

Deep-Sea Life

Issue 3, May 2014

Welcome to the third edition of Deep-Sea Life. Firstly, I want to say a huge congratulations to Bhavani Narayanaswamy and Craig McClain for getting the new Deep-Sea Biology Society off the ground! It promises to be a real asset to the Deep-Sea Biology Symposiums of the future. See P. 41 for further news. On a rather less upbeat note, I would also like to offer commiserations to the WHOI team and others on the sad loss of the Nereus hybrid ROV, lost whilst exploring the Kermadec Trench at a depth of 9.99km on 10 May. The world has been reporting on this unfortunate event for the past couple of weeks which both shocked and saddened many deep-sea folk. On the plus side, at least the general public are talking about deep-ocean trenches and hadal zones - although with this loss, it will now be some years before any of us will be able to talk about them with the level of knowledge that projects like HADES were hoping to gain using Nereus.

However, back to some good news for WHOI – read about the Alvin science verification cruise which took place in March (p.15). Here starts another new chapter of deep-sea exploration. Not only that - they have also won DSL issue 3 'photo of the issue' with this image of the new Alvin in action!

As ever, I appreciate feedback regarding any aspect of the publication, so that it may be improved as we go forward. Please circulate this issue to your colleagues and students who I have



Divers assist the Alvin launch effort. Image courtesy Chris Linder, WHOI

not reached as yet, and have them contact me if they wish to be placed on the mailing list for this publication in future. One again, I would like to sincerely thank all those that have contributed to this third issue. And of course, thanks too to (new mum!) Dr Abigail Pattenden (University of Limerick, Ireland) and Dr Eva Ramirez-Llodra (NIVA, Norway) for their invaluable help with production.

Dr Maria Baker (Editor)

INDEEP Project Manager, University of Southampton, UK

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Hot off the Press

The sustainable use and conservation of biodiversity in ABNJ: What can be achieved using existing international agreements?

Jeff Ardron, Rosemary Rayfuse, Kristina Gjerde & Robin Warner (2014)

Marine Policy (In Press, March 2014)

While the international community debates the desirability and possible content of a new global instrument for the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction, alternative approaches to improving the application and implementation of existing agreements for the protection of biodiversity appear to have fallen off the agenda. Recent practice under existing global and regional agreements suggests that, given political will, significantly greater protections could be achieved through the more effective implementation of individual sectoral agreements. However, while single-sector measures have the potential to make a valuable contribution, ultimately only multi-sectoral, integrated, cooperative management can ensure the conservation and long-term sustainable use of marine biodiversity in ABNJ. This requires establishing mechanisms for cooperation both intra and inter-sectorally, as well as between the sectoral and global and regional conservation agreements. This paper examines recent initiatives within various sectoral and conservation treaty regimes aimed at improving their application within ABNJ as well as some of the challenges to, and options for, further and better cooperation and coordination among and between existing regimes, and it identifies a range of possible mechanisms for achieving more effective implementation and coordination among them. Greater use of existing mechanisms represents a sensible approach to making the most of existing arrangements without in any way foreclosing the possibility of the adoption of a more comprehensive, integrated global agreement for the protection of marine biodiversity in ABNJ.

Link to the paper: <http://www.sciencedirect.com/science/article/pii/S0308597X14000499>

A call for deep-ocean stewardship

Kathryn J. Mengerink, Cindy L. Van Dover, Jeff Ardron, Maria Baker, Elva Escobar-Briones, Kristina Gjerde, J. Anthony Koslow, Eva Ramirez-Llodra, Ana Lara-Lopez, Dale Squires, Tracey Sutton, Andrew K. Sweetman & Lisa A. Levin (2014)

Science 344(6185): 696-698

USA Press release 16 May 2014: With Half the Planet Up for Grabs, a Call for Deep Ocean Stewardship

The world's deep ocean spans more than half the planet, and untold quantities of untapped energy resources, precious metals, and minerals reside in its depths. Humankind needs and depends upon many of the deep ocean's treasures, and the race is already on to exploit them.

In the May 16 issue of *Science*, Environmental Law Institute's Ocean Program Co-Director, Dr. Kathryn Mengerink, and co-authors call for stewardship of the world's largest living space—striking a balance between wise use of vast resources and maintaining the deep ocean's delicate ecological balance—now, before permanent loss occurs. According to co-author and Director of Scripps Institution of Oceanography's Center for Marine Biodiversity and Conservation, Dr. Lisa

Levin, “Most of the deep ocean has never been explored. But what we have seen reveals a vast diversity of life forms and habitats important to the health of our planet. Slow growing species are the norm, and some ecosystems once injured may never recover.”

The deep ocean, below 200 meters, faces mounting challenges, as impacts from activities such as fishing, oil and gas development, waste disposal, and land-based pollution have already caused long-term and possibly irreversible injury to some deep ocean environments. Industrial-scale mining looms on the horizon. Governance of the water column and the seabed below 200 meters is a mixed-bag of regulations across national and international jurisdictions, throwing more stumbling blocks in the path to ensure the long-term health of the deep ocean.

“As we explain in the paper, to advance deep-ocean stewardship,” Dr. Mengerink says, “We need to move forward with caution, protecting and minimizing impacts to known sensitive species and areas and the vast unknown. We should invest in improving our knowledge of the deep before further exploiting its resources, so that we don’t suffer irreversible loss of incredible organisms and ecosystems.”

The International Seabed Authority has already developed regulations for mining exploration for the international seabed and has just started the process to develop exploitation regulations. In addition, many nations are in the process of leasing for offshore mining. According to Dr. Mengerink, “Now is the time to carefully design laws and policies that enable wise use of mining and other resources, while maintaining healthy oceans and communities.” Given the substantial knowledge gaps, future exploitation of deep-ocean resources will inevitably be punctuated with new discoveries as well as unexpected harmful effects of planned activities. Both will require transparent and adaptive decision-making, balancing exploitation with lasting protection of habitats, biodiversity, and ecosystem services. The ideas for this paper arose during an inaugural meeting of the Deep Ocean Stewardship Initiative (DOSI). According to Dr. Levin, one of DOSI’s founders, “The Initiative is designed to bring natural and social scientists, regulators, the private sector and civil society together to provide guidance on environmental management of the deep ocean. We humans don’t have a great track record with stewardship of land and our coastal ocean. Hopefully, we can do a better job with the deep half of the planet”

Link to the paper: <http://www.sciencemag.org/journals> and link to pdf of paper via the DOSI webpage: www.indeep-project.org/deep-ocean-stewardship-initiative

Cranchiids of the South Atlantic Mid-Oceanic Ridge: results from the first southern MAR-ECO expedition

K.S.R. Bolstada, J.A.A. Perezb, J.M. Strugnellc & É.A.G. Vidald (2014)

Journal of Natural History

Cranchiids were the most diverse squid family collected during the first southern MAR-ECO expedition in late 2009, with nine taxa identified to species. A total of 45 young specimens were collected (mantle length 7.4–59.2 mm), allowing a survey of early ontogenetic tentacular morphology in cranchiids using scanning electron micrographs. Paralarval tentacular sucker morphology appeared similar among species within the same subfamily: in the Cranchiinae, the paralarval suckers possess relatively large, narrowly polygonal or ovoid-faced pegs in the innermost ring around the aperture, and the infundibular ring lacks the dentition observed in most taoniin genera. Hook development in *Galiteuthis armata* appears to vary widely among small individuals. Tissue samples were also collected from five genera (*Cranchia*, *Galiteuthis*, *Helicocranchia*, *Leachia* and *Teuthowenia*); phylogenetic trees (maximum-likelihood and Bayesian methods) built using these cytochrome oxidase subunit I sequences

and others available from GenBank show some support for the subfamilies Cranchiinae and Taoniinae, and that within the latter, the hooked taxa group together. It is hoped that reporting this opportunistic systematic and genetic information may be of eventual assistance in helping to resolve this most problematic of squid families.

Link to the paper: <http://www.tandfonline.com/doi/abs/10.1080/00222933.2013.867375>

Explaining bathymetric diversity patterns in marine benthic invertebrates and demersal fishes: physiological contributions to adaptation of life at depth

Alastair Brown & Sven Thatje (May 2014)

Biological Reviews 89(2): 406-426

Bathymetric biodiversity patterns of marine benthic invertebrates and demersal fishes have been identified in the extant fauna of the deep continental margins. Depth zonation is widespread and evident through a transition between shelf and slope fauna from the shelf break to 1000 m, and a transition between slope and abyssal fauna from 2000 to 3000 m; these transitions are characterised by high species turnover. A unimodal pattern of diversity with depth peaks between 1000 and 3000 m, despite the relatively low area represented by these depths. Zonation is thought to result from the colonisation of the deep sea by shallow-water organisms following multiple mass extinction events throughout the Phanerozoic. The effects of low temperature and high pressure act across hierarchical levels of biological organisation and appear sufficient to limit the distributions of such shallow-water species. Hydrostatic pressures of bathyal depths have consistently been identified experimentally as the maximum tolerated by shallow-water and upper bathyal benthic invertebrates at in situ temperatures, and adaptation appears required for passage to deeper water in both benthic invertebrates and demersal fishes. Together, this suggests that a hyperbaric and thermal physiological bottleneck at bathyal depths contributes to bathymetric zonation. The peak of the unimodal diversity–depth pattern typically occurs at these depths even though the area represented by these depths is relatively low. Although it is recognised that, over long evolutionary time scales, shallow-water diversity patterns are driven by speciation, little consideration has been given to the potential implications for species distribution patterns with depth. Molecular and morphological evidence indicates that cool bathyal waters are the primary site of adaptive radiation in the deep sea, and we hypothesise that bathymetric variation in speciation rates could drive the unimodal diversity–depth pattern over time. Thermal effects on metabolic-rate-dependent mutation and on generation times have been proposed to drive differences in speciation rates, which result in modern latitudinal biodiversity patterns over time. Clearly, this thermal mechanism alone cannot explain bathymetric patterns since temperature generally decreases with depth. We hypothesise that demonstrated physiological effects of high hydrostatic pressure and low temperature at bathyal depths, acting on shallow-water taxa invading the deep sea, may invoke a stress–evolution mechanism by increasing mutagenic activity in germ cells, by inactivating canalisation during embryonic or larval development, by releasing hidden variation or mutagenic activity, or by activating or releasing transposable elements in larvae or adults. In this scenario, increased variation at a physiological bottleneck at bathyal depths results in elevated speciation rate. Adaptation that increases tolerance to high hydrostatic pressure and low temperature allows colonisation of abyssal depths and reduces the stress–evolution response, consequently returning speciation of deeper taxa to the background rate. Over time this mechanism could contribute to the unimodal diversity–depth pattern.

Link to the paper: <http://onlinelibrary.wiley.com/doi/10.1111/brv.12061/abstract>

Identifying Ecologically or Biologically Significant Areas (EBSA): A systematic method and its application to seamounts in the South Pacific Ocean

Malcolm R. Clark, Ashley A. Rowden, Thomas A. Schlacher, John Guinotte, Piers K. Dunstan, Alan Williams, Timothy D. O'Hara, Les Watling, Edwin Niklitschek & Shinji Tsuchida (April 2014)

Ocean and Coastal Management 91: 65-79

The Convention on Biological Diversity (CBD) has adopted a scheme of using scientific criteria for identifying 'Ecologically or Biologically Significant Marine Areas' (EBSAs) in need of protection in open-ocean and deep-sea habitats. To date, expert opinion collated during regional workshops has been the main method to identify regional EBSAs. In this paper, we propose a new method that could complement this process by adding more objective and transparent analyses. There are four main steps: 1) identify the area to be examined, 2) determine appropriate datasets and thresholds to use in the evaluation, 3) evaluate data for each area/habitat against a set of criteria, and 4) identify and assess candidate EBSAs.

The method can be applied to any habitat, but offshore seamounts were chosen as a test habitat to develop and evaluate it. Several options for various combinations of criteria are presented, with one being proposed as the most appropriate to identify a tractable number of seamounts that satisfied the EBSA criteria and which could be combined into larger areas that represent meaningful ecological and practicable management units. This option selects seamounts that meet any one of the 5 "biological" criteria (i.e. unique/rare, diverse, productive, threatened species, critical habitat) and which contain environmental features that are vulnerable to human activities but not yet significantly impacted by them. This selection process resulted in 83 seamounts being identified from over 3000 evaluated in the South Pacific Ocean. The priority seamounts group into 10 areas, consisting of 5 clusters of seamounts, and 5 individual seamounts. The primary strength of the method is the adoption of a transparent, and logically sequential, selection process that is conceptually transferrable to other habitat types and regions beyond our model system. We contend that in a global EBSA context it can be a useful tool to assist deep-sea management.

Link to the paper: <http://www.sciencedirect.com/science/article/pii/S0964569114000271>

Rhythms and community dynamics of a hydrothermal tubeworm assemblage at Main Endeavour Field – a multidisciplinary deep-sea observatory approach

Daphne Cuvelier, Pierre Legendre, Agathe Laes, Pierre-Marie Sarradin & Jozee Sarrazin (May 2014)

PLoS ONE 9(5): e96924. doi:10.1371/journal.pone.0096924

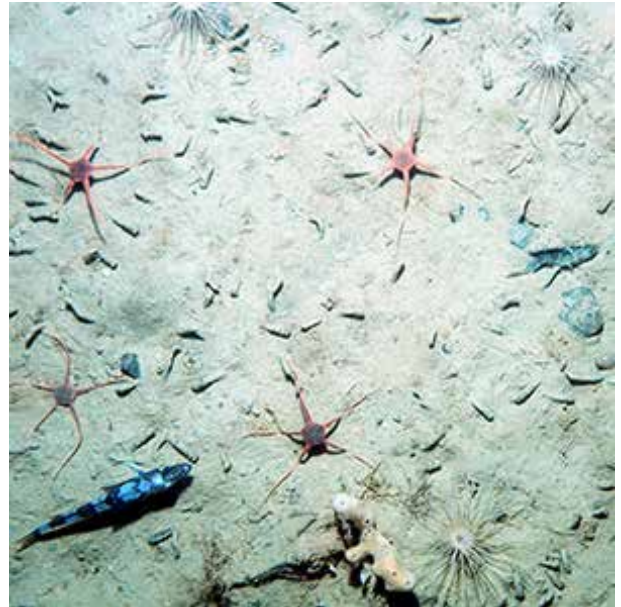
The NEPTUNE cabled observatory network hosts an ecological module called TEMPO-mini that focuses on hydrothermal vent ecology and time series, granting us real-time access to data originating from the deep sea. In 2011–2012, during TEMPO-mini's first deployment on the NEPTUNE network, the module recorded high-resolution imagery, temperature, iron (Fe) and oxygen on a hydrothermal assemblage at 2186 m depth at Main Endeavour Field (North East Pacific). 23 days of continuous imagery were analysed with an hourly frequency. Community dynamics were analysed in detail for *Ridgeia piscesae* tubeworms, Polynoidae, Pycnogonida and Buccinidae, documenting faunal variations, natural change and biotic interactions in the filmed tubeworm assemblage as well as links with the local environment. Semi-diurnal and diurnal periods were identified both in fauna and environment, revealing the influence of tidal cycles. Species interactions were described and distribution patterns were indicative of possible microhabitat preference. The importance of high-resolution frequencies (<1 h) to fully comprehend rhythms in fauna and environment was emphasised, as well as the need for the development of automated or semi-automated imagery analysis tools. Link to the paper: <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0096924>

Megafaunal communities in rapidly warming fjords along the West Antarctic Peninsula: Hotspots of abundance and beta diversity

Laura Grange & Craig Smith (Dec 2013)

PLoS ONE 8(12): e77917. doi:10.1371/journal.pone.0077917

Glacio-marine fjords occur widely in polar regions and have been extensively studied in the Arctic. These fjordic systems typically harbor low benthic faunal abundance and biodiversity, particularly in inner-middle basins, where high glacial sedimentation rates limit primary production and cause intense burial disturbance (Włodarska-Kowalczyk et al., 2005; Renaud et al., 2007; Kędra et al., 2010). In contrast ecosystem structure and function in the extensive glacio-marine fjords of the Antarctic continent remain poorly studied. Here we test ecosystem predictions from Arctic fjords on three subpolar fjord ecosystems in Andvord, Flandres and Barilari Bays along the West Antarctic Peninsula (WAP). In contrast to Arctic predictions, we find that the WAP fjords are hotspots of megabenthic abundance (mean megafaunal abundance 3-38 times that on the open shelf), and harbor trophically complex, species-rich assemblages. We suggest that WAP subpolar fjords differ markedly from their Arctic counterparts because they are in earlier stages of climate warming and thus sustain much less disturbance from glacial meltwater and sediment inputs. We hypothesize that the rapid warming occurring along the WAP will increase glacial meltwater and sediment inputs, deleteriously impacting the rich fjord benthos. We conclude that glacio-marine fjords along the WAP are likely to be important components of WAP coastal ecosystems (e.g., by enhancing regional productivity and habitat diversity, and by providing foraging areas and climate sensitive habitat for krill and baleen whales (Polis et al., 1997; Simard & Lavoie, 1999; Thiele et al., 2004; De Leo et al., 2010; Nowacek et al., 2011) and that there is a strong need to better understand the sensitivity of WAP fjord ecosystems to climate change. This study provides new insights into the potential consequences of climate change along the Antarctic Peninsula, one of the most rapidly warming regions on the globe.



Andvord Bay Fjord megafauna. Image courtesy Grange & Smith.

Link to the paper: <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0077917>

First in situ observations of the deep-sea carnivorous ascidian *Dicopia antirrhinum* C. Monniot, 1972 in the Western Mediterranean Sea

Mechó A, Aguzzi J, Company JB, Canals M, Lastras G, Turon X (Jan 2014)

Deep-Sea Research I, 83: 51-56

Dicopia antirrhinum C. Monniot, 1972 is a rare species of deep-sea ascidian belonging to the Family Octacnemidae, reported at depths of 1000-2500 m in European Atlantic waters. Adult individuals have never been reported before in the Mediterranean Sea, where only seven juvenile specimens were found in 1975 at 500 m water depth in the Central basin (Malta). The affinities of these specimens with *D. antirrhinum* were noted, but lack of some typical characters



Carnivorous ascidian *Dicipia antirrhinum*. Image courtesy of Ariadna Mechó

of the species in juveniles prevented a definite taxonomical identification. No other member of the Octacnemidae has ever been found in the Mediterranean. In this study we describe the sampling of an adult specimen of *D. antirrhinum* at around 1100 m water depth on the flank of the La Fonera (Palamós) canyon, Northwestern Mediterranean, confirming their presence in the Mediterranean Sea. We also observed 5 individuals of this species in their natural habitat with a Remotely Operated Vehicle (ROV). Our results highlight the potential occurrence of Octacnemidae, the presence of which has been largely overlooked, in several deep-sea canyon areas within the Western Mediterranean basin. These observations are important because they indicate the need for increased sampling effort with new

technologies, such as ROVs, in ecologically relevant habitats such as canyons, in order to obtain a more accurate picture of deep-sea biodiversity in the Mediterranean Sea.

Link to paper: <http://www.sciencedirect.com/science/article/pii/S0967063713002008>

Link to Youtube video: <http://www.youtube.com/watch?v=1PEFmTEF1Sk>

Link to Deep Sea News:

<http://deepseanews.com/2013/09/this-deep-sea-predator-is-the-love-child-of-a-macaron-and-a-snork>

First records, rediscovery and compilation of deep-sea echinoderms in the middle and lower continental slope in the Mediterranean Sea

Ariadna Mechó, David Billett, Eva Ramirez-Llodra, Jacopo Aguzzi, Paul Tyler & Joan B. Company
(2014)

Scienza Marina (In Press)

This study provides a compilation of all available information on deep-sea echinoderms from the middle and lower-slopes in the Mediterranean Sea, with the aim of providing a unified source of information on the taxonomy of this group. Previous records of species are updated with new data obtained from 223 trawl hauls from 11 cruises from the submarine canyons and surrounding open slopes of the north-western Mediterranean Sea



Deep-sea Mediterranean echinoid *Gracilechinus elegans*. Image courtesy Ariadna Mechó

between 800 and 2845 m depth. Valid names, summary descriptions, bathymetric ranges and geographic distributions are given for all species. The new data report, for the first time, the presence of the Atlantic echinoid *Gracilechinus elegans* (Düben and Koren, 1844) in the Mediterranean Sea. We also report the presence of the endemic holothurians *Hedingia mediterranea* (Bartolini Baldelli, 1914), dredged only once previously in 1914 in the Tyrrhenian Sea, and

Penilpidia ludwigi (von Marenzeller, 1893), known previously only from three samples, two in the Aegean Sea and one in the Balearic Sea. Additionally, the deeper limits of the bathymetric distribution of four species have been expanded: the asteroid *Ceramaster grenadensis* (Perrier, 1881) to 2845 m; the echinoid *Brissopsis lyrifera* (Forbes, 1841) to 2250 m; and the holothurians *Hedingia mediterranea* and *Holothuria (Panningothuria) forskali* Delle Chiaje, 1823, to 1500 m and 850 m, respectively. The compiled information on bathyal echinoderms occurring deeper than 800 m in the Mediterranean Sea is reviewed and provides a central source of information for deep-water Mediterranean echinoderms.

Frequent locations of ocean fronts as an indicator of pelagic diversity: application to marine protected areas and renewables

Peter Miller & Stelios Christodoulou (March 2014)

Marine Policy 45: 318–329

Frequent locations of thermal fronts in UK shelf seas were identified using an archive of 30,000 satellite images acquired between 1999 and 2008, and applied as a proxy for pelagic diversity in the designation of Marine Protected Areas (MPAs). Networks of MPAs are required for conservation of critical marine habitats within Europe, and there are similar initiatives worldwide. Many pelagic biodiversity hotspots are related to fronts, for example cetaceans and basking sharks around the Isle of Man, Hebrides and Cornwall, and hence remote sensing can address this policy need in regions with insufficient species distribution data. This is the first study of UK Continental Shelf front locations to use a 10-year archive of full-resolution (1.1 km) AVHRR data, revealing new aspects of their spatial and seasonal variability. Frontal locations determined at sea or predicted by ocean models agreed closely with the new frequent front maps, which also identified many additional frontal zones. These front maps were among the most widely used datasets in the recommendation of UK MPAs, and would be applicable to other geographic regions and to other policy drivers such as facilitating the deployment of offshore renewable energy devices with minimal environmental impact.

Link to the paper: Miller, P.I. & Christodoulou, S. (2014) Frequent locations of ocean fronts as an indicator of pelagic diversity: application to marine protected areas and renewables. *Marine Policy*. 45, 318–329. doi: [10.1016/j.marpol.2013.09.009](https://doi.org/10.1016/j.marpol.2013.09.009)

Marine litter distribution and density in European seas, from the shelves to deep basins

Christopher K. Pham, Eva Ramirez-Llodra, Claudia H. S. Alt, Teresa Amaro, Melanie Bergmann, Miquel Canals, Joan B. Company, Jaime Davies, Gerard Duineveld, François Galgani, Kerry L. Howell, Veerle A. I. Huvenne, Eduardo Isidro, Daniel O. B. Jones, Galderic Lastras, Telmo Morato, José Nuno Gomes-Pereira, Autun Purser, Heather Stewart, Inês Tojeira, Xavier Tubau, David Van Rooij & Paul A. Tyler (April 2014)

PLoS ONE 9(4): e95839. doi:10.1371/journal.pone.0095839

Anthropogenic litter is present in all marine habitats, from beaches to the most remote points in the oceans. On the seafloor, marine litter, particularly plastic, can accumulate in high densities with deleterious consequences for its inhabitants. Yet, because of the high cost involved with sampling the seafloor, no large-scale assessment of distribution patterns was available to date. Here, we present data on litter distribution and density collected during 588 video and trawl surveys across 32 sites in European waters. We found litter to be present in the deepest areas and at locations as remote from land as the Charlie-Gibbs Fracture Zone across the Mid-Atlantic Ridge. The highest litter density occurs in submarine canyons, whilst the lowest density can be found on continental shelves and on ocean ridges. Plastic was

the most prevalent litter item found on the seafloor. Litter from fishing activities (derelict fishing lines and nets) was particularly common on seamounts, banks, mounds and ocean ridges. Our results highlight the extent of the problem and the need for action to prevent increasing accumulation of litter in marine environments.

