

# Deep-Sea Life

Issue 5, June 2015

Welcome to the fifth edition of Deep-Sea Life: an informal publication for the deep-sea biology community and indeed all interested parties. Herewith, lots more interesting contributions highlighting recent cruises, projects, meetings and much more. Also, look out for our new section for job seekers called [DeepMatch.com](http://DeepMatch.com). Thanks to Ariadna Mecho for the idea – she kicks it off with her profile alongside two others. This section should help those searching for a variety of positions (including PhDs, Post-Docs and beyond) as well as those on the look-out for suitable candidates. Our “Photo of the Issue” is an action shot taken on a recent cruise to the Pacific Clarion-Clipperton Fracture Zone led by Pedro Martinez (see [page 22](#) for report).

Hopefully many of us will see each other shortly at the 14<sup>th</sup> Deep-Sea Biology Symposium (31<sup>st</sup> August to 4<sup>th</sup> September) in the beautiful town of Aveiro in Portugal. There promises to be a rich programme of talks and posters covering a range of topics including biodiversity and ecosystem function, taxonomy and phylogeny, autoecology, connectivity and biogeography, evolutionary history, natural and anthropogenic disturbance and stewardship of our deep oceans. The poster session will be especially impressive at this meeting as there were many more oral abstract submissions than slots and the standard was excellent, which made life pretty tough for the selection committee. Hence the posters will be well worth a read to stimulate discussions with their authors.



*Pedro Martinez and Ann Vanreusel hard at work during the recent JPI cruise to the Pacific Ocean CCZ. Photo courtesy of Pedro Ribeiro.*

Once again, I would like to sincerely thank all those that have contributed to this issue. Your efforts are appreciated (judging by the responses I receive). And of course as always, thanks to Dr Abigail Pattenden (University of Limerick, Ireland) and Dr Eva Ramirez-Llodra (NIVA, Norway) for their invaluable help with editing and production.

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

## Issue Contents

Hot off the Press	2	It's Your Opinion	43
Cruise News	17	Scientist Profiles	45
Project Focus	24	DeepMatch.com	50
News	31	Opportunities	53
Meetings and Workshops	39	Obituaries	59

# Hot off the Press

## Megabenthic assemblage structure on three New Zealand seamounts: implications for seafloor massive sulfide mining

R. E. Boschen, A. A. Rowden, M. R. Clark, S. J. Barton, A. Pallentin, J. P. A. Gardner (2015)

*Marine Ecology Progress Series, Volume 523, : 1-14*

Seamounts are recognized for their biological importance and, more recently, mineral wealth. However, in most cases the biological information required to assess the risk to seamount assemblages from mining is lacking. This study uses towed video footage and environmental data to investigate patterns of megafaunal distribution, assemblage structure and association with environmental variables, both within and between three seamounts along the Kermadec volcanic arc in the New Zealand Exclusive Economic Zone. These seamounts represent different levels of hydrothermal activity, with an overlapping depth range: Rumble II East has no history of hydrothermal activity; Brothers is hydrothermally active; and Rumble II West is predominantly inactive. All three seamounts fall within an area previously licenced for the prospecting phase of seafloor massive sulfide (SMS) mining. In total, 186 putative taxa were identified from video samples and assigned to 20 assemblages. Both seamount and a priori defined habitats (nested within seamount) contributed to explaining variation in assemblage structure, with a mixture of shared and unique assemblages found at each seamount. Magnetivity, as a proxy for hydrothermal activity, explained most of the variation in assemblage structure between seamounts, with depth, topography, substratum (and magnetivity for Brothers) explaining most within seamounts. Environmental management implications include the need to designate a network of 'set-aside' sites both within and between seamounts to adequately protect the range of faunal assemblages present. This study also suggests that inactive SMS areas may support faunal assemblages not found elsewhere within the region and would require suitable protection from mining activities.



*An assemblage including corals, crinoids, ascidians and brittlestars on Rumble II West seamount, in the vicinity of SMS deposits. Image: NIWA*

Link to article: <http://www.int-res.com/articles/feature/m523p001.pdf>

## Evaluating the Basic Elements of Transparency of Regional Fisheries Management Organizations

Nichola Clark, Jeff Ardron, Linwood Pendleton (2015)

*Marine Policy, Volume 57: 158-166*

This paper reports on the first global study of Regional Fisheries Management Organization (RFMO) transparency. It was prompted by recent scholarship that suggests that RFMOs are failing to meet their conservation and management mandates and that transparency is a critical element of this performance. In this study, 11 RFMOs were evaluated using

34 questions, divided into three sections: i) access to full, up-to-date and accurate information; ii) public participation in decision-making; and iii) access to outcomes. Secretariats for all 11 RFMOs were contacted, and all responded, to correct and comment on initial findings and to share additional information. The total scores in this study reflect transparency as measured against current good practices in RFMOs as a whole, rather than some sort of idealistic benchmark. Each question should therefore be seen as a diagnostic tool that shows where some RFMO(s) fall short and how they can correct the shortfall based on the practices of their peers. These results have highlighted a number of good practices amongst RFMOs, with no single RFMO standing out as having particularly poor transparency practices. On the other hand, there also were not any RFMOs that had exemplary transparency practices in every respect and all RFMOs still have room to improve upon their basic transparency practices. This first transparency assessment is necessarily broad in nature and considers only very basic elements of transparency. It is to be expected that as RFMO practices become more sophisticated, so will the techniques and criteria of future transparency assessments.

Link to article: <http://www.sciencedirect.com/science/article/pii/S0308597X15000524>

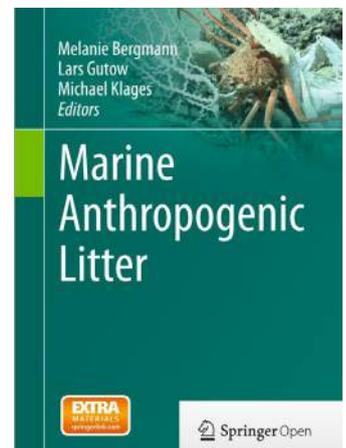
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## Marine Anthropogenic Litter

Bergmann, M., Gutow, L., Klages, M. (2015)

This book describes how manmade litter, primarily plastic, has spread into the remotest parts of the oceans and covers all aspects of this pollution problem from the impacts on wildlife and human health to socio-economic and political issues. Marine litter is a prime threat to marine wildlife, habitats and food webs worldwide.

The book illustrates how advanced technologies from deep-sea research, microbiology and mathematic modelling as well as classic beach litter counts by volunteers contributed to the broad awareness of marine litter as a problem of global significance. The authors summarise more than five decades of marine litter research, which receives growing attention after the recent discovery of great oceanic garbage patches and the ubiquity of microscopic plastic particles in marine organisms and habitats.



In 16 chapters, authors from all over the world have created a universal view on the diverse field of marine litter pollution, the biological impacts, dedicated research activities, and the various national and international legislative efforts to combat this environmental problem. They recommend future research directions necessary for a comprehensive understanding of this environmental issue and the development of efficient management strategies. This book addresses scientists, and it provides a solid knowledge base for policy makers, NGOs, and the broader public.

Link to book: <http://link.springer.com/book/10.1007%2F978-3-319-16510-3>

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## Distribution of nine cold-water coral species (Scleractinia and Gorgonacea) in the cold temperate North Atlantic: effects of bathymetry and hydrography

Lene Buhl-Mortensen, Steinunn Hilma Olafsdottir, Pål Buhl-Mortensen, Julian M. Burgos, Stefan Aki Ragnarsson (Nov 2014)

*Hydrobiologia*

The distribution of nine cold-water corals in the cold temperate North Atlantic is described based on existing records. The species studied are *Lophelia pertusa*, *Madrepora oculata*, *Paragorgia arborea*, *Primnoa resedaeformis*, *Paramuricea*

*placomus*, *Acanella arbuscula*, *Isidella lofotensis*, *Radicipes gracilis* and *Acanthogorgia armata*. The compiled number of records were 5,854, of which 4,875 were obtained from databases and 979 from publications. Distribution maps were produced and temperature, broad-scale topography and current patterns were considered to understand the distribution patterns and conditions at which the species thrive. Currents connecting shelves and slopes above 500 m can explain the wide spatial distribution of *L. pertusa*, *P. arborea* and *P. resedaeformis*. However, *L. pertusa* is scarce on the western side of the North Atlantic, *P. arborea* has only few records off Iceland and *A. arbuscula* and *A. armata* are not found on the Norwegian shelf. The differences in distribution patterns between species indicate that they are differently affected by the topographic barrier between the North Atlantic and the Nordic Seas. Present knowledge of dispersal ability of cold-water corals does not allow a firm causal explanation to the observed distribution patterns. These, however, are indicative of biogeographic provinces relevant to cold-water corals and their habitat requirements.

Link to article: <http://link.springer.com/article/10.1007/s10750-014-2116-x>

## A name for the ‘scaly-foot’, finally!

### “The ‘scaly-foot gastropod’: a new genus and species of hydrothermal vent-endemic gastropod (Neomphalina: Peltospiridae) from the Indian Ocean”.

Chong Chen, Katrin Linse, Jon Copley & Alex Rogers (2015)

*Journal of Molluscan Studies*

Since its initial discovery in 2001, the ‘scaly-foot gastropod’ is an iconic species of the deep-sea hydrothermal vents of the Indian Ocean. Not only is it the only snail known to have dermal scales on the foot, it is also the only metazoan animal capable of building a skeleton out of iron sulfide, which covers the sclerites as well as the shell. Though many inspiring studies have been published on this species, it unfortunately remained unnamed in the sense of the International Code of Zoological Nomenclature for more than a decade. Following a research cruise to sample the Longqi hydrothermal vent field of Southwest Indian



Ridge, where we discovered a previously unknown population of them, I was lucky enough to lead its formal description and naming. Our recent paper “The ‘scaly-foot gastropod’: a new genus and species of hydrothermal vent-endemic gastropod (Neomphalina: Peltospiridae) from the Indian Ocean”, published in *Journal of Molluscan Studies*, established the name *Chrysomallon squamiferum* Chen, Linse, Copley & Rogers, 2015. It is worth noting that this is the same name Dr Anders Warén and colleagues originally intended to give to it, which was included only on a Genbank submission and thus a nomen nudum. Another commonly seen misspelling is *Crysomallon*, which has made its way into a few academic papers. It is hoped that the formal description will prevent further confusions regarding the name of such a remarkable species.

Link to article: <http://mollus.oxfordjournals.org/content/early/2015/04/19/mollus.eyv013.abstract>

## Spectral tuning in the eyes of deep-sea lanternfishes (Myctophidae): a novel sexually dimorphic intra-ocular filter

Fanny de Busserolles, Nathan S. Hart, David M. Hunt, Wayne I. Davies, N. Justin Marshall, Michael W. Clarke, Dorothee Hahne, Shaun P. Collin (2015)

*Brain, Behavior and Evolution*, 85: 2

Deep-sea fishes possess several adaptations to facilitate vision where light detection is pushed to its limit. Lanternfishes (Myctophidae), one of the world's most abundant groups of mesopelagic fishes, possess a novel and unique visual specialisation, a sexually dimorphic photostable yellow pigmentation, constituting the first record of a visual sexual dimorphism in any non-primate vertebrate. The topographic distribution of the yellow pigmentation across the retina is species specific, varying in location, shape and size. Spectrophotometric analyses reveal that this new retinal specialisation differs between species in terms of composition and acts as a filter, absorbing maximally between 356 and 443 nm. Microspectrophotometry and molecular analyses indicate that the species containing this pigmentation also possess at least 2 spectrally distinct rod visual pigments as a result of a duplication of the Rh1 opsin gene. After modelling the effect of the yellow pigmentation on photoreceptor spectral sensitivity, we suggest that this unique specialisation acts as a filter to enhance contrast, thereby improving the detection of bioluminescent emissions and possibly fluorescence in the extreme environment of the deep sea. The fact that this yellow pigmentation is species specific, sexually dimorphic and isolated within specific parts of the retina indicates an evolutionary pressure to visualise prey/predators/mates in a particular part of each species' visual field.

Link to article: <https://www.karger.com/Article/Abstract/371652>

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## The deep sea is a major sink for microplastic debris

Lucy C. Woodall, Anna Sanchez-Vidal, Miquel Canals, Gordon L. J. Paterson, Rachel Coppock, Victoria Sleight, Antonio Calafat, Alex D. Rogers, Bhavani E. Narayanaswamy and Richard C. Thompson (2014)

*R. Soc. open sci.* 1: 140317

Marine debris, mostly consisting of plastic, is a global problem, negatively impacting wildlife, tourism and shipping. However, despite the durability of plastic, and the exponential increase in its production, monitoring data show limited evidence of concomitant increasing concentrations in marine habitats. There appears to be a considerable proportion of the manufactured plastic that is unaccounted for in surveys tracking the fate of environmental plastics. Even the discovery of widespread accumulation of microscopic fragments (microplastics) in oceanic gyres and shallow water sediments is unable to explain the missing fraction. Here, we show that deep-sea sediments are a likely sink for microplastics. Microplastic, in the form of fibres, was up to four orders of magnitude more abundant (per unit volume) in deep-sea sediments from the Atlantic Ocean, Mediterranean Sea and Indian Ocean than in contaminated sea surface waters. Our results show evidence for a large and hitherto unknown repository of microplastics. The dominance of microfibrils points to a previously underreported and unsampled plastic fraction. Given the vastness of the deep sea and the prevalence of microplastics at all sites we investigated, the deepsea floor appears to provide an answer to the question—where is all the plastic?

Link to article: <http://rsos.royalsocietypublishing.org/content/1/4/140317>

## The trophic and metabolic pathways of foraminifera in the Arabian Sea: evidence from cellular stable isotopes

Rachel M. Jeffreys, Elizabeth H. Fisher, Andrew J. Gooday, Kate E. Larkin, David S. M. Billett, and George A. Wolff (2015)

*Biogeosciences* 12: 1781-1797

The Arabian Sea is a region of elevated productivity with the highest globally recorded fluxes of particulate organic matter (POM) to the deep ocean, providing an abundant food source for fauna at the seafloor. However, benthic communities are also strongly influenced by an intense oxygen minimum zone (OMZ), which impinges on the continental slope from 100 to 1000 m water depth. We compared the trophic ecology of foraminifera on the Oman and Pakistan margins of the Arabian Sea (140–3185 m water depth). These two margins are contrasting both in terms of the abundance of sedimentary organic matter and the intensity of the OMZ. Organic carbon concentrations of surficial sediments were higher on the Oman margin ( $3.32 \pm 1.4\%$ ) compared to the Pakistan margin ( $2.45 \pm 1.1\%$ ) and sedimentary organic matter (SOM) quality estimated from the Hydrogen Index was also higher on the Oman margin (300–400 mg HC mg TOC<sup>-1</sup>) compared to the Pakistan margin (< 250 mg HC mg TOC<sup>-1</sup>). The  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values of sediments were similar on both margins ( $-20$  and  $8\%$ , respectively). Stable isotope analysis (SIA) showed that foraminiferal cells had a wide range of  $\delta^{13}\text{C}$  values ( $-25.5$  to  $-11.5\%$ ), implying that they utilise multiple food sources; indeed  $\delta^{13}\text{C}$  values varied between depths, foraminiferal types and between the two margins. Foraminifera had broad ranges in  $\delta^{15}\text{N}$  values ( $-7.8$  to  $27.3\%$ ). The enriched values suggest that some species may store nitrate to utilise in respiration; this was most notable on the Pakistan margin. Depleted foraminiferal  $\delta^{15}\text{N}$  values, particularly at the Oman margin, may reflect feeding on chemosynthetic bacteria. We suggest that differences in productivity regimes may be responsible for the differences observed in foraminiferal isotopic composition. In addition, at the time of sampling, whole jellyfish carcasses (*Crambionella orsini*) and a carpet of jelly detritus were observed across the Oman margin transect. Associated chemosynthetic bacteria may have provided an organic-rich food source for foraminifera at these sites. Our data suggest that foraminifera in OMZ settings can utilise a variety of food sources and metabolic pathways to meet their energetic demands.

Link to article: <http://www.biogeosciences.net/12/1781/2015/bg-12-1781-2015.html>

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## Distribution of macro-infaunal communities in phosphorite nodule deposits on Chatham Rise, Southwest Pacific: Implications for management of seabed mining

Daniel Leduc, Ashley A. Rowden, Leigh G. Torres, Scott D. Nodder, Arne Pallentin (2015)

*Deep Sea Research Part I, Volume 99: 105-118*

Protecting the structural and functional integrity of benthic communities is essential for the maintenance of ecosystem services by the deep sea. As large scale exploitation of minerals from the deep-sea floor becomes increasingly likely, there is a growing need for a better understanding of the spatial distribution of benthic communities and their relationships with environmental variables, so that effective management practices can be developed and implemented. Here, we present the results of a survey of the macro-infaunal community on the crest of Chatham Rise, Southwest Pacific, in an area rich in phosphorite nodule deposits that is proposed for future mining. Boxcore samples from the study area ( $\sim 2500 \text{ km}^2$ ) were used to describe macro-infaunal diversity and community structure relative to phosphorite nodule

density and environmental variation, these data forming the basis for predictive models of the distribution of benthic communities. Analyses showed that variation in macro-infaunal community structure was similar at two spatial scales, within the survey areas (1–5 km) and among survey areas (5–50 km). Overall, macro-infaunal community structure was most strongly correlated with phosphorite nodule density, and was also correlated with longitude. Habitat suitability models were generated for three benthic communities using boosted regression trees. Models showed that each of these communities was associated with different seabed morphologies (i.e., uneven topography, slopes of depression features, or flat seabed), and produced contrasting predicted spatial distribution patterns among communities across the study area. One of these communities, dominated by lysianassid and phoxocephalid amphipods, was strongly associated with the presence of high-density phosphorite nodules and may represent a nodule-specific community. Macro-infaunal diversity (taxon richness) was significantly correlated with topographic variables, and was greatest in areas with uneven topography and inside depressions. Our findings show that two environmental variables that will be directly and permanently impacted by mining (nodule density and mesoscale topographic features) may be key drivers of benthic community structure and diversity. Mitigating impacts of phosphorite mining on Chatham Rise will require protecting areas of seabed spanning the entire range of phosphorite nodule densities, as well as including key topographic features that are associated with distinct macro-infaunal communities. Furthermore, these areas should be distributed along the east to west axis of the crest of the Rise in order to encompass the longitudinal range of environmental variability across the area for which a mining permit and a prospecting licence are held. The present study demonstrates how modelling of benthic communities can be an effective tool for spatial management of seabed mining.

Link to article: <http://www.sciencedirect.com/science/article/pii/S0967063715000217>

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## **The distribution of benthic biomass in hadal trenches: A modelling approach to investigate the effect of vertical and lateral organic matter transport to the seafloor**

Matteo C. Ichino, Malcolm R. Clark, Jeffrey C. Drazen, Alan Jamieson, Daniel O.B. Jones, Adrian P. Martin, Ashley A. Rowden, Timothy M. Shank, Paul H. Yancey, Henry A. Ruhl (2015)

*Deep Sea Research Part, Volume 100: 21-33*

Most of our knowledge about deep-sea habitats is limited to bathyal (200–3000 m) and abyssal depths (3000–6000 m), while relatively little is known about the hadal zone (6000–11,000 m). The basic paradigm for the distribution of deep seafloor biomass suggests that the reduction in biomass and average body size of benthic animals along depth gradients is mainly related to surface productivity and remineralisation of sinking particulate organic carbon with depth. However, there is evidence that this pattern is somewhat reversed in hadal trenches by the funnelling of organic sediments, which would result in increased food availability along the axis of the trenches and towards their deeper regions. Therefore, despite the extreme hydrostatic pressure and remoteness from the pelagic food supply, it is hypothesized that biomass can increase with depth in hadal trenches. We developed a numerical model of gravitational lateral sediment transport along the seafloor as a function of slope, using the Kermadec Trench, near New Zealand, as a test environment. We propose that local topography (at a scale of tens of kilometres) and trench shape can be used to provide useful estimates of local accumulation of food and, therefore, patterns of benthic biomass. Orientation and steepness of local slopes are the drivers of organic sediment accumulation in the model, which result in higher biomass along the axis of the trench, especially in the deepest spots, and lower biomass on the slopes, from which most sediment is removed. The model outputs for the Kermadec Trench are in agreement with observations

suggesting the occurrence of a funnelling effect and substantial spatial variability in biomass inside a trench. Further trench surveys will be needed to determine the degree to which seafloor currents are important compared with the gravity-driven transport modelled here. These outputs can also benefit future hadal investigations by highlighting areas of potential biological interest, on which to focus sampling effort. Comprehensive exploration of hadal trenches will, in turn, provide datasets for improving the model parameters and increasing predictive power.

