diets comprised of predation on living coral and highly mobile invertebrates. Our understanding of adaptations to cope with food restrictions and competitive interactions in the deep sea is still limited. However, we do know that growth and reproduction may be coupled to the influx of surface-derived phytodetritus, which heavily influences growth of all taxa and reproduction of seasonal breeders. Known patterns in distribution, abundance, and habitat associations, as well as deep-sea sea urchin interaction with predators, competitors, and symbionts are outlined. The chapter concludes with the evolutionary history of deep-sea fauna, focusing on sea urchin diversity.

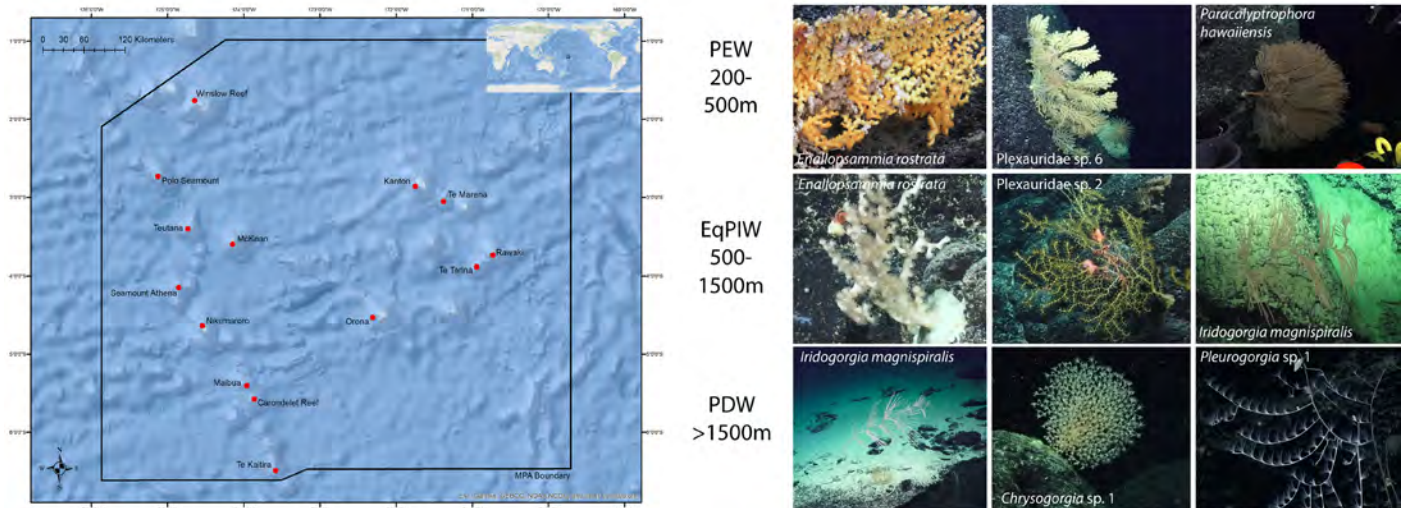
Link to paper: <https://www.sciencedirect.com/science/article/pii/B9780128195703000147>



# Oceanographic Drivers of Deep-Sea Coral Species Distribution and Community Assembly on Seamounts, Islands, Atolls, and Reefs Within the Phoenix Islands Protected Area

Auscavitch, S.R., Deere, M.C., Keller, A.G., Rotjan, R. D., Shank, T.M & Cordes, E.E. (2020)

*Frontiers in Marine Science*, 7, 42



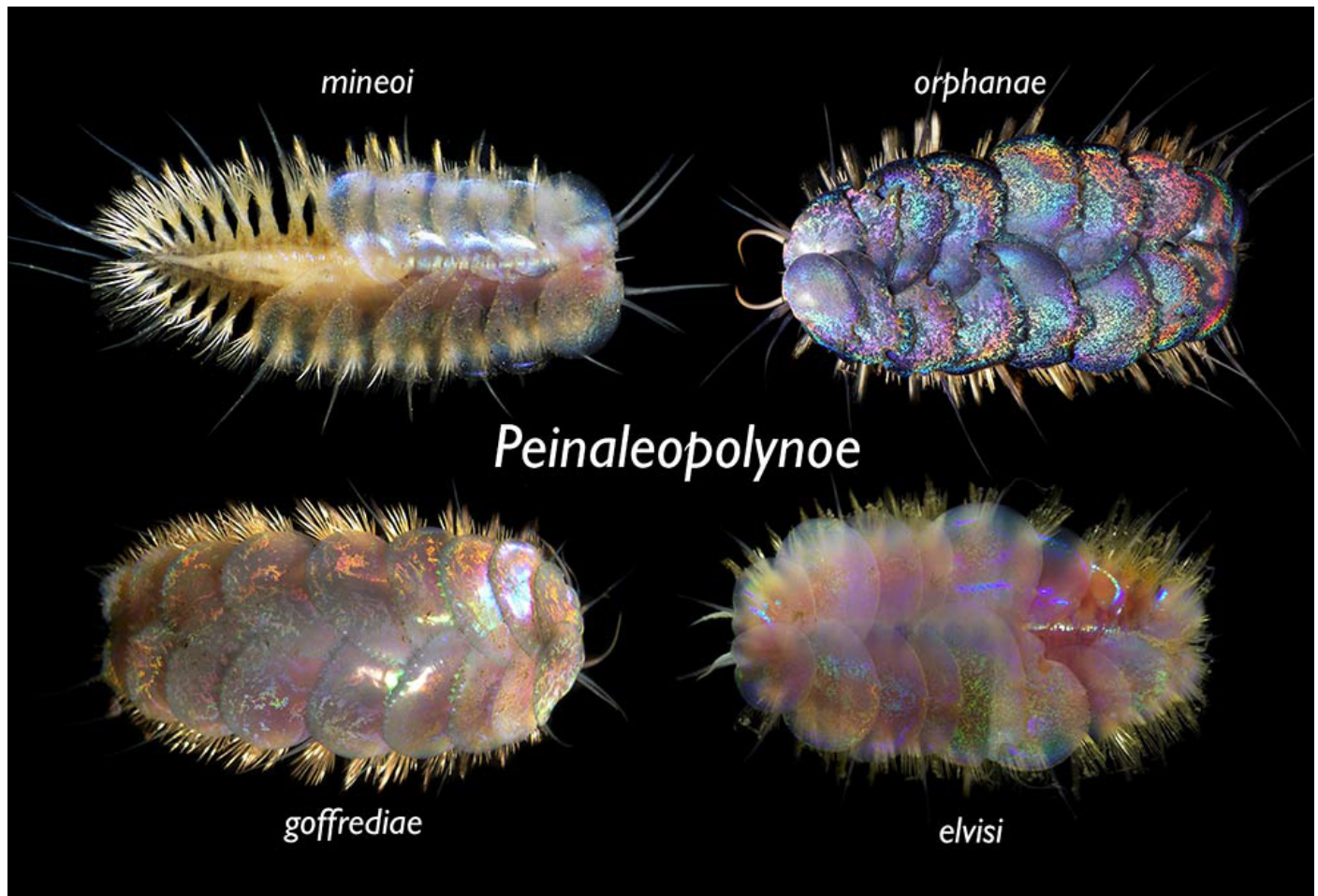
The Phoenix Islands Protected Area, in the central Pacific waters of the Republic of Kiribati, is a model for large marine protected area (MPA) development and maintenance, but baseline records of the protected biodiversity in its largest environment, the deep sea (>200 m), have not yet been determined. In 2017, explorations by the NOAA ship *Okeanos Explorer* and R/V *Falkor* were among the first to document the diversity and distribution of deep-water benthic megafauna on numerous seamounts, islands, shallow coral reef banks, and atolls in the region. Here, we present baseline deep-sea coral species distribution and community assembly patterns within the Scleractinia, Octocorallia, Antipatharia, and Zoantharia with respect to different seafloor features and abiotic environmental variables across bathyal depths (200–2500 m). Remotely operated vehicle (ROV) transects were performed on 17 features throughout the Phoenix Islands and Tokelau Ridge Seamounts resulting in the observation of 12,828 deep-water corals and 167 identifiable morphospecies. Anthozoan assemblages were largely octocoral dominated consisting of 78% of all observations with seamounts having a greater number of observed morphospecies compared to other feature types. Overlying water masses were observed to have significant effects on community assembly across bathyal depths. Revised species inventories further suggest that the protected area is an area of biogeographic overlap for Pacific deep-water corals, containing species observed across bathyal provinces in the North Pacific, Southwest Pacific, and Western Pacific. These results underscore significant geographic and environmental complexity associated with deep-sea coral communities that remain in under-characterized in the equatorial central Pacific, but also highlight the additional efforts that need to be brought forth to effectively establish baseline ecological metrics in data deficient bathyal provinces.