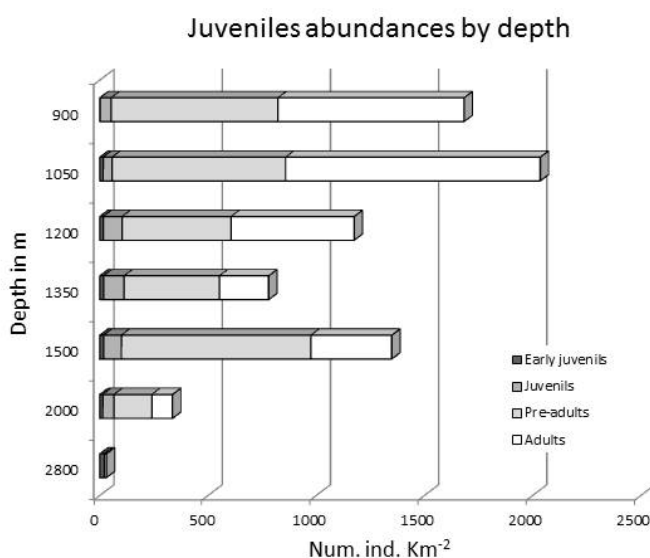
Link to the paper: <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0095839>

The deep-sea recruitment of *Aristeus antennatus* (Risso, 1816; crustacea: decapoda) in the Mediterranean sea

Francisco Sardà & Joan B. Company (2012)

Journal of Marine Systems 105-108: 145-151

Recruitment of deep-sea red shrimp *Aristeus antennatus* over the species' entire depth range and distribution area



in the Mediterranean Sea is described. Because of the dearth of information on the recruitment of deep-sea species in the literature, the findings reported here take on special significance. Samples were collected at depths between 900 and 2800 m on seven trawl surveys using three samplers: an OTMS bottom trawl, an Agassiz bottom frame trawl, and a Macer-Giroq suprabenthic sledge, computing a total of 80, 26 and 14 trawls, respectively. Early juveniles (≤ 15 mm CL) were observed to be present down to a depth of 2800 m and to attain maximum percentage abundance between 1350 and 2000 m. Spring was the season of peak abundance for juveniles. Several hypotheses

explaining this deep-sea recruitment are discussed, including oceanographic events coupled with enrichment of the bathyal bottoms and competitive exclusion in deep-sea species. Studying the deep-sea recruitment of *Aristeus antennatus* contributes to our understanding of the species' life history and supplies knowledge essential to proper management and sustainable exploitation of the species.

Link to the paper: <http://www.sciencedirect.com/science/article/pii/S0924796312001571>

Where are the post-larvae of deep-sea megafauna species? The western Mediterranean case study

Ulla Fernandez-Arcaya (Nov 2013)

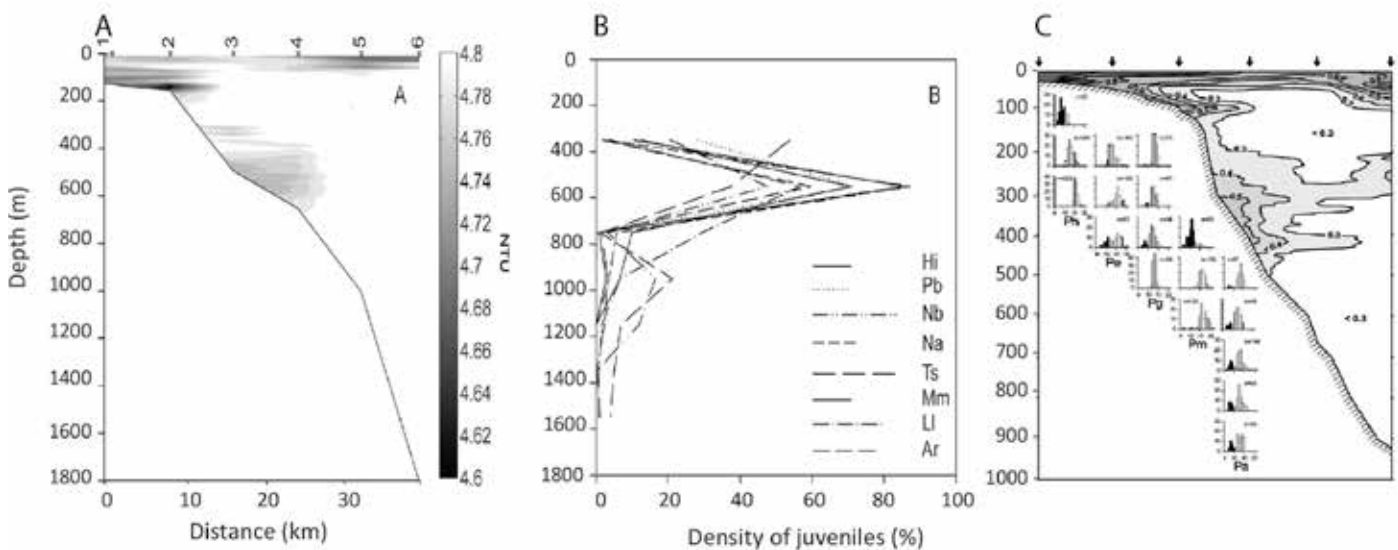
Progress in Oceanography 118:222-234

Deep-sea fish species present biological characteristics that make them especially vulnerable to fishing exploitation. To fully understand the maintenance of local populations, as well as estimating vulnerability and recovery of exploited systems, a good knowledge of the early life-history patterns of species is critical. However, there are still important gaps in our understanding, such as larval ecology and selection of recruitment areas by post-larvae (or young juveniles) in

deep-sea species. In Fernandez-Arcaya et al. (2013), the bathymetric size distribution of the most abundant species was analyzed to assess the occurrence of preference depth strata for recruitment. A series of seasonal trawling surveys were conducted between 300 and 1750 m depths in the Blanes submarine canyon and adjacent open slope (NW Mediterranean Sea). The physico-chemical characteristics of the water column were characterized from CTD deployments at each station. We found that, at intermediate depths (400 to 650 m), a low-transmissivity layer was registered all year round, indicating the presence of a nepheloid layer (Fig. A). This intermediate nepheloid layer (INL) spatially coincides with the maximum density of juveniles of most of analyzed fish species (Fig. B). We suggest that the retention of organic rich particles and aggregates within the INL generates a favorable habitat for settlement of the fish post-larval stages at a depth of approximately 400 to 650 m. These results, together with those of previous studies on crustacean decapods from the same area (Fig C), attest the influence of these hydrographic formations in the population biology of deep-sea species and allow us to define the affected areas as potential deep-sea megafauna nursery habitats. However, there is still an important lack of information regarding the direct and indirect uses of particulate organic matter by these species, and much more work needs to be done to understand these complex biochemical relationships.

This article is based on a recently published paper: Fernandez-Arcaya U, Rotllant G, Ramirez-Llodra et al. (2013). Reproductive biology and recruitment of the deep-sea fish community from the NW Mediterranean continental margin. *Prog Oceanogr.* 118: 222-34

Link to the paper: <http://www.sciencedirect.com/science/article/pii/S0079661113001328>



Relationship between juvenile distribution and the intermediate nepheloid layer. (A) Transmissivity diagram across the study area. (B) Density of eight species of fish' juveniles (C). Distribution of nepheloid layers and population size structure (juveniles: black bars) of five *Plesionika* species. Image courtesy Puig et al., 2001.

A sustainable development goal for the ocean and coasts: Global ocean challenges benefit from regional initiatives supporting globally coordinated solutions

Martin Visbeck, Ulrike Kronfeld-Goharani, Barbara Neumann, Wilfried Rickels, Jörn Schmidt, Erik van Doorn, Nele Matz-Lück & Alexander Proelss (April 2014)

Marine Policy (In Press)

The ocean regulates the global climate, provides humans with natural resources such as food, materials, important substances, and energy, and is essential for international trade and recreational and cultural activities. Together with human development and economic growth, free access to, and availability of, ocean resources and services have exerted strong pressure on marine systems, ranging from overfishing, increasing resource extraction, and alteration of coastal zones to various types of thoughtless pollution. International cooperation and effective governance are required to protect the marine environment and promote the sustainable use of marine resources in such a way that due account can be taken of the environmental values of current generations and the needs of future generations. The high seas deserve particular attention since they suffer from a number of regulatory shortcomings due to the basic structures set out under international law. Against this backdrop, developing and agreeing on a focussed Sustainable Development Goal (SDG) specifically for the Ocean and Coasts could prove to be an essential element to provide guidance and a framework for regional implementation agreements.

Link to the paper: <http://www.sciencedirect.com/science/article/pii/S0308597X14000487>

Commentary on the United Nations Convention on the Law of the Sea

James Kraska & Jamie Wagner* (Editors)

Marine Laboratory, Nicholas School of the Environment, Duke University, USA

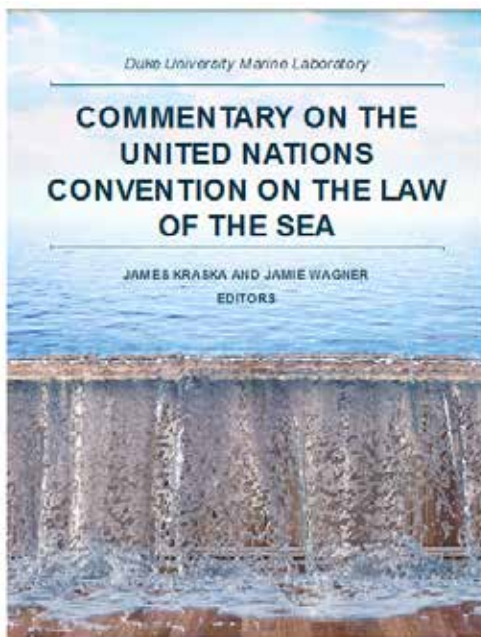
Commentary on the United Nations Convention on the Law of the Sea is a free iBook that includes the complete text of the Law of the Sea treaty (UNCLOS) together with legal and policy analysis of how rules on marine environmental protection, resource conservation, marine scientific research, deep seabed mining, and other issues have been applied since the treaty entered force in 1994.

The Commentary explores how States implement UNCLOS in the areas of:

- deep-sea mining and environmental protection
- vessel source pollution
- land-based CO₂ as a transboundary harm
- cetacean protection
- conservation of migratory fish stocks
- protection of high seas living resources
- rules relating to ocean iron fertilization

- marine environmental protection
- dispute resolution by the International Tribunal for the Law of the Sea
- special rights of small-island developing States to their offshore resources
- the role of landlocked and geographically disadvantaged states in the Law of the Sea
- sea level rise and maritime claims
- coastal zone management
- the right of innocent passage
- island boundaries

For example, the section on marine protection in relation to seabed mining beyond national jurisdiction (in “the Area”) highlights several articles from UNCLOS, which are the starting point for considering legal responsibilities to the environment when creating management plans. Emergent gaps in UNCLOS related to marine genetic resources and other living resources as part of the “common heritage of mankind” (Article 136)—in addition to mineral resources—are identified, and proposed options for filling these gaps are discussed. Sponsoring State responsibilities and liabilities for mining activities in the Area (Article 139) are emphasized as a result of the 2011 ruling that stems from Nauru’s request for an International Tribunal for the Law of the Sea advisory opinion (ITLOS Case 17). The precautionary approach, best environmental practices, and environmental impact assessments are discussed as vital components of “protection of the marine environment” in the Area (Article 145), established by the aforementioned advisory opinion and by International Seabed Authority documents on regulation of deep-seabed mineral exploration.



Multimedia components are also integrated throughout the Commentary, including applicable treaties like the London Convention on dumping, international court decisions like the 1941 Trail Smelter case that established “the polluter pays,” videos like Palau’s announcement of exclusive economic zone closure to all commercial fishing, interactives like clickable maps of International Whaling Commission member nations, and abundant photos.

Commentary on the United Nations Convention on the Law of the Sea is now freely available for download to your computer or mobile device from the iBook store.

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Species richness and community structure of benthic macrofauna and megafauna in the deep-sea chemosynthetic ecosystems around the Japanese archipelago: an attempt to identify priority areas for conservation

Ryota Nakajima, Takehisa Yamakita, Hiromi Watanabe, Katsunori Fujikura, Katsuhiko Tanaka, Hiroyuki Yamamoto & Yoshihisa Shirayama (March 2014)

Diversity and Distributions doi: 10.1111/ddi.12204

Aim

To characterize the species richness, endemism and community structure of benthic macro-/megafauna in the deep-sea chemosynthetic ecosystems around the Japanese archipelago and determine the conservation priority for deep-sea chemosynthetic habitats.

Location

Twenty-seven methane seeps from the Kuril–Japan Trench, Nankai Trough, Ryukyu Trench and Sagami Bay as well as 15 hydrothermal vents from the Izu–Bonin Arc and Okinawa Trough around the Japanese archipelago.

Methods

Species richness and the number of endemic species from 42 vents and seeps were examined using the distributional data of 155 mollusc, annelid and arthropod species. Multivariate analyses were performed to identify groups of sites with similar assemblage composition. Complementarity analysis was performed to determine the minimum number of sites required to conserve at least one population of all species for all 42 sites and for groups of sites detected by the multivariate analyses.

Results

The species richness of the deep-sea chemosynthetic sites around the Japanese archipelago was higher in the Okinawa Trough and Sagami Bay where higher methane concentrations were observed. Eight distinct biogeographic regions were detected at the community level, and the community structure was classified according to the geological variables of depth and latitude. Complementarity analysis for all 42 sites indicated 21 sites for conservation, while that for each distinct biogeographic region indicated 30 sites for conservation.

Main conclusions

As unique communities exist in each geographically isolated region around the Japanese archipelago, priority areas should be identified for each type of bioregion for effective conservation. At least 30 (17 seeps and 13 vents) of 42 sites should be conserved to avoid the extinction of the local populations of deep-sea chemosynthetic macro-/megabenthos.

Link to the paper: <http://onlinelibrary.wiley.com/doi/10.1111/ddi.12204/abstract>

First publications on Northwest Africa biodiversity: Discovery of a new crustacean species in Mauritanian deep waters

Ana Ramos

IEO Vigo, Spain



The New Zealand journal *Zootaxa* publishes next month a paper on crustaceans from Mauritanian deep waters. This work gathers the first faunistic results of the four Maurit surveys conducted by the Spanish Institute of Oceanography (IEO) in the region between 2007 and 2010. The paper focusses on the study of galatheids, a group of anomouran decapod crustaceans that look like small lobsters (in English they are named 'squat lobsters') of bright colors, very diverse and abundant in all oceans of the world.

The seven species listed in the work, belonging to genera *Eumunida*, *Munida* and *Munidopsis* and to families Galatheoidea and Chirostyloidea, were collected at depths between 91 and 1867 m along the continental slope. Some of them had never been recorded before in Mauritanian waters.

Among the more than 8000 specimens of benthic invertebrates kept on board the R/V *Vizconde de Eza*, constituting the faunistic reference collections currently under study, we have found new species of crustaceans, hydrozoans, holothurians and other groups. The identification is currently in progress and new descriptions will soon be published in specialized journals.

The first of the new described and illustrated species is a galatheid, found at 1000 m in the Banc d'Arguin area, called *Munidopsis anaramosae*, and whose holotype has been deposited in the National Museum of Natural Sciences in Madrid (Spain). The paper also re-describes another species, *Munidopsis chunii*, very succinctly described in 1913 (exactly one century ago) from only two individuals: a male and a small female.

This publication falls within the framework of ECOAFRIK project and is the result of a meticulous taxonomic identification of crustaceans, the most diverse benthic group in Northwestern Africa. This taxonomic work has been ongoing for over a year by the teams of the IEO and the Faculty of Marine Sciences (Vigo University, Spain). More specifically, the description, illustration and publication of the species were made by specialists Susana S. de Matos-Pita and Fran Ramil, who were kind enough to name the new species *M. anaramosae* as a tribute to the researcher of the Vigo Oceanographic Centre and project coordinator, Ana Ramos.

<http://dx.doi.org/10.11646/zootaxa.3765.5.2>

www.ecoafrik.es



The new species, *Munidopsis anaramosae*, discovered in Mauritanian slope at 1000 m depth (red star in the map). Left, the specimen on board just after being collected in November 2008, and right, the official picture taken for the publication, six years later. Image courtesy Ana Ramos.

Cruise News

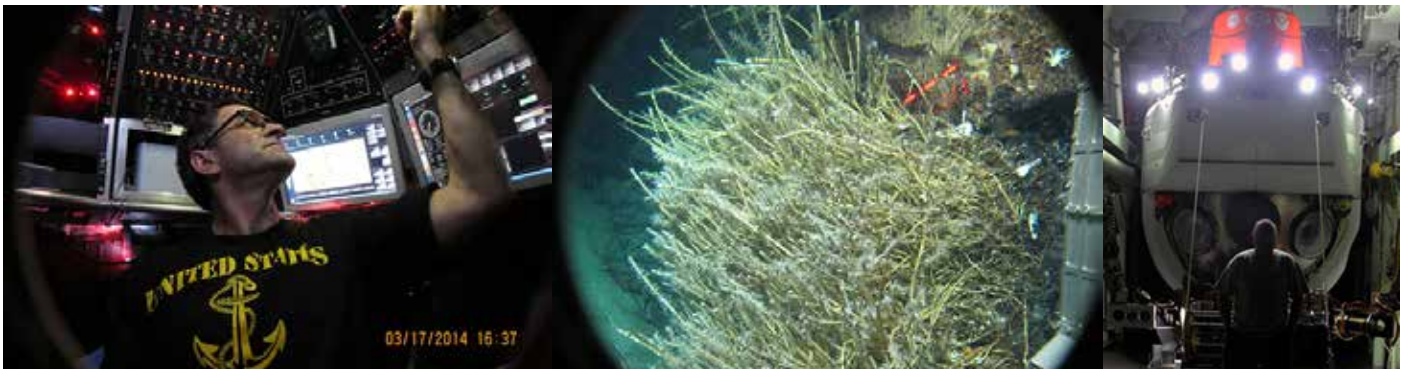
Welcome to the NEW ALVIN!

Jeffrey Marlow

California Institute of Technology, USA

The Deep Submergence Vehicle Alvin, initially built in 1964, has been a remarkably efficient and reliable workhorse for deep-sea scientists over the last several decades, playing a critical role in transformative investigations of hydrothermal vents, methane seeps, and shipwrecks. And yet, after 40+ years of use, the oceanographic community had come to realize that the vessel required a more substantial overhaul in order to retain its status as a world-class scientific tool for decades to come. And so, in the Fall of 2010, Alvin returned to its home port of Woods Hole for the most thorough remodeling of its life.

Roughly three years later, a substantially modified sub emerged, with several mechanical, electrical, and technical upgrades that would allow scientists to dive deeper and perform more advanced scientific work. After a series of sea trials in late 2013 and early 2014, Alvin was ready to return to its scientific pursuits. But before funded scientific expeditions resumed – with their focus firmly on results and efficient sample collection – the Science Verification Cruise (SVC) was tasked with kicking the proverbial tires and readying the sub and its handlers for streamlined operation.



From left: Alvin in sphere: Expedition leader Bruce Strickrott enjoys the roomier, more comfortable Alvin sphere. (Image courtesy WHOI); Tubeworms: A cluster of tubeworms on the seafloor, as seen through Alvin's larger viewports. (Image courtesy WHOI); Chris German, outgoing chief scientist for Deep Submergence at WHOI, silhouetted in front of the new Alvin, during the Science Verification Cruise, March 2014. (Image courtesy Chris German).

The SVC took place between March 13-26 in the Gulf of Mexico, involving several experienced Alvin users who would be best able to assess the vehicle's novel capabilities and communicate their findings to the oceanographic community. Among the enhanced features: more and larger viewports, additional HD cameras and brighter lighting, a larger sample basket that can carry up to 400 pounds of cargo, more dexterous manipulator arms, and more streamlined interfaces between sub controls and external sensors.

The reviews were uniformly positive, particularly with regard to visibility, ergonomic comfort, and sample collection abilities, though some obstacles were encountered. The reliability of video capture and transfer to shipboard archiving system proved challenging, and electrical interfaces between Alvin and onboard, user-contributed sensors presented some problems.

And although operational concerns trumped scientific objectives, a range of promising samples was collected. In situ

pH and Eh sensors were deployed, and geochemical profiles were characterized with novel electrodes. Authigenic carbonate rocks naturally oozing with oil were collected for microbial analysis, and meiofaunal communities were catalogued at a range of sites, contributing to the continued assessment of ecosystem response to the Deepwater Horizon oil spill.

By the SVC's conclusion, the technical kinks had been ironed out, and new and returning pilots had accumulated significant in-sphere time. In late March, a smoothly operating submersible was handed off to the first official scientifically oriented expedition of the new Alvin's career, opening a new chapter of deep-sea exploration.

Bathymetry of the Vema Fracture Zone and Puerto Rico Trench and Abyssal Atlantic BiodiverSITY Study (TRANSIT) with the new German R/V Sonne

Angelika Brandt¹ & Colin Devey²

¹Zoologisches Museum, Universität Hamburg, Germany, ²Geomar, Kiel, Germany

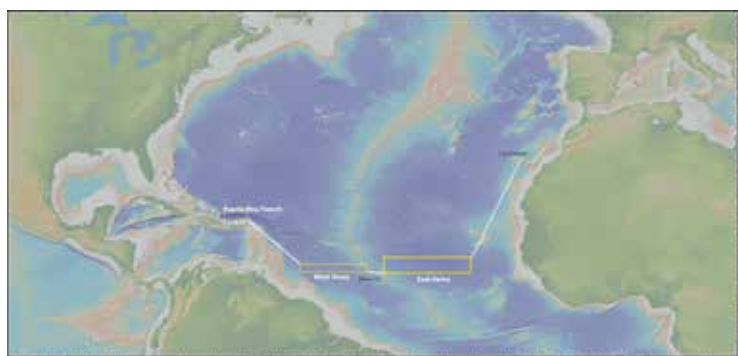


Figure 1: Planned area of investigation of the Vema-TRANSIT expedition with RV Sonne. Image courtesy A. Brandt.



Figure 2: Artist's impression of the new German R/V Sonne, presently in the final stages of construction in Emden, North Germany. Image courtesy A. Brandt.

The abyssal seafloor makes up > 60% of our planet's surface, however, it is largely unexplored. We know little about life on the deep seafloor or about how the hydrosphere, biosphere and lithosphere interact over this vast area. In the Atlantic, transform faults and fracture zones characterize most of the seafloor bathymetry. During the upcoming cruise, we intend to survey and sample the entire length of one of the major offsets of the Mid-Atlantic Ridge, the Vema Fracture Zone (Figure 1). Variations in benthic communities along this transect will be investigated using corers and towed gear as well as detailed photographic mapping of the benthic megafauna using AUV. We aim to test the hypothesis whether the Mid-Atlantic Ridge serves as a barrier limiting benthic species distribution in the abyssal basins on both sides of the ridge. The Puerto Rico Trench is much deeper than the surrounding abyssal West Atlantic. Therefore we plan to determine whether the biodiversity of its hadal meio-, macro-, and megabenthic fauna differs from that of the abyssal Atlantic due to isolation of the trench. This will be the first full scientific cruise of the new German R/V Sonne (Figure 2) and is planned to be carried out between December 2014 and February 2015.

