

# Deep-Sea Life

Issue 6, November 2015

Welcome to the sixth edition of Deep-Sea Life: an informal publication about current affairs in the world of deep-sea biology. Once again, we have a wealth of contributions from our fellow colleagues to enjoy concerning their current projects, news, meetings, cruises, new publications and so on.

Firstly, you may notice a slight change to the section ordering in that we have moved the “Hot off the Press” section to the end as we feel it works better there.

A key feature of this issue is a report and photos from the 14th Deep-Sea Biology Symposium (see page 13). It was a pleasure to see so many of you at this excellent and well-run event in Aveiro. Looking forward to the next one (in MBARI) already! So, hardly a surprise then that the “Photo of the Issue” is a lovely, sunny group photo of



the symposium participants taken outside the beautiful venue – the “Fábrica Jerónimo Pereira de Campos” AKA Cultural and Congress Center of Aveiro. Thanks to Isa Cunha for this contribution.

I always appreciate any feedback regarding any aspect of the publication, so that it may be improved as we go forward. My mailing list for Deep-Sea Life reaches around 1000 scientists and other stakeholders. Please circulate to your colleagues and students who I have not reached as yet, and have them contact me if they wish to be placed on the mailing list for future issues of this publication.

Once again, I would like to sincerely thank all those that have contributed to this issue of Deep-Sea Life. Your efforts are appreciated. And of course as always, thanks to my faithful co-editors and producers, Dr Abigail Pattenden (University of Limerick, Ireland) and Dr Eva Ramirez-Llodra (NIVA, Norway).

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

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# Cruise News

## GoMRI cruise to the deep Gulf of Mexico

Travis Washburn

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This summer, I had the chance to explore a different area of the Gulf of Mexico during a GoMRI cruise examining recovery of the deep-sea benthos from the Ixtoc oil spill. It was primarily a coring cruise using a multicorer to collect samples at various depths around the Ixtoc wellhead, which blew out in 1979. My research focus was on the infauna, to determine if they had recovered and to glean insights on how the deep-sea benthos in the northern GoM will recover from the Deepwater Horizon blowout.



*Cruise participants, styrofoam skulls and core processing on board the BO Justo Sierra*

While coring sediments is the same pretty much everywhere you go, working in Mexico was a unique experience for me. With most of the crew and several of the scientists only speaking Spanish, I soon learned the importance of hand gestures and the all-mighty finger point to work up samples. And while the BO Justo Sierra was not all that large by research standards, the 2-man bunks and bathroom for every two rooms was truly a luxury. The view was also nice, with the usual sight of oil rigs in the Northern GoM replaced with an empty expanse of ocean. I even celebrated my birthday by taking a large bite out of a layered cake per Mexican tradition and shrunk a Styrofoam dia De los Muertos skull in one of the deepest parts of the GoM. I am very grateful for the opportunity to work in Mexican waters and for the great American and Mexican friends I made during the cruise.

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## Mapping the deep: Striking coral gold off the coast of Ireland!

Amber Cobley<sup>1</sup>, Rebecca Ross<sup>2</sup>, Nils Piechaud<sup>2</sup>, Liam Lachs<sup>3</sup> and Joshua Davison<sup>2</sup>

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The Deep Sea Conservation and Research Unit (DeepSeaCRU) of Plymouth University, (PI Dr. Kerry Howell) along with partners from the National University of Ireland Galway (NUIG, Co-PI Dr Anthony Grehan) and Centre for Environment, Fisheries and Aquaculture (CEFAS) conducted a research cruise in July 2015 to verify predictive habitat models of



sponge grounds and cold-water coral reefs in the North East Atlantic (CE15011). Four new coral reefs have been discovered in the process!



Fig.1 – Montage of images from ROV Holland-1 during CE15011. (Copyright ROV Holland-1, Marine Institute and Plymouth University).

This expedition is thought to be the first ever cruise with the purpose of validating models. The funding was through EUROFLEETS and was conducted onboard RV Celtic Explorer with the wonderful piece of kit that is ROV Holland-1.

The models predict habitats formed by aggregations of *Pheronema carpenteri* and Scleratinian reef. Both fine (Ross et al. 2015, Piechaud. in progress) and coarse scale models (Ross et al. 2013, Piechaud. in progress) were produced for each habitat type using multibeam bathymetry (fine scale = 200m) and GEBCO bathymetry data (broad scale 750m). Topographic variables (depth, slope, BPI, rugosity) derived from the respective scale bathymetry and videos of the seabed taken from previous cruises determined the presence/absence of the aggregations and reefs to base the model on. Because the nature of the models required presence-only modelling, algorithms in Maxent elucidated the average conditions the habitat complex is found in. Searches based on these results calculated likelihood values across the rest of the map at both fine and broad scale.

Areas to validate on the cruise were chosen mainly based on where both models agreed, where the models disagreed, and areas where absences were predicted, to ensure the model was as good at predicting where the habitat complex is found as it is at predicting where they are not found.

The theory that the models produced not only predict *Lophelia* reef, but also *Solenosmilia* reef was proven when finding deeper, dead *Solenosmilia* reef on the second leg of the cruise, broadening the predictive impact of these models ever further.

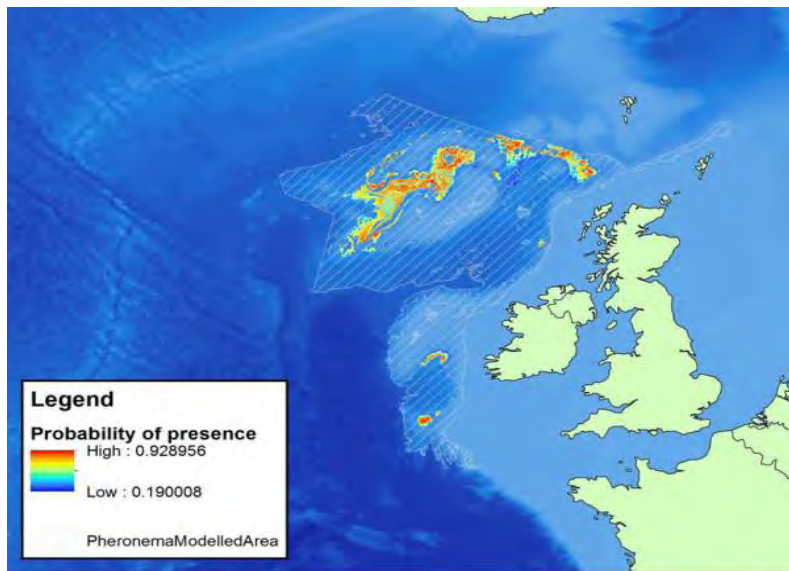


Fig. 2 - Map of the predicted distribution of deep-sea sponge fields composed of *Pheronema carpenteri* in UK and Irish deep sea

The team set out with the hypothesis that fine-scale models would perform better. This proved true for Scleractinian reefs but interestingly, the coarse model performed better when looking for *P. carpenteri*. This could potentially be evidence of a larger-scale process driving sponge aggregation presence, for example, a need to be near a flat slope but also with a large-scale camber, initially posited by Rice, Thursten & New, 1990.

With regards to these larger scale processes, NUIG researcher Allan Grassie and Liam Lachs were looking to detect internal tidal waves and analyse their interaction with the continental slope as a means of modelling carbonate mound environments. Moorings are the best way to

detect internal waves as they give data as a continuous time-series (Bogucki et al. 1997), however the experimental design used to detect internal waves used repeat CTD deployments along a transect on the continental slope of the North East Porcupine Seabight to trace the internal wave beams, similar to the method used in Pingree & New (1991). Internal tidal waves seem to be generated around an abnormality of the continental slope at around 1200m depth. Propagating upslope they graze the sea bed and reflect off the continental slope at 600-900m depth, as described in White & Dorschel (2010). The turbulent mixing that ensues from the reflection of these enhanced internal waves near the sea bed may be a source of resuspended organic material, that could drift in gravity-driven flows downslope (Wright & Friedrichs 2006), feeding thriving coral reefs on the carbonate mounds below. It is likely that the red and dark blue wave beams are generated from depth and the cyan and magenta wave beams are reflected off the slope (Fig. 3). More research is needed to assess if this type of hydrographic modelling is a useful predictive indicator for cold-water coral distribution, it's advantage being that cheap satellite bathymetry are sufficient for the analysis.

Dr. Anthony Grehan (NUIG) and his students used the cruise to monitor cold-water coral reefs on mound areas they had videoed 10 years previously. This will give a rare insight into temporal changes and degree of recovery after trawling ceased here over a decade ago.

One of the unique highlights of the cruise was the novel *in situ* approach applied to assess pumping rates and to find out whether the sponges were alive. The strange Flubber-esque blobs below (Fig.4) are large 15L bags of Fluorecein dye that were sent down on ROV Holland-1. Videos of the effective first experimentation of this method can be seen here: <https://www.youtube.com/user/DeepSeaEcologist>. We think they are pretty exciting!

Samples were also taken for identifying sponges from genetics, sediment samples for silica cycle research and future work will be focussed on population genetics of *P. carpenteri* and *Acanella arbuscula* samples.

Another cruise next year for the DeepSeaCRU

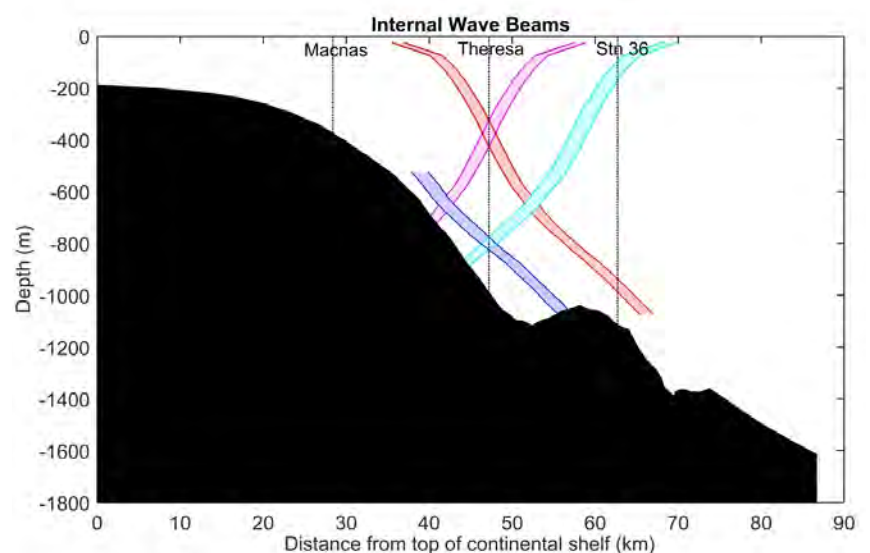


Fig.3 – Internal waves beams as modelled from CE15011 data at Theresa Mounds, North East Atlantic.





Fig. 4 – Fluorescein dye being prepared to assess sponge pumping rates at depth for the first time.

will supplement the population genetics collections from a wider area and will also look to ground-truth maps of connectivity models.

The cruise provided an amazing opportunity for a variety of ocean science students to put their learning into practice. Overall, the crew of RV Celtic Explorer and ROV Holland-1 were an absolute joy to work with. The only possible issue the cruise posed to the scientists on board was the embarrassing necessity of being rolled off the boat due to a vast consumption of delicious food from the wonderful Chefs!



Fig.5 – Allan Grassie, Anna Downie, Amber Cobley, Richard Ticehurst, Dr Anthony Grehan, Grace English, Nils Piechaud, Dr Kerry Howell, Josh Davison, Muireann MacCarthy, Liam Lachs, Fiona Carey, Rebecca Ross, Ross Brereton and RV Celtic Explorer Crew Dave, Barry and Paddy.

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# Project Focus

## NOAAs Deep-Sea Coral Data Portal

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NOAA has launched the [Deep-Sea Coral Data Portal](#) to better serve the data needs of ocean resource managers and scientists. The Data Portal has a map displaying the distribution of more than 300,000 deep-sea corals and sponges. This is the most comprehensive collection of deep-sea coral and sponge records in U.S. waters. It is built on the National Database for Deep-Sea Corals and Sponges maintained by NOAA's Deep Sea Coral Research and Technology Program.

Besides showing the locations of the corals and sponges, the map also includes:

- underwater photos of individual corals
- extensive data for download about the corals and sponges, such as their density, size and substrate
- reports that characterize the deep-sea coral and sponge habitats surveyed over the last decade by scientists from NOAA, other agencies, and universities.

The National Database for Deep-Sea Corals and Sponges is continually expanding, incorporating new records from recent fieldwork observations and historic archives. These records will be reflected on the Data Portal map. All data are also being submitted to OBIS.

The Portal also offers information about all 60 studies funded by the Deep Sea Coral Program since 2009, and a growing library of NOAA publications on deep-sea corals and sponges.

While the Data Portal is initially focused primarily on the U.S. EEZ, we welcome review and suggestions from the international community. Our hope is that the database and Data Portal will incorporate records from around the world and become a valuable resource for the researchers internationally.