Link to article: <http://www.sciencedirect.com/science/article/pii/S0967063715000333>

## Submersible- and lander-observed community patterns in the Mariana and New Britain trenches: Influence of productivity and depth on epibenthic and scavenging communities

Natalya D. Gallo, James Cameron, Kevin Hardy, Patricia Fryer, Douglas H. Bartlett, Lisa A. Levin (2015)

*Deep-Sea Research I, Volume 99: 119-133*



Figure 1: The DEEPSEA CHALLENGE submersible and lander meet up at ~1.1 km depth near the Ulithi atoll. Photo taken by an ROV.



Figure 2: The newly observed squidworm is on the upper right (*Teuthidodrilus* sp.), next to a swimming holothurian (*Enypniastes eximia*). Both organisms were observed during the DEEPSEA CHALLENGE submersible dive to depths of ~1 km near the New Britain Trench.

Deep-sea trenches remain one of the least explored ocean ecosystems due to the unique challenges of sampling at great depths. Five submersible dives conducted using the DEEPSEA CHALLENGER submersible generated video of undisturbed deep-sea communities at bathyal (994 m), abyssal (3755 m), and hadal (8228 m) depths in the New Britain Trench, bathyal depths near the Ulithi atoll (1192 m), and hadal depths in the Mariana Trench Challenger Deep (10908 m). The New Britain Trench is overlain by waters with higher net primary productivity (~3-fold) than the Mariana Trench and nearby Ulithi, and receives substantially more allochthonous input from terrestrial sources, based on the presence of terrestrial debris in submersible video footage. Comparisons between trenches addressed how differences in productivity regime influence benthic and demersal deep-sea community structure. In addition, the scavenger community was studied using paired lander deployments to the New Britain (8233 m) and Mariana (10918 m) trenches. Differences in allochthonous input were reflected in epibenthic community abundance, biodiversity, and lifestyle representation. More productive locations were characterized by higher faunal abundances (~2-fold) at both bathyal and hadal depths. In contrast, biodiversity trends showed a unimodal pattern with more food-rich areas exhibiting reduced bathyal diversity and elevated hadal diversity. Hadal scavenging communities exhibited

similar higher abundance but also ~3-fold higher species richness in the more food-rich New Britain Trench compared to the Mariana Trench. High species- and phylum-level diversity observed in the New Britain Trench suggest that trench

environments may foster higher megafaunal biodiversity than surrounding abyssal depths if food is not limiting. However, the absence of fish at our hadal sites suggests that certain groups do have physiological depth limits. Submersible video footage allowed novel in situ observation of holothurian orientation, jellyfish feeding behavior as well as lifestyle preferences for substrate, seafloor and overlying water. This study documents previously unreported species in the New Britain Trench, including an ulmariid scyphozoan (8233 m) and an acrocirrid polychaete (994 m), and reports the first observation of an abundant population of elpidiid holothurians in the Mariana Trench (10908m). It also provides the first megafaunal community analysis of the world's deepest epibenthic community in the Mariana Trench Challenger Deep, which was composed of elpidiid holothurians, amphipods, and xenophyophores.

Link to article: <http://www.sciencedirect.com/science/article/pii/S0967063715000060>

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## **Fragmentation of refractory detritus by zooplankton beneath the euphotic zone stimulates the harvestable production of labile and nutritious microbial biomass**

Daniel J. Mayor, Richard Sanders, Sarah L. C. Giering and Thomas R. Anderson (Dec 2014)

*BioEssays, Volume 36 (12): 1132–1137*

Sinking organic particles transfer ~10 gigatonnes of carbon into the deep ocean each year, keeping the atmospheric CO<sub>2</sub> concentration significantly lower than would otherwise be the case. The exact size of this effect is strongly influenced by biological activity in the ocean's twilight zone (~50–1,000 m beneath the surface). Recent work suggests that the resident zooplankton fragment, rather than ingest, the majority of encountered organic particles, thereby stimulating bacterial proliferation and the deep-ocean microbial food web. Here we speculate that this apparently counterintuitive behaviour is an example of 'microbial gardening', a strategy that exploits the enzymatic and biosynthetic capabilities of microorganisms to facilitate the 'gardener's' access to a suite of otherwise unavailable compounds that are essential for metazoan life. We demonstrate the potential gains that zooplankton stand to make from microbial gardening using a simple steady state model, and we suggest avenues for future research.

Link to article: <http://onlinelibrary.wiley.com/doi/10.1002/bies.201400100/abstract>

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## **Evolutionary and biogeographical patterns of barnacles from deep-sea hydrothermal vents**

Santiago Herrera, Hiromi Watanabe and Timothy M. Shank (2015)

*Molecular Ecology, 24 (3): 673-689*

The characterization of evolutionary and biogeographical patterns is of fundamental importance to identify factors driving biodiversity. Due to their widespread but discontinuous distribution, deep-sea hydrothermal vent barnacles represent an excellent model for testing biogeographical hypotheses regarding the origin, dispersal and diversity of modern vent fauna. Here, we characterize the global genetic diversity of vent barnacles to infer their time of radiation, place of origin, mode of dispersal and diversification. Our approach was to target a suite of multiple loci in samples representing seven of the eight described genera. We also performed restriction-site associated DNA sequencing on individuals from each species. Phylogenetic inferences and topology hypothesis tests indicate that vent barnacles have colonized deep-sea hydrothermal vents at least twice in history. Consistent with preliminary estimates, we find a likely

radiation of barnacles in vent ecosystems during the Cenozoic. Our analyses suggest that the western Pacific was the place of origin of the major vent barnacle lineage, followed by circumglobal colonization eastwards through the Southern Hemisphere during the Neogene. The inferred time of radiation rejects the classic hypotheses of antiquity of vent taxa. The timing and the mode of origin, radiation and dispersal are consistent with recent inferences made for other deep-sea taxa, including nonvent species, and are correlated with the occurrence of major geological events and mass extinctions. Thus, we suggest that the geological processes and dispersal mechanisms discussed here can explain the current distribution patterns of many other marine taxa and have played an important role shaping deep-sea faunal diversity. These results also constitute the critical baseline data with which to assess potential effects of anthropogenic disturbances on deep-sea ecosystems.

Link to article: <http://onlinelibrary.wiley.com/doi/10.1111/mec.13054/full>

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## In hot and cold water: differential life-history traits are key to success in contrasting thermal deep-sea environments

Leigh Marsh, Jonathan T. Copley, Paul A. Tyler and Sven Thatje (2015)

*Journal of Animal Ecology*, DOI: 10.1111/1365-2656.12337

1. Few species of reptant decapod crustaceans thrive in the cold-stenothermal waters of the Southern Ocean. However, abundant populations of a new species of anomuran crab, *Kiwa tyleri*, occur at hydrothermal vent fields on the East Scotia Ridge.
2. As a result of local thermal conditions at the vents, these crabs are not restricted by the physiological limits that otherwise exclude reptant decapods south of the polar front.
3. We reveal the adult life history of this species by piecing together variation in microdistribution, body size frequency, sex ratio, and ovarian and embryonic development, which indicates a pattern in the distribution of female Kiwaidae in relation to their reproductive development.
4. High-density '*Kiwa*' assemblages observed in close proximity to sources of vent fluids are constrained by the thermal limit of elevated temperatures and the availability of resources for chemosynthetic nutrition. Although adult Kiwaidae depend on epibiotic chemosynthetic bacteria for nutrition, females move offsite after extrusion of their eggs to protect brooding embryos from the chemically harsh, thermally fluctuating vent environment. Consequently, brooding females in the periphery of the vent field are in turn restricted by low-temperature physiological boundaries of the deep-water Southern Ocean environment. Females have a high reproductive investment in few, large, yolky eggs, facilitating full lecithotrophy, with the release of larvae prolonged, and asynchronous. After embryos are released, larvae are reliant on locating isolated active areas of hydrothermal flow in order to settle and survive as chemosynthetic adults. Where the cold water restricts the ability of all adult stages to migrate over long distances, these low temperatures may facilitate the larvae in the location of vent sites by extending the larval development period through hypometabolism.
5. These differential life-history adaptations to contrasting thermal environments lead to a disjunct life history among males and females of *K. tyleri*, which is key to their success in the Southern Ocean vent environment.
6. We highlight the complexity in understanding the importance of life-history biology, in combination with environmental, ecological and physiological factors contributing to the overall global distribution of vent-endemic species.

Link to article: <http://onlinelibrary.wiley.com/doi/10.1111/1365-2656.12337/abstract>

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## The metabolic cost of developing under hydrostatic pressure: experimental evidence supports macroecological pattern

Kathryn E. Smith, Alastair Brown and Sven Thatje (2015)

*Marine Ecology Progress Series. 524: 71–82.*

Hydrostatic pressure is the most constant physical parameter on Earth. It increases linearly with water depth and is stable over evolutionary timescales. Despite this, bathymetric shifts in physiological adaptations that are observed in marine invertebrates (eg in metabolic rate and egg size) are currently interpreted to result predominantly from decreases in temperature. However, analyses of invertebrate egg size data presented here indicates an increase in egg volume with depth in the absence of a thermal gradient. This suggests hydrostatic pressure may also be important in determining resource allocation to offspring. To test the hypothesis that an increase in energy expenditure during development occurs with increasing hydrostatic pressure, we examined the effects of sustained exposure to pressure (1, 100, 200 and 300 atm) on development of a shallow-water marine gastropod, *Buccinum undatum*. Embryos developed successfully at 1, 100 and 200 atm, but the rate of development slowed with increasing pressure (by 3 days at 100 atm and 6 days at 200 atm). No development was observed at 300 atm. In embryos reared at 200 atm, veliger dry weight and carbon and nitrogen biomass were significantly reduced. These results indicate that high pressure significantly increases the metabolic cost associated with development, demonstrating a negative and ultimately critical effect. We hypothesise that pressure imposes increased metabolic cost on all physiological processes. This offers an additional explanation for physiological adaptations observed with increasing depth, indicating that hydrostatic pressure is an important and previously underestimated factor contributing to metabolic theory for most of our biosphere. Hydrostatic pressure may represent a critical physiological limit for the maximum depth distribution of shallow-water fauna.

Link to article: <http://goo.gl/BrMidR>

## Future-proofing Marine Protected Area Networks for Cold-Water Coral Reefs

Emma L Jackson and Jason M Hall-Spencer (June 2014)

*ICES Journal of Marine Science: Journal du Conseil, 71: 2621-2629.*



The NE Atlantic has coral reefs all along the continental shelf-break region; these high biomass/high diversity habitats are threatened by trawling and are at risk from dissolution as the oceans continue to acidify.

As a fresh wave of Marine Protected Areas (MPAs) washes over our seas, many find themselves asking “will they really work?”. Given that the temperature and chemistry of the oceans are changing rapidly due to CO<sub>2</sub> emissions this is a genuine concern. The design of MPAs rightly revolves around the management of current pressures, but seems to neglect what future changes will do. In a study with the ICES Journal of Marine Science (doi:10.1093/icesjms/fsu099) researchers from the UK have examined how ocean changes will affect marine protected areas designed to safeguard cold-water coral reefs.

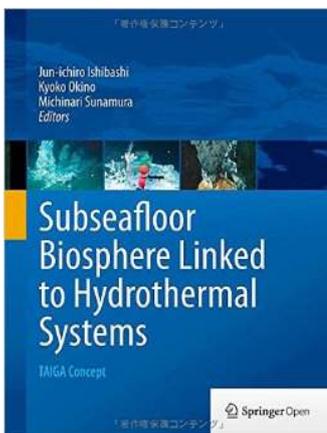
In the past decade cold-water coral reefs have been badly damaged by towed demersal fishing gear worldwide. In the NE Atlantic they and are now on the OSPAR Commission ([www.ospar.org](http://www.ospar.org)) list of Threatened and/or Declining Species and Habitats with protection provided under the European Union Habitats Directive. In response, a network of fisheries closures was designed to protect cold-water reefs, while minimizing the impact on fishing activity both in EU waters and on the High Seas. This has dealt with an immediate issue but what about ocean acidification, resulting from rising atmospheric CO<sub>2</sub> emissions? This is causing the aragonite saturation horizon to shoal, exposing deep-water corals to waters that are corrosive to the reefs.

The new study collated data on the known and predicted distribution of NE Atlantic coral reefs, their protected areas, and fishing effort. We modelled the effects of ocean acidification to examine whether existing protected areas will ensure adequate protection for cold-water coral reefs in the future. The most optimistic scenario, based on reducing CO<sub>2</sub> emissions immediately, suggests that there would only be minor impacts of ocean acidification on cold-water coral reefs and that trawling remains the main threat to these systems. If CO<sub>2</sub> emissions track the present rate of increase than by 2060, over 85% of these reefs are expected to be exposed to corrosive waters. If we are to ensure long-term survival of habitats it is clear that we need to take ocean change into consideration, in this case we were able to pinpoint relatively shallow areas off Scotland (ca 200 m depth) that will be disproportionately important to the regional survival of NE Atlantic coral reefs. We argue that with good predictive models it should be possible to help future-proof the emerging networks of marine protected areas.

Link to article: <http://icesjms.oxfordjournals.org/content/71/9/2621.short>

## Subseafloor Biosphere Linked to Hydrothermal Systems: TAIGA Concept

Editors: Jun-ichiro Ishibashi, Kyoko Okino, Michinari Sunamura (2015)



Hiromi Watanabe (JAMSTEC) and numerous colleagues have recently completed a project entitled TAIGA, to reveal the linkage between hydrothermal activity and micro- to mega-organisms, and the results are summarized in an e-book, which can be downloaded freely from SpringerLink via <http://link.springer.com/book/10.1007%2F978-4-431-54865-2>

The results of the project have been summarized comprehensively in 50 chapters, and this book provides an overall introduction and relevant topics on the mid-ocean ridge system of the Indian Ocean and on the back-arc systems of the Southern Mariana Trough and Okinawa Trough.

## A global map to aid the identification and screening of critical habitat for marine industries

C.S. Martin, M.J. Tolley, E. Farmer, C.J. Mowen, J.L. Geffert, J.P.W. Scharlemann, H.L. Thomas, J.H. van Bochove, D. Stanwell-Smith, J.M. Hutton, B. Lascelles, J.D. Pilgrim, J.M.M. Ekstrom, D.P. Tittensor (2015)

*Marine Policy, Volume 53: 45-53*

Marine industries face a number of risks that necessitate careful analysis prior to making decisions on the siting of

operations and facilities. An important emerging regulatory framework on environmental sustainability for business operations is the International Finance Corporation's Performance Standard 6 (IFC PS6). Within PS6, identification of biodiversity significance is articulated through the concept of "Critical Habitat", a definition developed by the IFC and detailed through criteria aligned with those that support internationally accepted biodiversity designations. No publicly available tools have been developed in either the marine or terrestrial realm to assess the likelihood of sites or operations being located within PS6-defined Critical Habitat. This paper presents a starting point towards filling this gap in the form of a preliminary global map that classifies more than 13 million km<sup>2</sup> of marine and coastal areas of importance for biodiversity (protected areas, Key Biodiversity Areas [KBA], sea turtle nesting sites, cold- and warm-water corals, seamounts, seagrass beds, mangroves, saltmarshes, hydrothermal vents and cold seeps) based on their overlap with Critical Habitat criteria, as defined by IFC. In total, 5798×103 km<sup>2</sup>(1.6%) of the analysis area (global ocean plus coastal land strip) were classed as Likely Critical Habitat, and 7526×103 km<sup>2</sup> (2.1%) as Potential Critical Habitat; the remainder (96.3%) were Unclassified. The latter was primarily due to the paucity of biodiversity data in marine areas beyond national jurisdiction and/or in deep waters, and the comparatively fewer protected areas and KBAs in these regions. Globally, protected areas constituted 65.9% of the combined Likely and Potential Critical Habitat extent, and KBAs 29.3%, not accounting for the overlap between these two features. Relative Critical Habitat extent in Exclusive Economic Zones varied dramatically between countries. This work is likely to be of particular use for industries operating in the marine and coastal realms as an early screening aid prior to in situ Critical Habitat assessment; to financial institutions making investment decisions; and to those wishing to implement good practice policies relevant to biodiversity management. Supplementary material (available online) includes other global datasets considered, documentation and justification of biodiversity feature classification, detail of IFC PS6 criteria/scenarios, and coverage calculations.

Link to article: <http://www.sciencedirect.com/science/article/pii/S0308597X14002991>

## The utility of near infrared spectroscopy for age estimation of deep-water sharks

Cassandra L. Rigby, Brett B. Wedding, Steve Grauf, Colin A. Simpfendorfer (October 2014)

*Deep-Sea Research I*, 64: 184-194

Reliable age information is vital for effective fisheries management, yet age determinations are absent for many deepwater sharks as they cannot be aged using traditional methods of growth bands counts. An alternative approach to ageing using near infrared spectroscopy (NIRS) was investigated using dorsal fin spines, vertebrae and fin clips of three species of deepwater sharks. Ages were successfully estimated for the two dogfish, *Squalus megalops* and *S. montalbani*, and NIRS spectra were correlated with body size in the catshark, *Asymbolus pallidus*. Correlations between estimated-ages of the dogfish dorsal fin spines and their NIRS spectra were good, with *S. megalops*



*Squalus megalops*: Piked spurdog

*R2* = 0.82 and *S. montalbani* *R2* = 0.73. NIRS spectra from *S. megalops* vertebrae and fin clips that have no visible growth bands were correlated with estimated-ages, with *R2* = 0.89 and 0.76, respectively. NIRS has the capacity to non-lethally estimate ages from fin spines and fin clips, and thus could significantly reduce the numbers of sharks that need to be lethally sampled for ageing studies. The detection of ageing materials by NIRS in poorly calcified

deepwater shark vertebrae could potentially enable ageing of this group of sharks that are vulnerable to exploitation.

Link to article: <http://www.sciencedirect.com/science/article/pii/S0967063714001794>

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## Ecological impacts of large-scale disposal of mining waste in the deep sea

David J. Hughes, Tracy M. Shimmield, Kenneth D. Black & John A. Howe (2015)

*Scientific Reports 5: 9985*

Deep-Sea Tailings Placement (DSTP) from terrestrial mines is one of several large-scale industrial activities now taking place in the deep sea. The scale and persistence of its impacts on seabed biota are unknown. We sampled around the Lihir and Misima island mines in Papua New Guinea to measure the impacts of ongoing DSTP and assess the state of benthic infaunal communities after its conclusion. At Lihir, where DSTP has operated continuously since 1996, abundance of sediment infauna was substantially reduced across the sampled depth range (800–2020 m), accompanied by changes in higher-taxon community structure, in comparison with unimpacted reference stations.

At Misima, where DSTP took place for 15 years, ending in 2004, effects on community composition persisted 3.5 years after its conclusion. Active tailings deposition has severe impacts on deep-sea infaunal communities and these impacts are detectable at a coarse level of taxonomic resolution.