Will large-scale habitat suitability models be useful for managing impacts on vulnerable marine ecosystems? Preliminary observations from a survey of the Louisville Seamount Chain east of New Zealand.

Malcolm Clark & Ashley Rowden

NIWA, Wellington, New Zealand

Vulnerable marine ecosystems (VMEs) are considered to be highly vulnerable to the impacts of human activity such as fishing. There is currently limited information about the distribution or characteristics of VMEs in the South Pacific Ocean, which is hampering the design of comprehensive management measures. NIWA is leading a “South Pacific VME Project” (see Deep-Sea Life issue 2) that is producing predictive habitat suitability models for a range of taxa to help understand the spatial distribution of VMEs relative to fish activity. But a key uncertainty in the use of these models is how realistic are they when applied to a large and unsampled area.

In February 2014 NIWA's research vessel R/V Tangaroa, with scientists from New Zealand, the USA

and Australia, was used to undertake a ground-truthing survey of preliminary habitat suitability models of the South Pacific at six seamounts on the Louisville Seamount Chain (Figure 1). There were very few actual data from the region, and so it was a good location to test the reliability of the modelling, and to collect data to refine subsequent modelling efforts. Sampling was carried out using a deep towed camera system (Figure 2), with transect locations determined primarily by the agreement/differences in preliminary modelling results from two methods (Maximum Entropy, and Boosted Regression Tree), and the level of previous fishing activity. In total, 119 camera deployments were made, backed up by direct sampling of specimens with a small epibenthic sled (25 tows).

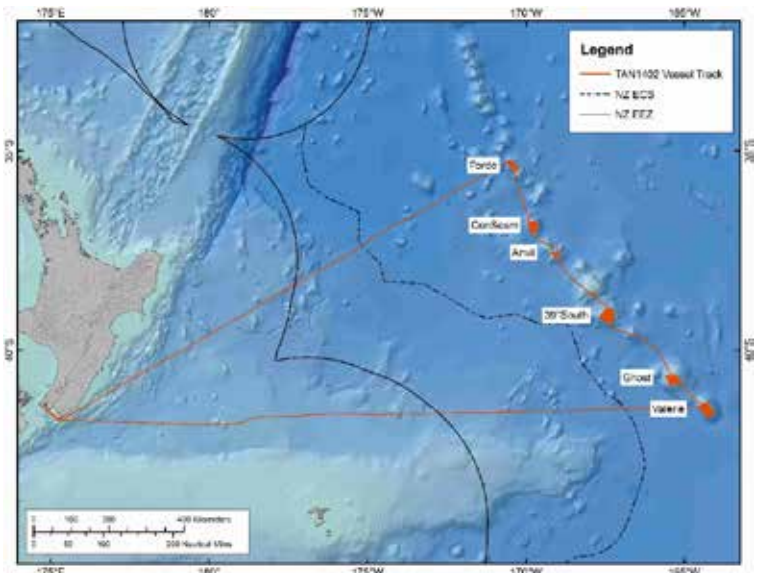


Figure 1: Track of RV Tangaroa during the survey. Image courtesy Clark & Rowden



Figure 2: NIWA's Deep towed imaging system (DTIS), which was the main sampling tool used for the survey. Image courtesy Clark & Rowden

The extensive collection of data and samples from the voyage are yet to be processed and analysed, but the survey has already resulted in some observations that may challenge the reliability of large-scale habitat suitability models for VMEs. For example, the bathymetry available from global datasets for one of the seamounts was almost 900 m out in its summit depth. Hence variables in the model that are based on values-at-depth will be misleading. In this case, we replaced the seamount with its neighbour. As a further example, the main “target” VME indicator taxa were the reef-building stony corals, the Scleractinia. These corals (Figure 3) tended to have a patchy distribution, and be localised in areas of steep and rough topography, such as ridges or small knob-like hills on the seamounts. This was often on a much smaller spatial scale than



Figure 3: A mixed benthic community of stony corals, brisingid seastars, feather stars and urchins on Forde Guyot. Image courtesy Clark & Rowden

the model grid size, at about 1km², and hence data averaged over the larger area could be misleading. Interestingly they occurred much deeper than usually found around New Zealand, with their main occurrences at 1200-1300 m.

The ground-truthing survey to the Louisville Seamount Chain, as well as serving to test the large-scale habitat suitability models for VMEs, will provide data for the production of finer-scale models based on multibeam-derived topographic variables. In addition, samples returned from the voyage provide valuable information on biodiversity of a previously little-sampled

region of the South Pacific, and material for determining the genetic connectivity of VME indicator taxa such as corals and sponges. The survey was funded by the New Zealand Ministry of Business, Innovation and Employment and NIWA.

Upcoming exploration of the Gulf of Mexico, Caribbean Sea, & Western Atlantic via E/V Nautilus

Katy Croff Bell

Ocean Exploration Trust, USA

In June, Exploration Vessel (EV) Nautilus will kick off its first cruise of the 2014 field season to explore the geology, biology, chemistry, and archaeology of the Gulf of Mexico, Caribbean Sea, and Atlantic Ocean. Owned and operated by the Ocean Exploration Trust (OET), Nautilus is a platform for exploration and education, using an advanced telepresence system to bring live exploration from the deep sea to millions of people in real time, from children at museums, aquaria, and science centers to scientists at leading oceanographic institutions around the world. A growing network of scientists is participating in Nautilus expeditions from their home institutions as part of our Scientist Ashore Program, crowdsourcing a vast amount of experience and expertise to respond to discoveries in real time through our website Nautilus Live (www.nautiluslive.org), as well as on Facebook and Twitter (@EVNautilus).

Nautilus spent its first four years exploring the Mediterranean region, before moving to the Caribbean Sea in the spring of 2013. To prepare for its Caribbean exploration, the Trust held a workshop to bring together the scientific community in an effort to identify locations that have never been explored or are poorly understood in the Caribbean. This



Exploration Vessel Nautilus is a 64-m vessel equipped with satellite telepresence system, dynamic positioning, an EM-302 multibeam echosounder, and the 4,000-m Hercules/Argus remotely operated vehicle (ROV) system. Image courtesy Katy Croff Bell

successful workshop resulted in a report on 20 high priority exploration targets that OET has used to plan its exploration of the Caribbean region in 2013 and 2014 (<http://www.oceanexplorationtrust.org/#!2012-caribbean-workshop/cg30>). Five of the regions identified during the workshop were explored in 2014, including Cayman Rise, the Greater Antilles, Montserrat, Dominica, and Kick'em Jenny submarine volcano (Grenada), and the preliminary results of those cruises were recently published by The Oceanography Society (http://www.tos.org/oceanography/archive/27-1_supp.html).



ROV Hercules being launched off the port side of Nautilus. Image courtesy Katy Croft Bell.

Participate in the 2014 Expedition

During the upcoming 2014 Nautilus Expedition, we will continue to explore priority areas identified during the Caribbean Workshop, including the Straits of Florida, Dry Tortugas, Gulf of Mexico, Mesoamerican Reef, Windward Passage, Kick'em Jenny Volcano, and the Barbados/Trinidad Mud Volcanoes, and we are looking for scientists to participate live with us from shore as we explore these areas from June to October 2014. Via telepresence technology, onshore scientists are able to view live video feeds from the remotely operated vehicles (ROVs) Hercules and Argus and topside from the ship during seafloor and water column mapping efforts, participate in a text dialogue with onboard scientists and other onshore scientists, and contribute to ROV dives and mapping operations.

To learn more about the Nautilus Scientist Ashore Program and how to apply (deadline June 1): <http://www.oceanexplorationtrust.org/#!scientists-ashore/civ1>

Participate in the 2014 Workshop on Exploration of the Pacific Ocean

The Trust is also pleased to announce a regional conference in December 2014 to enable stakeholders interested in exploration of the eastern Pacific Ocean to discuss which specific areas are the most promising for making new discoveries and for developing a collaborative region-wide research program for Nautilus, NOAA Ship Okeanos Explorer, and other vessels based upon these locations.

To learn more about the Pacific Workshop, and how to apply (deadline May 31):

<http://www.oceanexplorationtrust.org/#!2014pacificworkshop/cr81>



From left: Image taken from Argus of Hercules at the main Von Damm hydrothermal spire on the Mid-Cayman Rise in 2013; Mid-Cayman Rise Project Lead Scientist Cindy Van Dover dissects a chemosynthetic alvinocarid shrimp with Honors Research Program student Shannon Emrich. Image courtesy Katy Croft Bell.

Interdisciplinary cruise exploring the deep-sea food web

Monika Krach

Scripps Institution of Oceanography, USA

mkrach@ucsd.edu

Aboard the R/V Kilo Moana, investigators and students from University of Hawaii, UC Santa Cruz, and Scripps Institution of Oceanography conducted a truly interdisciplinary cruise exploring the deep-sea food web in the central North Pacific.



Swallow (Kapi sp.) Image courtesy Monika Krach.

Chief scientist Dr. Jeff Drazen led this cruise as part of an ongoing project to account for missing carbon inputs in the current model of the deep-sea food web, in which respiratory demand is 2-3 orders of magnitude higher than measured sinking particle supply. The project aims to uncover the unaccounted carbon, which could be suspended particles, by using amino-acid isotopic analysis, for which signatures of sinking and suspended particles differ. Sampling big-eye tuna, deep-sea micronekton, zooplankton, and tiny particle matter from the surface to 1,500 meters, Drazen coordinated a top-to-bottom investigation into the central North Pacific's meso and bathypelagic food web.

Public outreach was an important objective of this expedition. The cruise will be profiled in the educational project Voice of the Sea, a TV series that highlights the experiences of marine scientists exploring the Pacific Ocean. Drazen's work on bizarre creatures like anglerfish and squids is ideal for general audiences and a great conduit for promoting deep-sea science.

Drazen and his team will embark on a follow-up cruise in August to see if the isotopic signatures of zooplankton and micro-nekton in bathypelagic waters reflect the summer's high flux of photosynthetically-derived sinking matter. Voice of the Sea will air in Hawaii (KFVE, Channel 5, 1005 HD) in January 2015 and be shown as webisodes at <http://voiceofthesea.org>.



From left: Science team aboard the R/V Kilo Moana; viperfish (Chauliodus macouni). Image courtesy Monika Krach.

Exploring deep mysteries of Papua New Guinea

Eric Pante, Tin-Yam Chan, Ralph Mana, Philippe Bouchet, Sarah Samadi and the participants of the Tropical Deep-Sea Benthos cruises in Papua New Guinea

Contacts: pbouchet@mnhn.fr and sarah@mnhn.fr

Papua New Guinea is a place of wonders for us biologists. PNG and its satellite islands have played a remarkable role in shaping our understanding of the natural world, and have served as a playground for generations of field ecologists. While terrestrial and shallow water ecosystems of PNG have been studied since the late 1800s, surprisingly little information is available on its deep-sea ecosystems. Within the framework of the “Tropical Deep-sea Benthos” and the “Our Planet Reviewed” exploration programs, the French Muséum National d’Histoire Naturelle and Institut de Recherche pour le Développement, Pro-Natura International, and the University of Papua New Guinea have set to fill the gaps in our knowledge of PNG’s deep-water biodiversity. Since 2010, a series of cruises have taken place along the coasts of PNG, from the mouth of the Sepik River to the South of Vitiaz Strait, and across the Bismarck and Solomon Seas along the rugged slopes of New Britain, New Ireland and Bougainville. Of particular interest are the faunal assemblages associated with sunken wood and decomposing vegetation, as they may help us better understand the evolution of animals in reducing environments. Seamounts are also of particular interest, for their potential role as biogeographic stepping-stones. The pilot exploration cruise BioPapua allowed multibeam mapping of new cold seep sites and seamounts in the Bismarck Sea, sites that are now being imaged with the IFREMER Scampi tow cam (ongoing 2014 exploration cruise MaDeep). So far, PNG exploration resulted in collections from over 300 stations and in the inventory of over 10,000 specimen lots, made available to an international network of taxonomists, which may help us achieve a better understanding of the biogeography of tropical deep-sea organisms.

The authors wish to dedicate this feature to Christian Késiano Fitialeata, who tragically passed away during the first leg of the BioPapua cruise in Papua New Guinea.

To find out more about PNG’s deep-sea fauna: Pante et al (2012) *Oceanography* Vol 25, No 3, 214-225, and our research blogs at:

ird.fr/toute-l-actualite/science-en-direct/madeep-papouasie-nouvelle-guinee

ird.fr/toute-l-actualite/science-en-direct/la-planete-re-visitee-papouasie-nouvelle-guinee

ird.fr/toute-l-actualite/science-en-direct/campagne-biopapua



Illustration: From left to right: research vessel N/O Alis leaving the port of Madang, the Scampi tow cam on the deck of Alis, siboglinid worm patch and associated fauna photographed by Scampi on a cold seep site in the vicinity of the Sepik River (copyright Ken Olu-Le Roy, Laure Corbari, IFREMER-MaDeep-2014)

Schmidt Ocean Institute on the Mid-Cayman Rise

Julie Reveillaud¹, Chris German² & Julie Huber¹

¹Marine Biological Lab, Woods Hole, USA, ²WHOI, USA

Note from Editor: This news should have been included in DSL Issue 2 but was mistakenly omitted. My sincere apologies to the authors.

From May 30 to June 30 2013, a team of international scientists sailed on the Schmidt Ocean Institute's R/V Falkor to explore the depths of the Mid-Cayman Rise (MCR). The Mid-Cayman Rise (MCR) is Earth's deepest and slowest spreading mid-ocean ridge located in the western Caribbean. With an axial rift valley floor at a depth of ~4200-6500 m, it represents one of the deepest sections of ridge crest worldwide. In 2009 and 2010, the world's deepest hydrothermal vents (Piccard at 4960m) and an ultramafic-influenced system only 20 km away on top of an oceanic core complex (Von Damm at 2350 m) were discovered along the MCR through an on-going international collaboration. Each site is hosted in a distinct geologic setting with different thermal and chemical regimes, and each site also hosts distinct macrofaunal communities. Last year's expedition aboard the R/V Falkor was led by Dr. Chris German from the Woods Hole Oceanographic Institution (WHOI) and conducted interdisciplinary and complementary investigations of the geology, chemistry, microbiology and macrofaunal biology at both sites on this ultra-slow spreading center.



RV Falkor. Image courtesy Julie Reveillaud.

During the first Leg, the scientific team also investigated the water column elsewhere along the MCR, as well as above the Piccard and Von Damm sites, using a CTD rosette and the HROV Nereus in AUV mode, looking for the source of two further hydrothermal plumes previously detected in 2009. Despite collecting clear plume signals again, in both locales, the exact locations of the sites remain to be determined. Viral, microbial and abiotic particles from the Piccard and Von Damm plumes were also sampled and preserved for geochemical and biological characterization over Legs 1 & 2 of the cruise. The scientific team also used the new multibeam sonar systems on the R/V Falkor to re-map the entire MCR ridge axis and the oceanic core complexes of the rift valley walls from South to North along the length of the ridge axis.

In preparation for the second leg, the hybrid vehicle HROV Nereus shifted from an AUV to a ROV mode, an impressive 'transformer' operation, as described on the [cruise's blog](#). Nine dives to Piccard and Von Damm were carried out with Nereus and vent fluids from 30°C to 398 °C were collected for geochemical and microbiological analyses. In addition, a slurp sampler was used to collect the remarkably abundant chemosynthetic life, including *Rimicaris hybisae* shrimp, abundant at both sites. Biologists carefully dissected the shrimps to continue investigating the origin, evolution, and connectivity of both the symbionts and their hosts with their Pacific and Mid Atlantic counterparts.

During the expedition, live video streaming of ongoing operations allowed the on shore internet-connected world to remotely follow these amazing discoveries. Tweets along #Oases13 were shared everyday about the most exciting operations and days of research at sea. Participating scientists included those from WHOI, the Marine Biological Laboratory, University of Michigan, NASA Jet Propulsion Laboratory, Duke University in the US and U.Bremen, Germany and AIST, Japan. In an outreach first, the entire set of ROV dives can be relived on YouTube, [here](#).

First ABYSSLINE cruise to the CCZ is highly successful

Craig Smith & the ABYSSLINE project scientists

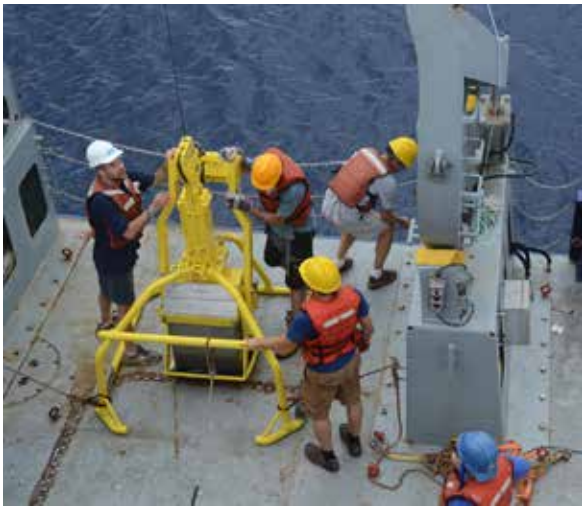


Figure 1: Cocking the box corer on board the RV Melville during the first ABYSSLINE cruise AB01. Deployment of the box corer from the starboard A-frame reducing vertical motion, yielding a high rate of sampling success. Image courtesy ABYSSLINE.

The ABYSSLINE Project is a new collaboration between an international team of deep-sea biologists and UK Seabed Resources Limited (UKSRL), a contractor with the International Seabed Authority for exploration of manganese-nodule mining in the Clarion-Clipperton Zone (CCZ) in the abyssal Pacific Ocean. ABYSSLINE scientists teamed with scientist and engineers from UKSRL in October 2013 to conduct the first intensive evaluation of biological and environmental baseline conditions in the UKSRL UK-1 lease block, a 55,000 km² area at depths of 3900-4400 m centered on approximately 13° 49 N, 116° 36 W in the eastern Pacific. During an ambitious 25-day cruise aboard the R/V Melville, ABYSSLINE scientists from the University of Hawaii, Hawaii Pacific University, the Natural History Museum (London), the National Oceanography Centre (UK), Senckenberg Gesellschaft für Naturforschung (Germany), UniResearch (Norway) and IRIS (Norway) collected baseline samples and environmental data at 12 stations randomly located within a 30 x 30 km² study area. The team of biologists led

by Craig Smith, and including Jeff Drazen, Eric Vetter, Adrian Glover, Andy Gooday, Thomas Dahlgren, Pedro Martinez, Andrew Sweetman, Christine Shulse, and Diva Amon, studied a broad range of ecological parameters using a diversity of equipment including : box corer (see Figure 1), megacorer, lander respirometer, baited traps, baited camera system, demersal plankton nets, Brenke epibenthic sled, CTD, sediment trap mooring, and a 6000 m-rated Remotely Operated Vehicle (ROV). Major effort was focused on coordinated collection of high quality samples for genetic and traditional biodiversity analyses to facilitate inter-calibration of molecular and morphological taxonomy and phylogenetics, and to allow studies of population connectivity and species ranges across the CCZ. UKSRL engineers, led by Ralph Spickermann and Greg Kurras, collected essential, state-of-the-art environmental data from the area, including high resolution multibeam bathymetry. Key questions being addressed by the ABYSSLINE scientists include:

- 1) What are the baseline conditions of community structure and biodiversity for the key benthic biotic components of this ecosystem, including megafauna, macrofauna, meiofauna and microbes?
- 2) How do community structure, sediment community respiration, and biodiversity vary as a function of environmental parameters (especially nodule cover) across the UK-1 lease block?
- 3) What is the connectivity at species and population levels within the UK-1 lease block, and across the CCZ, for representative components of the biota?



Figure 2: Some of the high diversity of megafaunal animals imaged by the ROV during the first ABYSSLINE cruise AB01. Image courtesy ABYSSLINE.

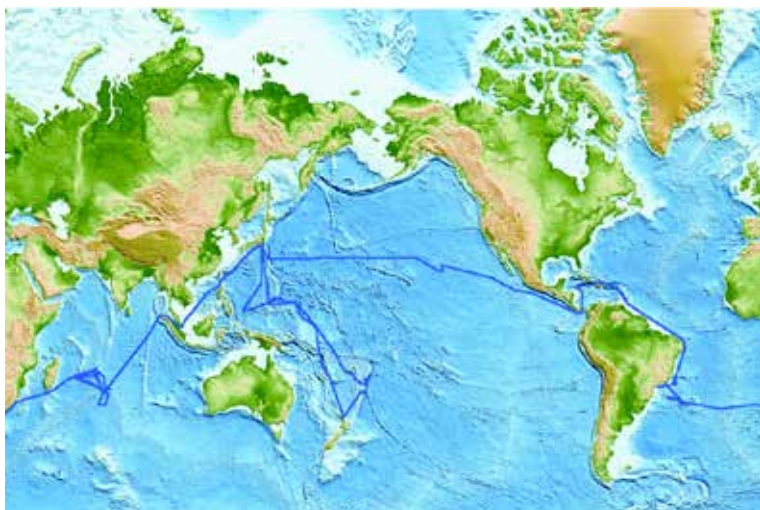
This first ABYSSLINE cruise was both grueling and very successful, yielding an extraordinary set of samples and environmental data from a very poorly studied region of the CCZ. Results are still very preliminary, but there appear to be at least 150 different morphotypes of megafauna within the claim area (see Figure 2), as well as diverse assemblages of macrofaunal polychaetes and foraminifera. Microbial metagenomic studies indicate significant differences between the microorganisms associated with nodules and the surrounding sediments, suggesting that unique taxa exploit the physico-chemical environment provided by the nodules. The ABYSSLINE scientists are completing data processing and analyses from this massive sampling effort, and expect to begin presenting results to the scientific community in the coming year. At least three additional cruises are planned for the ABYSSLINE Project over the next four to five years to support benthic biological baseline studies in the UK-1 lease block, and across the broader CCZ.

Summaries of HOV Shinkai 6500 diving expedition

~ QUELLE (Quest for Limit of Life) 2013 cruise ~

Hiroshi Kitazato, Nobukazu Seama, Manabu Nishizawa, Kentaro Nakamura,
Katsunori Fujikura, Ken Takai, Shinji Tsuchida & Yoshihiro Fujiwara

JAMSTEC, Japan



From January to November 2013, the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) conducted an “around-the-world” diving research expedition named “QUELLE 2013” using the human-occupied vehicle Shinkai 6500 and the research vessel Yokosuka. The main aims of this expedition were to elucidate the limits of life in various deep-sea marine environments and to understand the evolutionary processes of organisms living on the edges of the biosphere. Research abstracts from the biology-focused legs are shown below.

Left: Ship tracks of R/V Yokosuka during QUELLE2013 cruise. Image courtesy JAMSTEC.

Cruise PI & affiliation: Manabu Nishizawa (JAMSTEC)

Research area: The CIR segments 15 and 16 at 18°-20°S in the Indian Ocean

Cruise purpose: Main scientific purposes were to understand 1) geochemical and geobiological features of the DODO and Solitaire fields and 2) novel mechanism of sulfide biomineralization by scaly-foot gastropod.

Abstract: In this cruise, we have successfully conducted six Shinkai 6500 dives: one dive in the DODO field and five dives in the Solitaire field. We found no signs of presently active hydrothermal fluid discharge in the DODO field, indicating that hydrothermal activity in the DODO field had stopped during the period from 2009 to 2012. In-situ measurements of temperature and dissolved oxygen concentration were conducted for habitats of *Cryosomallon squamiferum*, *Alviniconcha* and *Bathymodiolus* spp. in the Solitaire field. Onboard cultivation experiments for *Cryosomallon squamiferum* (scaly-foot gastropod) were conducted in media with 35SO4²⁻ to test the hypothesis that iron sulfide on sclerite is deposited by microbial sulfate reduction.