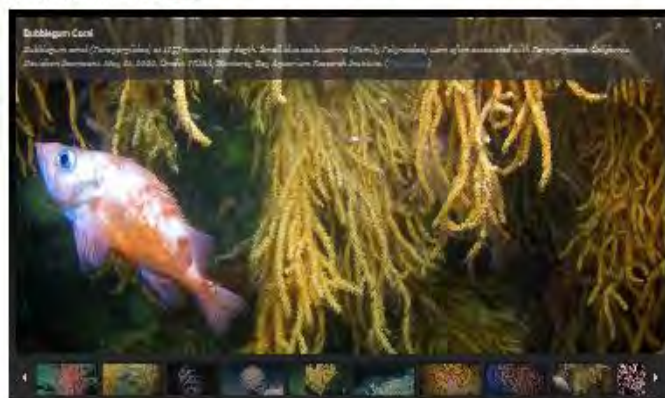
Deep-sea corals and sponges provide vital habitat for numerous fish and invertebrate species, including a number of commercially important species. Areas where corals and sponges grow to a large size or occur in high density can support a high level of biodiversity. NOAA is committed to working with partners to study and conserve these areas.

### Contact:

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### Welcome to the NOAA Deep-Sea Coral Data Portal

This Portal provides access to deep-sea coral and sponge data, images, and technical reports from research funded by NOAA's Deep Sea Coral Research and Technology Program (DSCRTP) and its partners.



### Digital Map & Database

#### Data Search, Discovery & Download

The DSCRTP map allows for search, discovery, and download of the National Deep-Sea Coral and Sponges Database. All points are categorized and colored by common nomenclature categories. Users can search by region, time, and depth. Data downloads can be initiated using the search parameters on the map and the on-screen geographic extent. Go to the digital map.

#### Information Access

Users can also view the characterization reports for DSCRTP-funded research. These reports give habitat summaries of specific under-sea areas and summarize the data on the area. Go to the digital map.

#### Deep-Sea Coral Database Documentation

DSCRTP's Technical Notes on the National Database. Go to the publication.

Metadata for the Deep-Sea Coral Database. Go to the metadata.





## Pacific countries discuss financial management options for deep-sea minerals development

Alison Swaddling, SPC-EU Deep Sea Minerals Project Environment Advisor, Fiji

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*Above: Participants of the Pacific ACP States 7th regional training workshop in Nadi, Fiji*

The Secretariat of the Pacific Community (SPC) and European Union initiative 'The Deep Sea Minerals (DSM) Project' held its 7th regional training workshop focusing on the financial management options for deep sea minerals development from 24-27 August in Fiji.

Jointly organised by the DSM Project and the International Monetary Fund, through the Pacific Financial Technical Assistance Centre, the workshop gathered representatives from 14 Pacific Island countries, civil society groups, the private sector, finance officials and experts to discuss financial management options for deep-sea minerals development.

The workshop involved the use of case-study exercises with the assistance from experts to enable the participants to:

- 1) increase their understanding and knowledge of the key components of DSM fiscal regime and revenue management;
- 2) improve their capacity to develop and implement appropriate fiscal regime and revenue management options;
- 3) become familiar with key issues and elements of public financial management for DSM revenue and expenditure management.

The DSM Project also took the opportunity to discuss, in detail, the draft Pacific Regional DSM Financial Framework to acquire participant's feedbacks and comments on prior to finalisation.

Pacific ACP (Africa Caribbean Pacific) States represented include: Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu and Vanuatu.

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## Strong Pacific Presence at the International Seabed Authority's 2015 Annual Session

Alison Swaddling, SPC-EU Deep Sea Minerals Project Environment Advisor, Fiji

The Secretariat of the Pacific Community (SPC) and the International Seabed Authority (ISA) signed a Memorandum of Understanding (MOU) on 20 July 2015 during the ISA's 21st annual session in Jamaica.



Above: SPC Chief Geoscientist, Dr Kifle Kahsai (left) signs the MOU with ISA Secretariat-General, Nii A Odunton (right)



Above: Pacific delegations represented at the ISA's 21st Annual Session in Jamaica

The MOU expresses the mutual interests of SPC and ISA in developing regional and national frameworks that support the interests of both organisation's Pacific member states, and efforts to regulate and manage deep-sea mineral activities in ocean areas beyond national jurisdiction; conducting marine scientific research and analysis results; and participating in capacity-building initiatives and sharing seabed resources information.

With assistance from the Deep Sea Minerals (DSM) Project, Pacific delegations from Cook Islands, Federated States of Micronesia, Fiji, Papua New Guinea, Republic of the Marshall Islands, Tonga, and Tuvalu attended and participated in the ISA's 21st annual sessions (14-24 July 2015).

A side-event organised by the DSM Project during the annual session witnessed the strong participation of these Pacific Delegations in raising awareness of the progress made in the development of their national legislation and DSM policies, mineral potential in their exclusive economic zones, and willingness to become

sponsoring States in ocean areas beyond national jurisdiction.

Participation of Pacific Island governments to the ISA is of critical importance as it allows them to engage in, and influence, decisions taken by the Authority, ensuring that decisions align with their national interests, and those of the Pacific region.

More Information: The Deep Sea Minerals Project is managed by SPC's Geoscience Division based in Suva, Fiji. For more information on the project and deep sea minerals, visit <http://gsd.spc.int/dsm>, email us at [dsmpoint@spc.int](mailto:dsmpoint@spc.int) or contact us via phone (+679 338 1377)







## Monterey Bay Aquarium Research Institute (MBARI) Deep-Sea Guide

The Monterey Bay Aquarium Research Institute (MBARI) maintains a well-established database of deep-sea observations that have been recorded by its remotely operated vehicles (ROVs) during over 25 years of operation. The database and associated software system, VARS (Video Annotation and Reference System), represents the collective knowledge of MBARI researchers and collaborators and serves as an investigative tool that has facilitated hundreds of deep-sea research publications as well as countless technical, agency, educational and outreach projects. From this unique and dynamic dataset, MBARI's video annotation team has developed the Deep-Sea Guide (DSG). The DSG is a web-based system that allows for the correlation of visual, descriptive and observational data with environmental data from multiple sources by providing tools for searching, identifying and examining occurrence data (e.g. depth, time, abundance) for biological, geological and experimental observations.

Basic features include searching and browsing by name (both common and scientific), image, or taxonomic relationship, customizable comparison tables, access to unique descriptive entries and links to references and taxonomic authorities. Also included are quality assessment metrics, which enable more precise characterization of taxa and better understanding of how data collection and analysis methods can be optimized. Delving deeper into mining this temporally and spatially rich dataset, standardized data products are created to provide a variety of data snapshots (e.g. raw or normalized depth distribution histograms for any observed taxa) allowing for efficient review and analysis. These new tools are delivering quantitative and qualitative information required for biodiversity assessment studies within MBARI's research locations and could provide context for and contribute to modelling of studies farther afield. In a continuing effort to refine sampling and analysis methods and to improve the effective exchange of information between deep-sea researchers, deep-sea community members are encouraged to contact MBARI's video analysis team to suggest improvements and explore potential collaborations. The VARS/DSG team includes: Nancy Jacobsen Stout, Linda Kuhn, Lonny Lundsten, Brian Schlining, Kyra Schlining, and Susan von Thun.

Link to website: <http://dsg.mbari.org/dsg/home>

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## The Canadian Healthy Oceans Network (CHONe II) was renewed for another five years

Anna Metaxas, Dalhousie University, Canada

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Increasing pressures on ocean resources have created a critical need to enhance ocean sustainability and to understand how different activities will change marine living resources. Ocean stakeholders need a strong, effectively networked marine science community to apply leading-edge scientific knowledge to develop sustainable ocean use strategies. CHONe II will help Canadian federal agencies meet national and international commitments on sustainable oceans and to advance the new National Conservation Plan. Canada's *Oceans Act* and international commitments promise to develop a network of MPAs to conserve marine life and ecosystem functioning and emphasize sustainability, but multiple, sometimes conflicting, human pressures challenge these goals.

CHONe II's research program will address two broad, interlinked questions: 1) What ecosystem characteristics define

the capacity of Canada's oceans to recover or respond to management strategies such as networks of Marine Protected Areas (MPAs), spatial closures, or restoration; and 2) Can we understand and quantify how key stressors, including cumulative impacts, alter marine biodiversity and ecosystem functions and services in high use environments?

CHONe II is a strategic partnership between Canadian university researchers and government scientists. The network is based at Memorial University in Newfoundland, Canada, but is made up of 39 researchers from 11 universities, one community college and multiple federal research labs from coast to coast in Canada. CHONe (pronounced Ko-Nee) is also a marine worm that occurs in all of Canada's three oceans and characterizes healthy benthic habitats. The Network will train a large cohort of interdisciplinary undergraduate and graduate students, and postdoctoral researchers who will work in multiple university and government laboratories.

The specific research objectives of the network are:

- To understand ecosystem characteristics that define the resilience and capacity of Canada's oceans to recover or respond to management strategies such as networks of Marine Protected Areas (MPAs), spatial closures or restoration;
- To understand how key stressors, including cumulative impacts, alter marine biodiversity and ecosystem functions and services in high use environments.

The CHONe II website is under construction, but you can read information about CHONe I here: <http://chone.marinebiodiversity.ca/>

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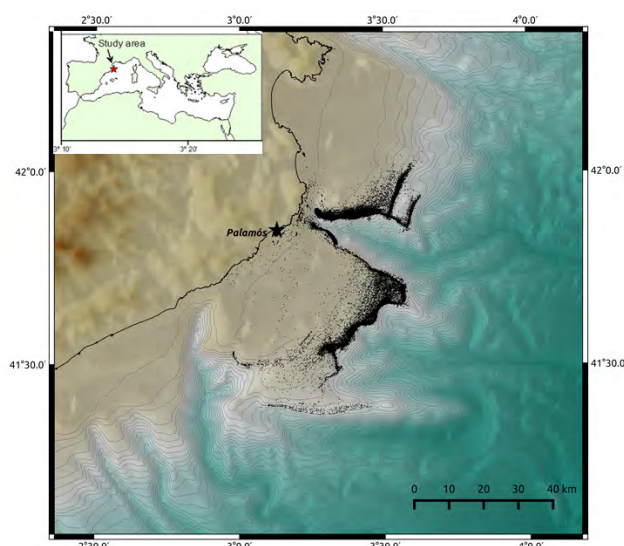
## The submarine canyon of Palamós (NW Mediterranean Sea): a new management strategy based on a participatory process between scientists, fishery stakeholders, NGOs and Policy Makers

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A Long Term Management Plan (LTMP) for the fishery of the deep-sea red shrimp *Aristeus antennatus* was officially



Above: Vessel monitoring system (VMS) data associated to *Aristeus antennatus* landings in the Palamós submarine canyon.

implemented in the area of the Palamós submarine canyon by the Spanish government in 2013. This deep-sea shrimp is the main target species in the western Mediterranean Sea and is fished exclusively by bottom-trawling at depths ranging from 300 m to 900 m. The LTMP in Palamós was the first plan of its kind for the Mediterranean Sea, where fishermen associations, regional and national administrations, scientists and NGOs discussed and integrated their knowledge on new management strategies to reduce fishing effort and preserve the juvenile population.

But, what prompted fishermen to take action? A sudden drop in shrimp catches and mean size in 2005



resulted in a dramatic income decrease - and the high reliance of the fishery on one single species pushed fishermen to look into urgent measures. They approached scientists to seek a solution to the suspected over-exploitation. The technical measures established by the plan include: fishery closure during two months in winter when juveniles are in the fishing grounds (with no public subventions); use of a more selective mesh size and reduction of the number of trawlers in the fleet.



*Above: On board, fishermen classify the target deep-sea red shrimp into different commercial categories.*

Currently, the project is in its third phase, which involves the monitoring of the stock, including evaluation of the results, study the efficiency of the adopted measures and apply, if necessary, corrective actions. Based on the results and 9 years of lessons learnt, the aim is to extend this management strategy to other areas of the Iberian Mediterranean. The positive trend in the conservation and sustainable exploitation of the red shrimp in the Palamós canyon has been successfully based on teamwork of different stakeholders (scientists, fishermen, administrations, NGOs) and the positive effects of the empowerment of fishermen in management discussions (self-regulations, control, etc.). All these management measures have been integrated in order to reach a sustainable exploitation of this important marine living resource and to improve the health of a highly impacted ecosystem such as are the submarine canyons of the NW Mediterranean Sea.

# News



## A global Deep-Sea biodiversity data-sharing platform

Tim O'Hara, Derek Tittensor, Maria Baker, Karen Stocks, Ward Appeltans

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In the 4th issue of Deep-Sea Life, Appeltans & Webb (2014) reported on the deep-sea biodiversity data in the Ocean Biogeographic Information System (OBIS) and the fact that there is a general decrease in the availability of biodiversity data from the deep sea since the 1990s.

The urgent need for a global deep-ocean data repository to provide baseline information for impact assessments and area-based management and decision-making in the deep sea has been expressed by Mengerink et al. (2014) and was called for in a statement from Deep Ocean Stewardship Initiative (DOSI) to the International Seabed Authority in May 2014. Both suggested building upon the already existing OBIS.

Tim O'Hara and Derek Tittensor (leads of INDEEP (International network for Scientific investigation of deep-sea ecosystems) working group 2 on global biodiversity & biogeography) together with Maria Baker (INDEEP Secretariat), Karen Stocks (Scripps, Census of Marine Life deep sea synthesis project) and Ward Appeltans (project manager OBIS) have brainstormed on what could be done to develop a deep-sea biodiversity data repository or data-sharing platform.

We propose that institutions holding deep-sea biodiversity data could provide data through the OBIS nodes in their country or region. Data in these nodes are regularly added to the global OBIS database. In case there is no national or regional OBIS node, data holders will be able to use the data-sharing platform hosted at the OBIS secretariat. OBIS can develop a customized, online deep-sea view on the global database providing open data access, mapping, data download and web services in a format appropriate to the deep-sea community.