Link to the paper: <https://doi.org/10.3389/fmars.2020.00042>

## Hungry Scale Worms: Phylogenetics of Peinaleopolynoe (Polynoidae, Annelida), with Four New Species

Avery S. Hatch, Haebin Liew, Stéphane Hourdez, & Greg W. Rouse (2020)

*ZooKeys*, 932, 27–74



These remarkable branchiate scale worms are native to deep-sea chemosynthetic-based ecosystems, such as methane seeps, hydrothermal vents, and organic falls (namely whalefalls). They possess elaborate, arborescent branchiae underneath their scales, which allow them to thrive in these low-oxygen habitats. Their colorful iridescent scales are evidently stunning! Additionally, we observed and recorded an interesting in situ fighting behavior of *Peinaleopolynoe orphanae* at the Pescadero Basin hydrothermal vents in the Gulf of California, Mexico:

[https://www.youtube.com/watch?v=NrNAleD\\_FIQ&t](https://www.youtube.com/watch?v=NrNAleD_FIQ&t)

All these interesting characteristics have made the four new *Peinaleopolynoe* species a hot topic in the media this month. Polynoidae Kinberg, 1856 has five branchiate genera: *Branchipolynoe* Pettibone, 1984, *Branchinotogluma* Pettibone, 1985, *Branchiplicatus* Pettibone, 1985, *Peinaleopolynoe* Desbruyères & Laubier, 1988, and *Thermopolynoe* Miura, 1994, all native to deep-sea, chemosynthetic-based habitats. Of these, *Peinaleopolynoe* has two accepted species; *Peinaleopolynoe sillardi* Desbruyères & Laubier, 1988 (Atlantic Ocean) and *Peinaleopolynoe santacatalina* Pettibone, 1993 (East Pacific Ocean). The goal of this study was to assess the phylogenetic position of *Peinaleopolynoe*, utilizing DNA sequences from a broad sampling of deep-sea polynoids. Representatives from all five branchiate genera were included, several species of which were sampled from near the type localities; *Branchinotogluma sandersi* Pettibone, 1985 from the Galápagos Rift (E/V *Nautilus*); *Peinaleopolynoe sillardi* from organic remains in the Atlantic Ocean; *Peinaleopolynoe santacatalina* from a whalefall off southern California (R/V *Western Flyer*) and *Thermopolynoe branchiata* Miura, 1994 from Lau Back-Arc Basin in the western Pacific (R/V *Melville*). Phylogenetic analyses were conducted using mitochondrial (COI, 16S rRNA, and CytB) and nuclear (18S rRNA, 28S rRNA, and H3) genes. The analyses revealed four new *Peinaleopolynoe* species from the Pacific Ocean that are formally described here: *Peinaleopolynoe orphanae* Hatch & Rouse, sp. nov., type locality Pescadero Basin in the Gulf of California, Mexico (R/V *Western Flyer*); *Peinaleopolynoe elvisi* Hatch & Rouse, sp. nov. and *Peinaleopolynoe goffrediae* Hatch & Rouse, sp. nov., both with a type locality in Monterey Canyon off California (R/V *Western Flyer*) and *Peinaleopolynoe mineoi* Hatch & Rouse, sp. nov. from Costa Rica methane seeps (R/V *Falkor*). In addition to DNA sequence data, the monophyly of

*Peinaleopolynoe* is supported by the presence of ventral papillae on segments 12–15. The results also demonstrated the paraphyly of *Branchinotogluma* and *Lepidonotopodium* Pettibone, 1983 and taxonomic revision of these genera is required. We apply the subfamily name Lepidonotopodinae Pettibone 1983, for the clade comprised of *Branchipolynoe*, *Branchinotogluma*, *Bathykurila*, *Branchiplicatus*, *Lepidonotopodium*, *Levensteiniella* Pettibone, 1985, *Thermopolynoe*, and *Peinaleopolynoe*.

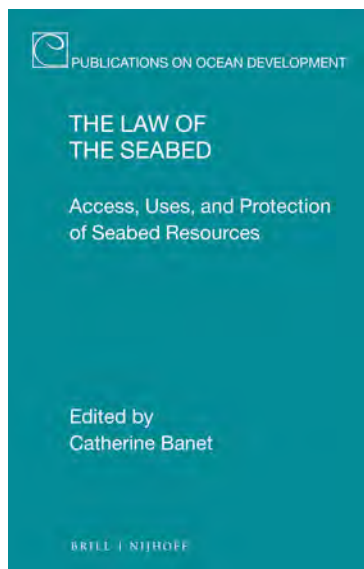
Link to paper: <https://zookeys.pensoft.net/article/48532/>

## The Law of the Seabed

Access, Uses, and Protection of Seabed Resources

Series: *Publications on Ocean Development*, Volume: 90

Editor: Catherine Banet



*The Law of the Seabed* reviews the most pressing legal questions raised by the use and protection of natural resources on and underneath the world's seabeds.

While barely accessible, the seabed plays a major role in the Earth's ecological balance. It is both a medium and a resource, and is central to the blue economy. New uses and new knowledge about seabed ecosystems, and the risks of disputes due to competing interests, urge reflection on which regulatory approaches to pursue.

The regulation of ocean activities is essentially sector-based, and the book puts in parallel the international and national regimes for seabed mining, oil and gas, energy generation, bottom fisheries, marine genetic resources, carbon sequestration and maritime security operations, both within and beyond the national jurisdiction.

The book contains seven parts respectively addressing the definition of the seabed from a multidisciplinary perspective, the principles of jurisdiction delimitation under the United Nations Convention on the Law of the Sea (UNCLOS), the regimes for use of non-living, living and marine biodiversity resources, the role of state and non-state actors, the laying and removal of installations, the principles for sustainable and equitable use (common heritage of mankind, precaution, benefit sharing), and management tools to ensure coexistence between activities as well as the protection of the marine environment.

Open Access E-Book (PDF): <https://brill.com/view/title/54208>

## Phylogenetics and Mitogenome Organisation in Black Corals (Anthozoa: Hexacorallia: Antipatharia): An Order-Wide Survey Inferred from Complete Mitochondrial Genomes

Nick J. Barrett, Raissa I. Hogan, A. Louise Allcock, Tina Molodtsova, Kevin Hopkins, Andrew J. Wheeler & Chris Yesson (2020)

*Frontiers in Marine Science*, in press





A black coral, *Dendrobathypathes* n. sp., seen at a depth of 1127 m at Whittard Canyon in the North East Atlantic, sampled in this study. Image credit: Marine Institute, NUI Galway

Black corals (Anthozoa: Antipatharia) are an ecologically and culturally important group of deep-sea cnidarians. However, as the majority of species inhabit depths >50 m, they are relatively understudied. The inaccessibility of well-preserved tissue for species of interest has limited the scope of molecular analysis, and as a result only a small number of antipatharian mitochondrial genomes have been published. On samples collected from surveys around the Irish Margin in the NE Atlantic, we used next generation sequencing to assemble eighteen complete and five partial antipatharian mitochondrial genomes, increasing the number of complete mitogenomes to twenty-two. This includes species from six antipatharian families, four of which were previously unrepresented, enabling the first family-level, full mitochondrial gene analysis over the whole order. The circular mitogenomes

ranged in size from 17681 to 21669 bp with the large range in size due to the addition of an intron in *COX1* in some species and size variation of intergenic regions. All mitogenomes contained the genes standard to all hexacoral mitogenomes (13 protein coding genes, two rRNAs and two tRNAs). The only difference in gene content is the presence of the *COX1* intron in five families. The most variable mitochondrial gene is *ND4* which may have implications for future barcoding studies. Phylogenetic analysis confirms that Leiopathidae is sister to all other families. Families Antipathidae, Cladopathidae and Schizopathidae are polyphyletic, supporting previous studies that call for a taxonomic revision.

Link to paper: <https://www.frontiersin.org/articles/10.3389/fmars.2020.00440/full>

## Traits and Depth: What Do Hydroids Tell Us About Morphology and Life-History Strategies in the Deep Sea?

Fernandez, M.O., Collins, A.G., Gittenberger, A., Roy, K. & Marques, A.C. (2020)

*Global Ecology and Biogeography*, 29, 908–924

**Aim:** Traits affect the survival and reproduction of individuals in different habitat conditions, ultimately altering their distributions. In the oceans, changes in environmental conditions with bathymetry may influence the occurrence of specific traits. Therefore, characterizing trait variation with depth can illuminate drivers related to the distribution of diversity of forms, functions, and life histories. We aimed to investigate patterns of variation in the diversified life histories and morphologies of hydroids with depth, integrating these patterns with the natural history of the group and ecological principles of the deep sea.