Link to article: <http://www.nature.com/srep/2015/150505/srep09985/full/srep09985.html>

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## Post-Drilling Changes in Seabed Landscape and Megabenthos in a Deep-Sea Hydrothermal System, the Iheya North Field, Okinawa Trough

Nakajima R, Yamamoto H, Kawagucci S, Takaya Y, Nozaki T, Chen C, Fujikura K,

Miwa T and Takai, K (2015)

*PLoS ONE 10(4): e0123095. DOI:10.1371/journal.pone.0123095*

There has been an increasing interest in seafloor exploitation such as mineral mining in deep-sea hydrothermal fields, but the environmental impact of anthropogenic disturbance to the seafloor is poorly known. In this study, the effect of such anthropogenic disturbance by scientific drilling operations (IODP Expedition 331) on seabed landscape and megafaunal habitation was surveyed for over 3 years using remotely operated vehicle video observation in a deep-sea hydrothermal field, the Iheya North field, in the Okinawa Trough. We focused on observations from a particular drilling site (Site C0014) where the most dynamic change of landscape and megafaunal habitation was observed among the drilling sites of IODP Exp. 331. No visible hydrothermal fluid discharge had been observed at the sedimentary seafloor at Site C0014, where *Calyptogena clam* colonies were known for more than 10 years, before the drilling event. After drilling commenced, the original *Calyptogena* colonies were completely buried by the drilling deposits. Several months after the drilling, diffusing high-temperature hydrothermal fluid began to discharge from the sedimentary sub-seafloor in the area of over 20 m from the drill holes, 'artificially' creating a new hydrothermal vent habitat. Widespread microbial mats developed on the seafloor with the diffusing hydrothermal fluids and the galatheid crab *Shinkaia crosnieri* endemic to vents dominated the new vent community. The previously soft, sedimentary seafloor was hardened probably due to barite/gypsum mineralization or silicification, becoming rough and undulated with

many fissures after the drilling operation. Although the effects of the drilling operation on seabed landscape and megafaunal composition are probably confined to an area of maximally 30 m from the drill holes, the newly established hydrothermal vent ecosystem has already lasted 2 years and is like to continue to exist until the fluid discharge ceases and thus the ecosystem in the area has been altered for long-term.

Link to article: <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0123095>

Link to video: [https://www.youtube.com/watch?v=djLBbe17OPU&feature=em-share\\_video\\_user](https://www.youtube.com/watch?v=djLBbe17OPU&feature=em-share_video_user)

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## Description of a new family, new genus, and two new species of deep-sea Forcipulatacea (Asteroidea), including the first known sea star from hydrothermal vent habitats

Christopher Mah, Katrin Linse, Jon Copley, Leigh Marsh, Alex Rogers, David Clague and David Foltz (2015)

*Zoological Journal of the Linnean Society, Volume 174 (1): 93-113*

Based on a phylogenetic analysis of undescribed taxa within the Forcipulatacea, a new family of deep-sea forcipulatacean starfishes, *Paulasteriidae* fam. nov., is described from deep-sea settings. *Paulasterias tyleri* gen. et sp. nov. was observed at recently documented hydrothermal vents on the East Scotia Ridge, Southern Ocean. A second species, *Paulasterias mcclaini* gen. et sp. nov. was observed in deep-sea settings in the North Pacific, more distant from hydrothermal vents. Both species are multi-armed (with between six and eight arms), with a fleshy body wall, and a poorly developed or absent adoral carina. Here, we include discussions of pedicellariae morphology, feeding biology, and classification. © 2015 The Linnean Society of London

The new starfish family has been named after Professor Paul Tyler, of the University of Southampton, UK, in recognition of the work he has done on deep-sea biology.

Link to video: <https://www.youtube.com/watch?v=hQuWNIIsSQDI>

Link to article: <http://onlinelibrary.wiley.com/doi/10.1111/zoj.12229/abstract>

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## Organic matter enrichment in the Whittard Channel; its origin and possible effects on benthic megafauna

Teresa Amaro, Henko de Stiger, Marc Lavaleye & Gerard Duineveld

*Deep-Sea Research Part 1, 102: 90-100*

The Whittard Canyon (NE Atlantic) is one of the largest canyon systems on the northern Bay of Biscay margin. It likely receives a high input of organic matter from the productive overlying surface waters, and part of this organic matter may eventually be transferred down the canyon into the Whittard Channel extending from the canyon mouth onto the Biscay Abyssal Plain. To establish if substantial transport of organic matter takes place from the canyon into the deep-sea channel we: (1) deployed a benthic lander in the Whittard Channel for a period of one year to measure near-bottom particulate matter transport and deposition rates; (2) collected surface sediment samples from the Whittard Channel and adjacent areas to assess possible organic matter enrichment in the channel (3) surveyed transects across the channel and adjacent areas with towed video camera to assess distribution of benthic megafauna potentially indicating

enhanced flux of fresh organic material. The video surveys revealed massive occurrence of elpidiid holothurians in the proximal Whittard Channel, whilst only low numbers were counted further down the channel and on areas adjacent to the channel. We speculate that these deposit-feeding holothurians were attracted by the elevated content of relatively fresh organic matter in surface sediments of the proximal channel, as indicated by analysis of the surface sediment samples. Yet, whilst we expected that organic matter enrichment in the channel could be attributed to down-canyon transport through the Whittard Canyon, this could not be confirmed by data recorded by the benthic lander. During most of the 1-year deployment period, the net near-bottom currents and suspended particulate matter transport was directed in up-channel direction. During two sediment-gravity flow events recorded in March and July 2011, most likely originating from the Whittard Canyon, substantial deposition of particulate matter did occur in the Whittard Channel. However, the material deposited during those events consisted largely of inorganic sediment and was relatively poor in fresh organic material, and hence could not have substantially contributed to the organic matter enrichment observed in the channel. The highest deposition flux of fresh organic matter, recorded in May 2011, was not associated with any down-channel flow and more likely was derived from local settling of phytodetritus produced during the spring phytoplankton bloom. Based on our observations we infer that the organic enrichment observed in the proximal Whittard Channel is due to redistribution of phytodetritus by bottom currents, and accumulation of this material in the topographic depression formed by the Whittard Channel. The mobility of the elpidiid holothurians allows them to exploit these localised food sources.

Link to article: <http://www.sciencedirect.com/science/article/pii/S0967063715000886>

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# Cruise News

## The cruise of the RV Professor Logachev to the Russian Claim Area on the Mid-Atlantic Ridge

Victor Beltenev<sup>1</sup>, Sergey Galkin<sup>2</sup>, Tina Molodtsova<sup>2</sup> and Andrey Gebruk<sup>2</sup>

<sup>1</sup>Polar Marine Geosurvey Expedition and <sup>2</sup>P.P. Shirshov Institute of Oceanology, Russia



On April 18, 2015 the scientific program of the 37th cruise of the RV Professor Logachev was successfully completed and currently the vessel is on her way to St. Petersburg, Russia. The cruise was conducted by Polar Marine Geological Survey Expedition with participation of P.P. Shirshov Institute of Oceanology, Geological Institute and VNIIOceangeology. It was the third cruise of Professor Logachev to the Russian Claim Area on the Mid Atlantic Ridge after signing in November 2012 the 15-year contract between the International Seabed Authority and the Ministry of Natural Resources and Environment of the Russian Federation for exploration for polymetallic sulphide ores. Between November 2014 and April 2015, 15 blocks have been examined on the MAR between 17°51'N and 16°41'N. For the first time in the Russian Claim Area the ecological survey was performed including benthos, plankton and mid-water fish sampling. In the course of geological survey two new ore fields were discovered on the south-western slope of the seamount at the eastern flank of the rift valley of MAR, one at 17°09'N and second at 17°07'N. During video profiling in this area indications of modern hydrothermal activity were discovered. Extensive fields of shells of *Bathymodiolus puteoserpentis* and *Thyasira* sp. were recorded and samples of bivalves were taken using the TVgrab and corer. We would like to thank the crew and the scientific team of the 37<sup>th</sup> cruise of Professor Logachev for their support and high professional level.



## Sampling the hadal Puerto Rico Trench with fine meshed gear

Angelika Brandt on the behalf of the Vema-TRANSIT epibenthic-sledge team

Centre of Natural History, Zoological Museum of the University of Hamburg, Martin-Luther-King-Platz 3, 20146  
Hamburg, Germany, [abrandt@uni-hamburg.de](mailto:abrandt@uni-hamburg.de)



During the Vema-TRANSIT expedition with the new German deep-sea RV Sonne, the hadal zone of the Puerto Rico Trench was sampled for the first time with fine meshed gear using an epibenthic sledge with a cod end of 300  $\mu\text{m}$ , yielding a much higher number of individuals than previously reported from hadal depths. Deep-sea research at hadal depths has been nicely reviewed by Jamieson (2015), who describes this remote and extreme environment as an enigmatic ecosystem. Ocean technology used for the exploration of its biodiversity should not only rely on autonomous gear such as AUVs, lander systems including cameras or traps or manned submersibles. For biological investigations, ROVs offer the opportunity to sample the seafloor selectively. However, ROVs cannot sufficiently sample material for comparative biodiversity research of meio-, macro or megabenthos. For the investigation of the benthic fauna we still depend on trawling and coring, meaning long wire times and high expenses with regard to ship time. Since the early

exploration of the deep sea from research vessels like the Challenger, Galathea, Vityaz and others, hadal samples were taken using varying corer systems or by means of beam or otter trawls. These trawls were characterized, however, by large mesh sizes, typically of 20 mm and cod ends of 10 mm nets, yielding only a small number of macroinvertebrates in the samples. For example, during the Galathea expedition, 83 specimens of bathyal and abyssal isopods were collected from 22 stations (Wolf, 1962): at hadal stations, a total of 53 specimens were collected at 11 stations (Wolff, 1956). Thus the Galathea expedition yielded a total of 136 isopod specimens from all deep-sea stations investigated. In January 2015 we collected 151 specimens of isopods at a single station (> 8300 m) in the Puerto Rico Trench on board of RV Sonne.

Jamieson, A. (2015): *The Hadal Zone: Life in the Deepest Oceans*. Oxford University Press, 1-372.

Wolff, T. (1956): *Isopoda from depths exceeding 6000 meters*. *Galathea Report*, 2: 85-157.

Wolff, T. (1962): *The systematics and biology of bathyal and abyssal Isopoda Asellota*. *Galathea Report*, 6: 1-320.

## Exploring the Antarctic deep seafloor

Aronson R.<sup>1</sup>, McClintock J.<sup>2</sup>, Thatje S.<sup>3</sup>, Smith K.<sup>1</sup>, Singh H.<sup>4</sup> and Amsler M.<sup>2</sup>

<sup>1</sup>Florida Institute of Technology, USA; <sup>2</sup>University of Alabama Birmingham, USA; <sup>3</sup>University of Southampton, UK;

<sup>4</sup>Woods Hole Oceanographic Institution, USA

Written by: Allison Randolph, Outreach and Media Specialist

In February 2015, collaborating scientists from the Florida Institute of Technology, the University of Alabama Birmingham, the University of Southampton, and the Woods Hole Oceanographic Institution set off on their third



Figure 1. Looking out at the Western Antarctic Peninsula from the R/V Laurence M. Gould.

NSF-funded research cruise to Antarctica. Aboard the R/V Laurence M. Gould, the team set out to better understand climate change and its impact on biological invasion off the western Antarctic Peninsula (WAP). Our particular focus was a recently discovered population of king crabs (*Paralomis birsteini*) in the bathyal zone. King crabs are generalized predators of invertebrates and are currently excluded from nearshore environments because water temperatures are too cold. Rapidly warming sea temperatures off the WAP are drawing down that physiological barrier and could allow the king crabs to expand to nearshore-shelf habitats within decades.



Figure 2: King crab (*Paralomis birsteini*) spotted on the Antarctic seafloor at about 1500 meters depth. This is one of hundreds that were imaged.

In order to image the seafloor, SeaSled, a rugged underwater camera vehicle, was towed behind the Gould at depths between 400 and 2000 meters. Equipped with cameras and strobe lights, SeaSled took over 110,000 images of the seafloor over the course of three weeks. SeaSled was also equipped with a CTD and an ADCP, allowing the team to collect environmental data in real time, as well as make sure she flew about 3 meters above the seafloor at all times. With SeaSled completing transects up, down, and across the continental slope in various depth-ranges, the team was able to learn about the population dynamics of the king crabs as well as other deep-seafloor inhabitants.

Collecting live specimens of deep-sea organisms complemented the photo-survey, allowing for much more precise identification and physical analysis. Deploying crab traps at the same depths surveyed by SeaSled, the team was able to collect more than fifty king crabs. Each crab was measured, weighed, and sexed aboard the Gould. A trawl net, also deployed to a similar depth range, allowed the team to collect a variety of seafloor organisms that were frequently being seen in the SeaSled images. Sea stars, sea urchins, brittle stars, fish, sea cucumbers, and more were collected and analysed.



Figure 3 (left): Live king crab (*Paralomis birsteini*) collected from the Antarctic deep seafloor.



Figure 4 (right): The bones making up a whale's vertebral column, laid out on the seafloor.

This expedition was highly successful in that a lot was learned about the ecology of the Antarctic deep seafloor community. Not only was the team able to gather all of the data and samples they had hoped to during the cruise, but

there were some unplanned discoveries too. While imaging the seafloor, the team discovered what appeared to be natural whale falls in several locations. Some of them could be the southernmost whale falls ever recorded.

To learn more (and see some awesome images!) visit the expedition's blog site, [poletopolescience.blogspot.com](http://poletopolescience.blogspot.com), and social media channels: Twitter: Antarctic\_SeaScience, Instagram: Antarctic\_SeaScience, and Facebook: Antarctic SeaScience. Email the author at [allisonwrandolph@gmail.com](mailto:allisonwrandolph@gmail.com).

## Can deep-sea benthos recover from bottom trawling?

Malcolm Clark, Dave Bowden, Ashley Rowden

NIWA, Wellington, New Zealand

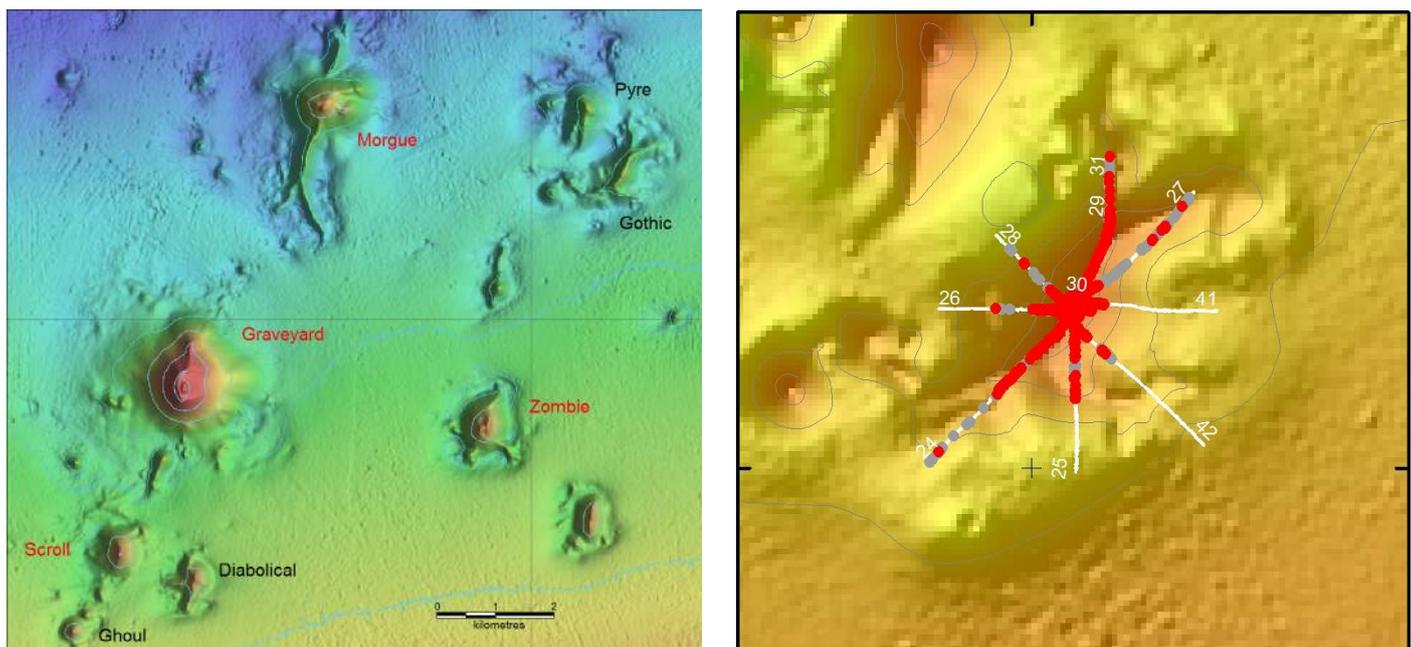


Figure 1 (left): The Graveyard Knolls, a small cluster of seamounts east of New Zealand (red= fished, black=unfished)

Figure 2 (right): Plot of "Gothic seamount" showing the photographic transect coverage (white lines) in 2015 and the occurrence of intact non-living (grey) and live (red) stony coral matrix. Use of the dynamic positioning system of the research vessel enabled transects to be followed accurately.

It is widely accepted that bottom trawl fisheries can damage the seafloor and associated benthic communities. However, very little is known about the ability of deep-sea benthos to recover from such disturbance. A study carried out as part of the Census of Marine Life on Seamounts using data from Australian and New Zealand seamounts indicated that there was no sign of recovery 5-10 years after trawling had ceased. That study used two surveys from New Zealand (in 2001 and 2006), and since then the time series has further developed, with a survey in 2009, and another just completed on RV Tangaroa in March-April this year.

Surveys have been carried out on the "Graveyard Knolls", a group of small seamounts 250 km east of New Zealand. These knolls lie in close proximity to one another and are at similar depths (750 m to 1000 m summit depth) (Figure 1), limiting geographical or depth confoundment of faunal composition. Fishing (bottom trawling for orange roughy) has been confined largely to four of them. Three of the seamounts were closed to trawling in 2001 (Morgue, Pyre, Gothic), hence the area offers a natural comparison of fished, fished-closed, and unfished habitats.

The survey this year adopted the same design as earlier surveys to enable valid comparisons over time. In most years six seamounts have been sampled, and survey transects have followed the same or similar paths. An example of the



Figure 3: The towed camera system (DTIS) employed during the survey.

type of radial survey design used is shown in Figure 2, with 8 transects run from the summit down the flanks of each seamount.

NIWA's deep-towed imaging system (Figure 3) was used, with both forward-angled video, and a direct downwards-facing still camera. The latter in particular gives high-resolution seafloor photographs, and enables accurate counts of individual animals, or areal coverage of habitat-forming species.

Data from the last survey are yet to be processed and analysed. However, strong fished-unfished contrasts are evident, with spectacular stony coral reef formations on unfished features (Figure 4). On fished seamounts, the fauna likely to show signs of recovery are hydrocorals, anemones, sponges and crinoids, which are often small-bodied and require detailed and careful examination of the still images. Their distributions may also be patchy, and extra transects have been undertaken on Morgue, the previously fished seamount that was closed to trawling in 2001. It is hoped that results of the survey, and analyses of the full time series, will be completed and published in 2016.