We also propose to organize a data training workshop in 2016 at the OBIS secretariat co-organized by INDEEP and use this opportunity to start the development of standardized, controlled vocabularies to describe deep-sea datasets (e.g. specific habitat terms, station names, sampling protocols).

We would like to invite an expert from the deep-sea scientific community to volunteer as the manager of a new global thematic OBIS deep sea node, which means he or she would coordinate this effort through networking, communicating and steering this important activity. We invite you to get in touch with us if you are interested in helping shape a global deep-sea biodiversity database. Contact Ward and Maria in the first instance: [w.appeltans@unesco.org](mailto:w.appeltans@unesco.org) and [mb11@noc.soton.ac.uk](mailto:mb11@noc.soton.ac.uk)

### References

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# Meetings & Workshops

## 14th Deep-Sea Biology Symposium - Epilogue

31 August – 4 September 2015, Aveiro, Portugal

Ana Hilário, Marina Cunha and the 14DSBS organizing committee

It has been a long time since we used DSL issue 3 (May 2014) to invite you to the 14th Deep-Sea Biology Symposium. Now, three issues later, here we are again! This time to thank all the participants for the wonderful symposium - MUITO OBRIGADO!



Above: A selection of photographs from the meeting.

The 14DSBS was held in Aveiro and had, according to several trustworthy sources, the highest attendance ever! During a week this small city in the North of Portugal was flooded with deep-sea biologists and ecologists from all around the World. In total there were 380 participants from 35 countries, representing universities, private and government institutes, NGOs, industry, and the media. More than 200 oral communications and 250 posters were presented covering a wide range of topics. Nonetheless, the symposium was marked by an increase in presentations addressing conservation and stewardship topics – a sign of the times, perhaps.

Many deep-sea related initiatives have also contributed to the symposium by organizing open meetings to provide information on their progress and the opportunity for the community to engage in their activities. The discussions promoted in these “side-meetings”, and many times continued over a coffee (or a glass of port!) will undoubtedly be wellsprings of cooperation and creation of new projects. The 14DSBS was also the official launching platform of two important initiatives: the European Marine Board 22nd position paper (Delving Deeper: Critical challenges for 21st century deep-sea research) and the Deep-sea Biology Society.

During the week of the symposium Aveiro offered us a truce from its characteristic north winds and we hope everyone could enjoy what best Portugal has to offer: sunshine, food and wine! We could have not organized a symposium in Portugal without a small taste of our culture: – Fado (apologies to those who find it extremely boring!). The traditional conference dinner took place in a port wine cellar, in Porto, and was accompanied by “classics” of this traditional music, classified by UNESCO as an Intangible Cultural Heritage of Humanity.

And the award goes to... As is traditional, the symposium closed with the presentation of the “best student presentation awards”. Congratulations to Franziska Bergmeier and Magdalena Georgieva, who received the “Frontiers in Marine Science Awards” and to Jennifer Durden and Rui Vieira that were awarded the “John Gage Awards”. During the closing session was also presented the first awardee of “INDEEP community Award”, Professor Lisa Levin, for her inspirational scientific presentations on the deep-sea, shared with Professor Paul Tyler, who was behind by only one vote.

Finally, the host of the next symposium was announced: Monterey Bay Research Institute! The 15th DSBS will be held in Monterey, California.

Typically, Deep-Sea Biology Symposia have not been producing a Special Volume, but it seemed important to us to contribute to the publication of the excellent research that was presented in the symposium and therefore submissions are now open for a special issue of Deep-Sea Research Part II that is expected to be out in October 2016.

We trust you enjoyed the symposium as much as we did and hope to see you all in Monterey!



## **ISA Endowment Fund Travel Bursary for the 14th Deep-Sea Biology Symposium, Portugal (Aug-Sept 2015)**

Dr Maria Baker, INDEEP Project Manager and Bursary Awardees

The [International Seabed Authority](#) (ISA) generously funded a total of six travel bursaries in order to enable scientists from developing nations (Brazil, Chile, South Africa, Trinidad and Tobago and Argentina) to attend the 14th Deep-Sea



Biology Symposium in Aveiro, Portugal from 30th August to 4th September 2015. INDEEP received 24 applications for the Travel Bursary Awards and the applications were administered and reviewed by the INDEEP office and INDEEP Committee Members. We were delighted to be able to fund six scientists for their travel and accommodation to enable them to attend this key scientific meeting. Each successful awardee gained a great deal from the opportunity that the ISA gave them to attend this meeting and greatly appreciated the presentations, organization and networking opportunities that they hope will lead to future collaborations. The awardees were: Ignacio Chiesa (Argentina); Eulogio Soto (Chile); Kerry Sink (South Africa); Maurício Shimabukuro (Brazil); Judith Gobin (Trinidad and Tobago) and Naití Morales Serrano (Chile). Each presented their work as follows:



### **Amphipods from the Mar del Plata Submarine Canyon, southwest Atlantic Ocean**

Ignacio Chiesa\*, Martínez A, Doti BL

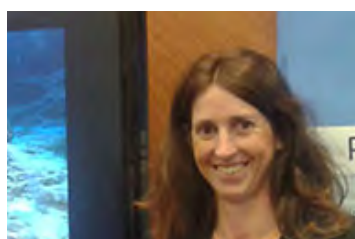
*\* Departamento de Biodiversidad y Biología Experimental, FCEyN, UBA and Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", Buenos Aires, Argentina*



### **Macrobenthos response and sediment properties under hypoxia conditions at continental margin of central Chile**

Eulogio H Soto\*, Quiroga E, Ganga B

*\*Facultad de Ciencias del Mar y de Recursos Naturales, Universidad de Valparaíso, Viña del Mar, Chile*



### **Stakeholder participation to support offshore protection: Lessons from Africa**

Kerry Sink\*, McQuaid KA

*\* South African National Biodiversity Institute, Cape Town, South Africa*



### **Abyssal polychaetes associated with enriched sediments around a whale carcass from Southwest Atlantic Ocean**

Maurício Shimabukuro \*, Alfaro-Lucas, JM, Rizzo, AE, Santos, CSG, Fujiwara, Y & Sumida, PYG

*\* Departamento de Oceanografia Biológica, Instituto Oceanográfico, Universidade de São Paulo, São Paulo – SP/Brasil*

### **New hesionid polychaetes from whalebones in deep Atlantic Ocean: potential connectivity between whale falls around the world**

Maurício Shimabukuro \*, Alfaro-Lucas, JM1, Rizzo, AE2, Fujiwara, Y3 & Sumida, PYG4



### **Methane seeps and oil exploration off the east coast of Trinidad and Tobago**

Judith F. Gobin\* and Diva J. Amon

*\* Faculty of Science and Agriculture, Department of Life Sciences, University of the West Indies, St. Augustine, Trinidad and Tobago, West Indies*



## Top predators of seamounts in the Easter Island Ecoregion

Naiti Morales\*, Easton EE, Gaymer CF

*\*Millennium Nucleus for Ecology and Sustainable Management of Oceanic Islands (ESMOI), Departamento de Biología Marina, Universidad Católica del Norte, Larrondo 1281, Coquimbo, Chile.*

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## Students at the 14DSBS and the Deep-Sea Biology Society

Paris Stefanoudis

*PhD Student, National Oceanography Centre, University of Southampton, UK*

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The 14th Deep-Sea Biology Symposium in Aveiro (Portugal) was a great meeting point for deep-sea biologists and ecologists from all around the world. With about 380 participants (around 50% were students) from more than 35 countries, 200 talks and 250 posters and several other working group meetings (e.g. DOSI and INDEEP), I was constantly bumping into someone whose papers inspired me throughout my studies in marine biology.

By the end of the conference, the National Oceanography Centre in Southampton (UK) had a good reason to celebrate, as two of its PhD students won both Jon Gage student awards sponsored by the Deep-Sea Biology Society: the best oral presentation went to Jen Durden for her work on megabenthic deposit feeding in the abyss, and the best poster communication to Rui Vieira for his work on quantifying trawling impacts on benthic megafauna.

Finally, as the new student representative of the Deep-Sea Biology Society (<https://deepseabiosoc.wordpress.com/>), I would like to encourage students from all levels to join the society in order to be kept up to date with the latest research trends in this field and have the opportunity to network and interact with deep-sea biologists from all over the world (we now have a linkedin group open to student members!). People can also join the general mailing list (send request to [DSBS-request@jiscmail.ac.uk](mailto:DSBS-request@jiscmail.ac.uk)) and/or the student mailing list (send request to [DSBS-request@jiscmail.ac.uk](mailto:DSBS-request@jiscmail.ac.uk)).



*Above: Recent NOC PhD graduate Dr Ming-Tsung Chung giving a talk about life-history traits of deep-sea fishes.*



## Advancing the Deep Ocean Stewardship Initiative (DOSI)



<http://dosi-project.org/>

**Open DOSI Meeting. Aug. 30, 2015.** Since its formal establishment in 2013 with 24 experts from 14 countries, DOSI has grown, largely by internet and word of mouth, to include almost 350 members. It soon became clear that the next steps required for advancing DOSI's development were determined to be (a) broad integration with the scientific community including students who represent the next generation of practitioners and (b) inclusive working group planning sessions. To this end we held a general DOSI science meeting on 30th August 2015, in conjunction with the 14th International Deep-Sea Biology Symposium (Aveiro, Portugal). The goals were to (a) introduce DOSI and its goals to a broader scientific community; (b) provide a venue to share information about ongoing and planned deep-sea stewardship activities; (c) engage new participants; (d) develop new directions and activities for the future; (e) consider funding options and ethical issues; and (f) provide an opportunity for working groups to meet and plan activities.

Approximately 136 people from 24 countries attended the meeting, including many students. The morning discussion reviewed the origins, mission and objectives of DOSI and presented past DOSI and working group actions and products. A description of the working groups and new website were presented. Open discussions were held to (a) take suggestions on new DOSI themes and actions, (b) update participants on other international and national programs of relevance to DOSI, (c) discuss possible sources of funding for DOSI, and (d) discuss conflict of issues and how to increase transparency. All participants were given an opportunity to sign on to one or more of 10 working groups.



The afternoon was spent in working group meetings. Six groups met: minerals impacts and management for deep-sea mining (led by C. Smith), oil and gas impacts (led by E. Cordes and D. Jones), deep-sea fishing (led by M. Gianni), deep-sea genetic resources (led by H. Harden-Davies and K. Gjerde), deep-sea tailings disposal (led by E. Ramirez-Llodra) and Climate Change (led by N. LeBris and L. Levin). A plenary session was held at the end of the meeting to share working group plans. These plans are outlined on the DOSI WG webpages. Following this, the Consortium for Ocean Leadership met with the DOSI advisory board to discuss potential collaborations.

Two new working groups emerged from DOSI deliberations, one on Climate Change (led by LeBris and Levin) and one on New Technologies (to be led by D. Lindsay). A third on marine debris in the deep ocean is under consideration.

**DSBS Activities.** DOSI members continued to be active throughout the 14th Deep Sea Biology Symposium. On the first day, DOSI sponsored a keynote presentation by Kristina Gjerde on deep seabed mining and hosted a day-long session

on “*International Research and Stewardship for our Deep Oceans*”, with 17 talks and 11 posters chaired by Maria Baker and Lisa Levin. DOSI also held a lunchtime town hall meeting for those not able to attend the Aug. 30 meeting and convened a special lunchtime session to broaden the discussion on questions related to the sharing of benefits of marine genetic resources derived from areas beyond national jurisdiction (led by Harriet Harden-Davies and Kristina Gjerde). DOSI members also organized a special half-day session on the environmental impacts of seabed mining (led by Adrian Glover).

The newly established DOSI working group on climate change circulated a statement to the UNFCCC (United Nations Framework Convention on Climate Change) 21st Conference of Parties (COP21) for signature by DSBS participants about the important role of the deep ocean in climate mitigation and potential impacts of climate change (<http://dosi-project.org/working-groups/climate-change>).

#### Join the DOSI mailing list

If you would like to receive further information regarding DOSI activities, send an email to: [Majordomo@lists.soton.ac.uk](mailto:Majordomo@lists.soton.ac.uk). Leave subject line EMPTY and type “subscribe dosi-alert” in the main body of the email. Remove all signatures or any other text from the email.

You will then receive an automated confirmation email from DOSI. If you wish, you can become an ACTIVE member of a DOSI WG and aid with activities relating to our current priorities. Please contact the WG leads for further details.

#### Webinar series

You may wish to tune into the WEBINAR “Deep Ocean Stewardship Initiative: Going Forward” on November 18th, either on the day or via the archived version. To register and get more information, go to: <http://www.linwoodpendleton.com/upcomingwebinars/>



European  
**MARINE BOARD**

Advancing Seas & Ocean Science

## A call for major progress in deep-sea research to underpin future management and exploitation of living and non-living deep-sea resources

Kate Larkin, Senior Science Officer, European Marine Board, Belgium

Contact: [KLarkin@esf.org](mailto:KLarkin@esf.org)

The European Marine Board (EMB) is an independent non-governmental advisory body that develops common



positions on research priorities and strategies for European marine science, facilitating enhanced cooperation between stakeholders involved in supporting, delivering and using marine research and technology. Marine Board stakeholders include the Board's members, partner European and international networks, policymakers, strategy developers and programme managers at national, European and international level, as well as the marine and maritime science community at large.