**Location:** Atlantic Ocean and adjacent polar seas, from 50 to 5,330 m deep.

**Time period:** Present day.

**Major taxa studied:** Hydrozoa.

**Methods:** Analyses were based on 14 traits collected for a total of 4,668 specimens of hydroids, belonging to 438 species. Records were divided into 12 depth strata for comparisons. We evaluated: how each trait varies with depth; whether variation in some traits is affected by the presence of other traits; how traits covary; and similarities in trait

compositions among depth strata.

**Results:** Traits of hydroids vary with depth, with more pronounced differences for regions deeper than 1,000 m. Hydroids are generally smaller, infertile, solitary, meroplanktonic, and devoid of protective structures with increasing depth. The relationship, however, is not always linear. Also, some covariation and correlation between traits was evident. For example, depth may affect size differently according to the presence of specific traits such as structures protecting against predation. The lower proportion of fertile specimens recorded in the deep sea suggests that chances for genetic recombination are reduced in deep-sea populations, ultimately leading to a slower rate of evolution.

**Main conclusions:** We identified novel trends in hydroid trait variation with depth by combining observations on morphology, ecology, and life history, clarifying selection pressures on hydroids in the deep sea.

Link to paper: <https://onlinelibrary.wiley.com/doi/full/10.1111/geb.13074>

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## Gradual and Rapid Shifts in the Composition of Assemblages of Hydroids (Cnidaria) Along Depth and Latitude in the Deep Atlantic Ocean

Fernandez, M.O., Collins, A.G. & Marques, A.C. (2020)

*Journal of Biogeography*

**Aim:** Despite growing knowledge on deep-sea benthic fauna, patterns of changes in species composition combining both bathymetric and latitudinal variation are still poorly known. In the first synthesis on the beta diversity patterns of assemblages of hydroids across an entire ocean basin, our aim was to infer limits and gradients of species distribution along depth and latitude.

**Location:** Atlantic Ocean and adjacent polar seas.

**Taxon:** Hydrozoa.

**Methods:** Hydroids from 50 to 5,330 m deep were studied primarily based on museum collections. Identifications were made by the authors, improving uniformity within the dataset by avoiding variations in taxonomic interpretation. Data totaled 3,699 records belonging to 432 species, at 1,444 unique sites. Records were assigned to three depth strata (50–200, 201–1,000 and 1,001–5,330 m) and eight latitudinal bands of 20° each, totalling 24 sample areas. We conducted non-metric multidimensional scaling (NMDS) ordination, clustering and PERMANOVA analyses of species compositions and abundances per area to examine differences and relationships in hydroid assemblages among areas.

**Results:** Assemblages primarily differentiate between those to the north and south of 40°S, regardless of depth, with southern ones separated between Patagonian and Antarctic. Northwards of 40°S, assemblages differentiate gradually along both depth and latitude, although a faunal turnover occurs at 1,000 m deep. Also, assemblages at 1,001–5,330 m deep tend to be more similar to each other than assemblages at shallower strata, suggesting significant connectivity over great distances in the deep sea. We note the problem of largely unequal hydroid sampling in the Atlantic Ocean across depths and latitudes, especially in the southern hemisphere and below 1,000 m deep.

**Main Conclusions:** Assemblages of hydroids differentiate gradually along latitude and depth, with more rapid shifts in species composition occurring at 40°S, 60°S and at 1,000 m deep. Greater similarity was found among deeper water assemblages.

Link to paper: <https://onlinelibrary.wiley.com/doi/full/10.1111/jbi.13853>

## Impacts of an Eruption on Cold-Seep Microbial and Faunal Dynamics at a Mud Volcano

Fanny Girard\*, Jozée Sarrazin & Karine Olu

*Frontiers of Marine Science*, 7, 241

Email: \*[fanny.girard13@gmail.com](mailto:fanny.girard13@gmail.com)

Cold seeps are widespread in the deep sea and, like other chemosynthesis-based ecosystems, often host high faunal biomass. Temporal changes at seeps have been inferred by comparing communities at different successional stages; nonetheless, temporal studies in seep ecosystems are rare. Using data collected as part of a benthic observatory, we characterized intra-annual microbial and faunal dynamics in a microbial mat habitat on the Håkon Mosby mud volcano (1256 m depth; Barents Sea), and evaluated the effects of a mud eruption on the biota. Video sequences recorded twice daily for 4.5 months with an autonomous imaging module were analyzed to quantify changes in microbial mat cover and megafaunal density and behavior. In addition, time series data for pressure, bottom currents, and seabed temperature were analyzed to characterize environmental changes. Of the five taxa observed on the video footage, the zoarcid *Lycodes squamiventer*, the pycnogonid *Nymphon macronyx*, and the skate *Amblyraja hyperborea* were the most common. Zoarcids made frequent incursions on microbial mats, but were more often documented on the adjacent sediments. The cyclic behavior of common trends identified between microbial mat cover, zoarcid densities, and abiotic variables using dynamic factor analysis suggested that seep ecosystem dynamics at the Håkon Mosby mud volcano may be modulated by tides and the activity of the volcano. Moreover, the eruption that occurred about 2 months after the start of the study had a significant impact on faunal densities, microbial activity, and environmental variables. The eruption was preceded by a steady increase in seabed temperatures, density of small holes (indicative of gas emissions), and microbial mat cover. It was followed by 3- and 5-fold increase in zoarcid and pycnogonid densities, respectively. To our knowledge, this study is the first to analyze intra-annual temporal data in a cold-seep ecosystem and to present data on the effects of a mud eruption on seep microbial and faunal dynamics. Overall, our results provide the first insight into ecosystem dynamics at a high-latitude cold seep and highlight the need to collect high-resolution temporal data to evaluate seep communities' response to a warming Arctic and their potential role in mitigating methane emissions.

Link to the article: <https://www.frontiersin.org/articles/10.3389/fmars.2020.00241/full>

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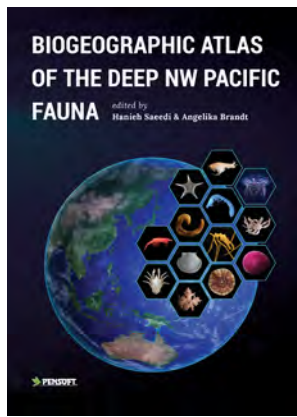
## Biogeographic Atlas of the Deep NW Pacific Fauna

Hanieh Saeedi and Angelika Brandt (editors)

This book is designed as a guide, synthesis, and review of the current knowledge of the benthic fauna that is distributed in the bathyal and abyssal zones (below 2,000 m) of the NW Pacific. This book consists of 21 chapters, with an introduction followed by 20 chapters on taxonomy and biogeography of different deep-sea taxa including Porifera, Cnidaria, Brachiopoda, Entoprocta, Nemertea, Solenogastres, Bivalvia, Sipuncula, Polychaeta, Echiura, Nematoda, Kinorhyncha, Pycnogonida, Ascothoracida, Ostracoda, Decapoda, Amphipoda, Isopoda, Ascothoracida, Tanaidacea, Echinoidea, and Asteroidea.

In times of rapid climate change and increasing anthropogenic impact, a compilation of life at the seafloor in the deep sea, where environmental parameters resemble those of the Arctic Ocean, is urgently needed. Based on such urgent needs, this book is very timely and provides not only insights into NW Pacific deep-sea benthic biodiversity and species





compositions, but also forms a fundamental regional study of the NW Pacific required for understanding the ecosystem services and decision-making assessments in order to prioritize conservation criteria across multiple biodiversity conservation initiatives and groups. This book also represents an important backbone study for the United Nations Decade of Ocean Science for Sustainable Development assessment (2021–2030). This decade aims to ensure that ocean science can support nations' activities to sustainably manage the oceans and in particular to reach the goals of the 2030 Agenda for Sustainable Development.

Link to book: <https://ab.pensoft.net/book/51315/>

## Cold-Water Coral Reefs Thriving Under Hypoxia

Hebbeln D, Wienberg C, Dullo WC, Freiwald A, Mienis F, Orejas C, Titschack J (2020)

### *Coral Reefs*

In early 2016, ROV-observations revealed the presence of thriving cold-water coral reefs in 250-500 m water depth in the south-east Atlantic. These reefs are thriving within the very strong oxygen minimum zone off Angola – conditions that traditionally would have been dismissed as unsuitable for coral growth. Mainly built up by *Lophelia pertusa*, the dominant reef-forming cold-water coral in the Atlantic, these reefs thrive in a rather warm, strongly oxygen depleted setting. According to textbook knowledge, the oxygen concentrations of  $<1 \text{ mL L}^{-1}$  observed in this area should preclude any coral occurrences in this region. Apparently well adapted to these conditions, the Angolan corals obviously have different preferences for ambient oxygen conditions compared to other known *L. pertusa* occurrences in the North Atlantic and contradicts our



Cold water coral reef with *Lophelia pertusa* in 350 meter water depth in the centre of the oxygen minimum zone off Angola in the south-east Atlantic. Photo: MARUM - Center for Marine Environmental Sciences, University of Bremen

knowledge from laboratory experiments to date. Obviously, there are regional differences in the lower range of oxygen levels that the corals can withstand. The Angolan corals' ability to cope with the low oxygen conditions may be bolstered by a very high food supply provided by the south-east Atlantic upwelling system.