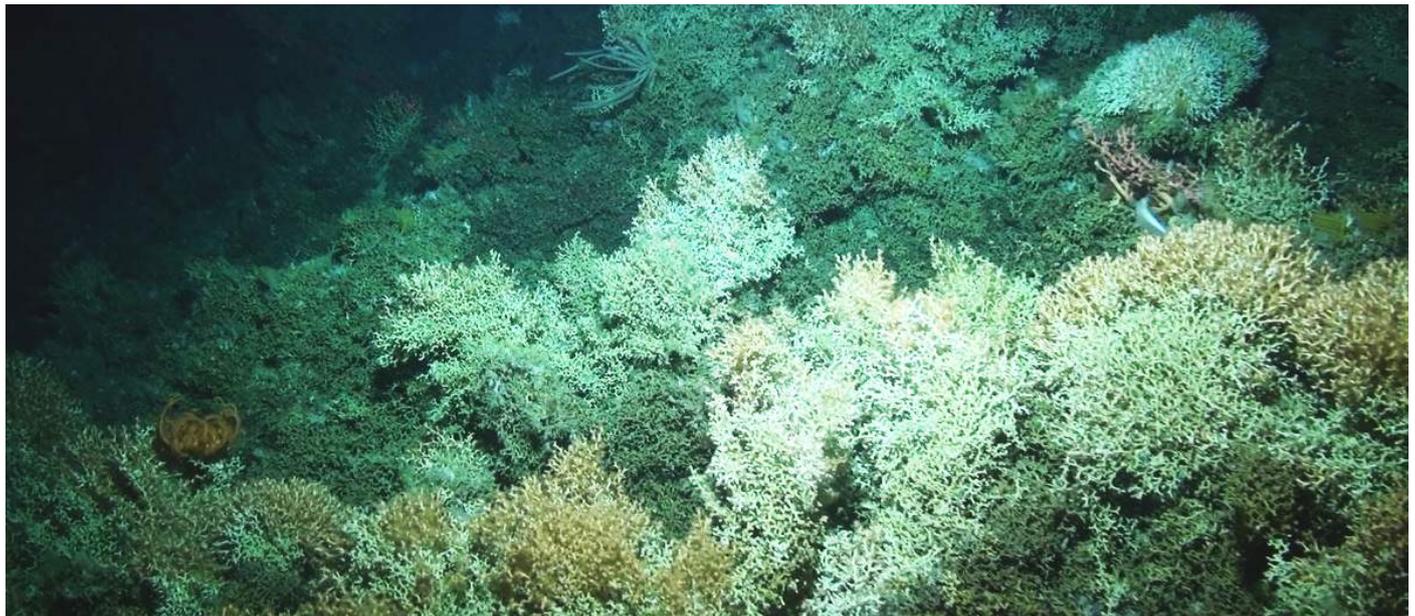


Figure 4: A reef-like habitat of stony coral *Solenosmilia variabilis* on the unfished "Ghoul seamount".

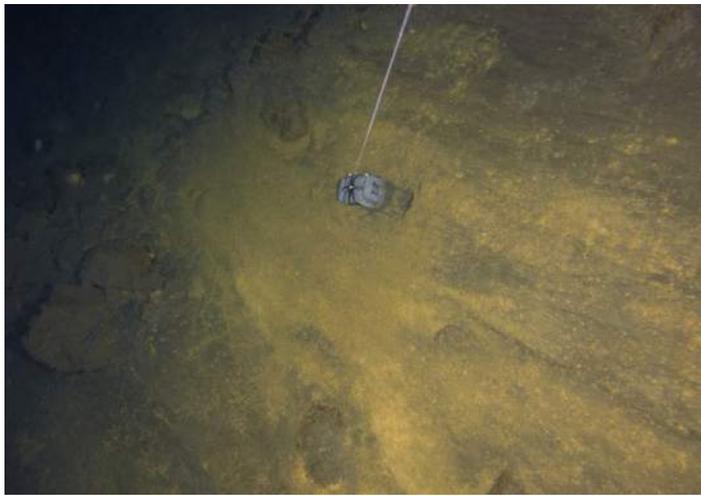
## Exploration of the Kavachi Submarine Volcano, Solomon Islands

Brennan T. Phillips<sup>1</sup>, Alex DeCiccio<sup>1</sup>, Brad Henning<sup>2</sup>, Alistair Grinham<sup>3</sup>, Matthew Dunbabin<sup>4</sup>, Simon Albert<sup>3</sup>,  
Corey Howell<sup>5</sup>

<sup>1</sup>URI Graduate School of Oceanography, USA; <sup>2</sup>National Geographic Remote Imaging Team, USA; <sup>3</sup>University of Queensland, AUS; <sup>4</sup>Queensland University of Technology, AUS; <sup>5</sup>The Wilderness Lodge, SI

In January 2015, a project sponsored by the National Geographic Society/Waite Grants Program, investigated the Kavachi

submarine volcano in the Western Province of the Solomon Islands. Kavachi's main peak has risen to form an island several times in the past century and is known for frequent, violent phraetomagmatic eruptions. This expedition found Kavachi in a rare, calm state with the rim of the tuff ring lying approximately 24 m below the surface and accessible by divers. Using bare-bones, lightweight technology supported by small boats, the team explored the volcano down to 1000m on all sides and investigated outer-lying areas for signs of seafloor venting.



The expedition was a smashing success, resulting in the discovery of a secondary peak exhibiting signs of diffuse venting. A total of 30 water column casts were made with associated seafloor imagery using an instrument package deployed off of a fishing reel. On one particularly calm day, a National Geographic autonomous (baited) DropCam was deployed directly inside the active caldera at the top of the main peak. Populations of ctenophores, reef fish, and large sharks were observed thriving inside, swimming amongst orange-green vent fluids and vigorously bubbling gases.



The most exciting observation of the expedition was an up-close-and-personal video of a large Pacific Sleeper Shark, which was seen at 940 m within 20 km of the main peak of the volcano. We believe it to be the best footage ever recorded of the species, and the first time it has been observed in Melanesia. Look for it (and other media from the trip) appearing on National Geographic's webpage in the coming months!

*Top: Orange-colored bacteria mats indicate diffuse venting on the summit of Kavachi's secondary peak.*

*Bottom: A snapshot of a Pacific Sleeper Shark stalking a baited autonomous camera. The length of this specimen is estimated at 4m.*

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## **EcoResponse - a very diverse cruise to investigate the consequences of polymetallic nodule mining**

Ana Hilario

*University of Aveiro, Portugal*

Manzanillo, Mexico, May 1<sup>st</sup> 2015. After 50 days at sea the EcoResponse (Ecology, Connectivity and Resilience of Polymetallic Nodule field Systems, SO239), led by the Senckenberg Institute, aboard the new German research vessel SONNE ended yesterday in Manzanillo, Mexico. During this time SONNE crossed approximately 1400 km along the eastern Clarion Clipperton Fracture Zone (CCZ) visiting four license areas (German, IOM, Belgium and French) and one Area of Particular Environmental Interest (APEI # 3). On board were scientists from eleven nationalities and different expertise, from geologists to ecologists and taxonomists.

As part of the JPI Oceans Pilot Action "Ecological Aspects of Deep-Sea Mining" the main goals of the cruise were to



perform a comparative ecological, geochemical and hydrodynamic study between different areas in the CCZ, and to assess the scale of recovery and ecosystem status following disturbance. As diverse as these goals were, the array of equipment used in the course of the cruise summed up to more than 200 (successful) sampling stations. In addition to one thermistor chain and two landers deployed at the beginning of the cruise, eight different gears were used to map, survey and sample the seafloor and the water column (AUV, ROV, epibenthic sled, gravity corer, box corer, multicorer, plankton net, and CTD). More than 250 megafauna and 11,000 macrofauna specimens were collected and sorted - a number that will grow in the next months. The micro- and meiofauna numbers are awaited with eagerness!

These were fun times, now the hard work starts. Both sediment-inhabiting and nodule-attached fauna will be characterized morphologically and genetically, and the spatial scales of diversity will be assessed. Further, the relationships between epibenthic fauna and nodule coverage, sediment chemistry and biodiversity over multiple spatial scales will be analyzed. Until we get back to our labs we still have time to sip some exotic drinks in sunny Manzanillo and start thinking of new research ideas that will again bring us together in the future.



# Project Focus

## Deep-Sea Corals of the Northeast Atlantic

Raissa Hogan

*PhD candidate, Ryan Institute, National University of Ireland Galway (NUI Galway)*

In submarine canyons, deep-sea corals play a pivotal role as foundation and engineer species, forming a complex three-dimensional habitat that provides shelter, nursery and food for a range of species. Unlike scleractinian corals (such as *Lophelia* sp.), octocorals and antipatharians are not reef forming. They can, nonetheless, occur in very dense assemblages comprising one or more species (Yesson et al. 2012). Such assemblages are recognised as vulnerable marine ecosystems (VMEs), not least because of their presumed poor recovery from population reduction due to their long life and slow growth. Some antipatharians have been estimated to reach ages measured in thousands rather than hundreds of years (Roark et al. 2006), and even sea pens (Pennatulacea) have had ages estimated as approaching 50 years (Wilson et al. 2002).



Phylogeography and population genetic work on deep-sea corals are in their infancy. To date, patterns of genetic connectivity among deep-sea coral populations throughout the Northeast Atlantic are not well understood and much work has focused on morphotypes because species are not easily identified and the limits of species are not clearly understood. The overall aim of our project is to assess the phylogeography, genetic structure and connectivity of Pennatulacea and Antipatharia populations over different spatial and bathymetric scales with an aim to improving our understanding of their evolution and the protection required by these vulnerable marine ecosystems.

Initially we are assessing the diversity of Antipatharia (black corals) and Pennatulacea (sea pens) from the Whittard Canyon on the Irish continental margin, collected with the Irish deep-water ROV Holland I during cruises CE13008 and CE14009 of RV Celtic Explorer using mitochondrial non-coding regions as described in France and Hoover (2002), Sánchez et al. (2003) and Wagner et al. (2010), . Our data suggest that there are at least 15 species of Pennatulacea in seven genera in Irish deep waters. Comparing superficial morphological data obtained from high definition video and digital stills, it is clear that we have not yet sequenced sufficiently variable markers in Antipatharia to delimit species. While seeking further molecular variation, we will also examine morphological characters to take advantage of recent progress made on the taxonomy of the group (e.g. Molodtsova 2006, Opresko 2006).

### *Acknowledgements*

*Support for this study was generously provided by the Brazilian National Counsel of Technological and Scientific Development - CNPq - Graduate Student Fellowship.*

For references or other information, please contact corresponding author: [r.hogan4@nuigalway.ie](mailto:r.hogan4@nuigalway.ie)

## Global analysis of recruitment in the deep sea: industry and science collaboration

Eva Ramirez-Llodra<sup>1</sup>, Anna Metaxas<sup>2</sup>, Maria Baker<sup>3</sup>

<sup>1</sup>NIVA, Norway; <sup>2</sup>Dalhousie University, Canada; <sup>3</sup>University of Southampton, UK



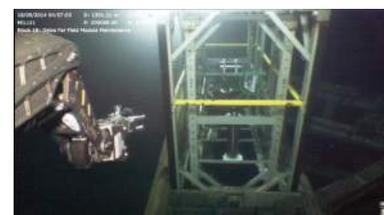
INDEEP's WG3 on Population Connectivity has been developing a global project on recruitment of deep-sea fauna, in collaboration with industry and scientists since 2011. Recruitment frames with four different substrates (wood, plastic, scrubbies and carbonate) have been deployed at different deep-sea locations, depths and habitat types. The first two frames were deployed on the blow-out preventer of a TransOcean rig on the Clair Rig (North Atlantic) at 150 m depth. The samples from these frames are currently being analysed at the National Oceanography Centre in Southampton (UK) by Drs Andrew Gates, Jon Copley, Maria Baker and Dan Jones (Figure 1).

Another important collaboration has been established with Ocean Networks Canada ([www.oceannetworks.ca](http://www.oceannetworks.ca)). Three frames were deployed on the Neptune cable observatory in Barkley Canyon for one year (2013-2014) and three new frames have been deployed in the same locations in 2014 (Figure 2). The samples will be the base of an MSc project supervised by Dr. Anna Metaxas (Dalhousie University).

In September 2014, a new collaboration was established between INDEEP and BP for the deployment of two frames on the DELOS observatory on the African margin off Angola (Deep-ocean Environmental Long-term Observatory System, [www.delos-project.org](http://www.delos-project.org)). The frames were deployed in September 2014, between 1300 and 1400 m depth, one within 50 m of the production well and one 8.9 nautical miles away from the production well (Figure 3). The recovery is planned for September 2015. This is a new and exciting venture in collaboration with industry.

Additionally, scientists around the world have been deploying the INDEEP frames on different deep-sea

ecosystems during their research cruises: two frames were deployed for eight months in the Baltimore Canyon by Sandra Brook and Steve Ross (2012-2013) (Figure 4); two frames were deployed for five months on the hydrothermal vent ecosystems in the Cayman Trough by Jon Copley (Feb -June 2013); six frames were deployed on the margin and deep basin off Brazil (1500-3300 m depth) by Angelo Bernardino and Paulo Sumida in 2013 and they are being collected at the end of May 2015 (Figure 5). Further frames are to be deployed next month in the Rockall Trough in the



Clockwise from top left: Figure 1: From left to right: Gates, Jones, Baker & Copley working on INDEEP frame recruit analysis; Figure 2: INDEEP frame in situ in Berkley Canyon; Figure 3: INDEEP frame in-situ on the DELOS platform (green circle); Figure 4: INDEEP frames on lander prior to deployment; Figure 5 INDEEP frame in place prior to deployment.

North Sea by Alan Jamieson. Some of these samples will be analysed by the research groups that deployed the frames, while others have been sent back to NOCS for analyses.

If you are interested in deploying INDEEP recruitment frames and helping to expand the geographic extension and habitat type of the project, send an email to: [eva.ramirez@niva.no](mailto:eva.ramirez@niva.no) and [anna.metaxas@dal.ca](mailto:anna.metaxas@dal.ca)

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## Areas beyond national jurisdiction: focus on the South West Indian Ocean

Aurélie Spadone

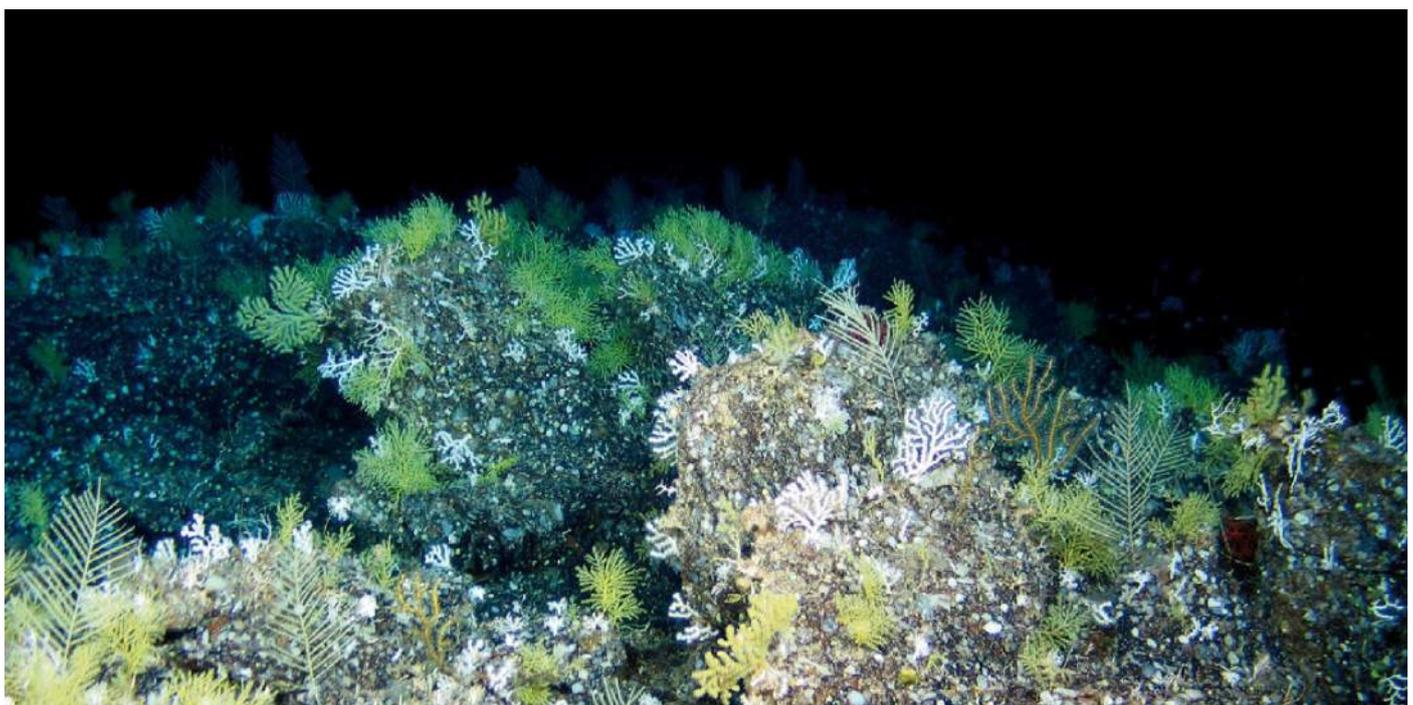
*IUCN Global Marine and Polar Programme, Switzerland*

IUCN is leading a project on conservation and sustainable use of seamount and hydrothermal vent ecosystems in Areas Beyond National Jurisdiction (ABNJ) of the South West Indian Ocean.

The project, funded by the French Global Environment Facility, is being executed by several partners -the National Museum of Natural History (France), the Institute of Research for Development (IRD, France), Institute for Sustainable Development and International Relations (IDDRI) and Oxford University- in collaboration with several institutions, ongoing projects or programmes (1). The project is supported by the French Ministry of Foreign Affairs and the French Ministry of Higher Education and Research.

One of the interesting features of the region that lies beyond national jurisdiction is an underwater plateau located 700 km south of Madagascar: the Walter Shoals. With shallower parts reaching as shallow as 18 m below sea level, this shoal constitutes a unique feature of the sea floor in the typically deep waters beyond national boundaries of the South West Indian Ocean. Within the framework of the project, a 32-day scientific expedition will notably explore the benthic fauna of this seamount area.

Beyond increasing our knowledge and understanding of seamount and hydrothermal vent ecosystems, the project is seeking to enhance governance in ABNJ and identify options for developing area-based management tools in the South West Indian Ocean, notably in exploring and discussing the possible scenarios with stakeholders in the region.



Coral garden on seamount of the South West Indian Ridge; ROV image JC066 Expedition, 2011. Copyright: IUCN/NERC.

For more information, please contact [aurelie.spadone@iucn.org](mailto:aurelie.spadone@iucn.org)

(1) Notably the Department of Environmental Affairs and the Department of Agriculture, Forestry and Fisheries of South Africa, the Deep Sea Project of the FAO GEF-funded ABNJ Program and its partners, The Nairobi Convention, The Southern Indian Ocean Deepsea Fishers Association, universities in South Africa and Reunion Island, IFREMER, the International Seabed Authority, and AfriCOG.

## Another new crustacean species discovered on the continental slope off Mauritania

Ana Ramos

IEO Vigo, Spain

The unexplored continental slope off Mauritania is becoming a source of species new to science. Zootaxa (a New Zealander journal) published in March a new paper on hermit crabs from deep Mauritanian waters.

It is a comprehensive 40-page publication, with a large and painstaking iconography mainly performed using a stereomicroscope and image treatment techniques. The paper describes 13 species of hermit crabs belonging to families Diogenidae, Paguridae and Parapaguridae, including one species new to science.

All specimens were collected from 83 of the 316 trawl stations conducted over the deep shelf and the continental slope off Mauritania during the 4 Maurit surveys, undertaken by the Spanish Institute of Oceanography (IEO) in the area between 2007 and 2010. Three specimens (one male and two females) of a new species, named *Paguristes candelae*, were collected at three different stations along the continental slope of Mauritania between 376 and 574 m depth (see map).



Hermit crabs are very abundant in Mauritanian sea-bottoms (left). The recently discovered new species, named *Paguristes candelae* (up center) and the locations (red stars in the map) where the three specimens were collected. Susana Soto, the specialist who has described the new species, onboard R/V 'Vizconde de Eza' during Maurit-1011 Survey (right).

Besides the description of the new species, the publication also proposes two genus transfers; describes for the first time a female specimen of *Paguristes marocanus*; extends the geographic distribution of two species and the bathymetric range of another three species; and records for the first time the presence of three hermit crabs in Mauritanian waters.