The EMB launched the publication of position paper 22 "Delving Deeper: Critical challenges for 21st century deep-sea research" on 1 September at the International Deep-Sea Symposium in Aveiro, Portugal: [http://www.marineboard.eu/file/290/download?token=\\_IW82LWK](http://www.marineboard.eu/file/290/download?token=_IW82LWK)

PP22 calls for major progress in fundamental deep-sea research delivering eight high-level goals for deep-sea research in the context of expanding commercial activities, increasing human and natural pressures and the need for effective and practicable governance frameworks to underpin the management of deep-sea activities and resources. See the press release here: [http://www.marineboard.eu/sites/marineboard.eu/files/public/images/EMB\\_PP22\\_PRESS\\_RELEASE\\_7Oct2015.pdf](http://www.marineboard.eu/sites/marineboard.eu/files/public/images/EMB_PP22_PRESS_RELEASE_7Oct2015.pdf)



This is an output of the EMB Working Group "Deep-Sea Research for Societal Challenges and Policy Needs" which brought together 14 experts from 8 countries with expertise ranging from natural science, socioeconomics and law. The study also consulted the wider stakeholder community on the deep-sea research landscape and investments across Europe.

You are invited to a briefing session on position paper 22 "Delving Deeper" on 11 November 2015 at 12:30-13:10 in Brussels. This is a special session of the "3rd Ocean of Tomorrow Conference: What results so far for healthy and productive seas and oceans?", European Commission (Madou building), Brussels. The session will highlight key outputs of the Deep-Seas WG, with opening statements by Prof. Ricardo Serrão Santos (MEP), Ms. Sigi Gruber (DG Research and Innovation, EC) and a presentation by the WG Chair Prof. Alex Rogers (University of Oxford). Invited participants include the European Commission, European Parliament, deep-sea stakeholders and the wider European marine scientific and stakeholder community.

Registration is now open at: <https://ec.europa.eu/eusurvey/runner/660305ef-0e14-48c5-8581-79ec344016b4>

A policy brief (8 pages) is in preparation to summarize key messages of the paper (this will be available at the 11 November event). We hope to see you there and please distribute this invitation to your networks! We also welcome your feedback on the position paper and upcoming meetings where we could disseminate this further. Hard copies are available upon request.

PP22 can be downloaded from the EMB website: [http://www.marineboard.eu/file/290/download?token=\\_IW82LWK](http://www.marineboard.eu/file/290/download?token=_IW82LWK)

## International Workshop on the Impacts of Mine Tailings in the Marine Environment

Lima, Peru, 10-12 June 2015

Eva Ramirez-Llodra, NIVA-Norway

Contact: [eva.ramirez@niva.no](mailto:eva.ramirez@niva.no)

A workshop on Deep-Sea Tailing Disposal (DSTP) was held in Peru, Lima, in June 2015. The workshop was co-organised by the MITE-DEEP project (funded by the Norwegian Research Council and INDEEP), the International Maritime Organisation – London Convention/London Protocol and the UN GESAMP group of experts and it was hosted by the Peruvian Government.

MITE-DEEP is a one year project (2015) led by Dr Eva Ramirez-Llodra (NIVA, NO) and co-led by Dr Maria Baker (Uni. Southampton, UK), Dr Lisa Levin (Scripps Institution of Oceanography, USA) and Mr Leonel Sierralta (Chilean DSTP Initiative). It is a major activity of the DOSI-DSTP working group (Deep-Ocean Stewardship Initiative, <http://dosi-project.org/working-groups/tailings-placement>).

During the two days, a group of 50 experts from different sectors (science, industry, policy makers, managers and environmental groups) discussed the current knowledge on submarine tailing disposal, and particularly DSTP, with the aim to identify gaps and discuss steps forward to develop Best Available Practices for ongoing and potentially new STDs and DSTPs, to provide knowledge-based advice to regulatory bodies and to identify major knowledge gaps that need urgent attention. The workshop was organised in 4 sessions with a total of 24 talks (16 of which were academic) and a short discussion panel after each session:

- Session 1: Mining practices, waste generation and disposal (tailings)
- Session 2: Understanding the marine environment
- Session 3: Knowns and unknowns on the effects of mine tailings in the marine environment
- Session 4: Existing regulatory (best) practices

The programme can be found here: <http://www.dicapi.mil.pe/taller/en/conference.html>. The presentations and list of participants can be downloaded here:

[http://www.dicapi.mil.pe/taller/en/down\\_workGesamp.html](http://www.dicapi.mil.pe/taller/en/down_workGesamp.html)

Currently, a workshop report is being prepared from GESAMP, which will be used for consultation with the London Convention/London Protocol nations.

Additionally, on Friday 12 June, 15 people of the DOSI-DSTP working group continued the discussions initiated during the workshop to identify the next steps forward. During this



Above: Participants to the International Workshop on the Impacts of Mine Tailings in the Marine Environment.



Above: Discussions during the DOSI-DSTP working group meeting in Lima.

meeting, a number of activities were agreed for development:

- DOSI-DSTP online survey: Eva Ramirez-Llodra (NIVA). Ongoing.
- Scoping paper: Lindsay Vare (SAMS). Ongoing.
- GIS map: Maria Baker (Uni. Southampton), Patricio Bernal (PUC) & GRID-Arendal. Initial stage.
- Data repository (including Endnote and pdf libraries): Maria Baker & Eva Ramirez-Llodra. Initial stage.
- Capacity building in PNG: Tracy Shimmield (SAMS). Initial discussion stage with relevant authorities.
- Communication with IMO/GESAMP: Eva Ramirez-Llodra. Ongoing.

The DOSI-DSTP working group is open to any interested person, so do contact me if you would like to be included in the mailing list: [eva.ramirez@niva.no](mailto:eva.ramirez@niva.no)



## The Conservation Value of European Deep-Sea Habitats

Chris Yesson

*Zoological Society of London, UK*

Contact: [chris.yesson.phd@gmail.com](mailto:chris.yesson.phd@gmail.com)

The deep sea is a critical component of the marine ecosystem. It can be home to cold water coral reefs and sponge fields, long-living fish and a myriad of other organisms. Deep-sea habitats are complex, diverse and beautiful, yet they are vulnerable too. Deep-water fish are particularly at threat, having characteristics such as low birth rates, slow growth and small populations. Yet some deep water species are the target for European fisheries.

### Evaluating the benefits of deep sea habitats

Sometimes my job as a marine scientist requires me to look for alternative methods to evaluate the benefits of the deep sea, beyond the intrinsic value of the habitats.

Therefore, I was delighted to chair an evening symposium, presenting the views of leading scientists and conservationists, discussing the value of deep sea habitats, with the aim of promoting conservation. This event was opportunistically timely, with the EU debating proposals to introduce measures to restrict deep-sea trawling in European waters.

### Depth based ban under consideration

David Bailey from the University of Glasgow started the evening with a presentation showing how deep trawls have unfavourably impacted deep-sea fish species (whether targeted by fisheries or not) of Western Scotland and Ireland. David documented declines in fish over two decades, many of which are



Above: Deep-sea corals. Photo courtesy IFREMER.



now classified as endangered or vulnerable. Fishing in waters deeper than 600 metres has a strong negative impact on areas of high diversity for very low financial gain. A simple and effective way to protect these species and areas is a blanket ban of bottom trawling at depths greater than 600 metres.

- The EU is considering introducing a depth based ban on bottom trawling below 800 metres

### **Public support for protecting deep sea habitats**

Claire Armstrong, an economist from University of Tromsø, The Arctic University of Norway (and the only economist in a room of 144 people), presented her research documenting perceived values of cold-water coral habitats based on surveys of the general public.

The research showed that the public (in Norway) place a high value on cold water corals as habitats for fish, and are willing to pay for their protection. Furthermore, there is little public concern for any additional costs this may impose on industry (fisheries, oil & gas).

- The public (at least in Norway) support protecting deep sea habitats

### **The economic value of deep sea habitats**

Clive Trueman from University of Southampton talked about his research valuing the role the deep sea plays as a carbon sink. Clive estimates that the amount of the greenhouse gas carbon dioxide captured by European deep seas is the equivalent to a woodland the size of Greater London. To provide the equivalent service with a man-made carbon capture and storage facility would cost around £1 billion. This ecosystem service of carbon capture is dependent on a healthy environment. The value of this carbon capture services greatly outweighs an uneconomic, heavily subsidised trawl fishery.

- The economic value of healthy deep-sea habitats greatly exceeds the value of the trawl fisheries.

### **Progress for deep-sea conservation?**

Matthew Gianni of the Deep Sea Conservation Coalition spoke on the current negotiations for new regulations to manage deep-sea fisheries in the EU. This could be a significant step in the conservation of deep seas. However, Matt spoke about the watering down of depth-based approach to prohibiting bottom trawling which is currently proposed at 800 metres and even so, there is still opposition from a number of EU countries in the negotiations, notably Spain. Even at 800 m, a trawl ban would provide greater protection for important deep-sea habitats such as certain sponge and xenophyophore species, which form important habitats in the deep sea, although roughly half of the cold-water coral reefs off the UK and Ireland would still be unprotected (based on work by Kerry Howell).

A bottom trawl ban below 600 m would affect no more than a couple of dozen UK fishing vessels fishing part time at these depths (out of more than 5,000 UK fishing vessels) and a few dozen more French and Spanish deep-sea trawlers at most. Nonetheless, fishing industry representatives are lobbying hard against the deep-sea trawl ban and trying to introduce loopholes in the regulation, complicating the negotiations. Matt reported that in practice the regulations will be decided by about 10 key countries, and the UK is playing a critical role in the negotiations.

Please find out more about the proposed EU trawl ban here: <http://eu.savethehighseas.org/>

## UK Deep-Sea Scientists meet to form a new national forum

Nicholas Higgs

*Plymouth University Marine Institute, UK*

*Deep Sea Ecosystems SIG Coordinator*

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### Deep-Sea Ecosystems SIG

At the end of June 2015, over 30 marine scientists met at the University of Liverpool (UK) for the inaugural meeting of the Challenger Society for Marine Science's Deep-Sea Ecosystems special interest group (SIG). The meeting brought together representatives from 10 UK universities, 3 NERC research facilities as well as other government agencies, museums and independent research organisations.

The Deep-Sea Ecosystems SIG was formed in February with the aim of creating a national forum for UK scientists working on deep-sea habitats. While most of its members are biologists, the group aims to bring together scientists from a broad range of related backgrounds. To that end, it was heartening to also welcome geologists, chemists and researchers straddling multiple disciplines. There were representatives from all levels of academia, with an encouraging number of PhD students in attendance.

The variety of presentations outlined below were complimented by a range of excellent posters. In addition to these traditional elements, a full half of the timetable was given over to structured discussion sessions, ensuring that all attendees were able to engage and contribute to the meeting. The discussion sessions were a resounding success and generated exciting new ideas and actions, such as the proposal for a new global expedition to celebrate the upcoming 150th anniversary of the Challenger expedition (more below).

We are very grateful to our host, Rachel Jeffreys from the School of Environmental Science, who heroically arranged all of the local logistics. The meeting was graciously sponsored by the Challenger Society for Marine Science.



*Above: The meeting participants*

The meeting began with a presentation by Louis Byrne from the British Oceanographic Data Centre, highlighting the services that they offer and stimulating discussions about how we could implement a data storage strategy for video data. This was followed by an introduction to the Marine Alliance for Science and Technology for Scotland (MASTS), particularly the work of their Deep-Sea Forum. As a research community, UK deep-sea biologists are spread far and wide so there were lots of useful insights from the success of MASTS in bringing together the resources from multiple institutions to get some science done.

Unfortunately, two colleagues were unable to attend because of last-minute difficulties. This space in the timetable allowed Tammy Horton to provide an impromptu overview of the leading work being undertaken by the DeepSeas

Research Group at the National Oceanography Centre in Southampton. Tammy joined us via the internet on both days to represent her colleagues, most of whom were at sea getting some science done!

After lunch Adrian Glover (Natural History Museum) led us through the history and policy of mining in the deep sea, with a preview of initial data coming from the Abyssline project. Adrian and a multinational consortium of colleagues have been working to collect baseline data on the UK's claim area in the central Pacific. This session continued into a wider discussion on the future of mineral resource exploitation in the deep sea and the implications for deep-sea research.

In the final session of the day Kerry Howell showcased some of the mapping and predictive habitat modeling work being carried out by the Deep-Sea Conservation Research Unit at Plymouth University. We then had a whistle-stop tour of recent research on chemosynthetic habitats in UK territorial waters across the globe, courtesy of Jon Copley (University of Southampton). Jon then led us in a discussion looking at how we could generate more funding to carry out biodiversity research on the huge areas of deep-sea habitats in UK territories and marine protected areas.

The first day was rounded off with dinner at HOST restaurant, providing a chance to unwind and catch up with old friends, as well as make new ones. A fine meal was had by all that evening with conversation flowing as freely as the wine. Discussions went on into the night as the merry band of scientists sampled some of Liverpool's finest establishments.

Day two took us to the deepest of deep-sea ecosystems with an overview of recent hadal research by Alan Jamieson (University of Aberdeen). Alan concluded with a plea to move beyond our preoccupation with the Challenger Deep to some more representative hadal provinces. This was followed by Michelle Gaither (Durham University) who took us through her fascinating work on the genetics of adaptation in deep-sea grenadier fish. The group's website ([deepseaevolution.com](http://deepseaevolution.com)) is well worth a look.