In-situ measurement of dissolved oxygen content in a colony of *Cryosomallon squamiferum* in the Solitaire field. Image courtesy JAMSTEC.

Cruise PI & affiliation: Hiroshi Kitazato (JAMSTEC)

Cruise purpose: The objectives of this project were to conduct field surveys on unique marine environments shaped by vast submarine topography and organisms living in such environments, and to find out exactly what is going on, unravel the correlation between organisms and their habitats, and learn how such unique environments were created. The unique marine environments include over-5,000-meter-high extremely-steep topography, a complex environment where deep-sea currents meet from both the Antarctic and the North Atlantic oceans, and areas with outcrops of mantle-derived rocks. Shinkai 6500 dived in the South Atlantic Ocean for the first time. The surveys off Brazil have been carried out jointly with CPRM (Companhia de Pesquisa de Recursos Minerais), the Institute of Oceanography at the University of São Paulo, and PETROBRAS



Diverse deep-sea species that dwell in the deep sea off Brazil. Image courtesy JAMSTEC.

Abstract: (1) Southern slopes of the Sao Paulo Ridge at depths of 2,600 to 4,200 meters during the period between April 23 and 28, 2013. Geological survey: Outcrops on southern slopes were observed and rock samples were obtained, using Shinkai 6500 and a deep-tow ocean floor survey system. Data on the submarine topography, gravity and magnetism were measured, using instruments on the vessel. We collected many volcanic rocks at the ridge. ii) Survey on depth distribution of organisms: Visual observation was conducted and samples were collected to survey depth-related distribution of organisms living near bottom and in/on rocks and sediments, using Shinkai 6500 and the deep-tow ocean floor survey system. Field data including seawater temperature, salinity and dissolved oxygen concentrations were measured with CTD/DO system during dives. Clear depth stratification of both Antarctic Bottom Current and North Atlantic Deep Water was existed along the

slope of Sao Paulo Ridge. Both fossil and modern cetacean bones were observed/collected at the ridge. (2) Surveys in Rio Grande Rise at depths of 650 to 1,200 meters during the period of April 22 and April 30 to May 2, 2013. Geological survey: Data on the submarine topography, gravity and magnetism were measured, using instruments on the vessel. Data on shallow subsurface geologic structure were measured, using a sub-bottom profiler installed in the vessel. Visual observation of outcrops was conducted and samples were obtained during dives of Shinkai 6500. Outcrop of basement rocks that show granitic rock like surface texture was found at 920m deep on the top of the Rio Grande Rise. Top surface of outcrop was covered with thick piles of manganese crust. Survey on biological communities in various habitats: We tried to discover and survey seepage-related ecosystems at pockmark site. We found degassing textures at inner crater bottom of a pockmark. But, we failed to find chemosynthetic community at the Rio Grande Rise. Visual observation of deep-sea coral ecosystems was conducted and samples were collected during dives of Shinkai 6500.

Cruise PI & affiliation: Katsunori Fujikura (JAMSTEC)

Research area: São Paulo Plateau off Brazil in the South Atlantic

Cruise purpose: The major task of the cruise was to search for cold seeps associated with natural gas and/or oil seepages.

Abstract: This cruise conducted under the Japan-Brazil Joint Research Initiative. This initiative was the first detailed geological and biological investigation of deep off Brazil areas under the cooperation between both countries. During cruise, we had unique data including deep-sea ecology (photo), biodiversity, biogeochemistry and geology. Currently, we were not obtained conclusive evidence of cold seeps existence. However, we do not disappoint. By progress of data and sample analyses, we do not discard the possibility that they exist.



A deep-sea cucumber, body surface covered by dead shells of foraminiferans. Image courtesy Suichi Shigeno, JAMSTEC.

Cruise PI & affiliation: Ken Takai (SUGAR project, JAMSTEC)

Research area: Mid Cayman Rise, Caribbean

Cruise purpose: A primary scientific goal of this expedition was to understand the geochemical, geomicrobiological

and biogeographical diversity of deep-sea hydrothermal activities and associated ecosystems in the recently explored province in the Mid Cayman Rise, the Caribbean.

Abstract: In YK13-05 cruise, we have totally conducted 9 dives of Shinkai 6500 in two hydrothermal fields (5 dives in Beebe Field and 4 dives in Von Damm Field) in the Mid Cayman Ridge (MCR). One of the significant events during the cruise, we have successfully attained a live streaming of full-time scientific dive survey of a day (from the preparation of Shinkai 6500's dive early morning to the completion of Shinkai 6500 onboard). This was the world's first example of a live streaming of a manned submersible's scientific dive survey and was the second example of a successful live streaming of a manned submersible survey after James Cameron's Titanic exploration. More than 300,000 peoples in the world (of course, mainly in Japan) watched the Shinkai 6500's day including fantastic images of 5000 m deep seafloor, hydrothermal vents and dense animals there. This challenge highly energized and fostered the deep curiosity and interest of public peoples, particularly younger generations who had never seen or known about the deep-sea world and the unique ecosystem, the yet-unexplored world in this planet. The widespread curiosity in public society will be the most powerful encouragement of the future scientific exploration and investigation of manned submersible that has been quickly replaced by unmanned vehicles such as ROV and AUV.



Black smoker vents and chimneys and dense colonies of Rimicaris hybisae in the Beebe hydrothermal vent field that were seen live by three hundred thousand people. Image courtesy JAMSTEC.

Of course, we have obtained lots of and diverse samples from two of the MCR deep-sea hydrothermal environments. We have confirmed that the world's deepest hydrothermal system (Beebe Field) has about 400 °C of endmember hydrothermal fluid and that the hydrothermal fluids probably immediately after effluent from the newly opened conduits represent the supercritical state by direct observation of human eyes and by recorded video images. The hydrothermal fluids from both Beebe and Von Damm fields were characterized by extraordinary high concentrations of H₂, which would be the world's highest concentrations or among the highest levels. The H₂-enrichment in the fluids are attributed to the association of subseafloor serpentinization somewhere in the overall hydrothermal circulation. However, different concentrations of CH₄ in each of the two systems clearly indicated that the hydrothermal recharge and reaction processes of the two systems are quite different. In Von Damm field, CH₄ is highly abundant while Beebe hydrothermal fluid contains a concentration level comparable to magmatic input. The different CH₄ concentrations in these hydrothermal systems point to the different host rock compositions and hydrothermal reaction processes: serpentinization of mantle peridotite and rapidly proceeding Fisher-Tropsch Type (FTT) reaction in Von Damm field and serpentinization of dunite and/or gabbroic rocks and sluggish proceeding Fisher-Tropsch Type (FTT) reaction in Beebe field. However, it is still a big mystery why quite low concentration of CO₂ is present in Von Damm hydrothermal fluids. This is a important subject for future onshore investigation.

According to a proposition proposed by Takai & Nakamura (2010;2011), the H₂-enriched hydrothermal fluid vents would host HyperSLiME-like microbial communities in the proximity of the hydrothermal fluid discharges. Prior to this YK13-05 cruise, we predicted that both Beebe and Von Damm hydrothermal systems harbored extraordinary populations of (hyper)thermophilic H₂-trophic methanogens and chemolithotrophic primary production by diverse H₂-trophs. However, based on the onboard experiments of microbial H₂ consumption using the very fresh chimney samples obtained from both fields, the microbial H₂ consumption was found to be much lower than that in the Kairei field in the CIR and the (hyper)thermophilic H₂-trophic methanogen populations seemed to be less abundant than those in CIR Kairei field and MAR Rainbow field. This preliminary results are quite interesting, and we are going to pursue why (hyper)thermophilic H₂-trophic methanogens are less abundant although H₂ concentration in the fluids represents the highest ever known. We wish that chemolithotrophic H₂-trophs other than (hyper)thermophilic H₂-trophic methanogens would serve as the primary producers of these hydrothermal vent microbial communities.

Cruise PI & affiliation: Hiroshi Kitazato (JAMSTEC)

Research area: Tonga Trench in the South Pacific Ocean

Cruise purpose: The objectives of the survey were to: (i) describe the environmental characteristics of the "hadal zone", including depths of greater than 10,000 meters, and sample the organisms living in this environment, and (ii) find out exactly what is going on there, unravel the correlation between organisms and their habitats, and learn how

the trench environment was created. The main survey area was the 10,850 meter-deep Horizon Deep in the Tonga Trench – the world's second deepest place in the ocean and the deepest point of the southern hemisphere.

Abstract: This was the first exploration with a manned research submersible in the Tonga Trench. For the first time, sediment was sampled and video footage was taken by using a sediment sampling lander system with a video camera attachment. Also for the first time, the oxygen profile was measured in the upper layer of the seabed, using a separate sediment profiling lander. A detailed bathymetric chart of an area around the Horizon Deep of the Tonga Trench was drawn. Geological features in the fastest-moving subduction zone were successfully revealed. At depths of 10,805 meters and 6,250 meters at the Horizon Deep of the Tonga Trench, the following was successfully achieved: (i) sampling of organisms living on, in or near the seabed, (ii) sampling of undisturbed sediment in the upper layer of the seabed, (iii) sampling of bottom water, (iv) measurement of oxygen profile, and (v) video recording of the seafloor



Snapshot photo from the Horizon Deep, Tonga Trench (10811m). Both small amphipod species and holothurian species are dwelled on sediment surface. Red circles in the photo indicate holothurian individuals. Image courtesy JAMSTEC.

with a high-definition camera. This video recording and the observation of seabed sediments were the very first to be made at the deepest point of the Tonga Trench. A supergiant (>20 centimeters long) hadal amphipod, *Alicella gigantea*, was successfully sampled. This was first time this supergiant amphipod has been sampled in the Tonga Trench. This amphipod has only been previously sampled in the South Pacific Ocean at the Kermadec Trench. In addition, other amphipod species (e.g. *Hirondellea dubia*) and other hadal organisms were observed and sampled. Marine geological survey was carried out on the landward (western) slope of the Tonga Trench. Rock and core samples were successfully collected, which will provide a clue to geological features and genesis of the Tonga Trench and Arc.

Cruise PI & affiliation: Shinji TSUCHIDA, JAMSTEC

Research area: North Kermadec Arc and Louisville Seamount Chain

Cruise purpose: Comparative studies of biology, geology, and geochemistry on subducting seamounts in the Louisville Seamount and active volcanoes in the Kermadec Arc.

Abstract: The seafloor was observed at the Louisville Seamount Chain for the first time in the world. Many animals were found, including sponges, corals, lobsters, crabs, sea cucumbers, sea urchins, starfish, and fish. Some of the species were successfully sampled. At Hinepuia Seamount located in the northern Kermadec Arc, a new hydrothermal vent field was discovered. Vent-associated communities including *Bathymodiolus* mussels, *Symphurus* flat fish, and other species were found there. These observations are important for understanding of the continuity and evolution of biological communities in the area and along the Kermadec-Tonga Arc.



Munidid squat lobster Babamunida callista (Macpherson, 1994) collected at a depth of 436 m in the Hinepuia Seamount, northern Kermadec Arc. Image courtesy JAMSTEC.

Project Focus



MANAGING IMPACTS OF DEEP
SEA RESOURCE EXPLOITATION

The MIDAS project (Managing Impacts of Deep-Sea Resource Exploitation) is now well underway (see www.eu-midas.net). This project, funded by the EC's Framework 7 programme and with 32 partners from across Europe, is investigating the environmental impact of deep-sea mineral and energy extraction. This includes the exploitation of polymetallic sulphides, manganese nodules, cobalt-rich ferromanganese crusts and methane hydrates from the seabed, and the potential extraction of rare earth elements from deep-sea muds.

The project brings together a unique combination of scientists, industry, social scientists, legal experts, NGOs and SMEs (Small and Medium Enterprises). The aim of the project is to carry out research on the nature and scale of the potential impacts of mining, and then to work with industry to find optimum solutions to reduce those impacts. Impacts will include 1) physical destruction of the seabed by mining, the creation of mine tailings and the potential for catastrophic slope failures from methane hydrate exploitation; 2) the potential effects of particle-laden plumes in the water column, and 3) the possible toxic chemicals that might be released by the mining process. Key biological unknowns, such as connectivity between populations, impacts of the loss of biological diversity on ecosystem functioning, and how quickly the ecosystems will recover will all be addressed. This information will be used to develop recommendations for best practice in the mining industry.

A key component is the involvement of industry within the project and through stakeholder engagements to find feasible solutions. The project will also work closely with European and international regulatory organisations to take these recommendations forward into regulatory frameworks. A major element of MIDAS will be to develop methods and technologies for 1) preparing baseline assessments of biodiversity, and 2) monitoring activities remotely in the deep sea during and after exploitation, including ecosystem recovery.

A number of MIDAS-related cruises have already taken place. This has enabled some of our experiments to get underway such as those using pressurised tanks, the deployment of long-term moorings to measure currents, and the release of tracers to provide mixing/dispersion data for physical oceanographic models. Our work on gas hydrates is also underway with a geophysical cruise to the Danube Fan to collect data on the extent of gas hydrates in that area.

For more information on MIDAS please contact the Project Coordinator, Prof. Philip Weaver at phil.weaver@seascapeconsultants.co.uk or visit the project website www.eu-midas.net.

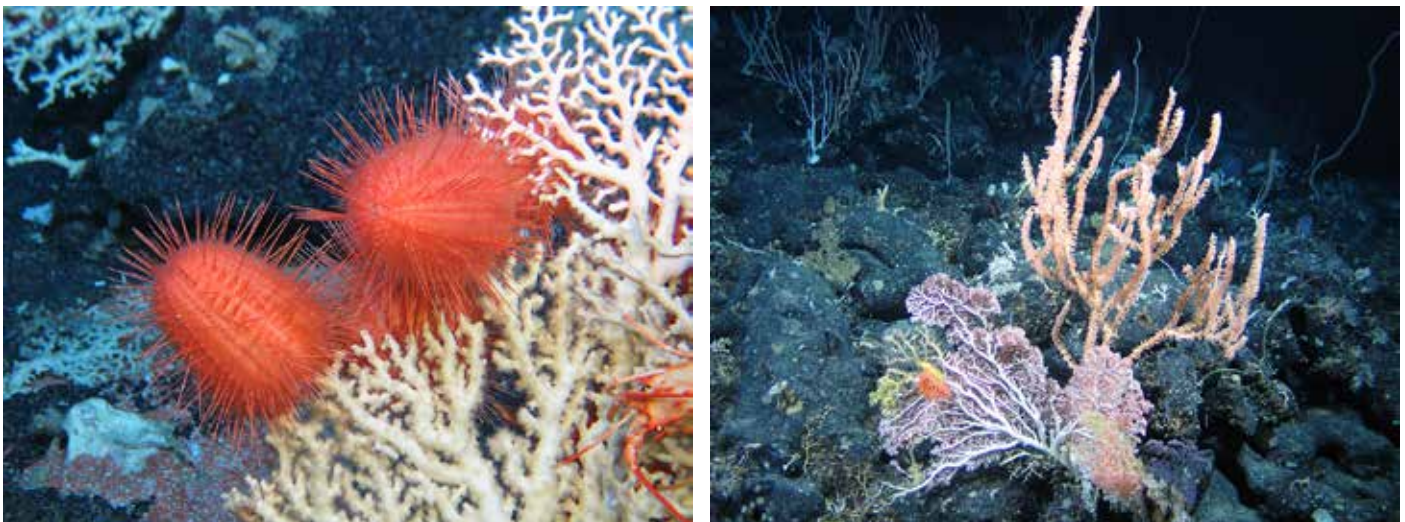
Advancing marine conservation beyond 200 nautical miles

Aurélie Spadone

IUCN Global Marine and Polar Programme, Switzerland

In early 2014, IUCN Global Marine and Polar Programme launched a new project on conservation and sustainable use of marine resources in areas beyond national jurisdiction (i.e. beyond 200 nautical miles (370 km) of the coast).

The project, financed by the French Global Environment Facility (FFEM), focuses on seamount and hydrothermal vent ecosystems of the South West Indian Ocean. The specific objectives are: (i) to advance the state of knowledge of deep-sea marine ecosystems associated with hydrothermal vents and seamounts; (ii) to improve and strengthen the governance framework for the management of fish stocks associated with deep-sea ecosystems including the monitoring, control and surveillance of fishing activities; (iii) to develop governance frameworks for the conservation of biodiversity and the preservation of habitats, especially with regards to the possibility of offshore mineral exploration and exploitation activities; (iv) to suggest sound conservation and management measures for deep-sea ecosystems in areas beyond national jurisdiction in this region; (v) to raise awareness of policy makers, the fishing and mining industries and the general public on the importance of preserving deep-sea life.



South West Indian Ocean Seamounts expedition JC066 on board the RRS James Cook (NERC; NOC). Image courtesy NERC/IUCN.

This 3-year project takes place within a broader context of reflexions on how to improve governance in areas beyond national jurisdiction (about 50% of the Earth's surface) within the international community, such as the meetings of the UN Working Group to study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction (BBNJ), or the development of a regulatory framework for the future exploitation of mineral resources in the Area by the International Seabed Authority.

Funding agency: FFEM (French Global Environment Facility) [www.ffem.fr]

Implementing agency: IUCN Global Marine and Polar Programme [www.iucn.org/marine]

Supporting institutions: the French Ministry of Foreign Affairs and the French Ministry of Higher Education and Research

Implementing partners: MNHN, IDDRI, IRD, University of Oxford

Collaborating partners and initiatives: AfriCOG, DEA & DAFF (Republic of South Africa), FAO/UNEP Deep seas Project of the GEF ABNJ Programme, IFREMER, ISA, the Nairobi Convention, SAPHIRE, SIODFA, Universités de la Réunion et d'Afrique du Sud.

For more information, please contact François Simard (francois.simard@iucn.org) or Aurélie Spadone (aurelie.spadone@iucn.org).

SPC-EU Deep-Sea Minerals Project



Akuila Tawake, Alison Swadling & Hannah Lily

Established in 2011, the SPC-EU Pacific Deep-Sea Minerals Project is helping Pacific Island countries to improve the governance and management of their deep-sea minerals resources through improved legal frameworks, increased technical capacity and effective monitoring systems.

A primary objective of the project is to support informed and careful governance of any deep-sea mining activities in accordance with international law, with particular attention to the protection of the marine environment and securing equitable financial arrangements for Pacific Island countries and their people. The Project is also working to encourage and support participatory decision-making in the governance and management of national deep-sea minerals resources.

The Project is funded by the European Union and managed by SOPAC, the Applied Geoscience & Technology Division of the Secretariat of the Pacific Community, on behalf of 15 Pacific Island Countries: the Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor Leste, Tonga, Tuvalu and Vanuatu.

You can find out more about the DSM Project on page 43 of this newsletter, and access a variety of project publications here: www.sopac.org/dsm

Towards the conservation of deep-sea sponge grounds

Hans Tore Rapp & Joana R Xavier

Centre for Geobiology, Biology Department, University of Bergen (Norway)

<http://www.uib.no/en/geobio>

Sponges (phylum Porifera) constitute an important and dominant invertebrate group in both hard- and soft-bottom benthic communities of the deep sea where they play key ecological roles. Sponge grounds, occurring in several areas of the North Atlantic, constitute Vulnerable Marine Ecosystems (VMEs) of utmost conservation priority. However, knowledge into their taxonomic composition, extent, connectivity or the eco-geographical factors shaping their distribution remains woefully scant and in much need of groundwork.



Figure 1: benthic assemblage at the Schultz Massif on the Arctic Mid-Ocean Ridge (AMOR) dominated by the glass sponge *Schaudinnia rosea* (Fristedt, 1887). Image courtesy Rapp & Xavier.

Our research group has been developing baseline knowledge on the taxonomy, community composition, distribution, ecology, and evolution of deep-sea sponges, in particular those forming sponge grounds, such as the multispecific assemblages of astrophorid sponges, known as “Ostur” occurring in the boreo-arctic region, or the mostly “monospecific” hexactinellid grounds usually associated with the slope of the European margin, islands and seamounts (e.g. *Pheronema carpensteri*, *Asconema*

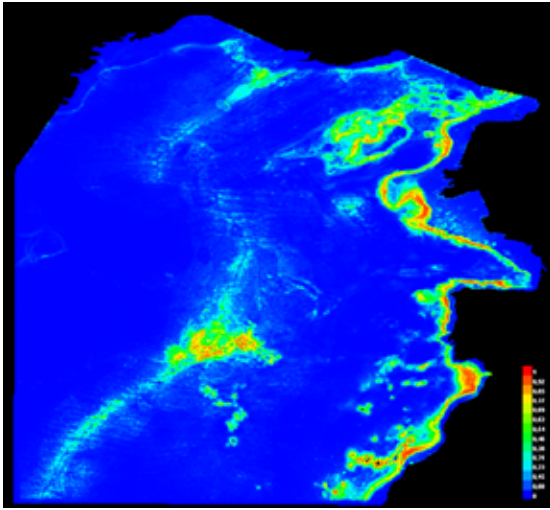


Figure 2: habitat suitability map of the birds' nest sponge *Pheronema carpenteri* using a maximum entropy approach. Image courtesy Rapp & Xavier.

setubalense, *Poliopogon amadou*).

By coupling morphological and molecular data we have been assessing the diversity, and revising the taxonomy and systematics of the major sponge groups occurring on the deep areas of the North Atlantic, and working on the development of identification tools for this area. In addition we're trying to understand the conditions favouring the association of some taxa with particular habitats such as vents, seeps and seamounts of the slow spreading Arctic Mid-Ocean Ridge (AMOR).

More recent areas of research include the inference of habitat suitability models for structural sponge taxa (e.g. the hexactinellid *Pheronema carpenteri*, the astrophorids *Geodia* spp.), and the application of next-generation sequencing technology to investigate the phylogeographic history and connectivity patterns of populations of the main ground-forming species. This integrated approach provides baseline knowledge

in support of a sound management and conservation strategy for these vulnerable species and ecosystems.

News



COMING SOON!

Free online deep-sea ecology and stewardship “Speaking Textbook”

Maria Baker

University of Southampton, NOC, UK

General awareness of deep-ocean issues among decision makers, industry stakeholders and civil society is an impediment to generating adequate support for the protection of deep-ocean ecosystems. This can be overcome by transforming available expertise on deep-ocean ecosystems and management into easily understandable, attractive information packages. Also, specific expertise on the deep ocean is not readily available for most universities, particularly in the developing world. Hence, the Deep-Ocean Stewardship Initiative (DOSI) WG4 on Capacity Building is embarking on a new project – funded by INDEEP and led by Maria Baker. Given the fact that any form of capacity building for deep-ocean stewardship needs to be underpinned by good scientific information and expertise, education and communication, one of the first activities we are taking forward within this WG is to put together a free online course on the fundamentals of deep-sea ecology and stewardship.

Currently, online lectures concerning the deep-sea are few and far between, so we are excited about this project whereby a series of around ~35+ (45-60 min) lectures will be delivered by experts from across the globe (who have also been selected as excellent communicators, and are most generously giving their time for free towards this endeavour), thereby giving everyone with access to the internet and an interest in this exciting ocean realm the opportunity to learn from the masters! In this way we hope to reach out to a wide variety of people across sectors and disciplines.

A small DOSI team (myself, Paul Tyler, Jon Copley & Verity Nye) with input from members of a wider WG4 group (Lisa Levin, Eva Ramirez-Llodra, Kristina Gjerde, Darlene Trew Christ, Jeff Ardron, Christian Neumann, Harry George & Elva Escobar) have devised a list of lecture subjects that we feel collectively will give a comprehensive overview of the subject of deep-sea ecology along with lectures on actual and potential impacts in the deep-sea and their management (and challenges thereof). In the future we will also welcome further, more specialised lectures from any INDEEP or DOSI member if they are relevant to the series. We would also hope that if there are any significant developments a particular field, lectures will be updated in future in order to ensure longevity for this treasure trove of lectures – a “speaking textbook”!