Although late 19th century researchers Milne-Edwards and Bouvier already described the fauna of hermit crabs from Northwest Africa, and Monod gave in 1933 a list of the Mauritanian decapods, this is the first paper exclusively focussed on Mauritanian hermit crabs. To date, the specimens gathered during the four Maurit surveys constitute the most significant collection of these decapods ever captured in the study area.

The paper results from more than a year of meticulous taxonomic identification of the Northwest African benthic collections carried out by the researchers of the IEO and the Faculty of Marine Sciences (Vigo University, Spain) jointly working within the framework of the ECOAFRIK project.

Link to article: <http://dx.doi.org/10.11646/zootaxa.3926.2.1>

Corresponding author: [ana.ramos@vi.ieo.es](mailto:ana.ramos@vi.ieo.es)

Related webistes: <http://zoobank.org/urn:lsid:zoobank.org:pub:F0CAD726-4F6A-4802-BF57-38FEF89C572F>:

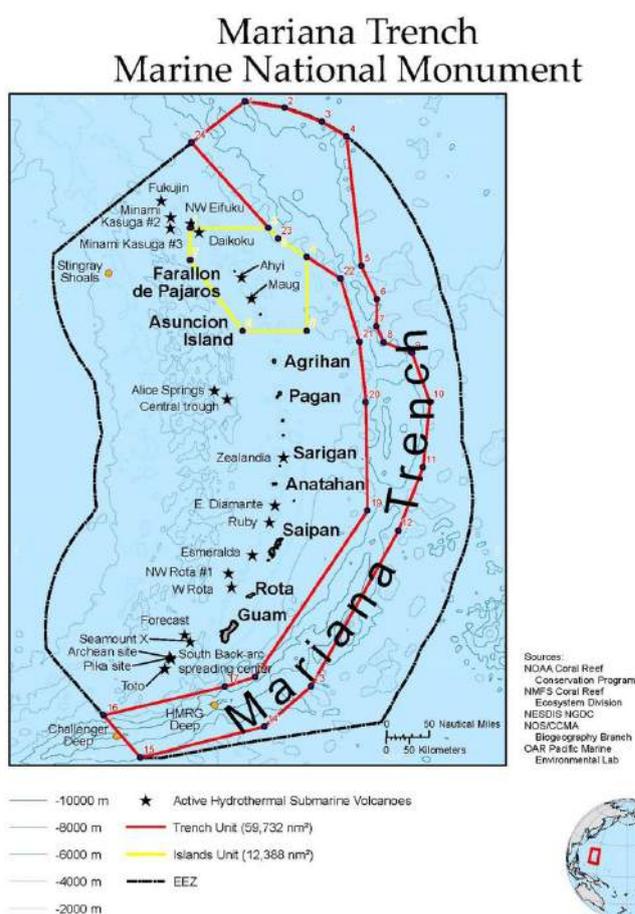
<http://www.ecoafrik.es>

## Study aims to elicit expert views on anthropogenic drivers of change in deep-sea environments of the Mariana Trench Marine National Monument

Stephanie Januchowski-Hartley and Natalya Gallo

There is currently limited understanding about the anthropogenic drivers of change in deep-sea systems of the Mariana Trench Marine National Monument (MNM). However, responsible agencies, such as the United States National Oceanic and Atmospheric Administration (NOAA) and Fish and Wildlife Service require knowledge and information to make informed conservation decisions for these systems and the species that depend on them. In response to this identified need, based on funding support from NOAA, a team of researchers from Texas A & M University Corpus Christi (CC), University of Hawaii and University of California (UC) Santa Barbara along with collaborators at the Scripps Institution of Oceanography at UC San Diego, are conducting an ongoing study on anthropogenic drivers of change in the Mariana Trench MNM, and are seeking the expertise of members of the deep-sea community.

The Marine Trench MNM protects approximately 95,216 square miles of submerged lands and waters and includes many fascinating deep-sea ecosystems including the deepest trench in the world, undersea mud volcanoes,



and hydrothermal vents. For this study, “deep sea” refers to locations at 1000 m depth or below, including the bathyal, abyssal and hadal zones, and encompasses bathyal plain, bathypelagic, abyssal plain, abyssopelagic, hydrothermal vent, seamount and trench systems. The purpose of the research is twofold. First is to understand in greater detail the anthropogenic drivers of change (e.g. climate change) in deep-sea systems within the Mariana Trench Marine National Monument (see map below). Second is to identify existing knowledge gaps and information needs to inform the conservation of deep-sea systems within the Mariana Trench MNM from anthropogenic drivers of change. The study is qualitative, with an underlying pragmatic philosophy, and is a case study, bounded by the Mariana Trench MNM. All interviews are being conducted by Dr. Stephanie Januchowski-Hartley (Texas A & M University CC), and interviews are semi-structured, and composed of both open and closed questions. Interviews have begun, but the project team is still actively seeking additional contributions and expertise from other members of the deep-sea community with knowledge of the Mariana region. If you have experience/knowledge of deep-sea systems in the Mariana region, please consider contributing your invaluable expertise and contact Stephanie directly at [stephierenee@gmail.com](mailto:stephierenee@gmail.com).

## MIDAS Project Cruise to CCZ – April/May 2015

Daniel Jones, JC120 Principal Scientist,

*National Oceanography Centre, Southampton, UK*

The UK Natural Environment Research Council ship James Cook has just returned from the UK National Oceanography Centre-led JC120 cruise to study the biology and geochemistry of an area of the Clarion Clipperton Zone (CCZ) as part of the EC FP7 Managing Impacts of Deep-sea resource exploitation (MIDAS) Project.



We returned to Manzanillo, Mexico, on the 19th May after a 34 day voyage on the RRS James Cook out to the north-easternmost Area of Particular Environmental Importance (APEIs). The 9 APEIs are large areas, of around 400 x 400km (200x200km core protected area with an additional buffer zone of 100km), that are set aside by the International Seabed Authority (ISA) from mining activities. In the spatial management plan for the CCZ the APEIs will form the largest of the protected areas within the CCZ mining area. Smaller set-aside areas will also be left within the mining claim areas themselves, but these will be determined later in the mining process. Until this year, these APEIs remained largely unexplored.



During the cruise we gathered a huge dataset on the subsea landscape, biology and geochemistry of the APEI. Our maps of the south western area (5,500 km<sup>2</sup>) of the APEI, created using shipboard bathymetry, revealed an area dominated by a series of ridges and seamounts,

which appear typical for the CCZ. We explored several representative areas in much greater detail with acoustic surveys carried out from the NERC AUV Autosub 6000. The resultant maps revealed a surprising amount of topography and landscape variation for an abyssal plain! We also used the AUV to take both forward and downward looking colour photographs from near the seabed. As well as the AUV photos, we took photographs and HD video using a towed camera platform (HyBIS). The cameras were very busy, we took over half a million photographs of the seabed! This

huge archive of seabed photos will be really valuable in describing the seabed habitats and megafauna of the area. We saw a surprising diversity of megafauna and found polymetallic nodules across much of the APEI.

Samples of seafloor sediments, animals and overlying water were taken from across the study area in the APEI. We obtained a strong multi-disciplinary dataset from the area, with information on various sizes of fauna (megafauna, macrofauna, meiofauna and protozoans), the sedimentary environment and its geochemistry and the overlying (and pore) water. We obtained cores up to 3 m deep for geochemical analysis, including assessment of metals, including rare-earth metals, and some dissolved gasses (e.g. Oxygen) in the sediments and pore fluids and assessment of the physical characteristics of the sediments. This will give us a much better understanding of the formation mechanisms of the nodules and some of the controls on life in the region. Smaller samples of sediments were taken to assess the biodiversity and community composition of the fauna of the region, quantitatively for many faunal groups. In addition, the team from the Natural History Museum in London, along with some other scientists from elsewhere, collected a range of fauna to add into their database of the fauna of the Clarion-Clipperton Zone with linked photographic, genetic and morphological data from all the species we found. Having an accurate taxonomic database is vital in understanding the connectivity between different areas of the CCZ and will help in ultimately determining how areas disturbed by mining will recover. Finally, we collected some nodules and fauna with trawls over the seafloor. All of these samples have given us a strong baseline dataset from the APEI, allowing us to evaluate this area and assess any future changes. We will also be able to make comparisons with the mining claim areas to better understand broad scale patterns. We have worked hard to ensure data are all collected in the same way on all the different cruises to the CCZ area to ensure that these comparisons are robust and useful to both science and environmental managers working for the nascent seafloor mining industry.

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# News



**WHAT IS DOSI?** DOSI addresses the research, management and decision-making actions required to maintain the integrity, functions and services of the deep ocean for future generations. DOSI acts through multi-stakeholder workshops, briefings, publications, surveys, assessment contributions, online resources and engagement. DOSI works with national, regional and global policy makers, educators and civil society to: (1) Identify priority management needs for resource use in our deep ocean (2) Develop best practices for human activities in the deep sea (3) Raise awareness and develop expertise, and (4) Centralize and promote observation and knowledge of the deep sea.

## Selection of Recent and Planned Activities

- International Deep Seabed Mining Webinar (Hosted by Env. Law Inst.) <http://eli-ocean.org/seminars/seabed/>
- 2nd DOSI/INDEEP Webinar Series started May 14, 2015 (Hosted by MESP and DOSI) <http://us8.campaign-archive2.com/?u=2393d2283aea03531a296f96d&id=ed1c33260a>
- Deep-seabed mining and Pacific cultures Symposium Univ. Hawaii (Smith, Watling) (April 2015)
- Gathering and summarizing response to ISA Report “Developing a Regulatory Framework for Mineral Exploitation in the Area” (C. Smith and V. Tunnicliffe)
- Workshop: International Workshop on Environmental Standards for Deep-seabed Mining. May 2015, Tromsø, Norway
- Workshop: From Seafloor Hydrothermal Systems to the Sustainable Exploitation of Massive Sulfide Deposits: Myths & Realities of the deep sea. May, 2015, Bergen, Norway
- Workshop: Towards the development of a strategic Environmental Management Plan for deep seabed mineral exploration and exploitation in the Atlantic basin (SEMPIA). June 1-3, Horta, Portugal (A. Colaco and L. Menot).
- Deep-sea Tailings Disposal Workshop, Lima Peru (June 2015) contact: eva.ramirez@niva.no. More info: <http://www.dicapi.mil.pe/taller/en/conference.html>
- DOSI Open Information Planning Meeting – Aug. 30, 2015, Aveiro Portugal. Open to all. Contact: Lisa Levin ([llevin@ucsd.edu](mailto:llevin@ucsd.edu))
- DOSI Session 7 – Stewardship of our Deep Oceans: 14th Deep Sea Biology Symposium, Sept. 1, 2015 Aveiro, Portugal (Convened by M. Baker and L. Levin. Keynote by Kristina Gjerde)
- DOSI WG5 Marine Genetic Resources workshop on “Assessing and sharing benefits from marine genetic resources beyond national jurisdiction: what role for the scientific community?” - Sept. 3, 2015 Aveiro, Portugal (Convened by Harriet Harden-Davies)

**JOIN the Deep-Ocean Stewardship Initiative at:**

<http://www.indeep-project.org/deep-ocean-stewardship-initiative>

## Experts Discuss the Future of Deep-Sea Mining

Jeff Ardron

*Commonwealth Secretariat, London UK*

On 15-16 April 2015, 25 experts from academia, civil society, government, and international organisations as well as industry (via remote connection) gathered in Berlin to discuss issues central to the success or failure of deep-sea mining (DSM). The workshop agenda considered the three pillars of sustainability: economics, society, and the environment. Additionally, it sought to separate out popular “myths” from current realities. It was run by the Institute for Advanced Sustainability Studies (IASS), in partnership with GEOMAR and the EU MIDAS project.



The workshop included a wide range of perspectives. Given humanity’s increasing consumption of metals and minerals, some participants argued DSM is necessary and

*Prof. Klaus Töpfer, Executive Director of IASS, and Jeff Ardron, formerly Senior Fellow at IASS discuss deep-sea mining*

inevitable, and that it makes sense to start slowly now, while there is time to do so. The potential economic development of Small Island Developing States was also raised. Another perspective called into question whether there would be a need for DSM in the near future if there were more attention given to re-use and recycling. There was nonetheless widespread agreement that getting effective rules and regulations in place, before activities are started, is prudent.

As a proposed new industry, the sustainable development of DSM was considered in various ways, including the context of existing pressures on the oceans, market drivers for additional mineral resources, sustainable economic development of States, the vulnerability of deep-sea ecosystem functions and services, as well as national and global developmental and environmental commitments. Its future, while currently uncertain, will hinge upon economic profitability, societal acceptance, and successful environmental protection. Until more is known, a “go slow” approach is recommended.

The IASS plans to release a briefing note on the meeting.

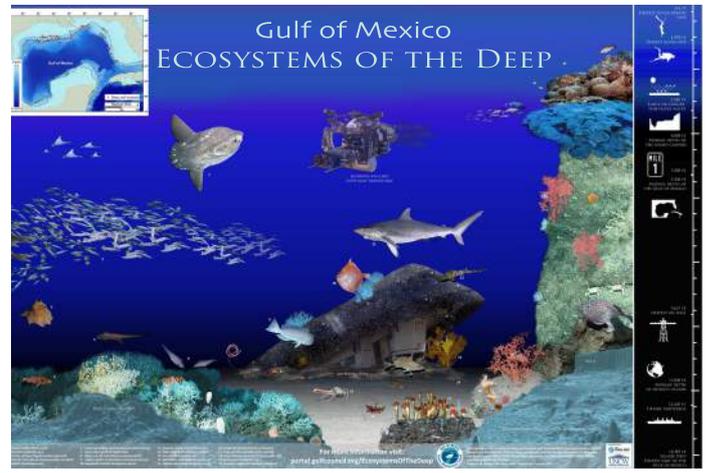
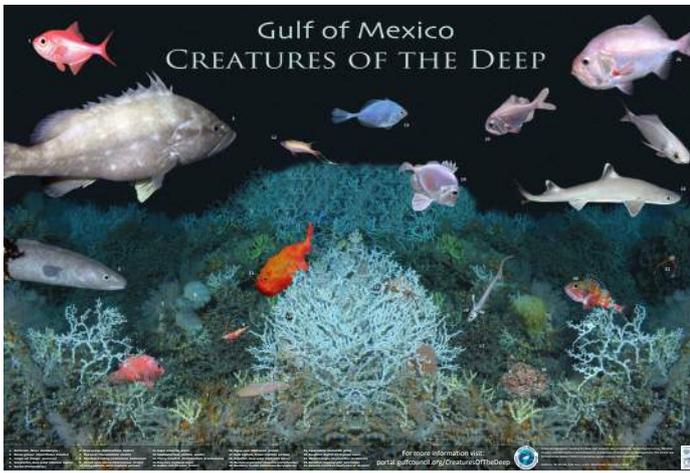
More information: Jeff Ardron; [j.ardron@commonwealth.int](mailto:j.ardron@commonwealth.int)

## Deep Reef Posters for the Gulf of Mexico

Steve Ross

*University of NC at Wilmington, USA*

The Gulf of Mexico Fishery Management Council recently released two posters concerning deep reefs of the region. The posters (Creatures of the Deep and Ecosystems of the Deep) were authored by Mike Rhode and Steve W. Ross (Univ. of NC at Wilmington) and Emily McDonald (Gulf Council). These materials are intended to inform a wide public audience of the important fauna and habitats that exist on and around these reefs. Several multi-year studies over the last decade have added considerable knowledge about deep coral and rocky reefs of the Gulf. The posters are available as hard copies (2 ft x 3 ft), and will also soon be available on the Council’s web site (<http://www.gulfcouncil.org/>) along with additional text. The Gulf Council is considering a number of new management options to protect these resources.



## Recent Workshop Evaluates Gulf of Mexico Fishes

During 20-24 April 2015, an international group of scientists (see photo) met in Merida, Mexico to continue an evaluation of the status of Gulf of Mexico Fishes. This effort was funded and organized by the International Union for Conservation of Nature (IUCN, <http://www.iucn.org/>) which produces the global red lists of species population status. This workshop included outer shelf and upper slope species, which are poorly known in this region. Dr. Steve W. Ross was asked to lead the workgroup on deep-sea fishes. The group evaluated nearly 400 species. A second workshop is planned perhaps to occur in Cuba.



JMSE is a new international open access journal of marine science and engineering published quarterly online by MDPI AG, Basel, Switzerland, <http://www.mdpi.com/>. The aims and topics are given at <<http://www.mdpi.com/journal/jmse/about>>. Article Processing Charges are fully waived for papers submitted to JMSE in 2015 and accepted papers are immediately published online.

Now it is running a special issue entitled "Research Tools and Methods for Marine Species Acquisition and Identification" [http://www.mdpi.com/journal/jmse/special\\_issues/acquisition-identification](http://www.mdpi.com/journal/jmse/special_issues/acquisition-identification). Prof. Dr. Angelika Brandt, of the Biocenter Grindel and Zoological Museum, University of Hamburg (Hamburg, Germany), is serving as a Guest Editor for this issue.

We welcome you to contribute papers to this topic (deadline: 30 September 2015) or JMSE directly.

For further details on the submission process, please see the instructions for authors at <http://www.mdpi.com/journal/jmse/instructions>

JMSE Editorial Office

MDPI AG

Klybeckstrasse 64, 4057 Basel, Switzerland

Tel. +41 61 683 77 34 (office)

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## The Deep-Sea Biology Society

Rachel Boschen

The Deep-Sea Biology Society board has been working hard to get and running. At this stage, as the student representative, I would like to start connecting with deep-sea biology students and to get feedback on what they would like the Society to be offering student members.

We already have a student page on the website <https://deepseabiosoc.wordpress.com/students/>, and a way for students to post relevant material using the dedicated Twitter hashtag: #DSBstu

I am now establishing an email list for students. This list will enable students to make contact with their peers and to share information and ideas. If you would like to be added to the list, please email [DSBS-STUDENT-request@jiscmail.ac.uk](mailto:DSBS-STUDENT-request@jiscmail.ac.uk)

If you have any ideas or suggestions for how the Society can support students or you have material that you would like to add to the student page of the website, please get in touch.

## RMI strives for participatory and inclusive process for the development of its deep-sea minerals

Alison Swaddling

*Environment Advisor, SPC-EU DSM Project, Fiji*

The Republic of the Marshall Islands (RMI), in its efforts to facilitate the participation of the population and key stakeholders in the development process of its national Deep-Sea Minerals Policy and Seabed Management Bill, recently held a series of public consultations in Majuro, the capital, and Ebeye.

The consultations, organized with the assistance of the Secretariat of the Pacific Community (SPC)-European Union (EU) Deep-Sea Minerals (DSM) Project between the 22 and 24 April 2015, aimed at presenting and discussing the vision, goals and objectives of the draft national DSM Policy and the contents of the Seabed Management Bill.

Secretary of the Ministry of Resources and Development of RMI, Rebecca Lorennij said the involvement of all people of Marshall Islands, including local communities, was key in the approach followed by the government to move forward with the deep-sea minerals industry.



Mrs Lorennij added that they hope that the partnership between the SPC-EU DSM Project with the Marshall Islands will continue and enable the RMI to build its expertise and capacities with the view of managing and regulating this new industry for the benefit of Marshall Islands people.

The RMI government, during the consultations, also took the chance to raise awareness of the opportunities for the country to engage with the DSM industry, with the view of discussing alternative sources of revenue that will be used for the well-being of the people. The challenges associated with the development of the DSM industry were also at the core of the discussions.

*Participants of the Republic of the Marshall Islands consultations in Ebeye*

The DSM Project Legal Adviser, Marie Bourrel, was amongst government representatives, national agencies, the private sector, non-governmental organisations (NGOs), churches, members of parliament, the Council of Iroij and communities that attended the consultations.

The SPC-EU DSM Project strongly supports public consultations as it recognises the importance of a consultative approach in ensuring informed decisions on deep-sea mineral activities and continues to assist its 15 participating Pacific countries by offering technical assistance and advice through awareness programmes and consultative workshops at both the national and regional level.