After a brief coffee break we began the first of the discussion sessions that took us through the rest of the meeting. Kerry Howell put forward her exciting proposal to commemorate the 150th anniversary of the Challenger Expedition in 2022 with a new global oceanographic venture in the spirit of Challenger. The idea was enthusiastically welcomed by the group with lots of useful advice on a timetable of action to get this ambitious project off the ground. Get in touch with Kerry for more information on how to get involved. Kerry then led us in another discussion on how we might be able to emulate the MASTS model to pool our shared resources to get some deep-sea work done in the current funding environment.

The final discussion session of the day was held as a continuation of lunch in the seminar room. We considered some of the most serious problems surrounding funding and resourcing of deep-sea research in the UK and explored ways that we, as a community, could work together to see more projects funded. The meeting concluded with a discussion about the future of the group and SIG activities. It was agreed that another meeting should be held at the Challenger Society conference next September (make a note in your diaries). Until then, we will be creating an email list to keep in touch, open to anyone who wants to keep updated on the discussions.

### **Next steps**

After two days of research highlights and fruitful discussion, we parted ways with a new community formed ready for the upcoming International Deep-Sea Biology Symposium in Portugal later in the summer. It was a genuine pleasure to have so many deep-sea researchers together in one place. The flow of discussion and ideas was exciting and inspiring. Now we need to keep the energy and enthusiasm going!

The next meeting of the SIG will be at the Challenger Society's Biennial Conference in Liverpool in September 2016.





## 6th International Symposium Deep-Sea Corals

September 12-16, 2016

*Boston Marriott Long Wharf, Boston, MA, USA*

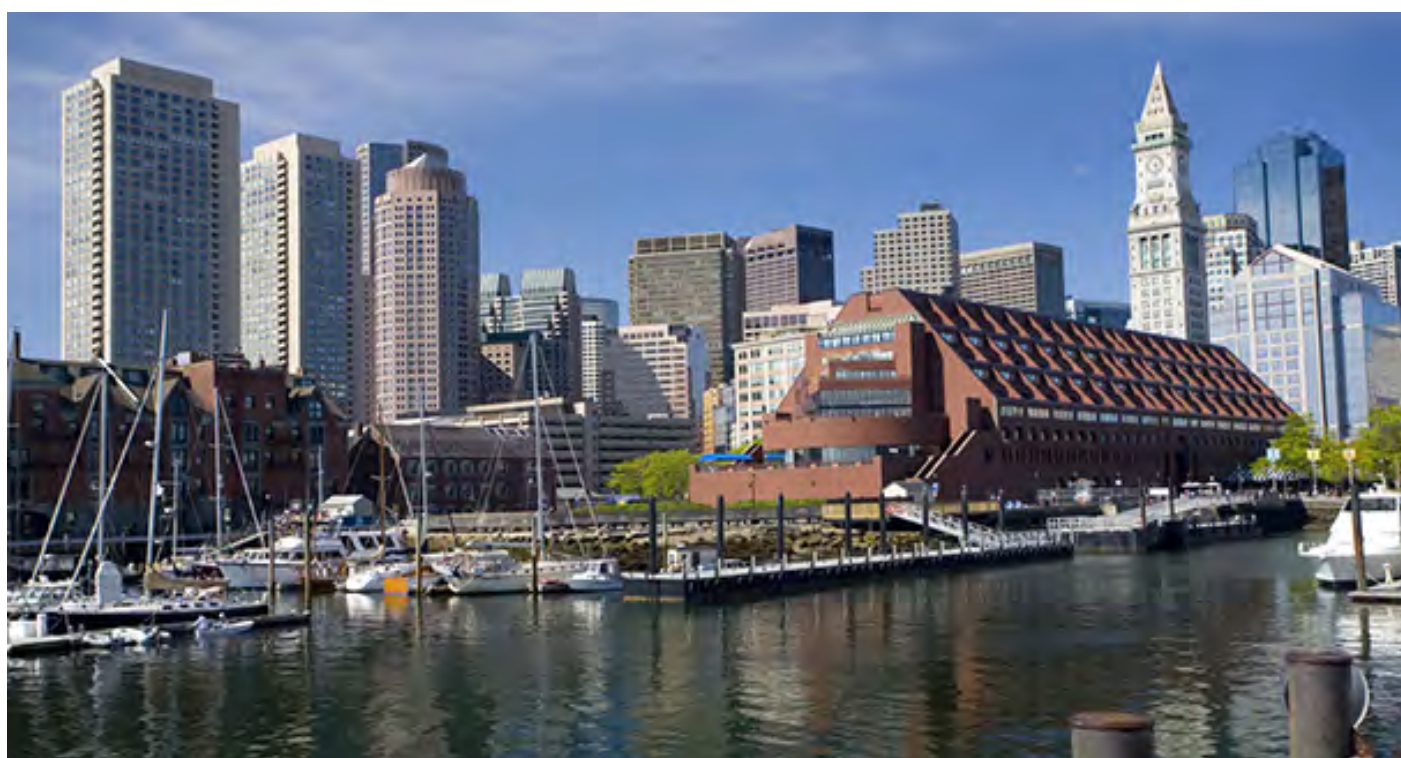
In the last decade, the global presence of deep sea, cold-water corals in a range of ocean margin settings has been established, and is still being expanded. Associated with the corals is the presence of huge carbonate mound structures and deep-sea reefs which contain unique records and a detailed history of ambient ocean-water conditions over periods of rapid climate change. The coral reefs and mounds form very rich benthic habitats, of spectacular biodiversity, housing more coral species in deep cold waters than in tropical coral reefs. Because of their function as a nursery for commercially important fisheries, in combination with increasing environmental pressures, the cold-water corals, reefs and mounds are seriously threatened and management and policy making is a must. The [6th International Deep-Sea Coral Symposium](#) will address new developments and knowledge through a range of themes and topics to take place in Boston, United States, in September 2016.

The ISDSC6 will bring together scientists, industry, students and managers with recent, state-of-the-art knowledge on the presence, distribution, linkages, ecosystem function and biodiversity of cold-water corals and their habitats. In addition, the forcing factors driving the past and present biogeography, past and present constraints and effects of climate change in a global context will be discussed and management and policy issues for conservation tackled. Topics include ocean acidification, biogeography, larval dispersal, evolution, connectivity, autecology and reproduction, predictive habitat modeling, (paleo)productivity, new proxies in paleoceanography, conservation strategies, national and international management, marine protected areas and beyond.

Organizers:

Tim Shank, Woods Hole Oceanographic Institution

Erik Cordes, Temple University







# 9<sup>th</sup> Course

## International School on Foraminifera

Urbino - 6<sup>th</sup>-25<sup>th</sup> June, 2016

The 9th Course on Foraminifera is designed to provide an overview of the Taxonomy, Ecology, Biodiversity, and Geological History of Benthic and Planktonic Foraminifera. This intensive course is intended for students interested in Micropalaeontology, Palaeoceanography, Palaeoecology, Climate History, Biology, and Environmental applications. The aim is to provide a primer on the study of foraminifera and examples of how foraminifera can be used as (paleo)environmental and (paleo)oceanographical proxies. We review the current classification schemes of the foraminifera, discuss their ecology and life history, review their usefulness for biostratigraphical applications, and use case studies to investigate the geological history of the group with lab and practical sessions. The entire course consists of approximately 60 hours of lectures and 60 hours of practical work.



### Course Structure

Four distinct courses are planned: *Foraminiferal Introduction* (7-11 June), *Larger Benthic Foraminiferal Course* (12-15 June), *Planktonic Foraminiferal Course* (17-21 June) and *Smaller Benthic Foraminiferal Course* (22-25 June).

### Teaching format



The course consists of lectures and practical classes covering the taxonomy, distribution, ecology, and paleoecology of foraminifera. Microscope lab sessions provide the opportunity for participants to learn the foraminiferal genera and species, and view Cretaceous to Neogene foraminiferal assemblages from Petroleum Exploration areas and ODP sites as well as Quaternary and modern assemblages. At the end of each lecture session, different tasks will be assigned to participants to reinforce the knowledge learned. Course materials include the lecture powerpoints and numerous pdf reprints of classic papers.

### Correspondence and information

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fabrizio.frontalini@uniurb.it or isf@tmsoc.org Tel: (+39) 0722 304309, Fax: (+39) 0722 304220

### How to make an application

Registration must be done by submitting the application form that can be download from <http://isf.tmsoc.org> website, or by sending an email to [isf@tmsoc.org](mailto:isf@tmsoc.org)

### Lecturers

**Prof. Michael A. Kaminski**, King Fahd University of Petroleum & Minerals (Saudi Arabia)  
**Dr. Fabrizio Frontalini**, Urbino University (Italy)  
**Prof. Laia Alegret**, University of Zaragoza (Spain)  
**Dr. Joan M. Bernhard**, Woods Hole Oceanographic Institution (USA)  
**Dr. Antonino Briguglio**, University of Brunei Darussalam (Brunei)  
**Dr. Claudia Cetaan**, Robertson Ltd (UK)  
**Prof. Rodolfo Coccioni**, Urbino University (Italy)  
**Dr. Danielle Foy**, Blue Phoenix Geological Ltd. (UK)  
**Prof. Johann Hohenegger**, University of Vienna (Austria)  
**Prof. Geraint Wyn Hughes**, King Fahd University of Petroleum & Minerals (Saudi Arabia)  
**Prof. Michal Kucera**, MARUM, University of Bremen (Germany)  
**Prof. Cesare Andrea Papazzoni**, University of Modena e Reggio Emilia (Italy)  
**Prof. Jan Pawłowski**, University of Geneva (Switzerland)  
**Prof. Maria Rose Petrizzo**, Milano University (Italy)  
**Dr. Anna Sabbatini**, Marche Polytechnic University (Italy)



For more information please visit our website at [www.isf.tmsoc.org](http://www.isf.tmsoc.org)





# CleanSea

Towards a Clean Litter-Free European  
Marine Environment through Scientific Evidence  
Innovative Tools and Good Governance

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European Environment Agency**

**Marine litter science highlights from  
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**Roadmap to litter-free seas**

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**Coordinator: Dr. Heather Leslie  
Institute for Environmental Studies  
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**Contact: [info@cleansea-project.eu](mailto:info@cleansea-project.eu)**

**Online registration required: [www.cleansea-project.eu](http://www.cleansea-project.eu)**



Co-funded by the European Union under grant agreement No. 308370



# It's Your Opinion

## MESP MARINE ECOSYSTEM SERVICES PARTNERSHIP

### Below the surface: inserting “oceans” into the Paris climate conversation

Linwood Pendleton, MESP



Marine scientists and conservation professionals are organizing to make “oceans” a priority at the 21st session of the Conference of the Parties (COP21) talks in Paris this December. Oceans, and the ecosystems they support, play an important role in mitigating the effects of climate change.

The Climate Meeting in Paris provides an opportunity to highlight the connections between oceans and climate—good and bad. But these meetings are the result of complicated and bureaucratic international processes and have all the constraints associated with major international agreements.

I sat down with [Dorothee Herr](#), Oceans and Climate Change Manager at the IUCN’s Global Marine and Polar Programme, to discuss what we might expect at COP21 on the topic of oceans.

#### **Pendleton: How is the UNFCCC applicable to Oceans?**

**Herr:** The Convention itself makes references to the need to manage and conserve the oceans at large - and coastal and marine ecosystems in particular - for climate change mitigation as well as adaptation. So far a lot of effort has been put on implementing adaptation activities across the world’s coastline, but less attention has been put on the mitigation role of coastal and marine ecosystems.

Oceans play an important role in the carbon cycle and act, in their entirety, as a carbon sink. Coastal ecosystems, such as mangroves, saltmarshes and seagrasses, are efficient and profound at sequestering and storing carbon mostly in sediment from which they grow. These coastal ecosystems play a valuable role in climate change mitigation and can currently be included in national carbon accounting mechanisms.

Marine ecosystems and species in the open ocean or deep sea, including corals, kelp, plankton and marine fauna, play a significant role in absorbing, moving, and storing carbon but are currently not considered or suited to be part of UNFCCC accounting mechanisms.

#### **Pendleton: REDD+ was designed for Forests. Why is there no carbon accounting system specifically for Oceans?**

**Herr:** For years, the COP discussed forests under one specific agenda item. These discussions have generated the emergence of the “Reducing Emissions from Deforestation and Forest Degradation” (REDD+) effort which allows

countries and projects to obtain credit for carbon storage, offering an incentive for developing countries to reduce emissions from forested lands. No other emissions sector - energy and transportation included - has ever been singled out like this.

There are distinct challenges for oceans, specifically for open oceans, to have their own carbon accounting mechanism or incentive scheme. A large portion of oceans is beyond national jurisdiction, but the carbon schemes are based on national or sub-national action. Furthermore, so much of the carbon held by oceans is not held in a long-term stock, like forests or wetlands, but is simply a dynamic part of the global carbon cycle. While carbon in stocks can be accounted for, cycling carbon cannot. The UNFCCC is not (yet) structured to fully incorporate these complex characteristics into national carbon balances and efforts.

By comparison, coastal ecosystems can be included in national greenhouse gas accounting. The Intergovernmental Panel on Climate Change (IPCC) created a [2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands](#) that extends national carbon accounting to these coastal ecosystems. All countries have or are in the process of preparing their national climate change plan, or Intended Nationally Determined Contribution (INDC), that provides an opportunity to reflect coastal wetland carbon accounting. And, under REDD+, if a country has classified its mangroves as “forests,” mangrove carbon management activities can be incentivized and accounted for as a top mitigation solution.