The lectures will be available via a new YouTube Channel – feel free to subscribe and log in after the summer to see the first of the lectures appear: https://www.youtube.com/channel/UCAA5zRQ8mSxJ9rKZ_fTTpnw/feed

Here are a small selection currently in production to whet the appetite.....

History of deep-sea exploration & discoveries by Paul Tyler

The deep-sea fauna by David Thistle

Sampling the deep by Adrian Glover

Hydrothermal Vents by Jon Copley

Seamounts by Tony Koslow

Organic falls by Craig Smith

The deep pelagic zone by Mike Vecchione

Deep biogeography by Tim O'Hara

Ecosystem Function by Andrew Thurber

Disposal by Eva Ramirez-Llodra

Elements of deep-ocean management – by Jeff Ardron, Kristina Gjerde & Linwood Pendleton



Ocean: New Frontiers – Get Involved!

Orla Doherty

BBC Natural History Unit, UK

The BBC's Natural History Unit (which produced the Blue Planet) is returning to the Ocean for a major seven-part series to be broadcast in 2017. Delving into the new frontiers of scientific discovery, we will be exploring the oceans from the poles to the tropics and from the tropical coral reefs to the abyssal plain and beyond.

One of the episodes will focus on the deep ocean. We are currently researching potential stories to feature in this episode – new species, new behaviours, new habitats and new understandings of how the ecosystems within the deep ocean work, how they are linked to surface waters and how they are relevant to us all.

We are keen to make contact with deep ocean scientists - to learn about recent discoveries, ongoing research programmes and research cruises planned for the coming years. We will start filming later this year and through 2015 and 2016.

Please contact Orla Doherty, Development Producer: orla.doherty@bbc.co.uk



A successful Marine Imaging Workshop 2014

Jennifer Durden

University of Southampton, NOC, UK

The beginning of April saw marine imaging experts coming together to discuss the state of imaging as a tool for gaining data about the underwater environment. This was the first meeting of its kind, bringing together 100 delegates from around the world, including many from Europe, the United States, Canada, Australia, Japan and the UK. Experts from different backgrounds brought their expertise to share with the group, so it was a melding of ideas from academia/research, government and from industry. It also united those from the computer vision field (largely computer scientists and engineers) with the end-users of images or extracted data from images to discuss common challenges, and foster collaboration and understanding between groups.

The objective of the workshop was to examine the stages in acquiring, preparing and extracting data from marine images, with an emphasis on methods for each. Keynote speakers Hanumant Singh (WHOI), Rafael Garcia (University of Girona) and Martin Dorhn (Ammonite) enlightened us on the latest technological advances in robotics, cameras, and lighting, and dazzled us with images of exotic seabeds and bioluminescence. Talks and posters were presented on themes of image acquisition, image processing, annotation, data management, automated annotation and biological data from images. Discussion sessions were held each day to identify common challenges and share strategies for getting the best of our image data. The workshop culminated in a look to the future of imaging, and the creation of an imaging wish list. We are looking forward to the next workshop in 2 years' time.

The present and future of deep-sea research using cabled observatories: the Ocean Networks Canada perspective



Fabio De Leo

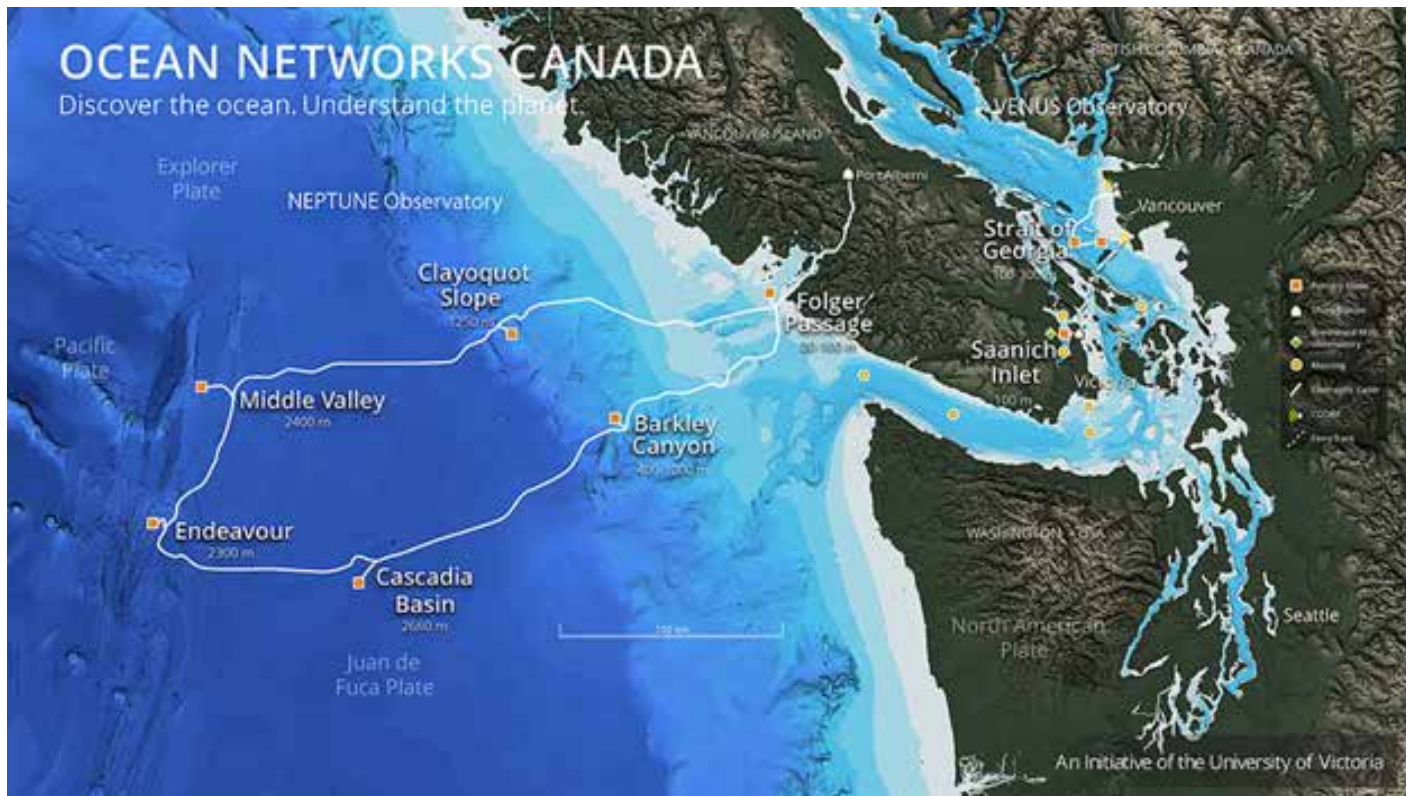
University of Victoria, Canada



Between 23-25 of this past April, Ocean Networks Canada (ONC) and INDEEP co-sponsored an workshop at University of Victoria, British Columbia, to foster new research partnerships between the INDEEP research community and the largest operational network of deep-sea cabled observatories, the NEPTUNE array. The workshop had the following specific goals:

- Introduce the NEPTUNE Observatory infrastructure to the INDEEP research community.

- Present Ocean Networks Canada's current research efforts.
- Learn about INDEEP's research goals and current initiatives - from 4 Working Groups - and investigate how could Ocean Networks Canada's infrastructure help INDEEP achieve its research goals.
- Discuss ship and Remotely Operated Vehicle (ROV) funding options for sampling and experimental deployments at NEPTUNE observatory sites.
- Plan possible integration of databases and educational/outreach initiatives.



Besides the INDEEP working group leaders and manager, and ONC scientists, who attended to the workshop in person, a host of other researchers actively participated remotely via a cloud-based video streaming tool (BlueJeans). Those remote participants were at Scripps Institute of Oceanography (Lisa Levin and two of her PhD students), National Oceanography Centre, UK (Tammy Horton, Laura Grange and Dave Billet), International Seabed Authority (ISA) in Kingstown, Jamaica (Sandor Muslow), Plymouth Marine Laboratory (Jeroen Ingels), Uni Misjlo, Bergen, Norway (Thomas Dahlgren), and Centre d'Estudis Avancats de Blanes, Spain (PhD student Chiara Romano). A dedicated page for the workshop, with a list of participants and links for the presentations given is linked below:

<http://www.oceannetworks.ca/science/getting-involved/workshops/onc-indeep-partnership-development-workshop>

During the workshop we discussed some key research questions that could be asked pertaining to the level of



interactivity between the various deep-sea habitats that the NEPTUNE array covers within its installations. The cabled observatory array is laid out in such a way that it covers deep seafloor habitats ranging from hydrothermal vents (Endeavour and Middle Valley), abyssal plains (Cascadia Basin), an open slope (Clayoquot) and a submarine canyon (Barkley Canyon) at the shelf-break, all of which are influenced by an extensive oxygen minimum zone. Those deep-sea habitats are embedded within the World's smallest tectonic plate, the Juan de Fuca Plate, subducting beneath the North American Plate on its eastern border and being accreted at the spreading

centre, margining the Pacific Plate. There is here, perhaps, an unique opportunity for deep-sea scientists to investigate how those singular ecosystems are connected in terms of energy supply and through the movements of adult and larval populations, and also to ascertain how the breadth of seafloor biodiversity would respond to the growing human interference on deep-sea habitats and to climate change. For example, some of the ideas discussed were to use some of the sites within the network, to develop disturbance experiments for studying environmental impacts of deep-sea mining and CO₂ injection into the seabed (proposed geo-engineering enterprise to contain green-house gas emissions to the atmosphere).

The workshop participants then discussed a series of possible new 'core measurements and surveys' that could be incorporated to the yearly routine of observations, new sensors that could be installed, and new experiments that could potentially become integral part of the yearly operations plan. The next obvious step involved in strengthening ONC-INDEEP partnerships will be to secure funding to support all these new potential research projects.

The INDEEP Working Group 3 'Population Connectivity' lead by Anna Metaxas at Dalhousie University and Eva Ramirez-Llodra at NIVA, is already using the NEPTUNE infrastructure by having deployed larval settlement frames in front of three deep-sea cameras connected online and streaming over the internet, all near or within Barkley Canyon. Those experimental frames are part of a collaborative effort with the SERPENT project and also with Transocean. You can find more about those experiments at INDEEP's Population Connectivity working group webpage (<http://www.indeep-project.org/wg/population-connectivity>). A week after the ONC-INDEEP partnership workshop wrapped up, ONC embarked on its yearly series of 'Wiring the Abyss' maintenance cruises, aimed both at servicing the observatory infrastructure and also to conducting deep-sea experiments and sampling. The first leg of the cruise visited the 'shallower' Barkley Canyon (~900 m) and Folger Deep (~100 m) sites, and the second leg covered the 'deeper' sites at Endeavour (2,300 m), Cascadia Basin (2,660 m) and Clayoquot Slope (1,250 m). You can follow future cruise updates as well as the live stream video of the ROV deployment and operations at the 'Wiring the Abyss' expedition website (<http://www.oceannetworks.ca/expeditions/2014/may/live-video>).

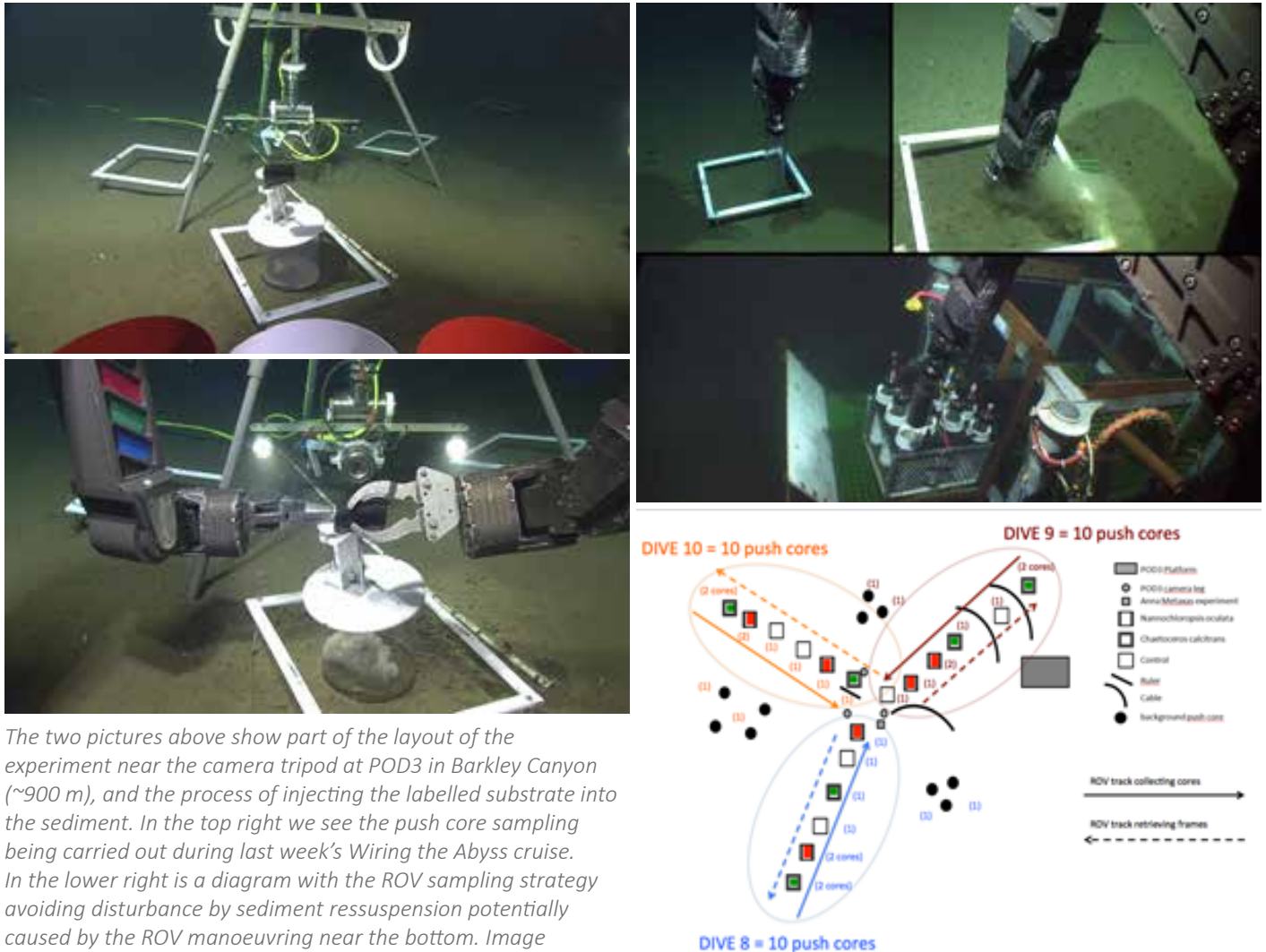


Recovering and redeploying INDEEP frames at Barkley Canyon aboard the Canadian Coast Guard Ship John P. Tully. The image above shows the wood block part of the frame covered with the boring bivalve *Xylophaga* sp. The image on the right shows the new position of a newly deployed frame in front of the camera at POD3. You can log-in online to SeaTube to check out our daily videos, scheduled to record with lights on for 5 minutes every 2 hours. Image courtesy ONC.

The figure to the left shows the successful recovery of three of those INDEEP larval settlement frames in Barkley Canyon and Slope.

Another ongoing research project using Ocean Networks Canada NEPTUNE cabled observatory is happening at Barkley Canyon, and is being conducted by Neus Campaña i Llovet, from Memorial University in Newfoundland, Canada. She is a PhD student under supervision of Paul Snelgrove and is carrying on sediment enrichment experiments using labelled ¹³C microalgae (*Nannochloropsis oculata* and *Chaetoceros calcitrans*). She is interested in investigating how the infaunal macrobenthos responds to pulses of different types of labile

organic matter inside a submarine canyon. The experiment was laid out in the seafloor last year in September using the submersible ROPOS, which was operated from the R/V Falkor (Schmidt Ocean Institute). During our cruise aboard the CCGS J. P. Tully we were able to successfully recover her experiment and conduct sediment push core sampling in the different enriched substrate patches. The experiment recovery and sediment sampling process had to be carefully planned and discussed among scientists onboard and on shore, the dive chief and the ROV crew since no disturbance by the ROV trusters should be allowed to avoid contaminating the sediment surface in each of the various patches.

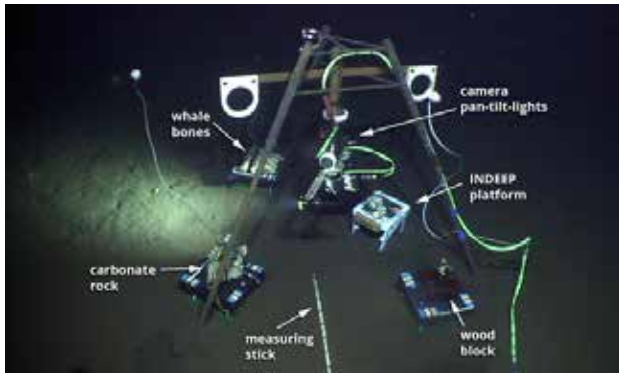


The two pictures above show part of the layout of the experiment near the camera tripod at POD3 in Barkley Canyon (~900 m), and the process of injecting the labelled substrate into the sediment. In the top right we see the push core sampling being carried out during last week's Wiring the Abyss cruise. In the lower right is a diagram with the ROV sampling strategy avoiding disturbance by sediment resuspension potentially caused by the ROV manoeuvring near the bottom. Image courtesy ONC.

New research projects were also initiated during this first leg of the 2014 Wiring the Abyss cruise. We were able to successfully deploy experiment packages with whalebones and wood blocks (led by Craig R. Smith), and also an authigenic carbonate block (led by Lisa Levin). This is the first time those types of deep-sea colonization experiments will be monitored online over the internet with a high-frequency interval between observations. Scientists using the ONC infrastructure can be given access to our seafloor cameras to operate its schedules according to their research questions. The whalebone experiment will also be followed closely by a group of international students attending to a summer course on Deep-Sea Biodiversity, Connectivity and Ecosystem Function, scheduled to happen between July 21-August 22 at the Friday Harbor Marine Labs, University of Washington P.55). The course will be organized by Craig R. Smith (University of Hawaii) and Kenneth Halanych (Albarn University), but will also have the participation of many other deep-sea specialists, including Ocean Networks Canada's scientists Fabio De Leo (myself) and Kim Juniper, giving lectures on submarine canyon ecology and hydrothermal vent ecosystems, respectively.

The main message to convey from the ONC-INDEEP partnership workshop, and also from the successful ongoing research efforts utilizing Ocean Networks Canada cabled observatory infrastructure, is that there are still many opportunities for

deep-sea scientists to engage with Ocean Networks Canada, being on research projects or on outreach and educational initiatives. The deep sea is the last vast frontier of our planet and we know so little about its inhabitants, processes and



Deployment of humpback whalebones, wood and authigenic carbonate in front of our seafloor camera at POD3 in Barkley Canyon (890 m). Image courtesy ONC.

resilience to human disturbance. We know the human footprint in the deep ocean is steadily growing. This fact alone calls for immediate engagement of the research community to study the unknowns but also to communicate to society and decision makers what is already known, and what should be prioritized in terms of conservation. If you care about the deep sea, join us from Ocean Networks Canada in this adventure of exploration and further understanding deep-sea processes, habitats and its enormous biodiversity. Stay tuned for the outcomes of the workshop when we release to the public the workshop report. Cheers to all and Aloha!

Deep-Sea Taxonomist Listing Now Online!

Tammy Horton

National Oceanography Centre, Southampton, UK



Have you found a deep-sea creature lately and wondered what on earth it was? Never fear – help is at hand! Dr Tammy Horton of the NOC has been working for the INDEEP project on the construction of an up-to-date listing of deep-sea taxonomists. The listing of experts working on major taxa is [now available here](#) as a downloadable excel file with lists of the names and contact details for each specialist. All specialists have been contacted independently to confirm their inclusion. The list covers the major taxonomic groups: Cnidaria, Echinodermata, Mollusca; Peracarida, Nematoda, Pycnogonida, Ostracoda, Fish, Polychaeta, Meiofaunal and other groups. This compilation is the only known comprehensive listing of current deep-sea taxonomic experts. It will be maintained by Tammy Horton and updated when necessary. How can you help? There are gaps (particularly in the Mollusca and Meiofauna sections) so if you are an expert and wish to be added, please contact Tammy directly: tammy.horton@noc.ac.uk

The point of this open-access listing is to inform the INDEEP community of the first point of contact for resolving taxonomic issues and may well lead to new collaborations. Deep-sea taxonomists are increasingly being included in grant proposals as it is recognised that there is a need to specify this activity at the outset.

To clarify, the term taxonomist here is defined as: persons working on resolution of alpha taxonomic problems (such as new species descriptions, revisions and keys), rather than 'users of taxonomy' (i.e. those who can identify deep-sea animals – we are all users of taxonomy whatever our biological research field!). Experts in Molecular systematics are welcome additions to the list. We are aware many morphological taxonomists also use this technique or collaborate with others who do.



Many thanks in advance for your help. As with all these type of efforts, this list will be as comprehensive as you make it!

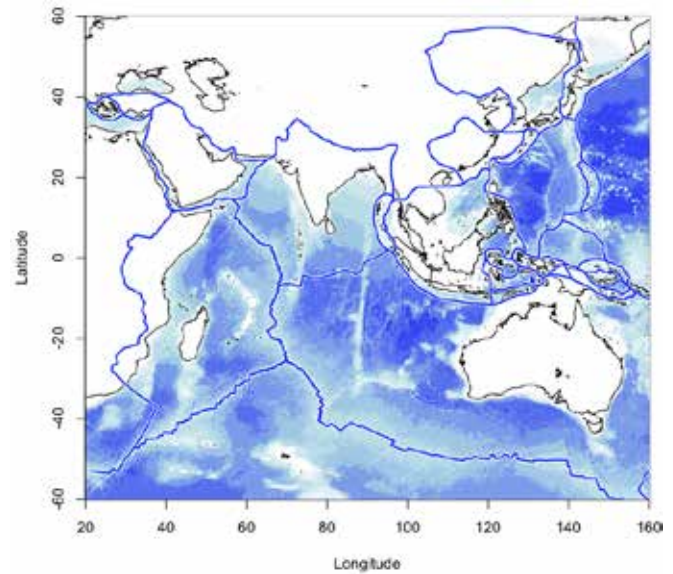
Cyclocaris (the four-eyed Franki). Image courtesy Tammy Horton, NOC

New open-source tools for deep-sea mapping

Eric Pante & Benoit Simon-Bouhet

LIENSs Laboratory, Université de La Rochelle, France

In an effort to ease the import, plotting and analysis of bathymetric data, we developed the free and open-source R package *marmap*. One of the primary goals of *marmap* is to allow the production of publication-ready sampling maps for deep-sea biologists, through easing automatic retrieval of xyz data from the NOAA. Functions to query data (bathymetry, sampling information...) are available interactively by clicking on maps. Bathymetric data can also be used to calculate projected surface areas within specified depth intervals, and constrain the calculation of realistic shortest path distances. Such information can be used in molecular ecology, for example, to evaluate genetic isolation by distance in a spatially-explicit framework. *Marmap* can interact with other GIS tools developed for R, for example to build 3D charts or plotting with different types of geographical projections. While *marmap* was initially built to assist deep-sea research projects, it was made to deal with topographic data as well. We are still working on adding new functions to *marmap* (currently in its version 0.7), for example to automatically space pie charts on maps, plot EEZ boundaries, tectonic plate limits, and ICES regions, and we welcome ideas on how to improve *marmap*. We have recently ported the project to GitHub (github.com/ericpante/marmap), and welcome contributors.