For more information, visit the SPC-EU Deep Sea Minerals website: [gsd.spc.int/dsm](http://gsd.spc.int/dsm)

## MASTS Deep-Sea visiting Fellows selected

Bhavani Narayanaswamy

*SAMS, UK*



The Marine Alliance for Science and Technology for Scotland – Deep Sea Forum is delighted to announce that two visiting Fellowships were awarded earlier this year. One to Dr Tina Molodtsova from the PP Shirshov Institute of Oceanology, Russia and the second (in conjunction with the Technology Platform and Sensors Forum) to Dr Steve Ross from UNCW Centre for Marine Science, USA.

Tina will be working in conjunction with Bhavani Narayanaswamy (SAMS), Alan Jamieson (OceanLab), Fiona Ware (National Museum of Scotland) and Jim Drewry (Marine Science Scotland), starting her Fellowship in early October 2015. Tina will be looking at “Black corals (Antipatharia) from the continental slope and adjacent seamounts of the NE Atlantic and SW Indian Oceans”. The main objective of the proposed project is to study both recent and historical collections of deep-sea black corals from the continental slope and adjacent seamounts that have been gathered over numerous fishery and scientific expeditions, with the specimens deposited in several Research Centers and Museums in Scotland and the UK in general. In revising the fauna of the black corals in these two areas we plan to describe new species and to make re-descriptions of previously known species using modern methodology (scanning electron microscopy, modern light microscopy) and modern taxonomic characteristics. The study will considerably extend our current knowledge of the fauna and distribution patterns of these fragile, yet important, black corals. Steve will be working in conjunction with Murray Roberts (Heriot-Watt) and Alan Jamieson (OceanLab) and will establish links with Phil Anderson (TPS Forum Lead based at SAMS) and will start his Fellowship in the summer of 2015. He will be looking at “Improving and developing access to the last great frontier – the deep sea”. Steve will initially undertake a general evaluation of conceptual and technological limitations to deep-sea research, specifically focusing on the technology and data analyses related to benthic landers and deep-sea video. Anticipated results include recommendations for standardized protocols, standardized designs, and summary publications. In addition, they will start to implement selected recommendations with existing resources and by incorporation into ongoing grant proposals.

The MASTS Deep-Sea Forum are looking forward to their visits. If anyone would like to visit them when they are here on their Fellowship, then please do not hesitate to contact either of the Fellows or Bhavani Narayanaswamy ([Bhavani.Narayanaswamy@sams.ac.uk](mailto:Bhavani.Narayanaswamy@sams.ac.uk)).

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## African Winter School on Marine Microbiology and Geochemistry

Kurt Hanselmann

*Swiss Federal Institute of Technology (ETH) Zurich, Switzerland*

From May 3rd to June 4th, the Sam Nujoma Campus of the University of Namibia hosts the 2nd African “Research Discovery Camp” for research-based training on the “Sustainable Use and Management of marine Ecosystems”. 14 selected students from 8 different countries and instructors and lecturers from 6 countries are carrying out actual research in the Benguela Upwelling Ecosystem (BUE). They are working at sea on the R/V MIRABILIS and in the laboratories of the Marine Research Center in Henties Bay, where they are analyzing samples and exchanging research ideas and results in lectures and seminars.

The Benguela Current creates one of the world's strongest upwelling systems that is the basis for a rich biodiversity and an economically important fish stock productivity. This year's research topics are focused on questions related to microbial and geochemical processes that assure the proper functioning of the ecosystem. Topics of interest are the cycling of nutrients and trace elements between sediments and the water column, the release of CO<sub>2</sub> and the loss of nitrogen and associated acidification in oxygen minimum zones and the diversity of microorganisms that mediate these processes. A second line of experiments is devoted to the natural mechanisms that can lead to phosphorite deposits, to causes of toxic microbial blooms and the search for biotechnologically useful marine microbes. Research findings were presented at an Open Symposium on June 2nd in Swakopmund.

Participation requires interest in carrying out a research project during the course and being recommended by project supervisors. The students are asked to propose research projects, which lead to discoveries and to a better understanding and the sustainable exploration of the BUE.

The course is part of SCOR's cross-national capacity building initiative, and it is supported by grants from the Agouron Institute and from the Swiss i-Research & Training Institute. Additional contributions come from the hosting institutions, the Universities of the participating instructors and the Namibian Ministry of Fisheries and Marine Resources through its National Marine Information and Research Center.

Courses are announced under the following websites:

<https://www.olat.uzh.ch/olat/url/RepositoryEntry/11651416065?guest=true&lang=en>

[http://www.microeco.ethz.ch/rgno\\_namibia\\_15/RGNO\\_Namibia\\_15.html](http://www.microeco.ethz.ch/rgno_namibia_15/RGNO_Namibia_15.html)

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## MESP and DOSI-INDEEP to host new Webinar Series: Deep-Sea Promises and Challenges

There is a lot happening in the deep sea: new science, new industrial activity, new proposals for management, and new challenges to tackle. We want to talk to people in the midst of it all. We want to know what's happening.

Linwood Pendleton will host these intimate webinars that are as much interview as seminar. Guests will represent perspectives from an array of deep-ocean stakeholders: minerals, oil, fishing, conservation and society. The series will include an all-encompassing Blue Economy segment that will feature Charles Goddard, Executive Director of The Economist's World Ocean Summit, and Maria Damanaki, the current Global Managing Director for Oceans at The Nature Conservancy.

The first webinar in the series, Industrial Mining in the Deep Sea: Social and Environmental Considerations, took place on May 14, 2015 at 5pm AWST, 7pm AEST and 11am CEST, a recording of which may be found here: <https://goo.gl/B5nlma>. It featured Samantha Smith, Director of Blue Globe Solutions and former VP of Corporate Social Responsibility for Nautilus Minerals, and Charles Roche, the Executive Director of the Mineral Policy Institute.

The second webinar in the series will take place on June 17th 4pm CET, 3pm BST, 10am USEastern. David Frazer - Chevron & Rob Obrien – BP will present and discuss oil drilling in the deep-sea and environmental protection measures. <http://us8.campaign-archive1.com/?u=2393d2283aea03531a296f96d&id=607254f08c>

The 2014 webinar series is available on the DOSI webpage: <http://www.indeep-project.org/deep-ocean-stewardship-initiative>

Linwood Pendleton holds the International Chair of Excellence at the European Institute for Marine Studies, in the Institute for Marine Law and Economics, at the University of Brest and Laboratory of Excellence in Brest, France. He

is a senior scholar in the Ocean and Coastal Policy Program at Duke University's Nicholas Institute for Environmental Policy Solutions.

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## A new InterRidge Working Group: Ecological Connectivity and Resilience

Anna Metaxas<sup>1</sup> & Lauren Mullineaux<sup>2</sup>

<sup>1</sup>Dalhousie University, Canada; <sup>2</sup>WHOI, USA

The ecological connectivity of vent communities, and their resilience in the face of disturbance, has been a hot topic of research ever since their discovery. Of late, this topic has become particularly timely and societally relevant as plans for deep-sea mining progress toward implementation. It is also directly relevant to management decisions under consideration for recently designated deep Marine Protected Areas (MPAs), such as those on the Endeavour Segment, in the Marianas region, on the mid-Atlantic Ridge off the Azores, and in the Guaymas Basin and Eastern Pacific Rise.

In this WG, we aim to generate a synthesis of scientific data on vent community connectivity. The intent is to assemble a group of objective scientists with broad expertise to assemble existing data, interpret it in the context of human disturbance, and disseminate it to the scientific community, the public, and policy makers. To ensure the research evidence meets the needs of potential stakeholders, we will engage organizations who are tasked with advising, managing and conducting activities related to seafloor mining and MPAs. We will use the data synthesis to identify gaps in our knowledge and facilitate international cooperation in future research in fields relevant to this topic. We are foremost a science group; this is the strength of InterRidge, and we believe that this approach gives us the best shot at objectivity. We will coordinate with DOSI directly in identifying potential stakeholders to whom our research evidence will be useful. Both DOSI and INDEEP can facilitate the dissemination of our results back to the stakeholders.

The Chairs and Members of the Steering Committee represent a wide spectrum of disciplines: larval and community ecology, population genetics, physiology, and physical oceanography. Linkages with relevant international initiatives are ensured through WG membership.

The Steering Committee had its first (virtual) meeting in early March and discussed the best angle to pitch our synthesis efforts. A second virtual meeting is planned for early summer. We will have our first face-to-face open meeting, during the 14<sup>th</sup> Deep-Sea Biology Symposium in Aveiro.

Anyone interested in joining our WG should contact either Anna Metaxas ([metaxas@dal.ca](mailto:metaxas@dal.ca)) or Lauren Mullineaux ([lmullineaux@whoi.edu](mailto:lmullineaux@whoi.edu)).

For more information, check out the website:

[http://www.interridge.org/Ecological\\_Connectivity\\_and\\_Resilience](http://www.interridge.org/Ecological_Connectivity_and_Resilience)

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## Deep Seabed Mining Webinar

The recent Environmental Law Institute Ocean Seminar Series webinar on Deep Seabed Mining is recorded and available to watch at ELI's website: <http://eli-ocean.org/seminars/seabed/>.

Moderated by Dr. Kathryn Mengerink (ELI) with panelists Michael Lodge (International Seabed Authority), Hannah Lily (Commonwealth Secretariat) and Dr. Lisa Levin (Scripps Institution of Oceanography).

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# Meetings & Workshops

**An introduction and practical use of European marine data infrastructures:**

## **FixO<sup>3</sup> workshop, Bremen**

Paris V. Stefanoudis

*National Oceanography Centre Southampton, Southampton, UK*

During this two-day workshop, 20 PhD and post-doctoral students in oceanography gathered from all over Europe in Bremen (Germany) for yet another FixO<sup>3</sup> workshop (<http://www.fixo3.eu>). Hosted by the Centre for Marine Environmental Sciences (MARUM) at the University of Bremen, the workshop's aim was to teach scientists i) how to obtain data from existing European marine data infrastructures (EMODnet, MyOcean, PANGAEA, EurOBIS, ICES, SeaDataNet), ii) the importance of metadata and property rights and iii) available tools for aggregating, harmonizing and transforming data (e.g. WoRMS, ODV, Matlab). It was certainly worth it! Speakers emphasized the need of researchers making their data available to the wider scientific community. Their motto was: "You are not finished when you publish your paper, you are finished when you share the data behind it". All of the participants were astonished by the amount of available data and felt that the usage of those online databases would greatly benefit their own research.

So don't forget: sharing is caring!



*Group photo of all the participants and speakers, in front of the Atlantic Hotel Universum, Bremen.*

## The Deep-Sea Mining Summit

Aberdeen Scotland

9-10 February 2015

*Reported by CL Van Dover, Duke University, USA*

In Aberdeen's Dyce airport, the promotional theme is relentlessly off-shore oil & gas. In town, Albert Street alone is lined by dozens of boutique support firms for the oil & gas industry – from A.O.K. Drilling to Zoey Procurement; altogether an appropriate setting for The Deep-Sea Mining Summit 2015. DSMS in its 2015 incarnation was intimate – maybe a few dozen participants, nearly half of whom were speakers. There were representatives from environmental consulting firms (DNV-GL, Blue Planet Marine, MESL, Marine Space Ltd) who discussed mining risks and environmental impact assessments, industry firms and leadership (RSC Mining and Mineral Extraction, World Ocean Council) presenting on benefits of regional rather than project-level approaches, and law (Lebuhn & Puchta, McInnes Cooper); plus geology and environmental science presentations by Fernando Barriga and myself and a discussion of mitigating uncertainty and of transparency by Jeff Ardon (IASS Potsdam). Dennis Hagemann of Marshall Hydrothermal presented a scheme for harnessing power from deep-sea hydrothermal systems, with report of output comparable to nuclear plants but without fuel costs, using known technologies, and with minimal environmental impact. Vitalyi Radchenko of Krypton Ocean Group (Ukraine) provided an overview of the design principles of a new class of mining AUV. DSMS 2015 serves as a networking forum for consulting firms, scientists, lawyers, engineers and mining contractors, among others, except the contractors didn't show.

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## New 'Deep-Sea Ecosystems' Group for UK Scientists

Rachel Jeffreys

*University of Liverpool, UK*

A new special interest group, Deep-Sea Ecosystems, has been created under the auspices of the Challenger Society for Marine Science in the UK. The aim of this group is to bring together UK scientists working on deep-sea ecosystems for a national meeting in years when we wouldn't meet for the international Deep-Sea Biology Symposium, with sponsorship from the Challenger Society.

In order to establish the group this year, an inaugural meeting will take place in Liverpool on the 30th June-1st July 2015. We are inviting presentations on updates on UK deep-sea research programmes, proposed future activities or "news & views" presentations on strategic directions for the future of deep-sea science in the UK. All members of the deep-sea community are welcome and discounted rates are offered for members of the Challenger Society, students and retired registrants.

To register and obtain more details please visit the meeting webpage:

[www.liv.ac.uk/earth-ocean-and-ecological-sciences/events/deep-sea-ecosystems/](http://www.liv.ac.uk/earth-ocean-and-ecological-sciences/events/deep-sea-ecosystems/)

The meeting is being co-convened by Dr Nick Higgs (Plymouth University Marine Institute) and Dr Rachel Jeffreys (University of Liverpool).

For more information please contact: [nicholas.higgs@plymouth.ac.uk](mailto:nicholas.higgs@plymouth.ac.uk)

# Deep-Sea Science in the UK

Building a community for the future



Tue 30<sup>th</sup> June – Wed 1<sup>st</sup> July  
University of Liverpool

Inaugural meeting of the Challenger Society's  
**Deep-Sea Ecosystems**  
special interest group





# Dynamics of the Indian Ocean : Perspective and Retrospective

([www.IO50.incois.gov.in](http://www.IO50.incois.gov.in))



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**Golden Jubilee of National Institute of Oceanography (NIO), Goa**  
**50<sup>th</sup> Anniversary of Completion of International Indian Ocean Expedition (IIOE)**  
Goa, 30 November - 4 December 2015

# It's Your Opinion

## From Seafloor Hydrothermal Systems to the Sustainable Exploitation of Massive Sulfide Deposits: Myths and Realities of the Deep Sea: Report from a student's perspective.

Daniëlle S.W. de Jonge, University of Groningen, Netherlands

*Center for Geobiology - University of Bergen - May 11th to 13th, 2015*



This month I was lucky enough to participate in the workshop «From Seafloor Hydrothermal Systems to the Sustainable Exploitation of Massive Sulfide Deposits», organized by Fillipa Marques and her colleagues of the Center for Geobiology. As an undergraduate Biology student with a strong interest in deep-sea mining it was very exciting to meet so many great people from different fields. I was the youngest person participating, and therefore thought it would be interesting to share my reflections on this workshop. This piece of writing is not a summary of the talks, but rather my reflections on the discussions that followed.

Massive Sulfide Deposits are formed at hydrothermal systems: metal rich sulfides precipitate as seawater heated in the crust meets cold ambient water. These deposits can contain high-grade ore with copper, zinc, silver and gold. Currently, many states hold an exploration license to explore the possibility of mining in an economically feasible manner. Only one company, Nautilus Minerals Inc., currently has an exploitation license. They plan to start their activities in the Manus Basin of Papua New Guinea in 2018. The workshop addressed the geological, biological, legislative and social aspect of deep sea mining.

My first remark is about the sense of excitement throughout the workshop. The deep sea has always spoken to the imagination, and the rate at which new discoveries are made illustrates the strong desire to gain more knowledge. We were presented with new technologies to map the seafloor at high resolution; the discovery of venting and new species at the Arctic Mid-Atlantic Ridge; a hypothesis about venting at fracture zones; new ideas about exploitation regulations; and more. Everybody marvelled at the video footage of an erupting underwater volcano, waving pools of molten sulfur, and highly adapted vent organisms. It is our shared excitement about the new possibilities the deep sea gives us, that brought us together for this workshop.

These many unknowns, however, are also a source of frustration. The ocean holds many resources and provides many services that people want to exploit. However, there are also environmental concerns: how much exploitation can the oceans handle before collapsing? There is an ongoing discussion about how much knowledge we should have, in order to make an informed decision. Scientific research will always create more questions than answers, but there must be a point where we decide we are informed enough to make some decisions about the management of our oceans. I think meetings like this and outreach to the public are important in this process. Both help getting everybody on the same page and to speak the same language, to have an honest conversation about our conflicting and overlapping interests. Considering the scale of the plans and the possible consequences, I don't think it's strange this is a slow process.

During the breaks and panel discussions, not only detailed questions, but also some very fundamental questions were discussed. Deep-sea mining is possible, but is it necessary? How do we define progress? What is more harmful: precaution or risk aversion? Who should be involved in decision making? Why is it important to maintain biodiversity?

In my opinion these questions extend to the larger debate about exploiting earth resources to sustain the growing population, and cannot only be answered by doing research. The answer depends on our common notion about how we would like to live, and treat each other and our environment. This notion is a social construct, and therefore it changes constantly. People should be given time to comprehend the impact of new ideas and technologies, and adjust their opinions accordingly.

All workshop participants were very welcoming, and I have learnt a lot. I will continue following all developments regarding seabed mining, and look forward to continuing my studies in this direction!

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# Scientist Profiles

## Judith (Judi) Gobin

Benthic Ecology and More!

*Lecturer (Marine Biology), Department of Life Sciences, University of the West Indies, Trinidad and Tobago Judith.*

[Gobin@uwi.sta.edu](mailto:Gobin@uwi.sta.edu)



Judi is a Marine Scientist with tremendous environmental and ecological experience in the marine and coastal areas of Trinidad and Tobago. She holds a Ph.D (1994) in the field of Marine Biodiversity (Univ. of Exeter/Plymouth Marine Laboratory, U.K.) and an M.Phil. (1988) in the field of Marine Biology/ Pollution Ecology (Univ. of the West Indies (UWI), St. Augustine, Trinidad). Judi is presently a Lecturer (Oceanography and Marine Biology and Coastal Ecosystems Management ) in the Dept. of Life Sciences, UWI. Her specialization is benthic ecology and she has worked extensively on Environmental Impact Assessments (EIAs) for coastal and land based operations of petrochemical (including BP/Amoco, Shell and Exxon) and other industries. Her expertise also extends to environmental law and she is presently the Environmental Scientist appointed to the Environmental Commission (a Superior Court of record) of Trinidad and Tobago.

As one of only a few Caribbean marine scientists, Judi had the amazing opportunity to join the EV Nautilus in both 2013 and 2014 on its Deep Sea explorations in the Caribbean- at Kick 'em Jenny, Grenada and off the East coast of Tobago. This was her very first introduction to the real "deep sea world" and in her own "backyard"! Judi is very enthusiastic about attending (for the first time) the 14th Deep Sea Biology meeting in Aveiro (Portugal), after which she begins a Sabbatical year! She expects to be working on some of the deep sea material from her Nautilus Caribbean trip!

Related website: <https://sta.uwi.edu/fst/lifesciences/jgobin.asp>

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## Fanny de Busserolles

Deep-sea fish visual ecology

*Postdoctoral Research Fellow, Queensland Brain Institute, University of Queensland, St Lucia QLD 4072 Australia*

[f.debusserolles@uq.edu.au](mailto:f.debusserolles@uq.edu.au)

Due to limited access and resources, and to the difficulty in performing in-situ experiments, the behaviour of most deep-sea organisms remains a mystery. The study of sensory systems such as vision, can be used to shed light on the behaviour of these animals and allows us to understand what their day-to-day life might be like. My research focuses on the visual system of deep-sea fishes and in particular, one of the most abundant family of mesopelagic fishes, the lanternfishes (Myctophidae). I use a multidisciplinary approach involving neurobiology, phylogeny and ecology in order to better understand fish visual adaptations in relation to their environment and evolutionary history, and unravel behaviour of deep-sea fishes.