**Pendleton: Should the UNFCCC at least define “oceans?”**

**Herr:** Potentially, but it is important to be clear what is meant by “ocean.” Is there one ocean or regional seas? Nearshore and offshore? Deep ocean and shallow? Where does the ocean stop and the coast start? What about estuaries?

**Pendleton: The Natural Ocean Carbon Cycle plays an important role in climate change mitigation, but how is this impacted by climate change?**

**Herr:** At the cost of ocean warming, ocean acidification and deoxygenation (‘the deadly trio»), the oceans have so far acted as a buffer for atmospheric climate change impacts. The continuous uptake of anthropogenic CO<sub>2</sub> by the oceans depends on processes that are sensitive to climate change. Climate change diminishes the oceans’ function as an effective carbon sink and only a fraction of 21st century emissions will continue to be absorbed by the oceans. More specifically, emissions remaining in the atmosphere are projected to increase by 30% to 69% depending on the emissions projections of possible future climate change.

The open ocean is at a crossroads, threatened by CO<sub>2</sub> emissions that cause ocean acidification and damage marine ecosystems and fauna, which play a crucial role in the carbon cycle (as well as for the storage of heat). An ecologically degraded ocean loses its capacity to support the carbon cycle as well as to provide other ecosystem services. The “deadly trio” has and will alter earth-system-regulating processes such as climate, carbon sequestration, heat distribution, weather, water flow and waste treatment. Ocean-derived ecosystem services that provide food and security are at risk, as well as public health, human wellbeing, cultural services (e.g., recreation and leisure) and cultural heritage.

**Pendleton: What else threatens oceans climate mitigation efforts?**

**Herr:** IPCC reports have identified that climate change and carbon emissions pose a serious ecological threat to oceans and the people who depend upon them. Less obvious in UNFCCC documentation is the acknowledgment that oceans are adversely affected by some climate change mitigation efforts, especially those that seek to use the oceans for enhanced carbon storage or geo-engineering schemes. The UNFCCC should contain language and objectives that curtail the threats to the continuation of the ocean’s role as a global carbon sink. Other international and national policies such as the U.N. Convention on the Law of the Sea and the Convention on Biological Diversity must mobilize to sustainably manage our manifold marine resources and their services while heightening the debate and discussion of



how to integrate and incentivize better ocean carbon management.

**Pendleton: How can ocean acidification be measured and reduced?**

**Herr:** For many ecosystems, the effects of sea temperature change and ocean acidification are now known to be synergistic - each compounding the effects of the other. At COP21, the [Global Climate Observing System \(GCOS\)](#) status report will be presented during the Subsidiary Body for Scientific and Technological Advice (SBSTA) meeting. Parties attending this meeting should use the opportunity to encourage the development of the GCOS and its capabilities for ocean observation and determining degrees of ocean acidification.

**Pendleton: How does COP21 set the stage for conversations on oceans?**

**Herr:** Overall, COP21 is just another, albeit important, milestone in the fight against climate change and the debate and efforts must continue beyond COP21. Many UNFCCC agreements and mechanisms address ocean activities and now must be properly implemented. For instance, the carbon emissions of ships are already accounted for and regulated by the International Maritime Organization. The Convention on Biological Diversity and the Wetlands Convention are other international regimes already discussing and working on issues such as ocean acidification, coastal and marine adaptation and sequestration. These organizations' incentive tools must be implemented at national and regional levels, and their efforts must be harnessed to ensure that "oceans" are properly reflected in the broader climate change discussions.

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# Scientist Profiles

## Travis Washburn

Harte Research Institute at Texas A&M – Corpus Christi, USA

Contact: [twashburn@islander.tamucc.edu](mailto:twashburn@islander.tamucc.edu)



My name is Travis Washburn and I am a Ph.D. candidate at the Harte Research Institute at Texas A&M – Corpus Christi. I am a benthic ecologist focusing on annelids and other infauna. Much of my research involves using benthic communities to determine the damages caused by anthropogenic stressors. My Master's degree involved examining the effects of watershed development on coastal communities, but my greatest interests lie in the deep sea. My dissertation work explores the effects of human released hydrocarbons (the Deepwater Horizon oil spill) and naturally released hydrocarbons (oil seepage) on the deep-sea macrobenthos. I am also exploring possible human benefits derived from the deep seafloor to explain the importance of changes in the benthic community. I plan on graduating near the end of 2016 and hope to continue my research on the deep-sea benthos with a focus on soft-bottom, hydrocarbon seep and deep-sea coral communities.

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## Sidi Mohamad

Mauritanian Institute of Oceanographic Research, Mauritania and Vigo University, Spain

Contact: [sidimhf@gmail.com](mailto:sidimhf@gmail.com)



I am a marine-biology researcher at the Mauritanian Institute of Oceanographic Research and Fisheries (IMROP). The mission of IMROP is to provide to authorities and users the knowledge necessary for fisheries and aquatic environment sustainable management. Also, IMROP contributes to the popularization of science by publishing its research. It is also involved in several international observing programmes, such as the Regional Project for the Protection of Canary Current Large Marine Ecosystem (CCLME), implemented by the EAF-Nansen FAO Project and PNUE.

In IMROP, I conduct research in biology and ecology of benthic ecosystems. In 2014, I started my PhD studies on biodiversity of benthic ecosystems of the shelf and slope off Mauritania in Vigo University (Spain). My dissertation work is based in the study of invertebrate collections and oceanographic and sedimentological data obtained in Mauritania during two ecosystem surveys carried out on board the Norwegian R/V Dr. Fridtjof Nansen in 2011 and 2012, in the framework of CCLME Regional project.

An important and basic part for my research project on biodiversity of benthic ecosystems is the taxonomic identification of the invertebrates collection obtained on the continental shelf and upper-slope off Mauritania.

## Simone Nunes Brandão

Universidade Federal do Rio Grande do Norte, Brazil

Contact: [brandao.sn.100@gmail.com](mailto:brandao.sn.100@gmail.com)



Simone Nunes Brandão graduated in Biological Sciences in the Universidade Federal do Rio de Janeiro (2000), received a master degree in Biological Sciences (Zoology) from the Museu Nacional (2002) and obtained her PhD in Natural Sciences (Zoology) from the University of Hamburg, Germany (2009). She was also a postdoctoral fellow and guest scientist at the German Centre for Marine Biodiversity Research (DZMB), Senckenberg Research Institute and at the Zoologisches Museum of the University of Hamburg. She returned to Brazil in mid-2013 to work as a postdoctoral fellow at the Universidade Federal do Rio Grande do Norte with a scholarship of the Young Talent , Science Without Borders program. For more than a decade, she has participated in international networks and is an editor and curator of the World Register of Marine Species, the Register of Antarctic Marine Species, the World Ostracoda Database and the Encyclopedia of Life. Simone collaborates or has collaborated with researchers in several countries, including Germany, UK, USA, China, South Korea, Japan and Norway. She has

experience in the area of biodiversity, focusing on macroecology, biogeography, genetics, paleontology, systematics and taxonomy. She participated in several international projects of deep-sea fauna and has obtained funding for projects and travel from international, Brazilian and German institutions. She has participated in training in methodologies and technologies (electron microscopy, synchrotron, statistics, morphology, molecular biology, curation of zoological collections) in internationally renowned institutions (Smithsonian Institution in Washington DC, The Natural History Museum in London, European Synchrotron Radiation Facility Institut Royal des Sciences Naturelles de Belgique, Eppendorf Customer Support Training Center, Karl-Franzens-Universität). She is a reviewer of 19 international and national journals from Elsevier publishing, Magnolia Press, Oxford Journals, Springer and others.

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## Marie Portail

Ecology of cold seep and hydrothermal vent ecosystems

*Ifremer, Deep-sea laboratory, France*

Contact: [marie.portail@ifremer.fr](mailto:marie.portail@ifremer.fr); [marie.anoa.portail@gmail.com](mailto:marie.anoa.portail@gmail.com)

The investigation of macrofaunal community structure and food-web patterns of cold seep and hydrothermal vent ecosystems is the central topic of my PhD. We first compared seeps and vents in the Guaymas basin, where both ecosystems are found at proximity, in a same sedimentary context and at comparable depths. The absence of biogeographic barrier allowed to specifically addressing the role of local environmental conditions as barriers for faunal exchange between ecosystems and as functional drivers. This work has led to two publications (Portail et al., 2015, Biogeosciences, doi:10.5194/bg-12-5455-2015 and Portail et al., 2015 submitted to PlosONE) and highlighted strong faunal and functional similarities between vents and seeps, thus reinforcing the hypothesis of a continuum across chemosynthetic ecosystems. Community structure and food-web complexity patterns along the fluid-flux gradient were consistent across the two ecosystems. These patterns were primarily shaped by seep- and vent-common abiotic factors including methane and hydrogen sulfide concentrations, whereas vent environmental specificities (higher





temperature, higher metal concentrations and lower pH) were not significant.

A second part of our research is to compare several hydrothermal vents across different geological settings and depths along the North Mid-Atlantic Ridge (Menez Gwen, Lucky Strike and Rainbow). The main outcome of this study is that the structure of the food webs remained remarkably similar across vent fields despite variations in community structure, vent-fluid composition and individual species diets. Species trophic flexibility, together with the depth-related turn-over of species within similar trophic niches, seemed to contribute to the stability of food webs across vent fields.

The multidisciplinary nature of my PhD has led to many collaborations and provides an integrative understanding of ecological processes structuring chemosynthetic ecosystems. The use of complementary approaches based on nitrogen and carbon stable isotopes, fatty acid

composition of neutral and polar lipids and carbon stable isotopes of fatty acids during my PhD proved powerful tools to describe and understand trophic structure and interactions. The ultimate aim of my research is to decipher ecological processes driving deep-sea ecosystems through structural and functional comparisons among and across ecosystems. I would be pleased to discuss my research as well as any job opportunities.

# DeepMatch.com

## **Postdoctoral Position in Ecosystem Modelling in the FjordEco Project at the University of Hawaii at Manoa**

University of Hawaii, School of Ocean and Earth Science Technology (SOEST), Antarctic Oceanography Ecosystem Modeling

SOEST, at the University of Hawaii in Manoa, seeks a Postdoctoral Scholar to collaborate in a significant inter-disciplinary and multi-institutional (Scripps, U. Hawaii, U. Alaska) project: FjordEco (see summary below) to observe, simulate, and understand the extreme biological productivity blooms that occur in the fjords of the Western Antarctic Peninsula. Using the Regional Ocean Modeling System (ROMS) coupled with a state-of-the-art ecosystem model, we will examine the processes that sustain a season long bloom in the Antarctic fjord. A significant observational program will be conducted, and the observations will help to validate the model processes. The results will provide new insight into the mechanisms that make the Antarctic fjords among the most biologically productive sites and how these mechanisms may be sensitive to changes in the Earth system. Further research into the influence of these physical processes on the biology of the region will be encouraged. The successful candidate will join a dynamic team of biological oceanographers, physical oceanographers and glaciologists studying fjord ecosystem dynamics along the West Antarctic Peninsula.

The successful candidate will be responsible for development of new ecosystem simulation of Antarctic fjords, comparison with in situ data, scientific research into impacts on the Fjord ecosystem, and understanding the controlling factors of nutrient delivery into the ecosystem. It is expected that the successful candidate will publish scientific articles and contribute to and/or write new funding proposals, etc.

Minimum Qualifications include: Ph.D. or equivalent in biological oceanography, physical oceanography (with ecosystem experience), marine ecosystems, or related field, ability to work well independently as part of a team, and strong communication skills both verbal and written. Preferred candidates will have experience with ecosystem modelling, mathematical and computational skills with background in ecosystem dynamics. Candidates should be motivated to drive new developments in ecosystems simulations.

The appointment is planned for three years, and it will be reviewed annually and renewed based upon performance and funding. Stipend is commensurate with qualifications and experience. Review of applications will begin immediately, and will proceed until the position is filled. Electronic applications containing: (1) curriculum vitae; (2) one-page statement of research interests; (3) one published academic article most indicative of your work; (4) contact information for three references to [powellb@hawaii.edu](mailto:powellb@hawaii.edu). Email verification will be sent upon receipt of your application, please inquire if receipt is not received. For more information, please contact Dr. Brian Powell <[powellb@hawaii.edu](mailto:powellb@hawaii.edu)>.

The University of Hawaii is an equal opportunity and affirmative action employer. All qualified applicants will receive consideration for employment without regard to race, color, national origin, religion, sex, age, veteran status, or disability. Applications from women, minorities, and persons with disabilities are encouraged.