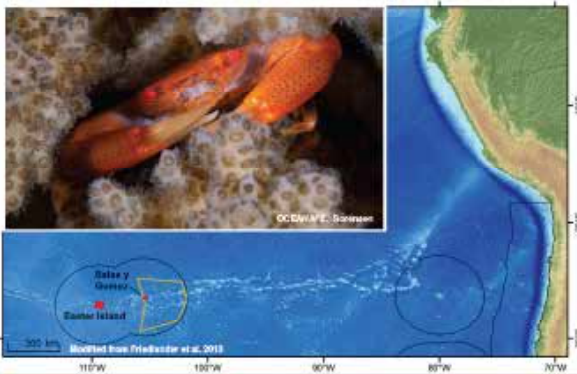
An example of marmap graph, based on the NOAA ETOPO1 database (ngdc.noaa.gov/mgg/global/global.html), and Peter Bird's tectonic plate boundaries (peterbird.name). This map can be produced with three lines of R code: one for automatic data download, one for plotting, and one for adding tectonic plate boundaries (this last function is to be released in version 0.8). Image courtesy Pante & Simon-Bouhet.

To find out more about *marmap*:

<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0073051>

<http://cran.r-project.org/web/packages/marmap/index.html>

**ECORREGION DE ISLA DE PASCUA
EASTER ISLAND ECOREGION**



Las islas de Pascua y Salas y Gomez son las más remotas del Océano Pacífico del Sur. Las islas oceánicas y los montes submarinos tienen una importancia estratégica para el desarrollo, debido a su potencial para el turismo, la pesca y además por la existencia de recursos biológicos únicos.

Easter Island and Salas y Gomez Island are the most remote islands in the South Pacific Ocean. Oceanic islands and seamounts are of strategic importance for development, because of their potential for tourism, fishery, and the existence of unique biological resources.

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**NÚCLEO MILENIO EMSIO
MILLENNIUM NUCLEUS ESMOI**



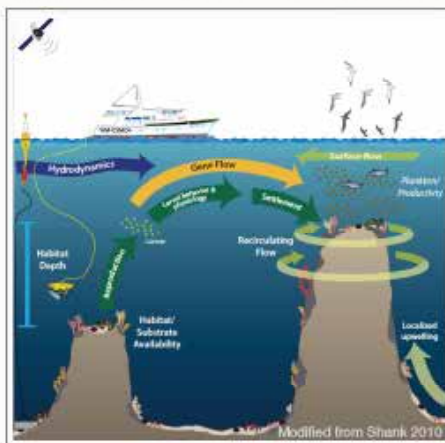
**Ecología y Manejo Sustentable
de Islas Oceánicas
Ecology and Sustainable Management
of Oceanic Islands**



OBJETIVO GENERAL/MAIN GOAL

Generar la base científica necesaria para fortalecer una estrategia de manejo sustentable y conservación de la biodiversidad de la ecorregión de Isla de Pascua (incluyendo Rapa Nui e Isla Salas & Gómez).

To provide the scientific basis needed to strengthen a sustainable management and biodiversity conservation strategy for the Easter Island ecoregion (including Rapa Nui and Salas & Gómez Island).



OBJETIVOS ESPECÍFICOS/SPECIFIC GOALS

- Describir los procesos oceanográficos
- Determinar la conectividad entre Rapa Nui & Salas y Gómez
- Describir los patrones de biodiversidad
- Estimar la biomasa local
- Caracterizar las tramas tróficas
- Evaluar la cantidad e impacto de la basura
- Establecer una red de científicos ciudadanos
- Desarrollar una estrategia de manejo y conservación basado en la comunidad

- Describe oceanographic processes
- Determine connectivity between Rapa Nui & Salas y Gómez
- Describe biodiversity patterns
- Estimate local biomass
- Characterize trophic webs
- Evaluate quantity and impact of litter
- Establish a citizen science observer network
- Develop a community-based management and conservation strategy

EMSIO es financiado por la Iniciativa Científica Milenio del Ministerio de Economía, Fomento y Turismo de Chile. Es liderado por el Departamento de Biología Marina, Universidad Católica del Norte y el Centro de Estudios Avanzados en Zonas Áridas (CEAZA), con la participación de la Universidad de Chile.



ESMOI is funded by the Millennium Scientific Initiative of the Ministerio de Economía, Fomento y Turismo of Chile. It is led by the Marine Biology Department, Universidad Católica del Norte, and the Centre for Advanced Studies in Arid Zones (CEAZA), with the participation of the Universidad de Chile.



The 8th International Conference on Coelenterate Biology

December 2013, Eilat, Israel - Workshop Summary

Tina Molodtsova

P.P. Shirshov Institute of Oceanology, Russia

The 8th International Conference on Coelenterate Biology (ICCB 8) was held in Eilat, Israel in December 2013. The conference has been awaited for a long time. The current venue was scheduled for the ICCB 7 already in 2002, but for reasons of political climate and a rather unstable situation in the Middle East the venue was re-scheduled and eventually the conference was held in Lawrence, KS, in July 2003. ICCB 8 encompassed aspects of the biology of all cnidarian groups and ctenophores and covered a broad range of topics: “Biodiversity and Systematics”, “Communities and Population Studies”, “Cnidarians and Global Change”, “Cellular and Developmental Biology”, “Reproduction and Life Cycles”, “Conservation, Management and Restoration”, “Genomic and Evolution”, “Pathogens and Diseases”, “Physiology and Biomineralization”, “Toxicology, Symbiosis and Coevolution” etc. Despite the fact that most of the papers presented at the conference covered aspects of shallow water communities and organisms, a few posters and presentations dealt with the deep sea. Papers focused on deep-sea topics included revision of the Corallidae, biodiversity and distribution of planktonic coelenterates of the Atlantic sector of the Arctic, distribution patterns of ten corals in the Arctic-Boreal Atlantic, growth rates in *Umbellula*, skeletal growth and recovery of cold-water corals etc.

The unique combination of deep, blue, clear waters, surrounding colorful granite rocks, and pleasant climate and hospitality of the Local Organizing Committee made the vote for the next venue quite surprising. It was decided that the ICCB 9 will take place again in Eilat, Israel, hopefully in 4 years.



Pictures from the meeting, from left: Hudi Benayahu; Cathy McFaden and Leen van Ofwegen; Pål Buhl-Mortensen; Lene Buhl-Mortensen; Carlos Spano, Anita George, Vreni Hausermann, Thomas Goreau and Nadia Santodomingo. Images courtesy Tina Molodtsova.



The Deep-Sea Biology Society

Bhavani Narayanaswamy¹ & Craig McClain²

¹ SAMS, UK, ² National Evolutionary Synthesis Centre, USA



After a long haul the Deep-Sea Biology Society is now official less than 18 months after Craig McClain and I first proposed the notion at the DSB Symposium in Wellington, NZ.

Our aims for the Society were to:

- support the organisation of the Deep-Sea Biology Symposium, held every three years (where possible) with the purpose of exchange of scientific information on deep-sea ecosystems,

- to foster and mentor the next generation of deep-sea biologists,
- ensure demographic diversity in deep-sea biology,
- to promote research on deep-sea ecosystems,
- facilitate communication between members,
- serve as a unified voice both in policy and public forums.

Given the importance, the constitution, bylaws and definitions and responsibilities of the officers took time to draft. We spent time ensuring the necessity and legality of the statements. We required a sub-committee to both provide feedback and approve the draft. Once the sub-committee approved the constitutional draft, the community read and voted on the constitution and the creation of a Deep-Sea Biology Society (if you would like to read the constitution and bylaws you can find it here). The community voted overwhelmingly in favour of establishing a DS Biology Society.

At the end of last year we put out a call requesting people to stand for various positions both office and non-office bearing members and we are delighted to announce that every position has now been filled.

The following people will be office-bearing members:

President: Paul Tyler (UK) (pat8@noc.soton.ac.uk)

Secretary: Chris Yesson (UK) (chris.yesson@ioz.ac.uk)

Treasurer: Bhavani Narayanaswamy (UK) (Bhavani.Narayanaswamy@sams.ac.uk)

Vice President Public Affairs and Communication: Holly Bik (USA) (hbik@ucdavis.edu)

Vice President Awards and Development (jointly coordinated): Teresa Amaro (Greece/Portugal) (amaro.teresa@gmail.com) and Rachel Jeffreys (UK) (rachel.jeffreys@liverpool.ac.uk)

Vice President for Conferences: Marina Cunha (Portugal) (marina.cunha@ua.pt)

Student Representative: Rachel Boschen (NZ) (Rachel.Boschen@niwa.co.nz)

The following are the Board Members:

Craig McClain (USA), Paul Snelgrove (Canada), Angelo Fraga Bernardino (Brazil), Anna McCallum (Australia), Kate Bromfield (New Zealand), Moriaki Yasuhara (Hong Kong), Kareen Schnabel (New Zealand)

Over the next few weeks and months the committee will consider the way forward, what we want to do and of course the topic about formal membership will also be discussed. If you are not currently on the Deep-Sea Biology Society mailing list and would like to become a member then please contact Bhavani and Chris Yesson (email addresses earlier) and we will include you on our list.

Craig and I would like to take this opportunity to thank everyone that has supported us and provided guidance and advice when needed, especially the sub-committee that helped when we were writing the constitution. The members of the sub-committee were, Teresa Amaro, Marina Cunha, Roberto Danovaro, Elva Escobar, Angelo Fraga Bernardino, Rachel Jeffreys, Anna Metaxas, Rosanna Milligan, Alexei Orlov, Ashley Rowden, Kerry Sink, David Thistle and Ben Wigham. In addition one last person we must thank is Paul Snelgrove who provided endless guidance and moral support.

Here's to the Deep-Sea Biology Society being a success and we look forward to seeing many of you at the Deep-Sea Biology Symposium in Aveiro, Portugal in 2015. See page 50 for further details.



Defining “significance” in environmental impact assessment for deep-sea mining - Workshop Summary

March 26-28, 2014, Scripps Institution of Oceanography, USA

Lisa Levin

Scripps Institution of Oceanography, USA



A group of 24 experts from 8 countries met to explore existing approaches to environmental impact assessment (EIA) of deep-sea mining, with a focus on manganese nodules, massive sulphide deposits, cobalt crusts and phosphorite nodules or deposits. The workshop considered challenges and practical options for evaluating significant environmental impact related to deep-sea mining in light of direct, indirect, and cumulative impacts to the deep ocean. Participants represented the fields of deep-sea biology, law and policy, economics, regulation, industry and conservation, and considered both national and international jurisdictions. The workshop, led by Kathryn Mengerink (Environmental Law Institute), Ashley Rowden (New Zealand National Institute of Water and Atmospheric Research) and Lisa Levin (Scripps Institution of Oceanography), represents an effort of the Deep-Ocean Stewardship Initiative (DOSI), with financial sponsorship from INDEEP. The resulting report and publications are intended to provide guidance to the International Seabed Authority and to individual nations currently facing decisions about and enacting regulations for deep-sea mining.

Fiji Workshop on environmental management of deep-sea minerals

9-13 December 2013

Alison Swaddling

SPC-EU Deep-Sea Minerals Project, Fiji

A Workshop held in Fiji, from 9th-13th December 2013, was designed to help Pacific Island Countries identify any environmental management needs before any deep-sea mining activities occur in the region. The workshop was run by the Secretariat of the Pacific Community’s (SPC) SOPAC Division Deep-Sea Minerals (DSM) Project and the Secretariat

of the Pacific Regional Environmental Program (SPREP).

The workshop included representatives from Pacific Island countries, civil society organisations, deep-sea mining companies together with international experts on deep-sea ecosystems such as Professor Cindy Van Dover from Duke University in the United States and Dr Malcolm Clark from New Zealand's National Institute of Water & Atmosphere (NIWA).

While access to the deep sea has improved in recent decades, the workshop found that the understanding of deep-sea ecology has been limited by the high cost of research and exploration. Most of the deep sea remains unexplored and key scientific questions have yet to be answered on the dynamics of the deep-sea "ecosystem" including linkages between habitats, depths, and the potential impacts from proposed activities such as mining.

SPREP's Director General, Mr David Sheppard, said there was a critical need for more baseline environmental data to be collected to enable Pacific countries to ensure informed decision making and strengthen the responsible management of their deep-sea mineral resources. "The companies themselves need to allocate money for independent scientific studies of the biodiversity and the environment in the deep sea. There is good understanding of the mineral deposits but we need to have the same level of information on the deep-sea ecosystems where they occur," he said.

SPC-SOPAC Division Director, Professor Mike Petterson said the workshop will help to ensure that the best current knowledge is used to put in place regulatory measures before any seabed mining starts. "By proactively agreeing common standards and tools across the Pacific, we can empower member countries to protect their marine environments and apply the precautionary approach, whilst exploring the economic opportunity presented by their seabed minerals," he said.

Mr Akuila Tawake, the Team Leader of the DSM Project, said the workshop recognised that deep-sea mining will be destructive at the local scale and may lead to species loss. However, he also said the three types of deep-sea mineral deposits will require significantly different mining methods and the management of their impacts will entail different requirements.

In 2011, the International Seabed Authority (ISA) with SPC-SOPAC, published an Environmental Impact Assessment (EIA) template for the environmental management of deep-sea mineral activities that countries can modify to suit their own national settings ([ISA Technical Study 10](#)) and during one session of the December workshop, working groups considered what amendments should be made. The workshop also recommended that any project-specific EIA should also be coupled with Strategic Environment Assessment (SEA). The SEA is a planning tool that assesses the environmental impacts of potential developments and resources used on the wider ecosystem. This will be necessary in order to consider wider impacts on trans-boundary resources, such as migratory fish stocks on which many Pacific Islands currently depend.

Mr Tawake said the workshop made several recommendations including the need for SPC and the Forum Fisheries Agency to bring fisheries and deep-sea minerals officials together to examine how deep-sea minerals policies and procedures can learn from and complement fishery policies. "Through the DSM Project, SPC and NIWA in collaboration with SPREP and other interest groups are now planning to develop Regional Guidelines for Seabed Mineral Research Activities to provide a framework for research that supports good environmental management of deep-sea mineral activities. This will support the development of region-wide understanding of biological and ecological communities and identify what is important to measure, how it can be measured and the frequency of monitoring required once a deep-sea mining operation commences," Mr Tawake said.

A copy of the Workshop outcomes, and the presentation and working group materials, can be found [here](#).

Cook Islands Workshop to focus on fiscal regimes and revenue management of deep-sea minerals

May 2014

Alison Swaddling

SPC-EU Deep-Sea Minerals Project, Fiji

A workshop for Pacific Island Countries will be held in May 2014 to cover fiscal regimes and revenue management for deep-sea mining revenue. The workshop will be run by the Secretariat of the Pacific Community's (SPC) SOPAC Division Deep-Sea Minerals (DSM) Project in partnership with the International Monetary Fund.

The workshop will focus on models of managing extractive industry wealth so as to provide long term sustainable benefits from the development of deep-sea mineral resources. The workshop is for Pacific Island Government Finance officials and interested NGOs. Expert facilitators will provide an introduction to DSM issues and then provide focussed training on (i) how countries can maximise revenue and other benefits from DSM and (ii) best-practice sustainable management of DSM revenue.

The SPC-EU DSM Project has already provided overview guidance on these issues in the 2012 Pacific Regional Legislative and Regulatory Framework for DSM. Available [here](#).

Following the workshop, a second Framework document focussing on DSM fiscal regimes and revenue management will be published. This will include model regimes, to assist Pacific Island Governments with their move to good governance in the deep-sea mining industry.

The Pacific Deep-Sea Minerals Report is now available

SPC-EU Deep-Sea Minerals Project



The Secretariat of the Pacific Community-European Union Deep-Sea Minerals (SPC-EU DSM) Project has launched the Pacific Deep-Sea Minerals Report. This publication, prepared in partnership with UNEP/Grid-Arendal, provides a synthesis and review of existing knowledge and information on deep sea minerals. It is designed as a tool for managers and national experts who are engaged in developing national legislation, policy, technical and environmental guidelines and strategies for deep-sea minerals activities. The report series was guided and supported by a Steering Committee, comprising some 60 world renowned experts and key stakeholders in the region.

Volume 1, split into 3 sections; A) Seafloor Massive Sulphides, B) Manganese Nodules, and C) Cobalt-Rich Ferromanganese

Crusts, examines the geology and biology of these deposit types and the environmental and technical aspects related to their extraction. Volume 2 provides a 'green economy' context examining how deep-sea mining could be profitable, sustainable and meet the needs of Pacific Island countries without sacrificing cultural heritage, community values or the health of ocean ecosystems.

The work of the SPC-EU DSM Project has helped generate important questions for countries to consider: Can minerals be extracted without significantly affecting environmental sustainability, marine life, and local communities? Can revenue support long-term development goals? Is it a good idea to start a new industry when exploitation of other resources has unsolved problems?

This report series collates information to help find ways to answer these questions.

You can find out more about the SPC-EU DSM Project and access a variety of project publications including this report here: www.sopac.org/dsm

Deep-Sea Minerals Documentary Series



SPC-EU Deep-Sea Minerals Project

Several Pacific Island nations are eagerly eyeing up the potential economic benefits from valuable deep-sea mineral resources that have been discovered within their extensive maritime territories. These Pacific Island countries have now become the centre of an international debate over whether the sustainable economic benefits for Pacific Islanders will outweigh the environmental risks of harvesting these precious metals from the bottom of the sea. A series of three documentaries, supported by the Secretariat of the Pacific Community-European Union Deep-Sea Minerals (SPC-EU DSM) Project, is underway to highlight Pacific regional concerns on deep sea mineral activities.

The first documentary 'Under Pressure' examines the perspectives of different stakeholders including concerned civil societies, politicians, government agencies, deep-sea mining companies, and the Secretariat of the Pacific Community.

'Out of Darkness', the second documentary, explores the current state of scientific knowledge about deep-sea minerals and focuses on the potential environmental issues related to the extraction of deep-sea mineral resources. It includes some spectacular underwater footage and interviews with leading scientists such as Dr Malcolm Clarke from NIWA (New Zealand), Dr Jim Hein from the US Geological Survey (USA) and Dr Ray Binns from CSIRO (Australia).

The third documentary, 'Life on the Margins', currently in production, will look at the process undertaken in Papua New Guinea, the Pacific Island country that has been at the centre of the deep-sea mining debate for the grant of the first deep-sea mining licence to Nautilus Minerals Inc. for the 'Solwara 1' site.

The documentaries can be viewed on the SPC-EU DSM Project's website (www.sopac.org/dsm) and free copies of the DVD can be obtained by emailing: vira@spc.int.

Ventbase 2014: advancing the management of SMS resources

Rachel Boschen

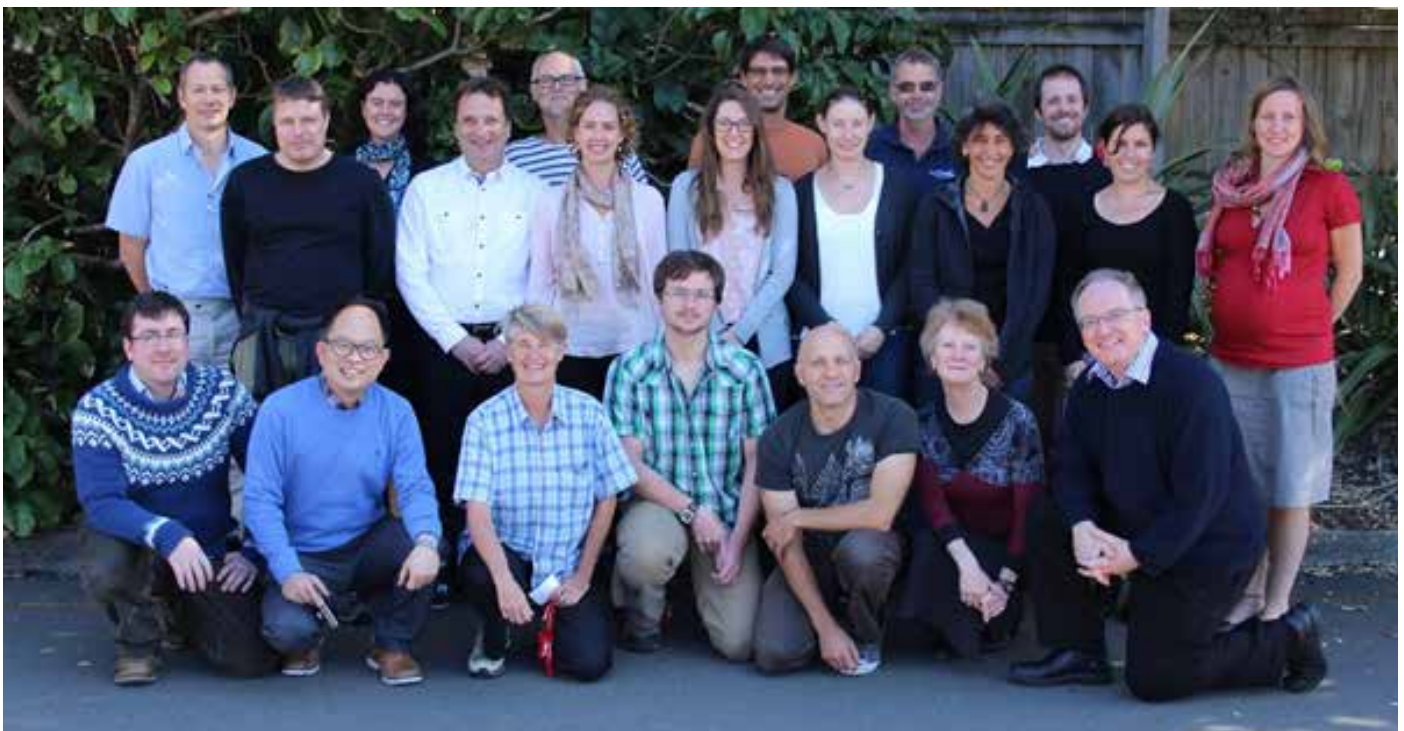
NIWA, NZ

VentBase is a forum where academic, commercial, government and other stakeholders can develop a consensus on the best way to manage the mining of seafloor massive sulfide (SMS) deposits. The 2014 workshop was held on the 2nd – 4th April at the National Institute of Water and Atmospheric Research in Wellington (NIWA), New Zealand. The aim of VentBase 2014 was to identify practical spatial management and mitigation strategies for the mining of SMS deposits and to further the development of a ‘primer-type’ document on conservation genetics at deep-sea SMS deposits.

The workshop was attended by 23 participants from 20 institutions in 9 countries. The participants were from wide-ranging backgrounds, including academic institutions, consultancies, industry, government agencies and NGOs. Generous travel bursaries from InterRidge supported the participation of two early career scientists.

VentBase aims to produce best-practice documents to inform stakeholders and highlight state of the art science to underpin effective management. A day of informative presentations and two days of fruitful discussions will be the basis for two 2014 workshop outputs; a paper on recommended spatial management and mitigation strategies for SMS mining, and a ‘primer-type’ document on conservation genetics at SMS deposits. These outputs are currently being drafted and are expected to be published open access with financial support from INDEEP.

There is increasing industry interest in SMS deposits along the mid-Atlantic Ridge, and VentBase 2016 is likely to be held in the Azores. For updates on post-workshop activities, please see the webpage, <https://www.niwa.co.nz/coasts-and-oceans/ventbase-2014>



Participants from the back, left to right: Jonathan Gardner, Rachel Boschen, Ashley Rowden, Telmo Morato, Malcolm Clark, Frederic Sinniger, Jens Carlsson, Kim Juniper, Alison Swaddling, Leigh Marsh, Amelia Connell, Anna Metaxas, Shannon Tyler, Heidi Berkenbosch, Patrick Collins, Se-Jong Ju, Ann McCrone, James Bell, Adrian Flynn, Verena Tunnicliffe and David Billett. Not pictured: Jonathan Lowe and Barry Winfield.