My passion for the deep-sea started 10 years ago while attending Professor Paul Tyler's Deep-Sea Biology course at the Southampton National Oceanography Centre (UK). I then joined the Ifremer Deep-sea Ecosystem Department in Brest (France) to work on hydrothermal vents ecosystems with Dr. Jozee Sarrazin. In 2009, I moved to Australia and completed my PhD on deep-sea fish vision at the University of Western Australia in 2013. Since then, I spent one year as a post-doctoral fellow at King Abdullah University of Science and Technology (KAUST) in Saudi Arabia and I have recently joined the Sensory Neurobiology Group at the Queensland Brain Institute, University of Queensland (Australia).



You can find my latest paper on the visual system of lanternfishes in the Hot of the press section! Please do not hesitate to contact me for more information about my work and/or experience.

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## Madeleine Brasier

Species diversity, biogeography and trophic traits of deep-sea Antarctic Polychaetes

*University of Liverpool and Natural History Museum, London, UK*

[m.brasier@liverpool.ac.uk](mailto:m.brasier@liverpool.ac.uk)

I am a second year PhD student at the University of Liverpool, under the supervision of Rachel Jeffreys, George Wolff, Adrian Glover (NHM, London) and Henry Ruhl (NOC, Southampton). My project aims to improve our understanding of the role of polychaetes within the deep Antarctic benthos on both taxonomic and functional levels, using a combination of genetic and stable isotope analyses.



Despite the increased sampling effort around the Antarctic, it is thought that Antarctic marine diversity could be hugely underestimated. This is partially a result of the unknown levels of cryptic species, i.e. those which are morphologically identical but genetically distinct. If we wish to document the potential impacts of climate change on species diversity within rapidly changing areas such as Antarctica, we need to apply molecular taxonomic methods. The first stage of my project will use DNA barcoding to assess the prevalence of cryptic species across several polychaete families using specimens collected within the Scotia, Amundsen and Bellingshausen Seas. Preliminary analysis of mitochondrial DNA has revealed the existence of several cryptic species with both overlapping and restricted distributions. These results also provide a genetic level insight into our understanding of polychaete biogeography, and I hope to assess the existence of previously considered cosmopolitan and circumpolar species.

Trait-based approaches to ecology are becoming an increasingly popular method when investigating ecosystem function. However, for many, taxa trait data is often limited to the family level. Furthermore, many traits are qualitative and not easily comparable. The second part of my project will use compound specific stable isotope analysis to determine the trophic traits of the genetically identified polychaetes. The aim is that this method will produce a quantitative comparable measure of trophic level that can be used to investigate the relationships between species and trait diversity, and highlight any functional differences between cryptic species. This in turn could provide insight into the potential consequences of species loss under changing environmental conditions.

## Neus Campanyà-Llovet

The influence of food quality on deep-sea benthic ecosystems

*Memorial University of Newfoundland, Canada*

[ncil58@mun.ca](mailto:ncil58@mun.ca)



I am a PhD student in Paul Snelgrove's lab with a strong interest in deep-sea benthic biodiversity and food webs. Most benthic studies and theories emphasize food quantity, and largely neglect its quality. A few studies, nonetheless, suggest that food quality may play a significant role in structuring deep-sea benthic ecosystems, such as the "Amperima event" in the Porcupine Abyssal Plain (NE Atlantic) (Billett et al. 2010). Climate variation influences community structure and species distributions of most deep-sea benthic food sources (i.e., shelf and pelagic primary producers) which may, in turn, impact deep-sea benthic community and trophic structure. At the same time, chemosynthetic environments provide deep-sea benthic ecosystems with an abundant but strongly contrasting food source in terms of quality.

The goal of my research is to understand the influence of food quality on deep-sea benthic biodiversity and trophic structure, using different methodologies. First, I deployed an algal enrichment experiment in Barkley Canyon (off British Columbia, Canada) to understand the response of infaunal and epifaunal organisms to food pulses of different quality. Second, I am using biochemical techniques (lipids and stable isotopes) to understand how variation in food quality and quantity influence benthic invertebrate foraging in submarine canyons with contrasting topography and hydrography from the Atlantic and Pacific. Finally, based on push core samples, I am trying to understand how differences in methane, and thus chemosynthetic production, influence the spatial distribution of fauna in Barkley Canyon sediments in relation to other food sources.

My thesis will provide new insights into how food quality affects benthic communities, and provide information to help plan best practice for any future exploitation of methane hydrate resources.

## Zoleka Filander

Deep-sea fish visual ecology

*Benthic Ecologist, Department of Environmental Affairs: Oceans and Coasts, Cape Town, South Africa*

[zfilander@environment.gov.za](mailto:zfilander@environment.gov.za)

In 2011 I completed my BSc and BSc (Hons) degrees at Walter Sisulu University (WSU), one of the 11 historically disadvantaged universities in South Africa, situated in Mthatha. After being awarded my BSc (Hons) degree, I was accepted into the Masters program at the University of Cape Town (UCT) in the field of Marine Biodiversity and Taxonomy under the supervision of Prof Charles Griffiths. My research thesis was on the taxonomy and biogeography of South African echinoids and described 19 new records, raising the number of species recorded to date to 71. After completing my MSc, I was appointed as an offshore benthic ecologist with the South Africa government's Department of Environmental Affairs (DEA) within the Oceans and Coasts research Chief Directorate. The below profile sketches my future aspirations as an offshore ecologist.



My passion for deep-sea research in taxonomy, ecology and biogeography has guided my aspirations to register for a PhD in this field. Apart from having a good understanding of the shallow water benthic biodiversity, very little is known about the benthic biodiversity over the greater part of the offshore continental shelf around South Africa. This paucity of data in deep-water benthic biodiversity hampers our effective management and conservation of our representative biodiversity and natural resources. Moreover, economic activities through resource extraction are expanding at a faster rate within the marine environment, and it is therefore important to promote sustainable development through Ecosystems Based Management and a Marine Spatial Planning (MSP) process. From a conservation point of view, data on species, habitats and ecosystems are important to define sensitive areas and to document our benthic biodiversity from the neglected offshore domain on the continental shelf. However, this process is hindered by the uncertainties regarding the position of these sensitive ecosystems, which has been exacerbated by the costs associated with sampling these remote ecosystems. In response to this, international efforts have been applied to develop guidelines to facilitate identifying vulnerable marine ecosystems (VMEs) and Ecologically and Biologically sensitive areas (EBSAs) with the goal to better protect and conserve our marine environment. In light of this, Dr Kerry Sink, South African National Biodiversity Institute (SANBI), and Dr Toufiek Samaai, (DEA) identified a number of potential VME's such as cold water coral beds, sponge beds, sea pen aggregations, submarine canyons and seamounts, within the South African Economic Exclusive Zone in 2009. The overarching aim of my PhD is to identify, map, verify and predict these sensitive ecosystems using various tools and models, and to sample cold water coral beds to understand connectivity and their importance as an EBSA. The current project will collate recently collected imagery data from oil and gas companies, observer data, skippers data and historical data from the South African Museum archives, and amalgamate it with the existing data.

The end product of this project will feed into the MSP process in defining EBSA, VMEs and priority areas for conservation to ensure an integrated approach to ocean related matters and shared sustainability goals between various sectors.

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## Adam Chivers

The Biodiversity and Ecology of Senghor Seamount (NE Atlantic).

*Department of Ecology, The Scottish Association for Marine Science (SAMS), Oban*

<http://www.sams.ac.uk/adam-chivers>



I have recently completed my PhD in deep-sea ecology at the Scottish Association for Marine Science (SAMS), under the supervision of Dr. Bhavani Narayanaswamy and Dr. Robert Turnewitsch. My research, which was funded by the Natural Environment Research Council (NERC) and the Marine Alliance for Science and Technology Scotland (MASTS), focused on the macrofaunal biodiversity and ecology of Senghor Seamount in the NE Atlantic.

The motile and sessile megafauna of seamount ecosystems are often the focus of seamount research. By comparison, few studies have focused on the more enigmatic, but no less important, infauna. The study of Senghor Seamount sought to address this knowledge gap and provide the very first quantitative and systematic analysis of a seamount macrofaunal community (Chivers et al., 2013).

In addition to the investigation of macrobenthic community characteristics, the response of the community to a range of environmental variables was also determined. A key aspect of my research was to determine the potential effect of topography-flow interactions on the macrobenthic community as part of the NERC-funded TopoDeep research programme.

The TopoDeep programme aimed to assess how seamounts affect the organic carbon export flux from surface waters to the deep ocean; the central hypothesis of this study was that organic carbon settling rates and burial within sediments would be influenced by the presence of intermediate-scale (1-10 km) topographic features, with organic carbon export flux and burial expected to be very different in regions with no topographical features e.g. featureless abyssal plains, with respect to regions with a much more complex landscape. The investigation of topography-flow interactions, related sediment dynamics, and POC flux with depth on Senghor Seamount (and the potential effect of these interactions upon benthic community characteristics) were therefore explored.

During my time at SAMS I also took part in a series of multidisciplinary research cruises that visited a number of different seamounts in the Atlantic and Indian Oceans. The first was a research expedition to Ampere Seamount (NE Atlantic) (Meteor M83/2) in 2010, and the second to five seamounts and the Dragon Hydrothermal Vent Field located on the South West Indian Ocean Ridge (JC66 and JC67). This enabled me to develop a broad range of experiences, undertaking sediment sampling with multi-corers and boxcorers, and also working with still imagery, video systems and ROVs. I have also gained extensive taxonomic identification experience, working to ID a range of macrofaunal groups and identifying new polychaete species from the Senghor Seamount region (Watson et al., 2014).

I am now looking to broaden my research portfolio and I have an interest in the impact of offshore industries, such as oil and gas exploration and deep-sea mining, upon benthic environments. Please feel free to contact me if you know of any post-doctoral (or any other) opportunities. You can contact me by email: [Ajch6@yahoo.com](mailto:Ajch6@yahoo.com) or find me on LinkedIn: <https://uk.linkedin.com/pub/adam-chivers/a8/934/194>.

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# DeepMatch.com

## Ariadna Mecho

Who needs a deep-sea taxonomist?

*Deep-Sea Renewable Resources - Institute of Marine Sciences (ICM-CSIC), Spain*

[mecho@icm.csic.es](mailto:mecho@icm.csic.es)



I recently finished my PhD thesis in the Marine Sciences Institute (ICM-CSIC, Barcelona, Spain) and I am searching now for a postdoctoral position abroad. My research topics are the taxonomy, distribution, community composition and life-history patterns of non-crustacean invertebrates from Mediterranean deep-sea ecosystems, with special interest in the Phyla Echinodermata, Echiura and Sipuncula. Concurrently, I have been working with Remote Operated Vehicle (ROV) images from deep-sea Mediterranean ecosystems. As long as I have been working with deep-sea species, I have found an amazing and unknown field to study. For this reason, I hope to continue my scientific career in this interesting field of research. My future research plans are aimed to acquire a detailed knowledge of molecular techniques in order to classify species combining both fields (molecular and morphological techniques), with interest in providing new data on new species, rediscovered species and bathymetric and regional distribution of deep-sea invertebrates. During my PhD, I participated in European and national projects (UE-FP7 and ESF, MEC-CICIT, MEC-CICYT), which have resulted in several papers, a co-authored chapter in an IUCN book on canyons, and numerous presentations in conferences and workshops. During my studies of deep-sea Mediterranean megafauna and I have participated in 18 oceanographic cruises, adding up to 179 days on board (national, European and international expeditions). I have given lectures on the MSc course 'Dynamic of marine ecosystems in the deep sea' at the University of Barcelona for two consecutive years. Moreover, I have acquired skills as a collection curator, since I collaborated to introduce and store in the ICM Reference Collection all the Echinoderms collected during our deep-sea cruises. Presently, I am working in the ICM applying my taxonomic expertise to the research group needs, while I look for a postdoctoral opportunity that allows me to contribute to the understanding of worldwide deep-sea species.

## Roser Siscar

The role of Metallothionein and Selenium in metal detoxification in the liver of deep sea fish from NW Mediterranean Sea.

University of Valencia, Spain

[rosersiscar85@gmail.com](mailto:rosersiscar85@gmail.com)

My name is Roser Siscar and I finished my PhD two months ago in the University of Valencia. One area of my PhD was focused on deep sea fishes from the Mediterranean Sea. As we know, the marine environment is subjected to physical and chemical changes, some caused by anthropogenic action. Some of these changes such as increased water temperature and the presence of metals in water can negatively affect the health of organisms living there. The particular characteristic of the Mediterranean Sea, in terms of the high human population density and the limited coastal water circulation, among others, makes this sea very vulnerable to contaminants. The heterogeneous nature of pollutants in general, and toxic metals in particular, and the proximity to the coast and for the effect of habitat depth, make it necessary to study pollution and its effects on all marine niches. Aquatic organisms have mechanisms for detoxifying metals such as metal binding metallothionein (MT) and selenium (Se). Consequently, it is very important to know to what extent the Mediterranean Sea fishes use these mechanisms to prevent harmful effects of metals. In addition, it must also investigate which organ contributes more to body detoxification, or whether one of these mechanisms are preferentially used in each species.

The aim of my Thesis was to study of the mechanisms involved in the metabolism and detoxification of metals in marine teleost fish in the Mediterranean Sea in different contexts. Regarding deep-sea fishes (Figure 1) the objective was to investigate the mechanisms that allow abyssal fish (*Alepocephalus rostratus*, *Bathypterois mediterraneus*, *Coelorinchus mediterraneus*, *Lepidion lepidion*, *Mora moro*, *Nezumia aequalis* and *Trachyrhynchus scabrus*) that inhabit submarine canyons in the Mediterranean Sea and belong to high levels in the food chain, to tolerate relatively high concentrations of potentially toxic metals in their tissue.



Results drew the following conclusions: a) In the liver of the fish species caught in the abyssal Blanes canyon there was a high diversity in metal content and the total content of each metal analyzed. These differences may be determined by the source of dietary habits and the physiology characteristics of each species; no common pattern was found of accumulation of metals between species belonging to the same family; b) High mercury concentrations in the liver of abyssal fish, caught in Blanes canyon, in comparison to the same species of fish caught in the Atlantic Ocean, are indicative of a high mercury contamination of animals that live in the Mediterranean abyssal systems; c) Metallothionein and selenium

concentrations found in the liver of the fish in Blanes canyon in relative amounts exceeding the concentration of metals (ratios greater than 1) which represents a protective reserve capacity to deal with toxicity of metals.

These results give us important information about the exposure to contaminants by deep-sea organisms and mechanisms of detoxification, and I would like to pursue research in this topic.

I am willing to apply to any research/grant position that will enable to continue my research career.

## Jane Collins

Interested in aiding mitigation of impacts related to development of marine resources

*GRID-Arendal, Norway*

[jane\\_eva\\_collins@hotmail.co.uk](mailto:jane_eva_collins@hotmail.co.uk)



I am seeking opportunities from within the marine environmental science industry, ideally focusing on development of strategies that might be deployed to contain possible adverse environmental impacts associated with human activity, especially through future sea floor mining.

Graduated in 2012 with an Msc in Geology from the University of Bristol, UK, specialising in seafloor hydrothermal sulphide deposits. Since graduation, employed as a marine geologist for Diamond Fields International Ltd., one of very few offshore mining and exploration companies. Seconded to the GEOMAR Marine Research Institute in Kiel, north Germany, for six months to investigate the composition, metal content and structure of sediment core collected from the Atlantis II Deep, Red Sea deposit, utilising a wide variety of analytical techniques.

The Atlantis II Deep deposit is the world's largest known sea-floor deposits of zinc, copper, silver, gold and lead. Six weeks were spent on board a scientific research expedition, cruising along the southern Mid-Atlantic Ridge in search of unmapped hydrothermal activity. Primary responsibilities included CTD operation, processing of ship-based multi-beam bathymetric data, interpreting side-scan sonar data together with various other marine data acquisition techniques.

Subsequently transferred to the Offices of Diamond Fields in Cape Town, South Africa to conduct due diligence and critical assessment of potential acquisition targets, both offshore and onshore. Recent work focused on modelling and mapping an extensive marine phosphate deposit offshore South Africa. Attended and completed several GIS courses and am proficient and experienced using most standard GIS programmes such as ArcGIS and Global Mapper. Currently completing a six month sponsored internship in Norway with GRID-Arendal, a centre collaborating with UNEP, linked primarily to the Marine Spatial Planning group. Duties focused on development of web based maps and related products designed to communicate data relating to GRID-Arendal marine projects. This work entails extensive spatial analysis and processing of marine environmental data.

I have a committed and strong interest in aspects relating to responsible development of the oceans and the monitoring and mitigation of possible impacts that might be connected in so doing.

# Opportunities



## FixO3 - 2nd call for free access to European ocean observatories

**Deadline for proposals: 20th of July 2015**

**Website: <http://www.fixo3.eu/tna/>**

Research organizations and marine technology companies are invited to access 15 ocean observatories to conduct scientific studies or to test technology prototypes with full financial and logistics support. The submission process is now open until the 20th of July 2015. All material and guidelines for submission are now available on <http://www.fixo3.eu/tna/>

This opportunity comes from the Europe-funded Fixed-point Open Ocean Observatory network (FixO<sup>3</sup>) project, coordinated by the UK's National Oceanography Centre (NOC). As part of this initiative private companies and research institutions working on marine technology or wanting to conduct scientific research, have the opportunity to apply for access to one or more observatories and receive full scientific and technological support.

The FixO<sup>3</sup> project started in September 2013 with a European Commission (EC) funded grant of €7m. It is a four-year project with 29 European partners from academia, research institutions and small and medium enterprises (SMEs). The project aims to integrate all infrastructures operated by European organizations and to enable continuity in ocean observations. It also aims to improve access for the wider community to these key installations and the data products and services.

### Transnational access

As part of FixO3 activities, 'Transnational Access (TNA)' is about supporting external users with coordinated access and full logistics support at no cost to the user for 14 open-ocean observatories and 1 shallow water test site, available to successful applicants. To illustrate the opportunity and practicalities, you are invited to visit the results of the 1st TNA call on the FixO3 website where selected proposal abstracts are also available.

Observatory locations range from the polar regions of the Antarctic and Arctic, to the Atlantic Ocean and Mediterranean Sea with a choice of seafloor, mid-water and surface infrastructures with varying scientific focus due to each location's characteristics.

These observatories were selected as they offer the broadest scientific and technological capabilities for multidisciplinary observations such as atmosphere-ocean interactions at the sea surface and processes in the water column and seafloor. Gliders are also available for some of the sites. The observatories address a wide range of disciplines such as biology, biogeochemistry, chemistry, physics and geology.

## Call for proposals

The call for proposals will close the 20th of July. Applicants are encouraged to start working on their proposals as soon as possible as they need to contact the observatory manager of the preferred FixO<sup>3</sup> location for a pre-feasibility evaluation of their project and a letter of support prior to submitting the proposal. Applicants also need to write a short research proposal explaining the reasons why they would like to use one of the observatories offered under TNA.

The proposals will be evaluated by a panel of experts, based on scientific merit, technical quality and the novelty of the proposed activities. The selection process will start as soon as the FixO3 TNA Office closes the second call on the 20th of July and successful applications will be decided by the end of the year.

User groups, particularly those working in countries where no similar research infrastructure exists or with no prior experience of accessing similar infrastructure, are encouraged to apply. The TNA is a unique opportunity for scientists and engineers to access high-quality, interlinked instrumented infrastructures operating in open ocean observatories in order to carry out research and/or to test equipment.

For more information please visit <http://www.fixo3.eu/tna/>; email the FixO3 TNA office at [fixo3.tna@plocan.eu](mailto:fixo3.tna@plocan.eu) or email the FixO3 Project Manager at [fixo3@noc.ac.uk](mailto:fixo3@noc.ac.uk)

FixO3 is a Seventh Framework Programme project funded by the European Commission

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## Polymetallic Nodule PhD grants

Kerry Howell

*Plymouth University, UK*

Applications are invited for two fully funded international PhD studentships within Plymouth University's Marine Institute funded by UK Seabed Resources Ltd as part of its training proposal and in line with its contract with the International Seabed Authority (ISA) to explore for potential Polymetallic Nodule collection in the deep Pacific Ocean.