## Summary of the NSF funded FjordEco Project

*PIs: Craig Smith, Brian Powell and Mark Merrifield (University of Hawaii at Manoa)*

*Maria Vernet (Scripps Institution of Oceanography)*

*Peter Winsor and Martin Truffer (University of Alaska Fairbanks)*

### **Fjord Ecosystem Structure and Function on the West Antarctic Peninsula - Hotspots of Productivity and Biodiversity? (FjordEco)**

Marine communities along the western Antarctic Peninsula are highly productive ecosystems which support a diverse assemblage of charismatic animals such as penguins, seals, and whales as well as commercial fisheries such as that on Antarctic krill. Fjords (long, narrow, deep inlets of the sea between high cliffs) along the central coast of the Peninsula appear to be intense, potentially climate sensitive, hotspots of biological production and biodiversity, yet the structure and dynamics of these fjord ecosystems are very poorly understood. Because of this intense biological activity and the charismatic fauna it supports, these fjords are also major destinations for a large Antarctic tourism industry. This project is an integrated field and modeling program to evaluate physical oceanographic processes, glacial inputs, water column community dynamics, and seafloor bottom community structure and function in these important yet little understood fjord systems. These Antarctic fjords have characteristics that are substantially different from well-studied Arctic fjords, likely yielding much different responses to climate warming. This project will provide major new insights into the dynamics and climate sensitivity of Antarctic fjord ecosystems, highlighting contrasts with Arctic sub-polar fjords, and potentially transforming our understanding of the ecological role of fjords in the rapidly warming west Antarctic coastal marine landscape. The project will also further the NSF goal of training new generations of scientists, providing scientific training for undergraduate, graduate and postdoctoral students. This includes the unique educational opportunity for undergraduates to participate in research cruises in Antarctica and the development of a novel summer graduate course on fjord ecosystems. Internet based outreach activities will be enhanced and extended by the participation of a professional photographer who will produce magazine articles, websites, radio broadcasts, and other forms of public outreach on the fascinating Antarctic ecosystem.

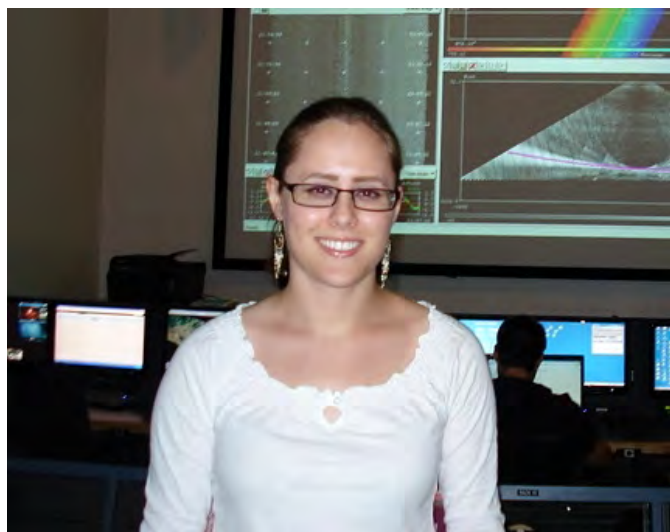
This project will involve a 15-month field program to test mechanistic hypotheses concerning oceanographic and glaciological forcing, and phytoplankton and benthic community response in the Antarctic fjords. Those efforts will be followed by a coupled physical/biological modeling effort study to evaluate the drivers of biogeochemical cycles in the fjords and to explore their potential sensitivity to enhanced meltwater and sediment inputs. Fieldwork over two oceanographic cruises will utilize moorings, weather stations, and glacial, sea-ice and seafloor time-lapse cameras to obtain an integrated view of fjord ecosystem processes. The field team will also make multiple shipboard measurements and will use towed and autonomous underwater vehicles to intensively evaluate fjord ecosystem structure and function during spring/summer and autumn seasons. These integrated field and modeling studies are expected to elucidate fundamental properties of water column and sea bottom ecosystem structure and function in the fjords, and to identify key physical-chemical-glaciological forcing in these rapidly warming ecosystems.



## Stephanie Sharuga

### Benthic Megafaunal Ecology Using Imagery-Based Platforms

Contact: [ssharuga@outlook.com](mailto:ssharuga@outlook.com)



I have recently completed my PhD in Oceanography and Coastal Sciences as well as a 6-month position as a postdoctoral researcher at Louisiana State University (USA), specializing in deep-sea benthic ecology. My research was part of a BP-funded project focusing on deep-sea benthic megafaunal ecology in the northern Gulf of Mexico (GoM), along with evaluating the use of ROVs and AUVs for environmental monitoring activities. In part, my research involved establishing an approach for quantifying abundances and biodiversity, along with evaluating natural and anthropogenic factors that may impact benthic megafaunal community characteristics in the deep-sea GoM.

Over the years, I have worked extensively with ROV and AUV seafloor data including through independent research projects using ROPOS data collected during NEPTUNE surveying in Canada and as a guest scientist during a Sentry AUV telepresence cruise. I have also participated in numerous other telepresence research cruises as a Scientist Ashore, and am very interested in the role of telepresence technologies in furthering scientific research and education. My background and research interests are very interdisciplinary – along with my PhD, I have a Bachelor of Science in Biology and Earth and Ocean Sciences from University of Victoria (Canada) and a Master of Science in Environmental Management and Sustainability from Illinois Institute of Technology (USA). Overall, my research interests lie in exploring the deep-sea benthic environment and evaluating natural and anthropogenic drivers of change. I am interested in exploring what natural environmental factors affect biodiversity and community characteristics, as these types of studies help provide information critical in deep-sea environmental monitoring programs. Further, I am particularly interested in assessing human impacts to the deep sea, including from offshore industries and fisheries, and the implications for conservation in the deep sea.

I am looking for opportunities where I can broaden my research portfolio and specialize further in deep-sea benthic ecology while working with a wide range of collaborators on interdisciplinary projects. I am interested in both short and long-term positions, and would be open to applying for funding to support the right opportunity, as well. If anyone knows of any postdoctoral or other research opportunities, I would greatly appreciate if you would contact me! Please contact me or find me on LinkedIn [www.linkedin.com/in/stephaniesharuga](http://www.linkedin.com/in/stephaniesharuga) for more information on my background.

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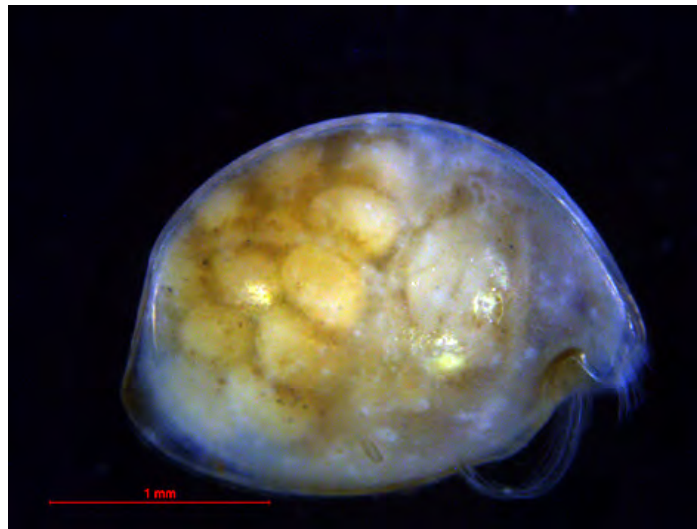
# Wanted

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## Looking for ostracods!

Simone Nunes BRANDÃO

I am very much interested in ostracod crustaceans from virtually all kinds of deep-sea ecosystems. I intend to gather data on specimens collected alive (i.e., specimens with soft parts), in contrast to empty valves. I would like to gather as much ecological information as possible on ostracod taxa in order to investigate for their preferences. So, if you have such material please don't hesitate to contact me: [brandao.sn.100@gmail.com](mailto:brandao.sn.100@gmail.com)



Above: Ostracod *Philomedes* sp.

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# Obituaries

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## **Prof. Dr. Michael Tuerkay**



As reported by Prof. Dr. Mosbrugger, general director...sadly, Prof. Dr. Michael Tuerkay passed away on September 9, 2015 at age 67.

With Michael Tuerkay, Senckenberg, the community of marine zoologists and especially crustaceology lost a highly respected and valued scientist and academic teacher. He served "his" Senckenberg for more than 50 years in many different positions from curator to deputy general director.

Michael Tuerkay the friend, colleague and scientist will be missed and always remembered with great respect and thankfulness.

Dr. Dieter Fiege  
Department of Marine Zoology  
Senckenberg  
Research Institute and Natural History Museum Frankfurt  
Germany

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# Hot off the Press

## **Biogeography of deep-sea wood fall, cold seep and hydrothermal vent Ostracoda (Crustacea), with the description of a new family and a taxonomic key to living Cytheroidea**

Karanovic I & Nunes Brandao S(2015)

*Deep-Sea Research II*, 111: 76–94

Stimulated by finding a novel cytheroid ostracod in a piece of sunken wood retrieved from the sea-bed in the Kuril–Kamchatka Trench, we have reviewed all previously published data on ostracods from similarly ephemeral deep-sea habitats (wood falls, hydrothermal vents and cold seeps). These data are placed in the context of all data on living, deep-sea ostracods from other environments. We confirm previous authors' conclusions that fauna from these ephemeral habitats are similar at the generic level, and include elements common to shallow and deep habitats. However, at the species level, endemism varies from zero at cold seeps, to 35% in wood falls and 60% at hydrothermal vents, which is an indication of the relative longevity of these habitats. Non-endemic species occur also in oligotrophic, deep-sea sediments but not in shallow environments. This is in contradiction to previous assumptions that these ephemeral fauna share more species and genera with shallow habitats than with the oligotrophic, deep-sea sediments. We agree with previous authors that the dispersal strategy of wood fall, vent and seep ostracods includes hitchhiking and we propose that it also includes the ability to survive ingestion by larger, more motile animals. The homogeneity of the faunas from ephemeral habitats collected off the American continent is in stark contrast to the highly endemic fauna found in Northwestern Pacific. This suggests that the ostracods may have biogeographical patterns similar to those previously proposed for other groups of benthos. However, any proposal for a global biogeographical scheme for ostracod distributions will have to await far more comprehensive coverage from presently unstudied regions.

Finally, we describe and name a novel species of ostracod from the wood fall collected at a depth of 5229m in the abyss east to the Kuril–Kamchatka Trench, Northwestern Pacific; erecting a new family Keysercytheridae fam. nov. and a new genus, Keysercythere gen. nov., to accommodate it, and name it, Keysercythere enricoi sp. nov. We present a preliminary key to all Cytheroidea families for which living representatives have been described.

Link to the article: <http://www.sciencedirect.com/science/article/pii/S0967064514002616>

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## **The role of ontogeny in physiological tolerance: decreasing hydrostatic pressure tolerance with development in the northern stone crab *Lithodes maja***

Munro C, Morris J, Brown A *et al* (2015)

*Proceedings of the Royal Society B: Biological Sciences* 282: 20150577

Contact: [jmorris@naturalsciences.be](mailto:jmorris@naturalsciences.be); Twitter: @EcoPhysJ

Extant deep-sea invertebrate fauna represent both ancient and recent invasions from shallow-water habitats. Hydrostatic pressure may present a significant physiological challenge to organisms seeking to colonize deeper waters or migrate



ontogenetically. Pressure may be a key factor contributing to bottlenecks in the radiation of taxa and potentially drive speciation. Here, we assess shifts in the tolerance of hydrostatic pressure through early ontogeny of the northern stone crab *Lithodes maja*, which occupies a depth range of 4–790m in the North Atlantic. The zoea I, megalopa and crab I stages were exposed to hydrostatic pressures up to 30.0 MPa (equivalent of 3000m depth), and the relative fold change of genes putatively coding for the N-methyl-D-aspartate receptor-regulated protein 1 (narg gene), two heat-shock protein 70 kDa (HSP70) isoforms and mitochondrial Citrate Synthase (CS gene) were measured. This study finds a significant increase in the relative expression of the CS and hsp70a genes with increased hydrostatic pressure in the zoea I stage, and an increase in the relative expression of all genes with increased hydrostatic

pressure in the megalopa and crab I stages. Transcriptional responses are corroborated by patterns in respiratory rates in response to hydrostatic pressure in all stages. These results suggest a decrease in the acute high-pressure tolerance limit as ontogeny advances, as reflected by a shift in the hydrostatic pressure at which significant differences are observed.

Link to publication: <http://rspb.royalsocietypublishing.org/content/282/1809/20150577>

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## Comparative study of vent and seep macrofaunal communities in the Guaymas Basin

Marie Portail, Karen Olu, Elva Escobar-Briones *et al.* (2015)

*Biogeosciences*, 12, 5455–5479 DOI:10.5194/bg-12-5455-2015

Understanding the ecological processes and connectivity of chemosynthetic deep-sea ecosystems requires comparative studies. In the Guaymas Basin (Gulf of California, Mexico), the presence of seeps and vents in the absence of a biogeographic barrier, and comparable sedimentary settings and depths offers a unique opportunity to assess the role of ecosystem-specific environmental conditions on macrofaunal communities. Six seep and four vent assemblages were studied, three of which were characterised by common major foundation taxa: vesicomid bivalves, siboglinid tubeworms and microbial mats. Macrofaunal community structure at the family level showed that density, diversity and composition patterns were primarily shaped by seep- and vent-common abiotic factors including methane and hydrogen sulfide concentrations, whereas vent environmental specificities (higher temperature, higher metal concentrations and lower pH) were not significant. The type of substratum and the heterogeneity provided by foundation species were identified as additional structuring factors and their roles were found to vary according to fluid regimes. At the family level, seep and vent similarity reached at least 58 %. All vent families were found at seeps and each seep-specific family displayed low relative abundances (< 5 %). Moreover, 85% of the identified species among dominant families were shared between seep and vent ecosystems. This study provides further support to the hypothesis of continuity among deep-sea seep and vent ecosystems.