Meetings & Workshops



Challenger Conference for Marine Science



Registration & call for abstracts: Programme themes

- Physical dynamics and connections of coastal oceans: from estuaries to the continental slope
- Observing and modelling the open ocean: from pole to pole and surface to seafloor
- Biogeochemical Cycles
- Remote-sensing of the marine environment
- Modelling Food web dynamics and Ecosystem functioning
- Modelling Interactions between Hydrodynamics and the Environment
- Exchanges at the air-sea interface: current status and future outlook
- Emerging Technologies
- Marine Time series
- Marine Microbes
- Marine Biodiversity
- Deep-Sea Ecosystems
- Marine policy: Challenges and tools for managing marine and coastal resources

Keynote Speakers

Prof Jason Hall-Spencer—Ecosystem effects of ocean acidification

Prof Icarus Allen— Towards next generation of marine ecosystem models

Dr Isabelle Rombouts—Pelagic biodiversity: from patterns to emerging processes

Dr Emily Shuckburgh—The polar oceans in a changing climate

Dr Adrian Glover—Environmental futures in the deep-sea mining frontier



Abstracts must be received by 30th June 2014

To register & submit an abstract, please visit:

<http://www.2014.challenger-society.org.uk/>

EurOCEAN²⁰¹⁴

7 - 9 October, Rome - Italy

Connecting Science, Policy and People



Setting a seas and oceans research agenda for Europe

EurOCEAN 2014 will provide a valuable opportunity for interaction and exchange between European marine and maritime research actors, stakeholders, policy makers and programme managers. The conference will identify future research priorities in support of blue growth, human health and wellbeing, and sustainable management of coastal seas and oceans. As a key theme, EurOCEAN 2014 will discuss mechanisms to achieve cross-disciplinary approaches in addressing complex societal challenges. The conference will also focus on the goal of connecting science, policy and people.

With a varied and stimulating programme running over 2½ days, EurOCEAN 2014 will include:

- Keynote horizon-scanning presentations from leading European and international scientists;
- Focused discussion sessions on societal, policy and regional challenges including maritime policy, ocean resources, managing marine space, and oceans and human health;
- Dialogue on capacity building including research infrastructures, ocean observing systems and human capital;
- A Mediterranean roundtable, dedicated side events and an open panel discussion moderated by Quentin Cooper, BBC Radio 4 science presenter;
- Identification of emerging challenges and opportunities in seas and oceans research.



Quentin Cooper, panel moderator at the EurOCEAN 2014 conference

The Rome Declaration - ensure you have a voice

Conference participants will contribute to the finalization of a Rome Declaration, designed to set high-level future strategic directions for seas and oceans science and research capacities in Europe. It is intended to seek a unanimous approval of the Rome Declaration during the final session of the conference.

Who should attend?

EurOCEAN 2014 will attract marine scientists, science stakeholders and European and national decision makers and programme managers, i.e. those that set, manage and implement the marine science agenda.

Conference venue and date

The EurOCEAN 2014 conference will take place at the headquarters of the National Research Council of Italy (Consiglio Nazionale delle Ricerche), located in Piazzale Aldo Moro7, 00185, Rome, from 7 to 9 October 2014.

Programme and Registration

Please visit: <http://eurocean2014.eu/programme/>
Register online at www.eurocean2014.eu/registration

- **Early Bird** until June 16, 2014 €150
- **Full Fee** June 17 - Sept. 30, 2014 €250



National Research Council of Italy



Credits: Sea & Sky: Tiago Fioreze - Sun & Clouds: Ifremer - Quentin Cooper: VLIZ

The EuroOCEAN Conference Series

EuroOCEAN 2014 is the 8th conference of the successful EuroOCEAN series initiated in the 1990s. Previous conferences were held in Brussels (1993), Sorrento (1995), Lisbon (1998), Hamburg (2000), Galway (2004), Aberdeen (2007) and, most recently, Ostend (2010). Since 2000, EuroOCEAN conferences have been organized by the European Marine Board and the European Commission (DG Research & Innovation) in partnership with the national agencies hosting the event. EuroOCEAN conferences are normally organized in association with a country holding the Presidency of the European Union.

EuroOCEAN conferences bring together marine scientists and science stakeholders to discuss and identify priority challenges and opportunities for marine science. Through EuroOCEAN conferences, the marine and maritime research community responds to, and impacts on, European science policy developments. Since EuroOCEAN 2004, conference delegates have delivered joint policy statements in the form of declarations. EuroOCEAN declarations are designed to draw the attention of research funders and policy makers to the key societal and scientific challenges for achieving a sustainable interaction with the coasts, seas and oceans. These statements have been critical drivers of research and policy developments in Europe.

EuroOCEAN 2014 will continue in the tradition of the preceding EuroOCEAN 2010 conference that took place in Ostend, Belgium and was attended by more than 450 delegates.

At the announcement of the EuroOCEAN 2014 conference in June 2013, **Máire Geoghegan Quinn**, EU Commissioner for Research, Innovation and Science noted that, *"EuroOCEAN is considered as a top science conference in Europe which delivers concrete messages to science and policy. These are instrumental in strengthening the knowledge base for Europe and developing common priorities in the area of marine sciences"*.

We look forward to seeing you in Rome at EuroOCEAN 2014.

Contact: info@euroocean2014.eu
www.euroocean2014.eu
www.eurooceanconferences.eu



EuroOCEAN 2014 is an official event of the Italian EU Presidency



To our deep-sea colleagues:

We are pleased to invite you to the 14th Deep-Sea Biology Symposium to be held in Aveiro, Portugal from August 31 to September 4, 2015.

Since their first edition in 1977, the international deep-sea symposia have been invaluable fora for exchange of information on the most recent deep-sea explorations and scientific advances. Moreover, the symposia have also been wellsprings of cooperation and formation of new research groups and projects.

In 2015 it is the turn of Aveiro, Portugal, to host the International Deep-Sea Biology Symposium. Previous conferences have been held in Kristineberg, Sweden (1977), La Jolla, USA (1981), Hamburg, Germany (1985), Brest, France (1988), Copenhagen, Denmark (1991), Heraklion, Greece (1994), Monterey Bay, USA (1997), Galway, Ireland (2000), Coos Bay, USA (2003), Southampton, UK (2006), Reykjavík, Iceland (2010) and Wellington, New Zealand (2012).

Once again the Symposium will provide the opportunity for members of the international deep-sea science community to discuss and present their latest research results.

Although the website is still under construction, all the details on the registration, programme and the venue will soon be available at: <http://14DSBS.web.ua.pt>

The conveners,

Marina R. Cunha (University of Aveiro)

Ricardo Serrão Santos (University of the Azores)

Ana Hilário (University of Aveiro)



The poster features a composite image of a coastal city with a crane, a research vessel on the surface, and an underwater scene with jellyfish and fish. The text is overlaid on this background.

IMBER Open Science Conference

FUTURE OCEANS

23-27 June 2014
Bergen, Norway
Research for marine sustainability:
multiple stressors, drivers, challenges
and solutions

www.imber.info





To conserve the world's oceans we must go beyond science, and use it to inform policy and management, and ultimately to catalyse change. The Society for Conservation Biology's International Marine Conservation Congress (IMCC) brings together conservation professionals and students to develop new and powerful tools to further marine conservation science and policy.

The overall theme of the congress is Making Marine Science Matter. For marine conservation to be effective, marine conservation science must matter to stakeholders, policy makers, and practitioners. To accomplish this, the congress will be organized around specific topics of interest for marine conservation in general, as well as the local area. See website for details. Two sessions that may be of particular interest to us are:

- Threats to deep-sea ecosystems*
- Marine conservation on the high seas*

Due to the number of emails received asking for another opportunity to submit abstracts, the organisers have opened additional times for presentations in the IMCC3 program! Your second opportunity to submit abstracts starts 13 May and runs until 3 June 2014.

VENUE INFORMATION

The CCIB - Centre de Convencions Internacional de Barcelona (Spain), the Barcelona International Convention Centre - is an integral part of Diagonal Mar, the newest section of Barcelona's seafloor. CCIB is in the heart of the technology and business district known as Barcelona 22. The CCIB is unique in Europe for the impact and originality of its architecture, for the versatility of its column-free meeting halls and spaces and for the superb use it makes of the warm, natural Mediterranean light.

The city of Barcelona offers numerous world class sightseeing opportunities and is unique for its cultural, artistic and historical richness lovely surroundings. It overlooks the sea with emblematic buildings of Catalan architects Antoni Gaudí and Lluís Domènech i Montaner declared to be World Heritage Sites by UNESCO. Its more modern facilities are the inheritance from the 1992 Olympics. Their mark can also be seen on the hill at Montjuïc, beside the monumental work from the 1929 World Exhibition.

Barcelona is connected worldwide by its international airport located in El Prat de Llobregat, 12 kilometres southwest of the city. A train connects the airport with the railway station.

REGISTRATION INFORMATION

On-line registration and booking information will be available in late October 2013.

Inquiries concerning meeting details should be directed to Dr. Luis Valdés l.valdes@unesco.org

Abstract submission opens November 15, 2013

SCIENTIFIC SPONSORS AND CONVENERs

*The Oceanography Society:
Dr. Mike Roman*

*The Intergovernmental Oceanographic Commission:
Dr. Luis Valdés*



Organization



<http://ioc.unesco.org>
www.ioc.unesco.org/plan/itn/occon.htm

FIRST ANNOUNCEMENT

2nd INTERNATIONAL OCEAN RESEARCH CONFERENCE

Barcelona (Spain), 17-21 November 2014





Jointly sponsored by the Marine Technology Society (MTS) and the Oceanic Engineering Society of the Institute of Electrical and Electronic Engineers (IEEE/OES), OCEANS '14 is a major international forum for scientists, engineers, and responsible ocean users to present the latest research results, ideas, developments, and applications in Oceanic Engineering and Marine Technology.

OCEANS 2014 features tutorials on special interest topics, a comprehensive technical program of lectures and presentations, a student program, and a large exhibit hall with products from over one hundred companies.

Details of the conference events, including a schedule of the technical program, are contained in the OCEANS'14 Program Book. Attendees will receive a printed Program Book at the onsite registration desk.

For more information email us at: info@oceans14mtsieestjohns.org



First Mares Conference
Marine Ecosystems Health and Conservation

November 17th to 21st 2014

Olhão, Portugal

Marine environments are generally considered as highly valuable and their health and conservation status are seen as top priorities. Marine wildlife and habitats are facing multiple anthropogenic threats ranging from eutrophication to overfishing and ocean acidification. There is an urgent need to advance our understanding of the menaces on the marine environment and to provide constructive guidelines for management strategies. The first Mares Conference will take place in this context, aiming to address the main issues dealing with both marine ecosystems health and conservation.

Through six leading themes, this international and open conference will bring together scientists from different levels and disciplines to discuss and address issues about the impact of humans activities on the natural marine environment. The conference will be dynamic, innovative and participative, mixing oral presentations, round table discussions, science café and posters/ digital objects sessions.

The small-scale, relaxed and multigenerational nature of this event will ease knowledge exchanges, networking and building of new collaborations.

The conference will be hosted in Olhão, eastern Algarve, Portugal. Olhão is located at the edge of the natural park Ria Formosa. The town originated from fishing activity and has still an important artisanal fishery activity, together with tourism.

<http://www.maresconference.eu/>



8th International Crustacean Congress (ICC-8) Frankfurt a. M., Germany

August 18-23, 2014

The 8th International Crustacean Congress will be held at the Campus Westend of the Goethe – University (GU) in Frankfurt and is co-organised by the Senckenberg Research Institute and the Faculty of Biological Sciences of the Goethe University.

The 8th International Crustacean Congress will be held at the Campus Westend of the Goethe – University (GU) in Frankfurt and is co-organised by the Senckenberg Research Institute and the Faculty of Biological Sciences of the Goethe University.

See [here](#) how to get there. Pictures of the Campus are [here](#)

Local organisers: Prof. Dr. Michael Türkay (Chairman of organising board), Prof. Dr. Sven Klimpel, Prof. Dr. Pedro Martinez, Doris von Eiff.

Congress language: English, no translation service will be available

Congress Fees:

Full participant	€ 400.—
Full participant “early bird”	€ 350,--
Student	€ 300,--
Student “early bird”	€ 250,--
Single day	€ 100,--

The fees include participation to all events, ice-breaker, lunch (Monday to Friday) at the congress venue, coffee/tea service, abstract volume, printed information matters. Information about payment modes [here](#). Students need a certification from their supervisor in order to be eligible to the reduced fees

Contributions, Abstracts: One oral contribution as first author is allowed per participant. A supplementary poster can be accepted upon application.

Abstracts should be sent in as an e-mail-attachment to the address ICC-8@senckenberg.de. The abstract has to follow a certain format in order to minimise reformatting effort. Please see the requirements here. Abstracts not taking into account the required format will be returned to the author(s) in order to be put in shape.

Publication of Proceedings: Conference papers will be published in one or two issues of *Crustaceana* and the results of some symposia/sessions in the *Journal of Crustacean Biology*, subject to peer review and acceptance by the editorial team.

Programme outline and keynote lectures: The Conference will start on August 18, 2014 at 10:30. Registration will be open from 08:00 on and continue during breaks and the whole day. The conference ends on August 23, 2014 at 13:00. A more detailed programme outline can be seen [here](#). For a list of keynote lectures go [here](#)

Special sessions and symposia: So far 8 special sessions and symposia have been announced. Details [here](#).

Communication: Please use exclusively the official e-mail Address: ICC-8@senckenberg.de for communication concerning congress matters and abstract submission. Using individual addresses of the organisers may result in delays when the person is absent.

Deadlines:

Abstract submission: May 1, 2014

Payment "early bird": May 1, 2014

Payment full participants: June 15, 2014

Registration will come into effect after payment is received

Instructions about mode of payment will be sent after registration.

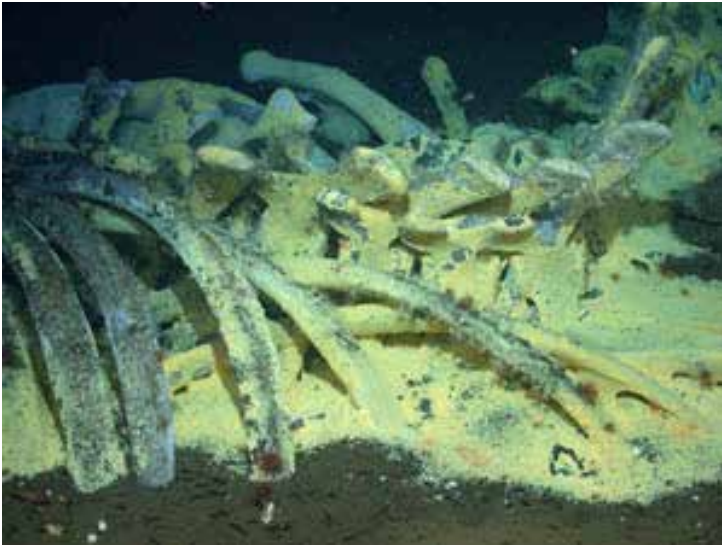
Registration: Registration is open now.

You can register online [here](#).

Friday Harbor Summer Course on deep-sea biodiversity, connectivity & ecosystem function

Craig Smith & Kenneth Halanych

This course, designed for graduate and advanced undergraduate students, will focus on deep-sea ecosystems (below depths of 100 m), which cover more than 60% of the Earth's surface and are increasingly influenced by human activities. Lectures and discussions will highlight the recent explosion in discoveries of new deep-sea habitats, novel adaptations, species radiations, and unusual patterns of biodiversity at the deep-sea floor. The extraordinary range of ecosystems, patterns of biodiversity, and connectivity in the deep sea, from the vast food-poor expanses of abyssal plains to food-rich ephemeral archipelagos of hydrothermal vents, whale falls and wood falls, provide outstanding exemplars to elucidate key principles of biodiversity and connectivity, and the interaction of these ecological properties with ecosystem function.



Whale fall ecosystem at 1670m. Image courtesy Craig Smith

Course goals are to (1) provide basic understanding (including hands-on experience) of deep-sea biodiversity, connectivity, and ecosystem function, (2) introduce methods and tools (from shipboard sampling to molecular genetics) used for their study, and (3) foster critical thinking about current hypotheses and societal environmental issues related to deep-sea ecosystems. Laboratory exercises and student projects will be centred around the study of biodiversity, connectivity, and ecosystem function on experimental whale-bone and wood substrates deployed for 15 months on the deep Oregon-Washington margin and in shallow water near Friday Harbor Laboratories. These whale-bone and wood substrates will be recovered just prior to the summer course. Field trips in the waters around Friday

Harbor will allow examination of ecosystem structure and live faunal collections in diverse deep and shallow marine habitats, providing additional material to support laboratory studies and student projects on biodiversity. These experiments and samples will provide students with a unique opportunity to work with a broad range of materials relevant to deep-sea and general marine biodiversity, allowing them to test key ecological hypotheses using state-of-the-art molecular techniques and statistical approaches.

This course has NSF-supported student stipends available.

Dr. Craig Smith
University of Hawaii at Manoa
Department of Oceanography
craigsmi@hawaii.edu

Dr. Kenneth Halanych
Auburn University
Biological Sciences Department
ken@auburn.edu

(Biol 533 E, 9 credits)

Please note: course is offered under the “umbrella” course Biology 533: Advanced Organismal Biology. Thus transcripts from University of Washington will list the course title ADV ORG BIOL rather than the specific Friday Harbor Laboratories’ course title listed above.

Summer Term B: July 21 - August 22, 2014 (5 weeks)

Monday-Saturday (Mon-Fri 8:30 am-5 pm, plus Sat morning 8:30 am-noon, except final week no Saturday meeting)

Arrive Sunday, July 20 after 3 pm, depart Friday, Aug. 22 after lunch.

Enrolment limited to 15 students.

Marine Conservation Summer Institute

A practicum in natural science, social science, law, and policy for professionals, graduate students, and advanced undergraduates at the DUKE MARINE LAB, BEAUFORT, NC

July 7 – August 8, 2014



ENROLL TODAY!

The Marine Conservation Summer Institute will immerse students in the world of marine conservation biology and policy, giving them a set of basic tools for addressing and understanding issues of conserving marine biodiversity in the context of 21st Century society and the ‘anthropocene’ epoch. The Institute is set in the vibrant educational and research setting of the Duke University Marine Laboratory in Beaufort, North Carolina.

The five-week course consists of three weeks of plenary lectures, field trips and activities, and two intensive week-long modules intertwined in weeks two and four and led by experts in the field. Plenary weeks and modules will be focused on hands-on, team-based, experiential learning with meaningful faculty-student engagement that are hallmarks of the educational environment at the Marine Laboratory. Students will be in the field and at the discussion table, learning the basic tools of conservation biology and policy in the plenary weeks and delving deeply into special topics with experts during the module weeks.

ENGAGE WITH WORLD EXPERTS



DOUG NOWACEK
Conservation Technology
Institute Director



JAMES KRASKA
International Law



ANDY READ
Conservation Biology
Marine Vertebrates



STEVE ROADY
Environmental Law



CINDY VAN DOVER
Deep-Sea Ecology &
Conservation

2014 Themes

- Human Dimensions and the Marine Environment
- Deep-Sea Conservation & International Ocean Governance
- Invasive Species
- Marine Vertebrate Conservation & US Oceans Law

Learning Objectives

- Apply fundamental concepts of conservation biology and policy
- Understand strategies used to protect biodiversity
- Analyze key concepts of social science and law involved in conservation

Skill Sets

- Effecting change, understanding process
- Mechanics of policy development
- Organizational behavior and misbehavior
- Negotiation dynamics
- Understand roles and parameters

Eligibility: Open to international practitioners, graduate students, advanced undergraduates.

Credits: 7 credits, 2 course equivalents

Tuition: \$7,028

Room & Board: \$2,340

Fees: \$180.75

Books: \$200

Questions? Contact mcsi@duke.edu

www.nicholas.duke.edu/marinelab/programs/mcsi



INCISE International Network
for submarine Canyon
Investigation and
Scientific Exchange

INCISE would like to invite you to the
**2nd International Symposium
on Submarine Canyons**

29 Sept – 01 Oct 2014

@ BGS Office

Edinburgh, Scotland, UK

Latest symposium updates on www.incisenet.org

Contact: incise.network@gmail.com

Bathymetry of
Whittard Canyon,
GSI Dublin



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL



**National
Oceanography Centre**

NATURAL ENVIRONMENT RESEARCH COUNCIL

Marine Institute
PLYMOUTH UNIVERSITY



Ifremer



International Network for submarine Canyon Investigation and Scientific Exchange

Submarine canyons are growing in interest due to their complexity, the variety of processes taking place and the resulting diversity of their habitats. The aim of INCISE is to bring together the community of submarine canyon scientists to stimulate cross-discipline discussions, leading to integrated research tackling the essential questions that will increase our understanding of these systems.

The 2nd INCISE Symposium will combine traditional conference-style oral and poster presentations with a set of break-out working-group discussions, focusing on themes such as:

- *Canyon processes in the space-time continuum*
- *Natural geological and physical disturbance processes and their impact on biological communities, compared to anthropogenic disturbance*
- *Submarine canyons as species refuges: what is the scientific evidence (biological & oceanographic)?*
- *Policy development for submarine canyon conservation*
- *Coordinated sampling and monitoring*

Important dates:

April 2014	Abstract submission & registration open
1st July 2014	Deadline abstract submission
1st Aug 2014	Early bird registration closes
1st Sept 2014	Late registration closes
28th Sept 2014	Ice-breaker reception
29th Sept 2014	Presentations & posters
30th Sept 2014	Presentations & posters, conference dinner
1st Oct 2014	Presentations & working group discussions

©NOC Southampton

Organising Committee:

Heather Stewart (BGS)
Sophie Green (BGS)
Jaime Davies (University of Plymouth)
Veerle Huvenne (NOC)
Lenaick Menot (IFREMER)

Scientific Committee:

Rob Hall (University of East Anglia)
Nathalie Valette-Silver (NOAA)
Joshu Mountjoy (NIWA)
Aaron Micallef (University of Malta)
Peter Harris (Geoscience Australia)
Steve Ross (UNC Wilmington)



There are a number of special sessions during the WCMB 2014 that maybe of interest to the deep-sea community:

Main Theme 6: Deep-sea Biodiversity

Session 7: Anthropogenic impacts on deep-sea biodiversity and their consequences

Session chairs: Telmo Morato (IMAR University of the Azores, Portugal), Eva Ramirez-Llodra (Norwegian Institute for Water Research, Norway), Kristina Gjerde (International Union for Conservation of Nature, USA) & Lisa Levin (University California San Diego, USA)

We are proud to announce that 3rd World Conference on Marine Biodiversity (WCMB-2014) will host a session on “anthropogenic impacts on deep-sea biodiversity and their consequences”. On behalf of the session chairs, I invite you to submit abstracts before 30th of May and disseminate your recent scientific work regarding current and future threats to deep-sea biodiversity, techniques for assessing diversity changes and their functional consequences, as well as measures to mitigate adverse impacts of human activities in the deep ocean. We expect to generate discussion that will explore how best to approach future challenges in this realm.

It is recognized that the deep sea is in trouble mainly due to the rapid depletion of their fish resources, consequent damage to sessile habitat-building organisms caused by destructive fishing gears, and the disposal of residues and litter. New industrial activities will emerge in the deep sea and will likely include deeper fishing, the extraction of gas hydrates, mining, carbon sequestration, and harvesting of genetic resources, among others. These new activities, along with the cumulative effects of ocean acidification and climate change, will further impact deep-sea biodiversity and, consequently, ecosystem functioning and the services these functions provide. Therefore, assessing the impacts of existing and future human activities on deep-sea marine ecosystems is one of the major challenges for future research aiming at informing sustainable management and conservation of our deep ocean. We invite you to disseminate your recent scientific work regarding current and future threats to deep-sea biodiversity, techniques for assessing diversity changes and their functional consequences, as well as measures to mitigate adverse impacts of human activities in the deep ocean.