Upper and lower tolerable limits of basic oceanographic boundary conditions for *L. pertusa* are usually determined based on presence/absence observations correlated to ocean conditions and laboratory data, and then applied at a global scale. Such global ecophysiological ranges are frequently applied in habitat suitability models to identify suitable environmental settings for corals in the present-day ocean, and under future ocean conditions, taking into account the expected changes to relevant oceanographic boundary conditions. However, putting all presence observations of *L. pertusa* with respect to oxygen together reveals a global range of  $<1$  to  $>6 \text{ mL L}^{-1}$ , which would not apply to all regional populations. Thus, for future studies applying such models, regional adaptations to oxygen levels, as well as the relationships between stressors (as documented here for oxygen levels and food supply) should be considered.

Link to paper: <https://link.springer.com/article/10.1007/s00338-020-01934-6>

## Meiofaunal Diversity at a Seamount in the Pacific Ocean: A Comprehensive Study Using Environmental Dna and Rna.

Tomo Kitahashi, Sachie Sugimeea, Kentaro Inomataa, Miyuki Nishijima,  
Shogo Kato and Hiroyuki Yamamoto (2020)

*Deep Sea Research Part I, 160:103253*

In deep-sea environments, which have low densities of large benthic animals, meiofauna are a useful indicator of biodiversity. However, in low-latitudes and in low-productivity areas, meiofaunal density is low, but is higher than that of megafaunal or macrofaunal density. Therefore, it is difficult to collect a sufficient number of specimens for statistical analysis. In addition, because faunal classification has been based on conventional microscopic observations, the use of meiofauna to estimate biodiversity in deep-sea environments is time-consuming. However, metabarcoding analyses focused on environmental DNA (eDNA) or RNA (eRNA) have recently been used to examine deep-sea eukaryotic diversity and communities. Here, we examined meiofaunal assemblages using microscopic, eDNA-, and eRNA-based methods at Xufu Guyot (JA06 Seamount), off the southeastern coast of Minami-Torishima Island in the North Pacific Ocean. Microscopic analysis failed to detect a significant difference in diversity or community structure between the seamount terrace and base. This was likely because of the low abundance of meiofauna, which was caused by the low surface productivity at the study area. However, eDNA/eRNA-based metabarcoding analyses revealed spatial variations in diversity and community structures within a single seamount. Therefore, metabarcoding analysis might be useful to elucidate meiofaunal assemblages in areas with low productivity and low faunal density. Free download till 8th July 2020-06-10: <https://www.sciencedirect.com/science/article/pii/S0967063720300418?dgcid=author>

Link to paper: <https://doi.org/10.1016/j.dsr.2020.103253>

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## Options to Improve Transparency of Environmental Monitoring Governance for Polymetallic Nodule Mining in the Area.

Komaki, K., and Fluharty, D. (2020)

*Frontiers in Marine Science 7*

This paper proposes institutional innovations to advance a transparent monitoring system for the environmental impacts from mineral development on the deep seabed beyond national jurisdictions managed by the International Seabed Authority (ISA). Using a literature review, ISA's regulations, and five cases of other environmental monitoring of the deep sea, this study observes that ISA's environmental monitoring system for exploration and exploitation currently lacks critical elements to facilitate transparency. Insufficient compliance reporting and review systems, as well as limited access to information by stakeholders, lower the system's effectiveness. ISA has not developed adequate mechanisms to support effective multinational collaboration in monitoring. The ISA monitoring system without these characteristics may not be sufficiently adaptive to allow detection and management of environmental changes in the deep seabed. This study suggests 15 institutional recommendations to ISA in order to enhance transparency for monitoring nodule mining in the Central Pacific deep seabed. Principal recommendations include establishing compliance review committees independent of ISA governing bodies, implementing collective monitoring and reporting by adjacent contractors, and reconsidering the centralized decision-making authority by the Secretary-General to improve confidentiality.

Link to paper: <https://www.frontiersin.org/articles/10.3389/fmars.2020.00247/full>

## A New Genus for the Giant Hydrothermal Vent Clam '*Calyptogena*' *Magnifica* (Bivalvia: Vesicomidae: Pliocardiinae) Named After Ruth D. Turner

Elena M. Krylova & Yu. M. Yakovlev

Email: [elenamkr@mail.ru](mailto:elenamkr@mail.ru); [yuriyakovlev@yandex.ru](mailto:yuriyakovlev@yandex.ru).

Forty years ago, Ruth D. Turner and Kenneth J. Boss described a species of the giant white clam discovered around hydrothermal vents on the Galapagos Rift as *Calyptogena* (*Ectenagena*) *magnifica*. In a very short time it became an iconic hydrothermal vent species and a subject of various studies of physiology, biochemistry, symbiotic relationships, genetics, population connectivity, functional anatomy, and developmental biology.

The accumulating data on pliocardines has helped to show the extent of the conchological, anatomical and molecular distinctiveness of '*C.*' *magnifica*, and eventually, to accommodate this species a new monotypic genus, *Turneroconcha*, was established (Krylova, Sahling, in press). '*C.*' *magnifica* is endemic to the East-Pacific Rise and Galapagos Rift and it is the only pliocardine known so far with mainly epifaunal life habit.



Ruth Turner together with her colleague Yuri Yakovlev, Biological Station Vostok near Vladivostok, Russia, 1978.

The genus was named after Ruth Turner, one of the authors of '*C.*' *magnifica*, the bright American malacologist and the first lady to dive in the deep submersible research vehicle Alvin (1971). She passed away 20 years ago, on the 30 April 2000. One of us (Yu Ya.) was fortunate to meet her personally and to collaborate with her. Ruth was a member of the Russian Hydro-Biological Society. In the 1970s she visited Moscow several times, met her friend Zinaida A. Filatova, a renowned Russian malacologist, and was one of the first foreign colleagues to visit the Biological Station Vostok in the



Clams in their natural habitat, Gulf of California, Alarcón Rise, 2293 m, RV *Western Flyer*, dive D752. Photo courtesy of MBARI with permission of R.C. Vrijenhoek. Length of clams about 15 cm.

Russian Far East. Ruth tried to find (and did it!) clams from the type locality of the only species of teredinids missing in her collection. Until now staff at the station remember her kindness, friendly warmth, energy and dedication to science. Ruth named more than 70 species of marine animals, and it is a privilege to name a deep-sea creature after her.

Details are in: A new genus *Turneroconcha* (Bivalvia: Vesicomidae: Pliocardiinae) for the giant hydrothermal vent clam '*Calyptogena*' *magnifica* by E. Krylova & H. Sahling, *Zootaxa*, in press.

## ROV's Video Recordings as a Tool to Estimate Variation in Megabenthic Epifauna Diversity and Community Composition in the Guaymas Basin

Pedro H. López-Garrido, James P. Barry, Juan Ignacio González-Gordillo and Elva Escobar-Briones (2020)

*Frontiers in Marine Science*

Patterns in benthic megafauna diversity in littoral and intertidal zones in the Gulf of California have been associated



with both habitat heterogeneity and substrate type. Current knowledge of invertebrate communities in hard bottom habitats at depths > 200 m in the Gulf is poor due to the methodological limitations inherent in sampling deep habitats. Using video imagery of benthic habitats coupled with environmental data from the Remotely Operated Vehicle *Doc Ricketts*, we documented variation in the diversity and community composition of the benthos from 849 to 990 m depth in the NW limit of the Guaymas Basin, in relation to dissolved oxygen and substrate characteristics. This depth range overlaps an oxygen minimum zone where oxygen drops to levels < 0.5 ml L<sup>-1</sup> and strong gradients in a narrow depth range occur. Dissolved oxygen varied along our benthic survey from 0.200 to 0.135 ml L<sup>-1</sup>. We observed high taxonomic richness across an area of rocky outcrops through the lower transition zone. This megafaunal pattern differs from reports from other oxygen minimum zones characterized by a great abundance of a few species. Taxonomic richness diminished at depths with reduced dissolved oxygen in the lower boundary of the oxygen minimum zone with increasing soft sediment cover. We found that rocky outcrops and structure-forming organisms such as corals, sponges, and oyster aggregations supported a higher diversity ( $H' = 0.8$ ) than soft sediment ( $H' = 0.7$ ) as have been observed in other habitats such as seamounts. Environmental variables that explained most of the megafaunal variation were substrate type (18.4%), depth (1.14%) and temperature (0.9%). Salinity (0.45%) and dissolved oxygen (0.3%) were less important factors to explain the megafaunal composition variance. Substrate type played a key role in the diversity and composition of benthic megafauna. These results broaden our understanding concerning the potential roles of substrate characteristics in the community composition of the deep-sea benthic megafaunal assemblages in the Gulf of California and oxygen minimum zones in general.