The subjects of the two PhDs are:

1. The application of predictive modelling to marine spatial planning associated with deep-sea mining.
2. A new look at the critical material potential of polymetallic nodules using advanced imaging techniques.

Both studentships will start on 1 October 2015, each with a duration of four years.

Applicants must be from a developing nation (see UN list of such nations: developing economies by region). For more details, see:

<https://www.plymouth.ac.uk/student-life/your-studies/the-graduate-school/postgraduate-research-studentships/marine-institute-studentships>

## Participate in Deep-Sea Exploration from Shore!

The Ocean Exploration Trust recently began a six-month expedition season to explore the Gulf of Mexico, Galapagos and eastern Pacific from April-September 2015. Join us from the comforts of home by signing up as a Scientist Ashore (Scientist Ashore Sign-up). Through real-time telepresence, anyone can view live video feeds from the remotely operated vehicles (ROVs) Hercules and Argus as well as topside from the ship during seafloor and water column mapping efforts at our website: NautilusLive. By signing up, you can also participate in a text dialogue with onboard scientists and other onshore scientists, and contribute to ROV dives and mapping operations. Additionally, you will receive regular cruise updates and plans via email during the cruise(s) in which you choose to participate. Samples and data collected during these cruises (and past cruises) are available upon request. Biological samples are distributed through Harvard's Museum of Comparative Zoology (MCZ database) and geological samples through the University of Rhode Island's Marine Geological Samples Lab (MGSL).



Stay tuned to [www.oceanexplorationtrust.org](http://www.oceanexplorationtrust.org) for student science and engineering internship opportunities aboard E/V Nautilus in 2016 and follow us online at [www.nautiluslive.org](http://www.nautiluslive.org), on Facebook and Instagram at NautilusLive, and on Twitter as @EVNautilus.

## Ocean research priorities and prioritizing ocean research

<http://journal.frontiersin.org/researchtopic/ocean-research-priorities-and-prioritizing-ocean-research-3604>

*Murray Rudd*

### About this Research Topic

What science is needed to support and facilitate effective ocean governance? Given the magnitude and diversity of the challenges that are today affecting oceans, how can the natural and social sciences help decisions-makers and the public better understand those threats, why they are important, and the possible solutions that can be crafted to ensure ocean health and sustainability?

In recent years, a variety of 'big question' and horizon scanning exercises have more generally identified areas of research important for environmental sustainability. In a recent synthesis of those exercises in *Frontiers in Marine Science* (Scientists' perspectives on global ocean research priorities, *Frontiers in Marine Science* 1: 36 [10.3389/fmars.2014.00036]), 67 research questions potentially important for supporting the development of effective ocean policy and management were identified. The questions were drawn from the physical, ecological and social sciences, representing input from the thousands of scientists who participated in 22 different big question and horizon scanning exercises from 2006. Those 67 questions were ranked by almost 2200 scientists who participated in the survey.

In this Research Topic collection, our goal is to solicit submissions that could elucidate what science is needed to fill the gaps that currently constrain effective ocean policy. Specifically, we are encouraging submissions that: (1) more fully examine the current status of ocean challenges and emerging research opportunities; (2) explore how important questions may vary by region and for particular ecological, social and governance contexts; and (3) improve our understanding how cross-disciplinary science can contribute to policies supporting sustainable ocean use and governance.

We would welcome a variety of types of contributions to this Research Topic, potentially including mini-reviews or reviews, opinions, perspectives, or other contributions. We encourage submissions that focus specifically on the 67 existing research questions, that compare and contrast those 'bottom-up' priorities with priorities identified by national or regional organizations, or that explore opportunities for improving the communication and uptake of ocean science by policy-makers, business organizations and the public.

Our hope is that submissions to this Research Topic will act as a catalyst for stimulating broad discussions about the science needed to help societies respond to global environmental change in marine environments. Further, we hope that the submissions help advance thinking about how ocean research needs can be identified, tracked and prioritized in the future.

### About Frontiers Research Topics

With their unique mixes of varied contributions from Original Research to Review Articles, Research Topics unify the most influential researchers, the latest key findings and historical advances in a hot research area! Find out more on how to host your own Frontiers Research Topic or contribute to one as an author.



# INTERNATIONAL INDIAN OCEAN EXPEDITION - 2

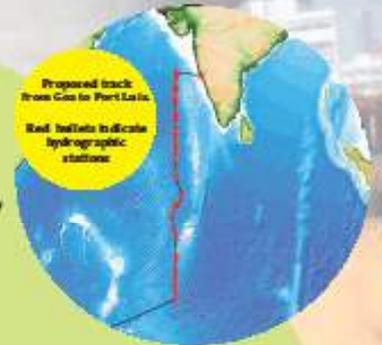
## 1<sup>ST</sup> EXPEDITION



ORV Sagar Nidhi: 4 - 24 December 2015

### Call for Expressions of Interest for Participation

The first expedition of IIOE-2, is to be flagged off from the port of Goa, India on 4 December 2015 on board ORV Sagar Nidhi at the concluding session of the International Symposium on "Dynamics of the Indian Ocean: Perspective and Retrospective" to be held in Goa during 30 November - 4 December 2015.



The primary objective of this expedition is to revisit a hydrographic section along 73°E which was sampled in 1962, during the IIOE. This expedition will conclude at Port Louis, Mauritius on December 24. ORV Sagar Nidhi (<https://www.niot.res.in/index.php/node/index/118/>) is a modern oceanographic research vessel with facilities for physical, chemical and biological oceanography measurements. A tentative cruise track is shown. This cruise is supported by the Earth System Science Organization (ESSO), Ministry of Earth Sciences, Govt. of India and its constituent institutes.

This call is to invite expressions of interest from the international scientific community to take part in this observational program. The proposal should contain a short write-up on the scientific objectives and the measurements that are to be made. Brief CVs of proposed cruise participants and scanned copies of their passports may also be included at the end of the proposal. The preferred format for the proposal is PDF.

The number of berths available on the ship are limited and the selection will be based on the scientific merit of the proposal as well as feasibility. Free boarding and meals will be provided to all participants. Equipment available on board the vessel will be made available for participants as per the approved cruise plan. All other expenses are to be borne by the participants. There is no financial support available from the organisers of the expedition.

Interested scientists may email their proposals, latest by **15 June 2015** to:

IIOE-NOC Secretariat  
[iioe@incois.gov.in](mailto:iioe@incois.gov.in)

ESSO-Indian National Centre  
for Ocean Information Services,  
Hyderabad - 500090,  
INDIA.

All data collected on board is required to be deposited at the National Oceanographic Data Centre at the ESSO- Indian National Centre for Ocean Information Services (ESSO-INCOIS) (<http://www.incois.gov.in/portal/datainfo/datainfohome.jsp>) for archival. The data may be shared with non-participants of this cruise as per the guidelines of the IOC/IIOE-2 data policy.

## Postdoc and PhD positions

### “Development of environmental DNA surveys of eukaryotic communities for benthic monitoring of marine ecosystems”

Department of Genetics and Evolution, University of Geneva  
<http://genev.unige.ch>

A postdoc and a PhD position are available in molecular ecology and bioinformatics as part of the Swiss National Science Foundation project.

**Objectives:** To establish new eDNA biomarkers for assessing the quality of marine ecosystems based on eukaryotic benthic diversity data generated by high-throughput sequencing.

**Rationale:** Marine ecosystems are threatened by rapidly growing industrial activities prompting the development of new environmental management tools to ensure the sustainable development of these activities while accurately assessing their impact on marine biodiversity. Currently, environmental impacts are measured by species inventories based on morphological identification of benthic macro-invertebrates. Numerous NGS-based studies reveal a huge and disparate diversity of micro- and meiobenthic eukaryotes but their potential application for environmental monitoring remain unexplored.

**Required and preferred qualifications:** We are looking for highly motivated and independent scientists interested in mathematics, informatics, molecular ecology and environmental monitoring. Applicants should have a strong background in molecular ecology, environmental genomics and NGS data analysis. Experience in one or more of the following areas/techniques is advantageous: metabarcoding, marine ecology, programming (C, C++, Python), bioinformatics analysis, statistics (R or MATLAB).

**Mode of application:** To apply, please send an email to Jan Pawlowski ([jan.pawlowski@unige.ch](mailto:jan.pawlowski@unige.ch)) containing a short letter of motivation, a detailed CV (including a brief description of research interests, previous employments, and publication list), and contact details of at least two references (letters of recommendation are optional).

**Application deadline** is June 30. **Job starts** in Autumn 2015.

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## Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

### Postdoctoral Fellow Programme

#### Available Position

JAMSTEC will be recruiting a total of 5 JAMSTEC Postdoctoral Fellow positions

#### Aim of the Position

JAMSTEC wants to help talented young researchers who have completed promising Ph.D. theses to develop their scientific excellence in the fields of ocean and earth sciences. For this purpose, JAMSTEC has established an international postdoctoral fellowship programme. It is intended that research grants will be provided to successful applicants, which will enable them to work independently on research topics of their choosing: ¥1,000,000 for the first fiscal year and ¥500,000 for each of the second and third years. During the contract period, they will have access to the necessary facilities and equipment at JAMSTEC.

The full announcement can be found on the JAMSTEC website at:  
[http://www.jamstec.go.jp/e/about/recruit/jinji\\_20150721.html](http://www.jamstec.go.jp/e/about/recruit/jinji_20150721.html)

# Obituaries

## Roger Bamber

By Tammy Horton



Roger Norman Bamber (1949-2015) was an integral member of the World Register of Marine Species (WoRMS) community and served as a Taxonomic Editor responsible for the Pycnogonida and Tanaidacea, and also provided valuable input to the World Register of Deep-Sea Species (WoRDSS). Roger was involved in the WoRMS project since its establishment as ERMS and attended many meetings of editors, providing valuable input to the development of the project.

Roger Bamber published a total of 213 scientific papers in his lifetime in addition to many hundreds of reports and non-peer reviewed papers and articles. Throughout his working life, Roger developed and maintained an interest in numerous diverse fields, including of course deep-sea biology, and he will be remembered by many for his attendance at international meetings. Roger is probably best known in taxonomic circles for his work on both pycnogonids and tanaidaceans and it is in these fields and by the researchers who study these

taxa in particular that his loss will be profoundly felt.

Roger's first paper on the Pycnogonida (or Pycnobeasts as he referred to them) was published in 1979 and he followed this first paper with a further forty-six papers on them. He established an Order, a Family, a Subfamily, a Genus and 42 species new to science. He was also instrumental in the creation, with Aliya El. Nager, of 'PycnoBase'. PycnoBase is an enduring legacy to his contribution to pycnogonid systematics and today it represents the foundation for all future work in the field. Roger was particularly proud of his 2010 book 'Sea-spiders (Pycnogonida) of the Northeast Atlantic. Keys and notes to the identification of species', to which he would point anyone with a query on the group as it was likely covered somewhere within.

His second love was perhaps the Tanaidacea. Roger published his first paper on the Tanaidacea in 1986 and his first taxonomic work on them in 1990. His 'second love' could be argued to have somewhat overtaken his first, as he has since 1990 authored (or co-authored) a total of two families, three subfamilies, 38 genera, one subgenus and an astounding 225 tanaidacean species!

His extraordinary track record for species descriptions does not stop at these favoured taxa as Roger also authored or co-authored seven isopod species, two amphipod species, one leptostracan, six mysids, one Bocheusean, 2 copepod taxa (including a new genus) and 3 polychaete taxa (including a new genus).

In total Roger Bamber established 338 taxa.

Currently there are seven species named in his honour, including genera of Pycnogonida and Tanaidacea. There is also a special issue of Zootaxa in preparation that will name many more.

[Bamberus jinigudirus Stepieni, Blazewicz-Paszkowycz, 2013](#)

[Austrodecus bamberi Wang, Huang, Lin & Zheng, 2013](#)

[Kalliapseudes bamberi Drumm & Heard, 2011](#)

[Leptognathia bamberi Larsen & Shimomura, 2007](#)

[Makassaritanais bamberi Gutu, 2012](#)

[Bamberene Staples, 2014](#)

[Chauliopeleona bamberi Bird, 2015](#)

Roger was a well-known member of a number of editorial boards (Zootaxa Editor, for Pycnogonida, Tanaidacea, Cumacea; Editor of Zookeys, Pycnogonida; Editorial Advisory Board for Polish Polar Research; Guest Editor for Journal of Natural History) and his input to these was invaluable.

Roger was always great company, interesting, engaging, controversial, but always good fun. He certainly stood out from the crowd. He was unusual, amongst academics, in successfully carrying off a mixture of a great intellect and no-nonsense approach to science, with an infectious amiability and ability to enjoy life to the fullest.

He will be greatly missed.

Link: <http://www.marinespecies.org/pycnobase>

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## Kristian Fauchald

*WoRMS Polychaeta founding editor*

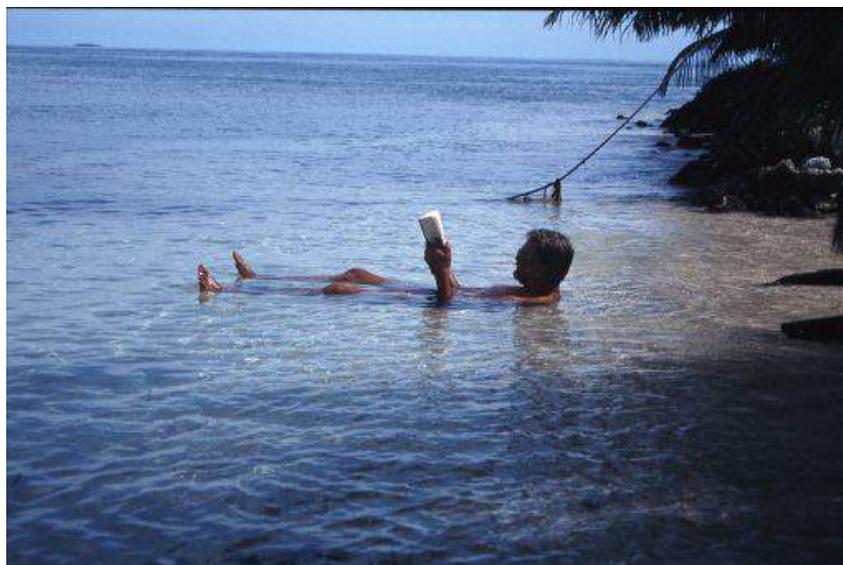
Leen Vandepitte

Kristian Fauchald, emeritus research zoologist at Smithsonian, and a founding editor of the World Register of Marine Species (WoRMS) passed away the 5<sup>th</sup> April 2015.

Contributed by Fredrik Pleijel (University of Gothenburg, Sweden) and Greg Rouse (Scripps Institution of Oceanography, UCSD, USA).

Kristian was born in Norway in 1935, took degrees at the University of Bergen and, in 1961, made his first publication on Norwegian occurrences of a crab; he thereafter published nearly exclusively on annelids for the rest of his career. He moved to California in 1965 for his Ph.D.

studies with Olga Hartman and, in 1969, was appointed assistant professor of biology at University of Southern California (USC). He was also appointed curator of marine annelids at the Allan Hancock Foundation, where he worked until 1979. The Allan Hancock Foundation had developed an outstanding polychaete collection under Olga Hartman, and Kristian collaborated with her and carried on the tradition she had built as well as developing his own influential studies. While at USC and the Allan Hancock Foundation, Kristian's publication highlights were his famous "Pink Book" guide to the polychaetes



*Kristian on Carrie Bow Cay in 2006. The book is on Chinese philosophy.*

(Fauchald 1977) and the "Diet of Worms" together with Peter Jumars (Fauchald & Jumars, 1979), the former cited 1005 and the latter 1737 times!

Kristian moved in 1979 to the Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution where he remained. While there, he concentrated on systematics within Eunicida, resulting in a series of major revisionary monographs. In more recent times, he has devoted his time to the problematic scaleworms. He was also instrumental in the first broadscale morphological cladistic analyses across annelids.

Beyond his own research, Kristian was a mentor for many worm workers and he taught in a series of 'Polychaete Biology Classes' at Santa Catalina Marine Lab (with Paul C. Schroeder), Friday Harbor (with Peter Jumars, and later with Sally Woodin and Herb Wilson) and Biologisk Stasjon Espeland, and in other polychaete-oriented courses at Ischia and Lecce in Italy, Brazil, Iceland and Madrid. The home of Kristian and his husband Leonard Hirsch in Washington DC was a haven to a long list of annelid workers.

Kristian was rare in many ways and, not least in keeping an open mind and being able to take part in a paradigm shift in systematics. Starting out with his first publication in 1961, he was well educated in the school of evolutionary taxonomy, but later, in the 80th and 90th decades, re-educated himself into tree-thinking and phylogenetics. He had a life-long interest in philosophy of science and life itself.

A sense of the esteem with which he was held in the annelid community can be seen in the taxa that were named for him (including homonyms!) as compiled from WoRMS:

*Amphisamytha fauchaldi* Solís-Weiss & Hernández-Alcántara, 1994, *Caulleryaspis fauchaldi* Salazar-Vallejo & Buzhinskaja, 2013, *Chirimia fauchaldi* Light, 1991, *Clavodorum fauchaldi* Desbruyères, 1980, *Clymenella fauchaldi* Carrasco & Palma, 2003, *Diopatra kristiani* Paxton, 1998, *Dodecaseta fauchaldi* Green, 2002, *Eunice kristiani* Hartmann-Schröder & Zibrowius, 1998, *Hypereteone fauchaldi* (Kravitz & Jones, 1979), *Eunice fauchaldi* Miura, 1986, *Fauchaldius Carrera-Parra & Salazar Vallejo*, 1998, *Fauchaldonuphis* Paxton, 2005, *Fauveliopsis fauchaldi* Katzmann & Laubier, 1974, *Gesaia fauchaldi* Kirtley, 1994, *Hypereteone fauchaldi* (Kravitz & Jones, 1979), *Kinbergonuphis fauchaldi* Wu, Wang & Wu, 1987, *Kinbergonuphis fauchaldi* Lana, 1991, *Kinbergonuphis kristiani* Leon-Gonzalez, Rivera & Romero, 2004, *Linopherus fauchaldi* San Martín, 1986, *Linopherus kristiani* Salazar-Vallejo, 1987, *Lumbrineris fauchaldi* Blake, 1972, *Marphysa fauchaldi* Glasby & Hutchings, 2010, *Melinna fauchaldi* Gallardo, 1968, *Neogyptis fauchaldi* Pleijel, Rouse, Sundkvist & Nygren, 2012, *Nereis fauchaldi* Leon-Gonzalez & Diaz-Castaneda, 1998, *Notodasus kristiani* García-Garza, Hernandez-Valdez & De León-González, 2009, *Paradiopatra fauchaldi* Buzhinskaja, 1985, *Piromis fauchaldi* Salazar-Vallejo, 2011, *Poecilochaetus fauchaldi* Pilato & Cantone, 1976, *Prionospio fauchaldi* Maciolek, 1985, *Pseudatherospio fauchaldi* Lovell, 1994, *Rullierinereis fauchaldi* Leon-Gonzalez & Solis-Weiss, 2000, *Sarsonuphis fauchaldi* Kirkegaard, 1988, *Sphaerephesia fauchaldi* Kudenov, 1987, *Sphaerodoridium fauchaldi* Hartmann-Schröder, 1993 and *Sphaerodoropsis fauchaldi* Hartmann-Schröder, 1979.

Kristian, or maestro as we called him behind his back, was a wonderful mentor for us both. He and Len hosted us in Washington DC as we began our wormy careers and we met many times over the succeeding years; in the field, at conferences and at courses. His deep knowledge of worms and philosophy constantly had us questioning and discussing, such as over a cold beer after a day's work at the Smithsonian's laboratory at Carrie Bow Cay, Belize.

He had a great laugh and we miss him.