Theme 6: Deep-sea Biodiversity

Session 8: Evolution in the deep sea: origins, adaptation and diversity

Session chairs: Adrian Glover (Natural History Museum, UK), Moriaki Yasuhara (University of Hong Kong, China), Holly Bik (University of California Davis, USA), Mike Rex (University of Massachusetts, USA)

The proposed session will bring together multiple complementary lines of evidence with respect to the fundamental question of the origin, evolution and adaptation of life in the deep sea, Earth’s largest and least-explored habitat. At a time of rapidly increasing exploration of the deep for both scientific data and resource exploitation we propose this session to help synthesise existing knowledge and present new data from palaeontologists, palaeobiologists, molecular biologists, zoologists and ecologists that will provide a new benchmark for the future study of evolution in the deep sea.

We would welcome abstracts in areas of deep-sea evolutionary biology, deep-sea palaeontology and palaeobiology, past

deep-sea extinctions, deep-sea adaptations, deep-sea genomics, deep-sea biodiversity, macroecology and macroevolution.

Theme 6: Deep-sea Biodiversity

Session 6: Ecological and evolutionary paradigms in marine biology and how meiofauna can be used to address them

Session Chairs: Jeroen Ingels (Plymouth Marine Lab, UK), Richard Warwick (PML, UK), Zhi Nan Zhang (Ocean University of China), Gustavo Fonseca (University of Sao Paulo, Brazil)

This special session will address how marine meiofauna research is contributing to advances on major biological, ecological and evolutionary paradigms at different levels of biological organisation; i.e. from the molecular level (genome, proteins, etc.) to organismal, population, communities and ecosystems, and how meiofauna can help us to tackle issues on climate change, anthropogenic pressures, conservation, marine management, and sustainable development. Many members of the International Association of Meiobenthologists (IAM), the international meiofauna community, INDEEP researchers and multidisciplinary researchers from other scientific networks have supported this proposal and are keen to take the opportunity of the likely well-attended WCMB III to highlight the importance of meiofauna in marine biodiversity research and to bring together a diverse group of scientists from all over the world to exchange ideas, enhance collaboration and identify the paths of future marine biodiversity research. Particularly important is the potential of developing and strengthening collaborations and ideas between biodiversity researchers from different geographical regions; given the rise in scientific interest in meiofauna research in Asian countries and other parts of the World and as part of more holistic approaches to marine biodiversity science, we anticipate that the proposed session would evoke great interest.

Topics will include (but are not limited to) basal questions into the origins, nature and extent of biodiversity, its relatedness to ecosystem function, cosmopolitanism and endemism, energy flow at the basis of the food web or the plant-animal interface, size ranges of species, biology of organisms and reproduction, etc. Topics will cover a wide array of habitats and environments, and include a diverse range of morphological, molecular and combined techniques.

All sessions at a glance:

Session 1: Effects of multiple stressors on ecosystem process, functioning and services (Convenor: Martin Solan, M.Solan@soton.ac.uk)

Session 2: Marine ecological disaster and biodiversity (Convenor: Song SUN, sunsong@qdio.ac.cn)

Session 3: Valuation of marine biodiversity and ecosystem services (Convenor: Shang CHEN, gdcs@163.com)

Session 4: The Energetic Basis for Marine Macroecological Patterns (Convenor: Craig R. McClain, cmclain@nescent.org)

Session 5: Linking marine biodiversity science and advice (Convenor: Henn Ojaveer, henn.ojaveer@ut.ee)

Session 6: Ecological and evolutionary paradigms in marine biology and how meiofauna can be used to address them (Convenor: Jeroen Ingels, jein@pml.ac.uk)

Session 7: Anthropogenic impacts on deep-sea biodiversity and their consequences (Convenor: Telmo Morato, telmo@uac.pt)

Session 8: Evolution in the Deep Sea: Origins, Adaptation and Diversity (Convenor: Adrian Glover, a.glover@nhm.ac.uk)

Session 9: From ocean observation to decision making (Convenor: Ward Appeltans, w.appeltans@unesco.org)

Session 10: Global patterns in marine biodiversity (Convenor: Mark Costello, m.costello@auckland.ac.nz)

Session 11: Marine Algal Resources & Global Change (Convenor: Siew Moi Phang, phang@um.edu.my)

Session 12: Microphytobenthos: Advances in understanding- Ecology, Biodiversity and Function (Convenor: David M. Paterson, Rupert Perkins, dp1@st-andrews.ac.uk)

WOC to convene business forum on ocean policy and planning



September 28-30, 2014, New York City

Ocean governance, policy and planning developments are occurring at an increasing pace at national, regional and international levels - with significant implications for ocean business. Unfortunately, ocean industries are often not aware of - much less engaged in - these processes critical to their future.

The World Ocean Council (WOC) will convene a Business Forum on Ocean Policy and Planning to address the need for the ocean business community to be more informed and proactively involved in marine policy and planning activities affecting ocean economic activity.

The WOC Business Forum on Ocean Policy and Planning (28-30 September, 2014, New York City) will bring together representatives of oil and gas, shipping, seafood, fisheries, aquaculture, mining, renewable energy, ocean science and technology, maritime law, marine environmental services and other sectors of the diverse ocean business community.

Planning for the Business Forum has begun and more information on the program will be available soon. Please set aside the dates for this important event.

The WOC welcomes the participation of the international ocean business community as well as representatives from the non-ocean business community interested in working with the private sector towards responsible and effective ocean policy and planning.

The WOC is monitoring, analyzing and reporting on the ocean policy and planning developments affecting responsible ocean business activities and has usually been the only private sector entity involved in these processes.

At the international level, critical ocean policy arenas include UN negotiations on a new "Implementing Agreement" for the Law of the Sea, the UN Biodiversity in Areas Beyond National Jurisdiction (BBNJ) discussions, the UN Sustainable Development Goals development, and the Convention on Biological Diversity (CBD). It is important to ensure that ocean industries are informed and constructively engaged in these processes, and that ocean policy and planning efforts have full and balanced information from ocean economic operators.

Ocean business community representatives are invited to participate in the WOC Business Forum's Program Committee which will be developing the technical program including the Forum Goals, Expected Outcomes and Program/Format/Sessions.

Please indicate your interest in participating on the Program Committee for the Business Forum on Ocean Policy and Planning by emailing Leslie-Ann McGee: la.mcgee@oceancouncil.org, prior to 10 April 2014.

2nd International workshop on taxonomy of Atlanto-Mediterranean deep-sea sponges

University of Bergen, Norway

2nd – 6th June 2014

<http://spongedeep2014.b.uib.no/>

The Centre for Geobiology and the Biology Department of the University of Bergen (UiB) will be hosting the 2nd International Workshop on Taxonomy of Atlanto-Mediterranean deep-sea sponges, following a very successful first edition in the Azores in 2012. The main aim of this workshop is to bring together established sponge taxonomists and taxonomists-in-training to present their latest research and work side-by-side on the identification and classification of Atlanto-Mediterranean deep-sea sponges. The workshop is fully booked, but the main highlights can be followed on a daily basis via the workshop webpage and blog: <http://spongedeep2014.b.uib.no/>

For further information please contact Joana Xavier – Joana.Xavier@bio.uib.no

It's Your Opinion

The curious child

(Winning Essay of NERC's Inaugural Short Article Competition)

By Laura Hepburn

PhD student, University of Southampton, UK

Violent plumes of hot, metal-rich, seawater are released into the ocean at tectonic boundaries in the Earth's crust through hydrothermal vents akin, in appearance, to underwater volcanoes. Hydrothermal vents are deep-sea oases, teeming with diverse animals found nowhere else on Earth.

I still remember the first time I came across them. Aged eleven, I stood in our local aquarium engrossed by a photograph of gnarled, ochre-coloured chimneys issuing plumes of dense 'black smoke'. Bizarre animals, the likes of which I had never seen before, were clamouring over one another in a desperate attempt to reach the dark, writhing plume.



Thirteen years later I'm sat in a cold, dark shipping container on the back of the 'Royal Research Ship – James Cook' in the Southern Ocean as a first-year PhD student. This particular container has been modified into a hi-tech laboratory currently controlling the movements of our unmanned, deep-sea submersible 'ISIS'. Thirty television monitors relay the live images and scientific measurements recorded by ISIS as it navigates the barren seabed nearly a mile below, hunting for the telltale signs of a vent.

Hydrothermal systems have not yet been discovered in this part of the world, mainly due to the technical challenges posed by extreme weather conditions south of the Antarctic

Polar Front. I've been watching monotonous seabed since my 'watch shift' began nearly four hours ago. Then ISIS turns around. Suddenly our monitors are engulfed in a thick plume of black smoke and we can't see a thing. Carefully our pilots manoeuvre ISIS into position and there it is. A magnificent chimney stands proud of the seabed billowing 180°C fluid: stalked barnacles that look like strange lollipops wave majestically at the top of chimney; hairy-chested crabs scramble over one another for prime position closest to the oozing fluid; dark, inanimate patches of chimney turn out to be a large group of snails; while predatory starfish and anemones wait patiently below to catch any stray creatures that wander too far from the safety of the warm vent fluid. I sit motionless; spellbound once more by that magical scene that seemed so alien to me all those years ago. In that moment it strikes me that at the heart of every scientist is an inquisitive child fixated with mind-blown awe by the incredible world around them.

Teaching deep-sea ecology in developing countries

Ana Hilário

University of Aveiro, Portugal

The Portuguese Speaking African Countries (PALOP: Angola, Cape Verde, Guinea Bissau, Mozambique and São Tomé and Príncipe) and East Timor are amongst the poorest in the world. With the conviction that education, particularly science education, is the most important driver of social and economic development in a country, the Graduate Program Science for Development (PGDC; <http://pages.igc.gulbenkian.pt/pgcd/en/>) was created to prepare African and East Timorese students to pursue a scientific career and train a new generation of University professors.



The PGDC is structured to include one year of graduate courses, taking place in Praia, Cape Verde, followed by a 3-year research period leading to a PhD thesis that will be split between the home countries and institutes and universities worldwide. PGDC first edition is currently under way and has a strong focus on plant biology, tropical diseases and marine biology. It was with great joy that I received an invitation to be part of this innovative project as the coordinator of a teaching module on marine ecology and sustainable use of marine resources, with a special focus on deep-sea ecosystems.



Benefiting from extensive coastlines the PALOP and East Timor have always used the ocean, but with the possibility to exploit deep-sea mineral resources these countries have pinned much of their hopes on economic development and self-reliance on the offshore gas and oil reserves. However, to respond to all stewardship challenges bestowed by the exploitation of deep-sea resources, a new generation of trained deep-sea scientists is fundamental. The fifteen students, with scientific backgrounds as disparate as marine ecology, chemical engineering and veterinary medicine, were presented with key concepts of science, technology, economics, policy and law and were, in the end, able to debate cutting edge research on deep-sea ecology and current themes on marine policy and governance as well as to identify specific problems and possible solutions for the exploitation and the conservation of marine resources in their own countries. For me, as a Portuguese scientist, this was a most rewarding experience: Portugal and the PALOP and East Timor share not only a language but also a common history and it is very satisfying to think that my contribution, although small, may help to reduce the scientific, technological and economic gaps between these countries and so-called developed countries.

A plea for high-throughput molecular monitoring of the deep sea

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¹University of Geneva, Switzerland, ²NOC, UK

Recent developments in DNA barcoding and environmental genomics based on next-generation sequencing technologies offer a new avenue for exploring the diversity of life in the oceans. These techniques can be applied to any type of marine sample (water, sediment, stomach contents) and can focus on a specific group of organisms or provide data on global biodiversity. They can be used to detect only metabolically active organisms (RNA) or to follow long-term changes by analysing DNA preserved in the environment.



Benthic foraminifera from Scottish lochs: Leptohalysis scotti.
Image courtesy Jan Pawlowski.

Molecular monitoring provides an extremely powerful way to monitor the health of deep-ocean ecosystems. Among its many advantages are: (1) easy and reliable taxonomic identification, including cryptic and small-sized species; (2) insights into global marine biodiversity, including all taxonomic groups; and (3) rapid and standardized processing of large numbers of samples. In contrast, traditional, morphology-based biomonitoring demands highly trained and experienced specialists and is costly and time-consuming. A study just published in *Molecular Ecology Resources* (Pawlowski et al. 2014) describes the application of molecular monitoring for assessing the impact of salmon farming on shallow-water foraminiferal assemblages. In the deep sea, where foraminifera are a dominant and highly diverse faunal component that

includes many undescribed species, their sensitivity to environmental changes make them potentially very valuable bioindicators. As we enter an era when plans for the industrial exploitation of the deep sea are gaining considerable momentum, we believe that high-throughput molecular monitoring of foraminifera and other groups of meio- or micro-organisms could become a gold standard for the assessment of deep-sea ecosystem impacts.

Scientist Profiles

Mia Roditi-Elasar

Canyon Food Webs

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As a dolphin researcher, I found myself in a whole new world in my Ph.D. studies. A high number of bottlenose dolphin (*Tursiops truncatus*) sightings above Achziv submarine canyon on the northern Israeli coast motivated a research project, under the supervision of Drs. Dani Kerem, Dror Angel and Michael Lazar, of the underlying food web in an attempt to collect more evidence in support of the canyon serving as a production “hotspot”.

Achziv Submarine Canyon creates a unique marine ecosystem along a coastline characterized by a generally broad and shallow continental shelf in the ultra-oligotrophic Levantine Basin.

Seven research cruises over a period of 3 years were conducted atop the canyon and at iso-bathic reference sites at depths ranging between 150-700m. CTD profiles were obtained and samples taken from the water column (nutrients, chlorophyll, bacteria and plankton) and seafloor (total organic carbon, benthic invertebrate composition). An additional cruise to explore the fish, molluscs and crustaceans captured by a trap, net and hook system is planned for the near future. The cruises followed and partly coincided with 6 years of marine mammal surveys in the area.

As I enter the final stages of assembling the unique food web puzzle of this canyon system, I can truly appreciate my encounter with the amazing world of planktonic and benthic invertebrates in general and those of the deep sea in particular.

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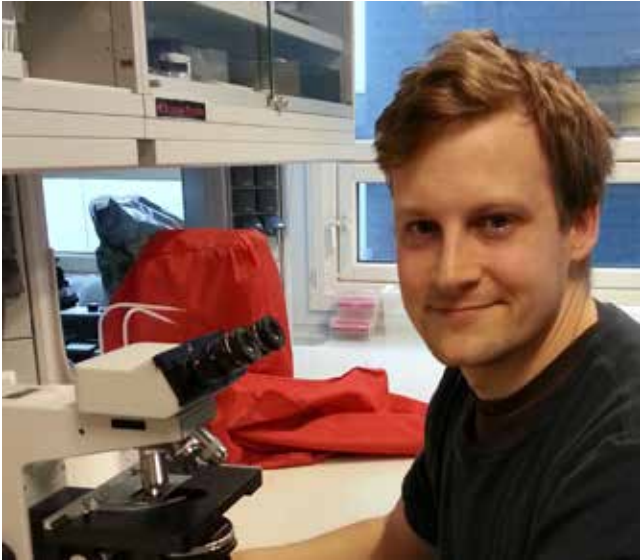
Hyperiidea sp. Image courtesy Mia Roditi-Elasar.

Jon Hestetun

Carnivorous sponges of the deep

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I am a PhD student of the Centre for Geobiology and Biology Department at the University of Bergen in Norway. In my PhD project I investigate the taxonomy, phylogeny, biogeography and ecology of a very particular group of sponges – the carnivorous sponges – mainly contained within the family Cladorhizidae.

Although cladorhizid sponges have been described as far back as the 1870s, it was not until 1995 that they were found to employ a carnivorous feeding strategy. This trait, present in more than 100 currently described species, is a major departure from the normal filter-feeding mode of all other known sponges thus challenging, to some extent, the definition of the phylum itself. In carnivorous sponges prey items such as small crustaceans or larvae are trapped by entangling filaments or

within inflated spheres, enveloped by migrating sponge cells and then digested over several days. Although a couple of species have been recorded as shallow as 20 m, most carnivorous sponges are found in deep sea on the shelf, slope, abyssal plains and mid-ocean ridges, with the deepest record being that of *Asbestopluma occidentalis* at 8840 m.

The three main goals of my PhD project are (1) to provide a taxonomic review of Atlantic and Arctic cladorhizid species, (2) to investigate the phylogenetic relationships of the Cladorhizidae and allied families using molecular data and (3) to investigate the ecology of and presence of suspected chemoautotrophic symbiotic bacteria in vent- and seep-associated cladorhizids.

For the taxonomic review I have been examining, by means of optical and electron microscopy, the external and internal morphological characters of numerous specimens from various cruises and museum collections. Thus far we have described five new cladorhizid species of the Atlantic, and a similar number of new species descriptions is underway. For the molecular phylogeny I am generating and analyzing sequence data from several nuclear and mitochondrial markers. For the ecology and vent association of cladorhizid species a combination of methods such as stable isotope analysis, transmission electron microscopy, fluorescence in-situ hybridization, and next-generation sequencing will be employed.

I consider myself lucky to work with these exciting deep-sea animals, especially in conjunction with the special vent and seep habitats in the Norwegian-Greenland Seas. The upcoming cruise of the Centre for Geobiology to the vents along the Arctic Mid-Ocean Ridge will allow me to focus on the role of cladorhizid sponges in these systems as well as looking into their microbial diversity.

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Karen Jacobsen

Scientific Illustration

In-Situ Science Illustration, USA

Scientific Expedition Illustrator Karen Jacobsen is available to accompany your research expeditions and provide hand rendered watercolor images for immediate use in educational outreach, web sites, blogs, or other publications.

20+ years experience with deep-sea research, and 15 international expeditions at sea, Jacobsen provides a unique science communication angle adding beautiful visuals to your research cruise information and outreach.



Jacobsen works directly with science on board ship. This provides opportunities for personal and accurate observations of environment, and detailed inspection of original specimens. Original imagery thus captures the subtle and innate beauty of the environments and unique fauna of the deep sea. Also available are services for identification drawings and new species work for research publication.

References, CV, and other information available on request.

For more information please contact Karen Jacobsen at In Situ Science Illustration

issikj@aol.com or 208.412 9444

<http://web.wm.edu/muscarelle/exhibitions/traveling/beyond/index.html>

<http://oceanography.ml.duke.edu/vandover/cruises/science-and-art-at-the-moment-of-discovery/>



Ariadna Mecho

Mediterranean deep-sea echinoderms and more!

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

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I am currently finishing my Ph.D. research at the Institute of Marine Sciences (ICM-CSIC) and expecting to submit my thesis in June 2014.

My expertise focuses on morphological taxonomy, distribution, biology and life-history patterns of non-crustacean invertebrates from the deep Mediterranean Sea, with special interest in the Phyla Echinodermata, Sipuncula and Echiura. Our samples were collected by trawling between 850 m and 4000 m depth. For Mediterranean Echinoderms alone, we have reported one first record, one rediscovered species, one 'rare' species and we have expanded the depth range of four species. I have also been working with ROV imaging, resulting in the first visual observation of a carnivore ascidian in the Mediterranean Sea. All these data reflect how little we know about non-crustacean invertebrates in the deep Mediterranean and opens doors to exciting and interesting scientific projects. During my Ph.D. fellowship, I also acquired a considerable competence in scientific cruise planning and sea-going experience by participation in over 18



multidisciplinary oceanographic cruises in the Mediterranean Sea and Atlantic Ocean. I also have teaching experience gained through lectures given during the MSc course 'Dynamics of marine ecosystems in the deep sea' in the University of Barcelona.

I am searching now for a postdoctoral position abroad. My future research plans are aimed at acquiring 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, faunal behavior, bathymetric and regional distribution of these specific groups. My ultimate goal is to use molecular techniques for the comparison of endemic deep-sea fauna of the Mediterranean Sea with sister species dwelling in other oceans.

Christine Shulse

Microbial communities of the CCZ

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I am a microbiologist interested in the function and structure of microbial communities within the marine environment, from coral reefs to the deep sea. I received my Ph.D. in Biology from the University of California San Diego in 2012, where I researched the genetic and functional diversity of microbial secondary lipid biosynthetic pathways. Currently I am a postdoctoral scholar studying bacterial and archaeal diversity in the sediments of the Clarion-Clipperton Fracture Zone, an area of high interest for polymetallic nodule mining. Marine sediments cover ~75% of Earth's surface, yet we have little understanding of the forces that shape microbial community structure within these environments. Likewise, microbes residing in marine sediments are presumed to play important roles in the global carbon cycle, yet the predominant microbial metabolisms remain uncharacterized. As part of the ABYSSLINE team, I

sampled the water column, sediment, and nodules within the United Kingdom's claim area in order to gather baseline microbial community structure and function data before any potential disturbance through mining activities. Samples are currently being analyzed using a variety of molecular techniques, including high-throughput amplicon sequencing and metagenomics, in order to reveal the genetic potential of these communities. Through this work I hope to contribute to the conservation, recovery, and responsible exploitation of our deep-sea resources. Central to this will be an understanding of the biogeography, connectivity, and ecological role of microbial populations at the seafloor.

Website: <https://sites.google.com/site/cmoreshulse/>

Ulla Fernandez-Arcaya

Deep-Sea fish of the Mediterranean

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I am a deep-sea biologist specialised in bathyal and abyssal megafauna and, in particular, in deep-sea fishes. I have been lucky to work with the Deep-Sea Group of the Institute of Marine Sciences (ICM, CSIC) during the previous five years of my research, as a PhD and young postdoc, where I have learned about the structure and functioning of deep-sea ecosystems.



The final aim of my PhD, which I finished in December 2013, was to better understand the reproductive patterns of the Mediterranean deep-sea fish community and their specific response to physico-chemical variables.

Throughout my PhD, I was part of a successful field period, participating in 18 multidisciplinary oceanographic cruises. I have worked with environmental and megafaunal samples from the Mediterranean slopes, submarine canyons and deep basins, between 400 and 4000 m, using different equipment (CTDs, suprabenthic sledge, Agassiz and benthic otter trawls). By analysing the large amounts of data, we described for the first time the reproductive biology of 9 deep-sea fish species, greatly increasing our knowledge of the reproductive ecology of deep-sea fishes, including population distribution, gametogenesis, egg size, fecundity and recruitment patterns. I also conducted a comparative analysis of population structure and reproductive patterns for the whole fish community distributed along the continental margin, resulting in the first observation of preference recruitment areas of deep-sea fishes in the Mediterranean Sea and a temporal synchronisation of reproduction related to the depth of distribution of the species. Currently, I am working on a comparative study of fecundity and egg size of deep Mediterranean fish species along a wide bathymetric range (from 200 to 3000 m depth).

I am excited to develop further my research career in deep-sea research and I am currently searching for a postdoctoral position abroad. My main interest areas of research are related to fish life-history patterns in relation to natural and anthropogenic changes, with the view to develop tools and guidelines for knowledge-based management.

If the opportunity arises, I would be delighted to further discuss my research and personal capabilities. Please do not hesitate to contact me at: ulla@icm.csic.es.

Wanted

WANTED!!

Carnivorous sponges – Family Cladorhizidae

Jon Hestetun

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Any specimens (or subsamples) of carnivorous sponges fixed and preserved in 96% ethanol, i.e. suitable for my ongoing work on the molecular phylogeny of the group. Sponges are usually erect, branching or stalked, and set with numerous filamentous projections or spheres; color usually white or light grey/beige/pink. Vent- or seep-associated specimens are especially welcome. For further information please contact Jon Hestetun – Jon.Hestetun@bio.uib.no