Link to paper: <https://doi.org/10.3389/fmars.2020.00154>

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## Climate Velocity Reveals Increasing Exposure of Deep-Ocean Biodiversity to Future Warming

Isaac Brito-Morales, David S. Schoeman, Jorge García Molinos, Michael T. Burrows, Carissa J. Klein, Nur Arafah-Dalmau, Kristin Kaschner, Cristina Garilao, Kathleen Kesner-Reyes & Anthony J. Richardson (2020)

*Nature Climate Change volume 10, p576–581*

Slower warming in the deep ocean encourages a perception that its biodiversity is less exposed to climate change than that of surface waters. We challenge this notion by analysing climate velocity, which provides expectations for species' range shifts. We find that contemporary (1955–2005) climate velocities are faster in the deep ocean than at the surface. Moreover, projected climate velocities in the future (2050–2100) are faster for all depth layers, except at the surface, under the most aggressive GHG mitigation pathway considered (representative concentration pathway, RCP2.6). This suggests that while mitigation could limit climate change threats for surface biodiversity, deep-ocean biodiversity faces an unavoidable escalation in climate velocities, most prominently in the mesopelagic (200–1,000 m). To optimize opportunities for climate adaptation among deep-ocean communities, future open-ocean protected areas must be designed to retain species moving at different speeds at different depths under climate change while managing non-climate threats, such as fishing and mining.

Link to paper: <https://doi.org/10.1038/s41558-020-0773-5>

## Impacts of Deep-Sea Mining on Microbial Ecosystem Services

Beth N. Orcutt James A. Bradley William J. Brazelton Emily R. Estes Jacqueline M. Goordial Julie A. Huber  
Rose M. Jones Nagissa Mahmoudi Jeffrey J. Marlow Sheryl Murdock Maria Pachiadaki

*Limnology and Oceanography*

Microscopic life in the deep sea provides many essential ecosystem services, such as primary production and nutrient recycling to support food webs. To consider how these services might be impacted by potential deep-sea mining activities, and how to account for them in environmental impact assessments, a new open-access review in the journal of *Limnology and Oceanography* summarizes what is known (and unknown) about microbial ecosystem services in the deep-sea.

Link to paper: <https://aslopubs.onlinelibrary.wiley.com/doi/10.1002/lno.11403>

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## 3-Miles Down, 30-Year Study, the Giant Amphipods are Changing

Tammy Horton

Two new papers have been published by scientists at the National Oceanography Centre, Southampton, UK, focussing on scavenging amphipods at the NOC's long-term deep-ocean observation site, the [Porcupine Abyssal Plain Sustained Observatory \(PAP-SO\)](#) at 4850 m. The studies are based on specimens that have been collected at the site since 1985 and held in the [Discovery Collections](#) at NOC, highlighting the importance of maintaining these historical samples.

The giant amphipod genus *Eurythenes* was previously thought to be represented at the PAP-SO by two cosmopolitan and widely recorded species: *Eurythenes gryllus* and the pelagic *Eurythenes obesus*. Samples of *Eurythenes* collected using free-fall baited traps were studied using both morphological and phylogenetic analyses. This showed that there are actually four distinct species occurring at PAP, one of which is new to science. Three species: *E. maldoror*, *E. c.f. magellanicus* and the new species are commonly found in the baited trap samples, but *Eurythenes gryllus* has not yet been recorded at the Porcupine Abyssal Plain, although confirmation of this will require further study of the full collection of >5000 *Eurythenes* specimens.



The new species of *Eurythenes* from the Porcupine Abyssal Plain. Photo: Tammy Horton, NOCS, UK

The second paper is an analysis of the long-term observations of near-bottom scavenging amphipod populations at the PAP-SO. This is the longest time-span study of the benthos at the PAP-SO to date (1985-2016), and remains an active component of NOC research to the present day. The results show that the species composition of scavenging amphipods has changed through time, with a remarkable change in the dominant species since 2011, and that that change might equate to a 'regime shift' potentially linked to upper ocean climate as assessed by the Atlantic Multi-decadal Oscillation index. There is also some indication that the diversity of the scavenging

amphipods is lower when there is higher organic matter flux through the deep-water column at the PAP-SO.

Both papers are published in a [special issue](#) dedicated to research at the Porcupine Abyssal Plain-Sustained Observatory (PAP-SO).

Horton, T., Thurston, M.H., Vlierboom, R., Gutteridge, Z., Pebody, C.A., Gates, A.R. & Bett, B.J. (2020). Are abyssal scavenging amphipod assemblages linked to climate cycles? *Progress in Oceanography*, 184. <https://doi.org/10.1016/j.pocean.2020.102318>

Horton, T. Cooper, H., Vlierboom, R., Thurston, M.H., Hauton, C. & Young, C.R. (2020). Molecular phylogenetics of deep-sea amphipods (*Eurythenes*) reveal a new undescribed species at the Porcupine Abyssal Plain, North East Atlantic Ocean, *Progress in Oceanography*, 183. <https://doi.org/10.1016/j.pocean.2020.102292>

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## **Tying Up Loose Ends of Microplastic Pollution in the Arctic: Distribution from the Sea Surface through the Water Column to Deep-Sea Sediments at the Hausgarten Observatory**

Tekman, M.B., Wekerle, C., Lorenz, C., Primpke, S., Hasemann, C., Gerdt, G., Bergmann, M. (2020)

*Environmental Science & Technology*, 54: 4079–4090

Recent studies have shown that despite its remoteness, the Arctic region harbors some of the highest microplastic (MP) concentrations worldwide. Here, we present the results of a sampling campaign to assess the vertical distribution of MP particles (>11 µm) at five stations of the HAUSGARTEN observatory. Water column samples were taken with large volume pumps by filtering 218–561 L of seawater at two to four depth strata (near-surface, 300 m, 1000 m, and above seafloor), and sediment samples were taken with a multiple corer. MP concentrations in the water column ranged between 0 and 1287 N m<sup>-3</sup> and in the sediment from 239 to 13 331 N kg<sup>-1</sup>. Fourier transform infrared spectroscopy (FTIR) imaging with automated data analysis showed that polyamide (39%) and ethylene-propylene-diene rubber (23%) were the most abundant polymers within the water samples and polyethylene-chlorinated (31%) in sediments. MPs ≤ 25 µm accounted for more than half of the synthetic particles in every sample. The largest MP particle recorded was in the 200 µm size class. The concentrations of fibers were not reported, as fiber detection by FTIR imaging was not available at the time of analyses. Two- and three-dimensional simulations of particle transport trajectories suggest different pathways for certain polymer types. A positive correlation between MP size composition and particulate organic carbon indicates interactions with biological processes in the water column.

Link to paper: <https://pubs.acs.org/doi/10.1021/acs.est.9b06981>

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## **The State of Knowledge of Deep-Sea Corals in the New Zealand Region**

Tracey, D.M. & Hjørvarsdóttir, F. (eds, comps) (2019)

*NIWA Science and Technology Series Number 84. 140 p.*

- Chapter 1. Taxonomic Coral Classification
- Chapter 2. Coral Biology
- Chapter 3. Coral Population Connectivity
- Chapter 4. Species Associations with Deep Coral Communities
- Chapter 5. Geological and Oceanographic setting
- Chapter 6. Seafloor Mapping
- Chapter 7. Spatial Distribution
- Chapter 8. Stressors on Coral Communities
- Chapter 9. Current Management Measures and Threats



- Chapter 10. South Pacific Regional Fisheries Management
- Chapter 11. Coral information needs/gaps, and research priorities
- Chapter 12. Key Coral Groups

Link to paper: <https://niwa.co.nz/file/45820>

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## Deep-sea sponge aggregations (*Pheronema carpenneri*) in the Porcupine Seabight (NE Atlantic) potentially degraded by demersal fishing

Vieira, R. P., Bett, B. J., Jones, D. O., Durden, J. M., Morris, K. J., Cunha, M. R.,  
Trueman, C. N. & Ruhl, H. A. (2020)

*Progress in Oceanography*, 183, 102189

Deep-sea sponge aggregations are widely recognised as features of conservation interest and vulnerable marine ecosystems that may particularly require protection from the impact of commercial bottom trawl fishing. In 2011 we revisited deep-sea sponge aggregations in the Porcupine Seabight (NE Atlantic, c. 1200 m water depth) originally described by Rice *et al.* (1990, *Prog. Oceanogr.* 24: 179–196) from surveys in 1983/4. Using an off-bottom towed camera system, broadly comparable to the bottom-towed system originally employed, we resurveyed four key transects detailed in that publication. In the intervening years, there has been a substantial increase in deep-water fishing activity; our primary objectives were therefore to establish the continued presence of *Pheronema carpenneri* (Hexactinellida, Pheronematidae), the current status of the sponge population, and whether there was any evidence of bottom trawl fishing impact on the sponges and their associated fauna. We noted a very substantial reduction in the standing stock of sponges: in Rice *et al.*'s (loc. cit.) peak abundance depth range (1210–1250 m) numerical density declined from 1.09 to 0.03 ind m<sup>-2</sup>, and biomass density from 246 to 4 gwwt m<sup>-2</sup>, between the surveys. Our assessment of available vessel monitoring data suggested that commercial bottom trawling had been occurring in the area, with some indication of focussed effort in the sponge's bathymetric range. We also recorded the presence of multiple apparent seafloor trawl marks on two of the transects. Despite the potential disturbance, the presence of sponge aggregations continued to exert a statistically significant positive influence on the diversity of the local megafaunal assemblage. Similarly, faunal composition also exhibited a statistically significant trend with *P. carpenneri* numerical density. Megafaunal numerical density, particularly that of ascidians, appeared to be enhanced in the core of Rice *et al.*'s (loc. cit.) peak abundance depth range, potentially reflecting the residual effect of sponge spicule mats. Our observations were suggestive of a substantive impact by bottom trawl fishing; however, a definitive assessment of cause and effect was not possible, being hampered by a lack of temporal studies in the intervening period. Other causes and interpretations were plausible and suggested the need for: (i) a precautionary approach to management, (ii) an improved understanding of sponge natural history, and (iii) temporal monitoring (e.g. seafloor sponge habitat cover).

Link to paper: <https://doi.org/10.1016/j.pocean.2019.102189>

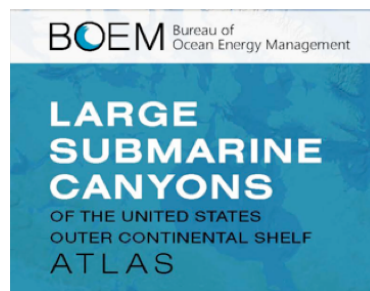
# Age and Growth of Brauer's Lanternfish *Gymnoscopelus Braueri* and Rhombic Lanternfish *Krefftichthys Anderssoni* (Family Myctophidae) in the Scotia Sea, Southern Ocean

Saunders, R. A., Lourenço, S., Vieira, R. P., Collins, M. A., Assis, C. A. & Xavier, J. C. (2020)

*Journal of Fish Biology*, 96 (2), 364-377

This study examines age and growth of Brauer's lanternfish *Gymnoscopelus braueri* and rhombic lanternfish *Krefftichthys anderssoni* from the Scotia Sea in the Southern Ocean, through the analysis of annual growth increments deposited on sagittal otoliths. Otolith pairs from 177 *G. braueri* and 118 *K. anderssoni* were collected in different seasons from the region between 2004 and 2009. Otolith-edge analysis suggested a seasonal change in opaque and hyaline depositions, indicative of an annual growth pattern, although variation within the populations of both species was apparent. Age estimates varied from 1 to 6 years for *G. braueri* (40 to 139 mm standard length; SL) and from 0 to 2 years for *K. anderssoni* (26 to 70 mm SL). Length-at-age data were broadly consistent with population cohort parameters identified in concurrent length-frequency data from the region for both species. The estimated values of von Bertalanffy growth curves for *G. braueri* were  $L_{\infty} = 133.22$  mm,  $k = 0.29 \text{ year}^{-1}$  and  $t_0 = -0.21$  year and the values for *K. anderssoni* were  $L_{\infty} = 68.60$  mm,  $k = 0.71 \text{ year}^{-1}$  and  $t_0 = -0.49$  year. There were no significant ( $P > 0.05$ ) differences in growth between sexes for either species, suggesting that males and females have similar growth and development trajectories in the Scotia Sea. A positive allometric relationship between SL and wet mass was found for each species, as well as a significant ( $P < 0.0001$ ) linear relationship between otolith size and SL. Growth performance ( $\Phi$ ) was similar between the two species and congruent with other myctophid species across the Southern Ocean. This study provides important parameters for future Southern Ocean ecosystem studies in a resource management context.

Link to paper: <https://doi.org/10.1111/jfb.14206>



## Large Submarine Canyons of the United States Outer Continental Shelf ATLAS

CSA Ocean Sciences Inc., De Leo, F.C. and Ross, S.W. 2019.

The US Bureau of Ocean Energy Management (BOEM) has recently released a new atlas of the major submarine canyons within US waters. The Atlas was designed to present a consistent way to define canyon boundaries, provide large scale bathymetry for each included canyon, note protected areas, and include notable facts for each canyon. The Atlas is intended as a resource for the public, managers, agencies, educators, and the science community.

Download the Atlas from: [https://epis.boem.gov/final-reports/BOEM\\_2019-066.pdf](https://epis.boem.gov/final-reports/BOEM_2019-066.pdf)

This is the low resolution version. A high resolution version will be available soon. Hard copies are being printed and should be available shortly. Reference: *Sterling (VA): US Dept. of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2019-066. 51 p*

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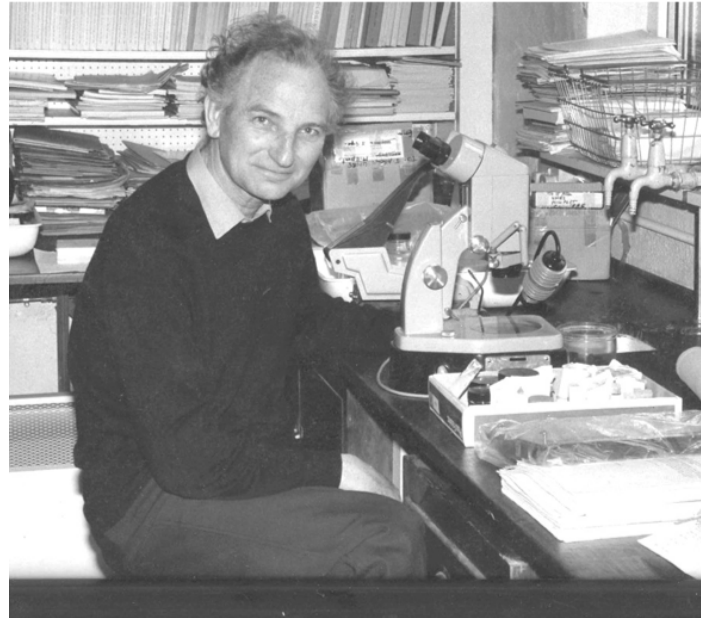
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# Obituaries

## John Allen

1926-2020



It is with great sadness that I have to report the passing of John A. Allen at the age of 94, after a number of years of increasing frailty.

For the deep-sea community, he will be remembered most for his great series of studies on the bathyal and abyssal Bivalvia from the oligotrophic deep Atlantic. He first published on deep-sea bivalves with Howard Sanders of Woods Hole in 1966, and with Howard and a number of research assistants and Ph.D students, he completed the entire bivalve fauna in 2008. JA, as we knew him, will be best remembered for his elegant anatomical drawings revealing adaptations to life in the abyss as well as confirming the great diversity of species in an apparently hostile environment. These observations led to Howard Sanders' Stability-Time hypothesis.

JA introduced over 100 new nominal taxa, but at a time when molecular systematics were not available. He recognised unresolved issues, especially concerning the isolation of the Atlantic basins, the concepts of a cosmopolitan abyssal fauna and the interpretation of small differences in morphology. While there has been an explosion of interest in the enigmatic chemosynthetic communities, few have returned to study the diversity of the minute species brought to us by JA's work.

In 2017, Fiona Hannah and I published a retrospective on JA's contributions (see Oliver, P.G. & Hannah, F. 2017). The publications and new nominal taxa introduced by John. A. Allen. *Journal of Conchology*, 42: 257-266 download from <https://www.researchgate.net/publication/312579239>

I would be happy to receive any recollections of JA that you may have: [graham.oliver@museumwales.ac.uk](mailto:graham.oliver@museumwales.ac.uk).

## In Memoriam – Ron O’Dor

1944-2020



Photo: Dalhousie University, Canada

Many of us in the deep-sea community had the pleasure to work with Ron during the Census of Marine Life days - he was involved in organizing and leading this global and highly successful 10-year programme, which investigated abundance, diversity and distribution of life in the oceans, from the coast to the abyss. The deep-sea groups under the Census came together to form INDEEP (2011) which subsequently spawned DOSI (2013).

Ron’s obituary was published in the media and here is a link: <https://www.thechronicleherald.ca/obituaries/ronald-keith-odor-39357/>

The [following](#) is the In Memoriam that Ron’s colleagues at Dalhousie prepared.

Dr. Ron O’Dor, a visionary scientist, colleague, and great friend to the Dalhousie University Department of Biology and the Faculty of Science, as well as to the international scientific community, passed away on 11 May due to COVID-19 related complications.

Ron was born in Kansas City, Missouri, and his career spanned the fields of biochemistry, physiology and marine biology, with specialties in cephalopod biology and aquatic animal telemetry. He completed his undergraduate degree in biochemistry at the University of California, Berkeley, and his PhD in physiology at the University of British Columbia. After a postdoctoral fellowship at Cambridge University in the UK, Ron took up a faculty position in Biology at Dalhousie University in 1973. He was Director of Dalhousie’s Aquatron Laboratory from 1986-1993, Chair of the Biology Department from 1997-2000, and held short-term positions of Visiting Researcher/Scientist at various universities in Canada, the USA, Australia, China, France, Japan, Papua New Guinea, Portugal, and South Africa, until he became Emeritus Professor at Dalhousie upon his retirement in 2015.

Perhaps Ron is best known for his immense contributions to cephalopod ecology and physiology, achieved by using a suite of interdisciplinary techniques including behaviour and ecology, physiology and innovative telemetry tracking techniques. He was an ecophysiological long before the term became popular. His lab was always filled with repurposed scientific equipment tied together with wire and plumbing bits. In fact, for a time there was a “MacGyver Award” (named after the TV show hero who was always cobbling things together to save the day) in the Biology Department, but it went out of fashion after a while because Ron was in almost permanent possession of the award. One of the favourite contraptions was a squid “swim tunnel” he put together on a field trip to the Azores, made out of building supplies and a fish trolling motor. He harnessed this to observe at what current speeds squid switched between fins and jet propulsion. He famously published papers such as the “Choreography of the squid’s nuptial dance” and “The incredible flying squid.” One of Ron’s quests was to know why squid fly – that is, squid not only swim, they occasionally fly, propelling themselves like rockets forward up and out of the water. His response to a journalist when he was asked why they fly, was typical Ron: Who wouldn’t want to be a rocket? Why be an astronaut when you can be a rocket?

When the Census of Marine Life (CoML) - a 10-year international effort undertaken to assess the diversity, distribution, and abundance of marine life – formally launched in 2000, the breadth and depth of Ron’s interests and sense of humor made him the obvious candidate for Chief Scientist. He moved to Washington DC to take on this role from 2000-2010. Ron took a big gamble on the CoML and did an unsurpassable job in recruiting, stimulating, connecting, and communicating, in Nova Scotia, across Canada, and around the entire planet. Out of the CoML grew a dream of Ron’s: the idea to build a global network of acoustic receivers and oceanographic sensors in all the ocean regions of the world to track keystone tagged animals along migratory routes. And hence was born the Ocean Tracking Network (OTN), headquartered at Dalhousie University and launched as a Canada Foundation for Innovation International Joint Venture Project in 2008. Fast forward to today and the work of many dedicated personnel who made it happen: OTN is now a global research, conservation and infrastructure platform and one of Canada’s National Research Facilities, focused on understanding aquatic animal movements and survival in relation to changing environments in order to enable better stewardship of the world’s aquatic resources. OTN also has been fundamental to the birth and growth of other major ocean initiatives and research at Dalhousie. For his work with the CoML and the OTN, Ron was named Canada’s Environmental Scientist of the Year by Canadian Geographic in 2009.

Ron was also a valuable mentor to students, postdoctoral fellows and other trainees. He was known for encouraging students to visualize the puzzle as a whole before trying to put the pieces together, and to learn the importance of resourcefulness - the ability to take the tools you have at your disposal and adapt them to solve a problem at hand. One past student described how the defining moment of their research career came when, after much pondering and discussion of how they could study the relative roles of hydrodynamic drag and gravitational forces in the feeding and swimming dynamics of larval scallops, Ron saw a Request For Proposal from the Canadian Space Agency for work on the NASA space shuttle. Voila: a simple solution – blast the larvae into space to eliminate gravity and see what they did. It was another Ron moment where a tool was adapted by a resourceful mind for an unconventional purpose. But they did it: “Scallops in Space.” Students fondly remember that Ron was kind, gentle, smiled ALL the time, could speak on an incredible breadth of topics, and always wore a suit jacket with his signature turtleneck.

And finally, with students and colleagues alike, Ron was a social animal, working the fifth-floor lounge or rooms at conferences, bouncing ideas and jokes around with a smile and clap on the shoulder. The weekly Biology Departmental seminars and associated BioBeer were essential events for him and an opportunity to discuss ideas and foster the social cohesion of the Department.

Ron will be sorely missed but always remembered. He will be remembered for his big ideas on big science, the use of cutting-edge technologies, for his ready smile and laugh, for his inventiveness worthy of MacGyver, and for his kindness and humanity. Ron leaves behind his loving companion Janet, who tolerated his idiosyncrasies and brought out the best in him for 52 years. He also leaves two children, and four grandchildren. For those of us in the science community who knew him as a colleague, teacher and friend, the world is a bit dimmer, and science less fun, than it was just yesterday.

Ron O’Dor Memorial Fund has been set-up in his legacy: <https://alumniapps2.dal.ca/giving/?gift=ronodor>

# Deep-Sea Biology Society News

## Deep-Sea Biology Society Update

President's Letter, June 2020

Dear Deep-Sea Biology Colleagues,

This is my 8<sup>th</sup> President's Letter. It is definitely the strangest I have written. Rather than my usual ramble about the weather, or politics, we will start with some announcements and work backwards from there. The first is that the deadline for abstracts to be submitted to our [online 'eDSBS' meeting](#) is fast approaching - 26 June 2020. The meeting itself is going to be on 20 and 21 August 2020. The second is that the Society has released a new [plan to address diversity, inclusion and equity in our community](#). All of these updates, and further details on them are to be found on our website, and I will talk more about both now.

For those that follow world events - and with a few exceptions it is pretty hard to avoid them - it will be obvious how we have come to make these new announcements. Let's start with eDSBS. The Covid-19 pandemic has forced almost the entire population of the planet to re-configure their lives at home and at work. Within the specific remit of scientific societies, the impacts are huge. Societies such as ours are primarily focussed around providing platforms for discussion - our conferences and meetings - and primarily meetings where we meet and network in person. For this year that possibility has been taken away from us, and whilst we will bring back our regular in-person meetings, it's likely that the way we conduct future conferences will change considerably.

Conferences where we can meet and network are the lifeblood of our community. For many it is their only chance to meet scientists from around the world, discuss data, projects, policies, concerns and further their careers. I am sure I am not alone in that the majority of my own career progression, and project development has come from conference discussion, and mostly the DSBS. My first was in Galway in 2000, and I have not missed one since. But is this happy picture of our regular conferences being the driver of our success as a community missing something important? The horrors of Covid-19 are going to force us to address this.

There is an alternative view. That our conferences only serve a small fraction of those that should have a stake in deep-sea science. They are exclusive, not inclusive. They are expensive and generally hosted by the wealthiest nations. They do little to encourage diversity, inclusivity or equity. Which brings me to my second point. The #BlackLivesMatter movement and associated protests around the world have forced individuals, institutions, societies, corporations, governments and intergovernmental organisations to reflect on their own degrees of exclusivity. DSBS is no exception. We cannot claim to be anything other than reactionary. Prior to last week, we had no code of conduct in the Society that explicitly made statements on racism or discrimination. We had no member of the Trustees whose job it was to promote diversity in our community. We had no funding stream to support diversity and inclusivity in our community. We must hold up our hands and admit that as a board and as a community we have done very little.

So, we are listening. We have an email address where you, our members, can reach out to your trustees to raise issues and propose solutions: [diversity@dsbsoc.org](mailto:diversity@dsbsoc.org). We have proposed our first [plan of action](#). And this August, we will have our first ever online-only meeting - eDSBS. The online-conference was not born out of a plan to address diversity. It was a necessary response to the [postponement of the CBE meeting](#) and hence our society Annual General Meeting (AGM). We have focussed it on the needs of early-career researchers, who would otherwise have nowhere to present their results and meet other scientists in their fields. But it is also an opportunity for us to explore, as a community, new ways of networking and meeting each other at vastly lower cost. This brings with it potential new ways we can improve the diversity and inclusivity of our community.

Next year will be our triennial Deep-Sea Biology Symposium. We have no plans to replace these meetings with online ones. Like most of you, I desperately want to see my colleagues again, to shake hands, have a hug, a coffee, a beer. Maybe not all those things will be possible. But some will be and we will facilitate it. But this 2020 moment of reflection, and our eDSBS this August should give us the momentum to think afresh about what we want as a community, and what we can do to make us inclusive, not exclusive.



I am excited for the future of our science. It continues to grow. Young minds are fizzing with ideas for our science. I feel extraordinarily lucky to be part of this community, and I want everyone to have the same.

Adrian Glover,  
President, Deep-Sea Biology Society  
[president@dsbsoc.org](mailto:president@dsbsoc.org)



**eDSBS** is open to everyone in the deep-sea biology community, and talks and posters are welcomed on any subject that fits within our sessions. As the global pandemic has prevented the normal conference cycle this year, the trustees of the Society have decided that priority will be given to early-career researchers who need to present their work as part of their career milestones. However, we are very keen to receive abstracts from everyone to ensure we have a good balance of presenters.

Note that eDSBS is not a replacement for the normal deep-sea biology in-person meetings (e.g the Deep-Sea Biology Symposium, the Deep-Sea Coral Symposium or the Chemosynthesis-Based Ecosystems meetings). The cycle of these physical meetings is planned to continue from 2021.

eDSBS will also host the 2020 Annual General Meeting (AGM) of the Society, where the Trustees will present our financial reports and overview of activities of the past year, award prizes, and go over our plans for the next year.

#### Key Dates

- **22 May 2020:** Registration opens (free to DSBS members). Register and submit abstracts here: <https://forms.gle/YyB21k83a6Bofaw99>
- **26 June 2020:** Abstract deadline for talks or posters.
- **10 July 2020:** Estimated date for sending confirmation of talks/posters to participants.
- **10 Aug 2020:** Final registration deadline for non-presenting participants.
- All deadlines are 24:00 UTC.

More information on the meeting format, science sessions, abstracts and presentation guidelines are available on the link below:

<https://dsbsoc.org/conferences/edsbs/>

Please spread the word across your networks and to anyone who might be interested.

We look forward to meeting you all online soon!

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## Deep-Sea Biology Society Communications

Paris Stefanoudis

*Communications Officer*

Email: [communications@dsbsoc.org](mailto:communications@dsbsoc.org)

We have been continuously updating the Society's website and social media with content derived from Deep-Sea Life 14, as part of the integration of the communication aspects of the Deep-Sea Biology Society, INDEEP and DOSI, and will continue to do so over the next six months with content from the current Deep-Sea Life issue. You can see some examples on our [website](#) using the tag "Deep-Sea Life". You can also access all previous Deep-Sea Life issues on the Society's [website](#) and the [DOSI website](#).

We are witnessing a continuous growth on our Twitter account, which now stands ~5,400 followers, up ~7% from this point six months ago. We are committed to strengthen our social media presence in the coming months even more, so as to ensure that we stay connected with the growing community of deep-sea biologists around the world. You can follow us [here](#).

We are really keen on promoting the next generation of deep-sea researchers on our social media and website, particularly Black, Indigenous and/or People of Colour, in order to inspire younger audiences, and promote diversity, inclusivity and equity in our field. This can be a simple tweet with a few lines on the work that you do, a picture, some URLs, or a more comprehensive scientist profile that can be featured on our website. The latter is an initiative that has already been in place for students (check <https://dsbsoc.org/students/meet-the-next-generation-of-deep-sea-researchers/>), but now will be expanded to include early career researchers as well. Therefore, if you are a student or early-career researcher interested in this, please get in touch with the Student Officer ([students@dsbsoc.org](mailto:students@dsbsoc.org)) and Early-Career Officer ([early\\_career@dsbsoc.org](mailto:early_career@dsbsoc.org)), respectively.

Finally, if you want us to help spread the word about upcoming events, courses, new papers etc. that are of interest to the wider deep-sea biology community please direct message us on our Twitter Account or contact our Communications Officer at [communications@dsbsoc.org](mailto:communications@dsbsoc.org).

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## Deep-Sea Biology Society Development

Julia Sigwart

*Development Office*

Email: [development@dsbsoc.org](mailto:development@dsbsoc.org)

The Society is a registered charity in the UK and we recently gained important recognition that we have equivalent status under US regulations with support from the Gordon and Betty Moore Foundation. We are always seeking new ways to diversify the income for the Society beyond the contributions from membership fees, so that we can support awards and meetings, but most importantly so that we can support efforts that diversify participation in deep sea biology at all career stages.

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

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## Deep-Sea Biology Society Awards and Prizes

Rachel Jeffreys

*Awards Officer*

Email: [awards@dsbsoc.org](mailto:awards@dsbsoc.org)

### Paper of the Year

Deadline: Nominations to be received by 1 July 2020

This year the Society is awarding the 'Paper of the Year' award, which will be awarded to an outstanding paper published in the period leading up to the [eDSBS](#) meeting. The prize will be one-year free membership of the Society and a £100 cash prize. Please email nominations to [awards@dsbsoc.org](mailto:awards@dsbsoc.org)

### **Cruise Bursaries**

Deadline: none

The Deep-Sea Biology Society cruise bursaries are designed to support student and early-career deep-sea biologists to participate in research cruises, encourage new collaborations and develop new research directions. Bursaries are awarded for travel, subsistence and associated shipping costs required to join a research cruise. These bursaries are open to graduate (Masters and PhD) students and postdoctoral scientists.

Up to £2000 will be awarded to facilitate cruise participation. Successful applicants should provide a twitter feed highlighting the cruise and with links and credit to the DSBSoc and produce a short video blog and report on their return for the Deep-Sea Biology Society website.

### **Prize for best Student and Early-Career Talks and Posters: eDSBS**

Deadline: none

A three-year free membership to the Society will be awarded to the best student as well as early-career oral and poster presentations at [eDSBS](#).

All terms and conditions for our awards can be found on our website here: <http://dsbsoc.org/grants-awards/society-awards/>

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## **Deep-Sea Biology Society Finances**

Chris Yesson

*Treasurer*

Email: [treasurer@dsbsoc.org](mailto:treasurer@dsbsoc.org)

Draft accounts covering 2019 have been submitted to the auditors and will be circulated to the membership for approval prior to the AGM.

The first half of 2020 has been relatively quiet for finances. Membership income is ~6% down on the same time last year. Membership remains our main income stream. Expected expenditure on the AGM scheduled for the postponed CBE meeting has been redirected to the virtual eDSBS meeting.

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## **Deep-Sea Biology Society Early-Career Support**

Andrea Quattrini

*Early Career Officer*

Email: [early\\_career@dsbsoc.org](mailto:early_career@dsbsoc.org)

To continue the early career webinar series, we will be hosting a webinar with the National Science Foundation Bio-Oce program managers on June 22 at 130pm EDT. We are also hosting several early career events during eDBS, including a virtual happy hour/tea hour, webinars and a panel discussion on international funding opportunities. We also wish to highlight early career researchers through the creation of [scientist profiles](#) on the Society website.

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## Deep-Sea Biology Society Students

Ily Iglesias

*Student Officer*

Email: [students@dsbsoc.org](mailto:students@dsbsoc.org)

In addition to continued communication to our student members, we have been working collaboratively to highlight the research and journey of individual students through the creation of student profiles for the [Society website](#). As mentioned above, the Society has decided to offer a eDSBS virtual conference this coming summer, which will provide a wonderful opportunity for students to showcase their work and network virtually with other scientists in their field. We are currently working on a student-specific event for this conference that will focus on career progression and opportunities (details to follow soon), and will continue to be working to support future student-mentoring opportunities.

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## Deep-Sea Biology Society Mentoring

Rachel Jeffreys, Awards Officer, [awards@dsbsoc.org](mailto:awards@dsbsoc.org)

Andrea Quattrini, Early Career Officer, [early\\_career@dsbsoc.org](mailto:early_career@dsbsoc.org)

The mentoring network was set up as a space to provide advice and support for both graduate and early career researchers. It consists of groups of scientists at various stages in their careers, from graduate scientists to professors. 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.

Currently there are 11 mentoring groups with ~80 scientists. These groups have been in place since the summer 2019 and we hope that you are all finding the network useful. If you are interested in joining the network please do get in touch. Similarly if you already participate in the network and have any suggestions or ideas please let us know.

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## Deep-Sea Biology Society Membership

Santiago Herrera

Email: [membership@dsbsoc.org](mailto:membership@dsbsoc.org)

Membership is stable, currently standing at 267, which is about on par with the beginning of 2020 (290). We expect an increase in membership over the next couple of months linked to the upcoming eDSBS meeting. As membership grows, the services that the Society offers to the community also increase in number and scope.