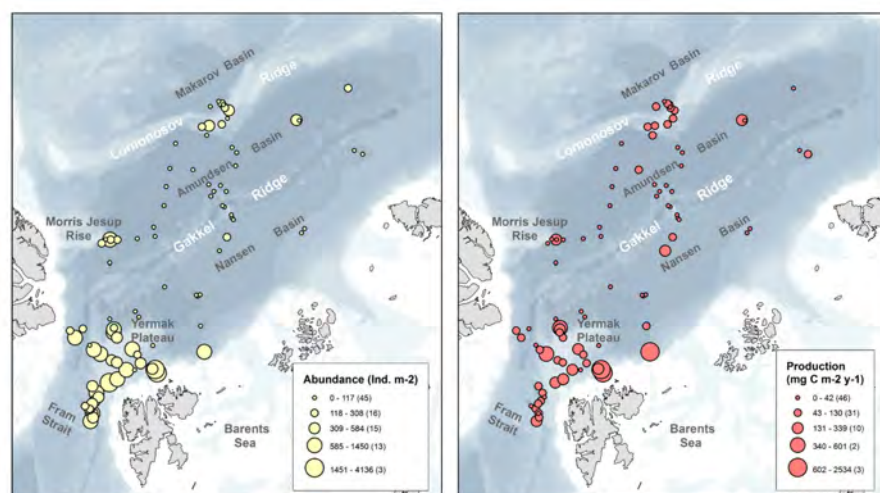
Link to article: <http://www.biogeosciences.net/12/5455/2015/bg-12-5455-2015.html>

## Patterns and trends of macrobenthic abundance, biomass and production in the deep Arctic Ocean

Degen R, Vedenin A, Gusky M *et al* (2015)

*Polar Research*, 34, 24008

Corresponding Author: [renate.degen@hotmail.com](mailto:renate.degen@hotmail.com)



Macrobenthic abundance (ind. m<sup>-2</sup>) and estimated production (mg C m<sup>-2</sup> y<sup>-1</sup>).

Little is known about the distribution and dynamics of macrobenthic communities of the deep Arctic Ocean. The few previous studies report low standing stocks and confirm a gradient with declining biomass from the slopes down to the basins, as commonly reported for deep-sea benthos. In this study, we investigated regional differences of faunal abundance and biomass, and made for the first time ever estimates of deep Arctic community production by using a multi-parameter artificial neural network model. The underlying

data set combines data from recent field studies with published and unpublished data from the past 20 years, to analyze the influence of water depth, geographical latitude and sea-ice concentration on Arctic benthic communities. We were able to confirm the previously described negative relationship of macrofauna standing stock with water depth in the Arctic deep sea, while also detecting substantial regional differences. Furthermore, abundance, biomass and production decreased significantly with increasing sea-ice extent (towards higher latitudes) down to values <200 ind.m<sup>-2</sup>, <65 mg C m<sup>-2</sup> and <73 mg C m<sup>-2</sup> y<sup>-1</sup>, respectively. In contrast, stations under the seasonal ice zone regime showed much higher standing stock and production (up to 2500 mg C m<sup>-2</sup> y<sup>-1</sup>), even at depths down to 3700 m. We conclude that particle flux is the key factor structuring benthic communities in the deep Arctic Ocean as it explains both the low values in the ice-covered Arctic basins and the higher values in the seasonal ice zone.

Link to article: <http://www.polarresearch.net/index.php/polar/article/view/24008>

## Taxonomy of Deep-Sea Trachyleberidid, Thaerocytherid, and Hemicytherid Genera (Ostracoda)

Yasuhara M, Hunt G, Okahashi H *et al* (2015)

*Smithsonian Contributions to Paleobiology*, 96:1-216

We conducted a comprehensive systematic revision of deep-sea Trachyleberididae, Thaerocytheridae, and Hemicytheridae (Ostracoda, Crustacea) covering almost all Cenozoic genera using high-resolution scanning electron microscopy. Trachyleberididae, our main focus, is one of the most diverse and abundant ostracod families, but its genus-level taxonomy is still confusing. Approximately 700 specimens from 177 species from 47 genera were examined. The studied samples range in age from the Cretaceous to the present day and cover all major oceans in the world, including



the Atlantic, Pacific, Indian, and Southern Oceans, the Mediterranean Sea, and the Gulf of Mexico. Five new genera and 45 new species are described: *Bensonodutoitella* gen. nov., *Hornibrookoleberis* gen. nov., *Croninocythereis* gen. nov., *Bensonocosta* gen. nov., *Ryugucivis* gen. nov., *Abyssocythere* *scotti* sp. nov., *Ambocythere* *tomocaudata* sp. nov., *Ambocythere* *whatleyi* sp. nov., *Ambocythere* *hyakunome* sp. nov., *Atlanticythere* *bensoni* sp. nov., *Atlanticythere* *oculi* sp. nov., *Dutoitella* *cronini* sp. nov., *Dutoitella* *symmetrica* sp. nov., *Dutoitella* *mazziniae* sp. nov., *Dutoitella* *paradinglei* sp. nov., *Dutoitella* *ayressisp.* nov., *Dutoitella* *colesi* sp. nov., *Dutoitella* *spinosa* sp. nov., *Dutoitella* *whatleyisp.* nov., *Dutoitella* *atlantiformis* sp. nov., *Bensonodutoitella* *bicornigeri* sp. nov., *Oligocythereis* *sylvesterbradleyi* sp. nov., *Cythereis* *guerneti* sp. nov., *Cythereis* *johnnealei* sp. nov., *Cythereis* *parajohnnealei* sp. nov., *Cythereis* *neoanteplanasp.* nov., *Cythereis* *sylvesterbradleyi* sp. nov., *Cythereis* *bensoni* sp. nov., *Cythereis* *purii* sp. nov., *Cythereis* *fungina* sp. nov., *Cythereis* *tomcronini* sp. nov., *Cythereis* *legitimoformis* sp. nov., *Cythereis* *richardsoni* sp. nov., *Cythereis* *dinglei* sp. nov., *Cythereis* *ovi* sp. nov., *Cythereis* *swansonii* sp. nov., *Croninocythereis* *tridentiferi* sp. nov., *Croninocythereis* *cronini* sp. nov., *Bensonocosta* *bensoni* sp. nov., *Ayressoleberis* *colesi* sp. nov., *Leguminocythereis?* *buzasi* sp. nov., *Legitimocythere* *tomi* sp. nov., *Ryugucivis* *jablonskii* sp. nov., *Ryugucivis* *acuminatasp.* nov., *Ryugucivis* *obtusa* sp. nov., *Phacorhabdotus* *mazzinireticulatus* sp. nov., *Phacorhabdotus* *nudus* sp. nov., *Phacorhabdotus* *slipperi* sp. nov., *Taracythere* *ayressoabyssora* sp. nov., and *Taracythere* *thalassoformis* sp. nov. Amended concepts are proposed for several important genera to better stabilize their taxonomy. This study considerably reduces taxonomic uncertainty of this important component of the modern and fossil deep-sea ostracod community and provides a robust taxonomic baseline for deep-sea ostracod-based paleoceanographic, paleoecological, and macroevolutionary research.

Link to article: <http://opensi.si.edu/index.php/smithsonian/catalog/book/83>

## Patchiness of deep-sea communities in Papua New Guinea and potential susceptibility to anthropogenic disturbances illustrated by seep organisms

Samadi S, Puillandre N, Boisselier M et al. (2015)

*Marine Ecology, Volume 36*

The deep-sea part of the 'Papua Niugini Biodiversity Expedition' surveyed the deep-sea environments along the coasts of New Guinea Island in the Bismarck Sea, from the Vitiaz Strait to the border between Papua New Guinea (PNG) and Irian Jaya. This expedition was a follow-up of the BIOPAPUA cruise (2010) that gave some of the first insights into the diversity of the deep-sea fauna of the Bismarck and Solomon Seas for environments other than deep-sea hydrothermal vents. The main aims of the cruise were to survey the diversity of the fauna of (i) hard bottoms that are typically found on deep seamounts, (ii) Astrolabe Bay from 200 m to about 1000 m, (iii) the chemosynthetic environments of the deep sea, including cold-seep environments and plant debris. Astrolabe Bay was one of our targets because its topography allows sampling over the complete bathymetric gradient covered by our sampling gear (down to 1000 m depth), and the recent start of nickel refining activities in the bay is a potential threat to its marine fauna for which little reference data are available. Sampling in the bay revealed not only a diversified fauna associated with soft bottoms and plant debris, but also a chemosynthetic fauna typical of cold-seep environments (e.g. siboglinid worms and bathymodioline mussels) below the Ramu refinery. Although the refinery activities had officially started just one week before our work in the area, we observed impacts of these activities. Our molecular work indicates that the siboglinid tubeworm species and one of the two mussel species collected below the Ramu refinery have so far only been documented from this location, despite intensive sampling effort. This illustrates the potential destructive effects of human activities in areas where the diversity and uniqueness of deep-sea communities are poorly understood.

Link to article: <http://onlinelibrary.wiley.com/doi/10.1111/maec.12204/epdf>

## Environmental Change in the Deep Ocean

Alex Rogers (2015)

*Annu. Rev. Environ. Resour.* 2015. 40:11.1–11.38

Patterns of abundance, biomass, and species richness are reviewed for deep-sea ecosystems. Long-term monitoring studies have indicated that deep-sea ecosystems are sensitive to climatic variability through its influence on the quantity and quality of surface primary production. The potential impacts of climate change, through its effects on primary production and through changes in the temperature, pH, and oxygenation of the deep ocean are explored. It is concluded that deep-sea ecosystems are likely to be highly sensitive to changes in food supply and the physical environment driven by global climate change. As a result, ecosystem services will be negatively impacted with likely positive feedbacks to atmospheric CO<sub>2</sub> levels. It is a matter of urgency that baselines are established for diversity, abundance, and biomass of deep-sea ecosystems, particularly for the pelagic realm and that a mechanistic understanding is developed of how food supply and physical parameters affect community structure and function.

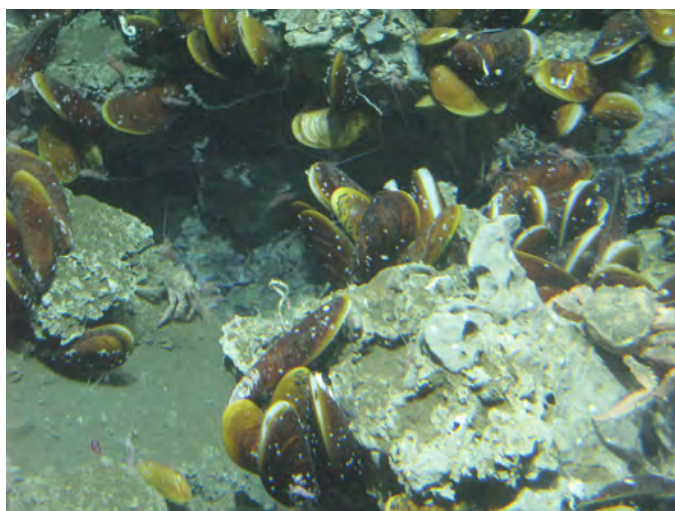
Link to article: [DOI: 10.1146/annurev-environ-102014-021415](https://doi.org/10.1146/annurev-environ-102014-021415)

## Biodiversity on the Rocks:

### Macrofauna Inhabiting Authigenic Carbonate at Costa Rica Methane Seeps

Levin L, Mendoza G, Grupe B *et al* (2015)

*PLoS ONE* 10(7): e0131080. doi:10.1371/journal.pone.0131080



*Mussel bed on Costa Rica Margin*

The macrofauna [ $>0.3\text{mm}$ ] on authigenic seep carbonates are major contributors to biodiversity of chemosynthetic ecosystems and the deep sea in general, but remain largely overlooked. Carbonate rocks provide unique macrofaunal habitat and food resources at seeps on the Costa Rica margin (400–1850 m). The attendant fauna is surprisingly similar to that in rocky intertidal shores, with numerous grazing gastropods as dominant taxa, but they feed upon seep-associated microbes. Macrofaunal density, composition, and diversity on carbonates vary as a function of seepage activity, biogenic habitat and location, and at non-seeping (inactive) sites with depth, temperature, and O<sub>2</sub> of overlying water. Densities are highest on active rocks from tubeworm bushes and mussel beds, particularly at the Mound 12

location (1000 m). Species diversity is higher on rocks exposed to active seepage, with multiple species of gastropods and polychaetes dominant, while crustaceans, cnidarians, and ophiuroids are better represented on rocks at inactive sites. Macrofauna from tube cores taken in nearby seep sediments at comparable depths exhibited densities similar to those on carbonate rocks, but have lower diversity, fewer gastropods, and higher densities of ampharetid, dorvilleid, hesionid, cirratulid and lacydoniid polychaetes.

The stable isotope signatures of carbonates and animals were heterogeneous. Carbonate  $\delta^{13}\text{C}_{\text{org}}$  =  $-33.83\text{‰}$  (range

74.4‰ to -20.6‰) was similar to mean invertebrate  $\delta^{13}\text{C}$  values of -31.0‰ (range -18.5‰ to -46.5‰), with mean  $\delta^{15}\text{N} = 5.7\text{‰}$  (range -4.5‰ to +13.4‰), indicating carbonate fauna from both active and inactive settings depend on chemosynthesis-based nutrition. Community metrics reflecting trophic diversity and species packing also did not vary as a function of seepage activity or site. Overall, the substrate and nutritional heterogeneity introduced by authigenic seep carbonates act to promote diverse, uniquely adapted assemblages, even after seepage ceases.

Link to article: [doi:10.1371/journal.pone.0131080](https://doi.org/10.1371/journal.pone.0131080)

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## Endosymbionts escape dead hydrothermal vent tubeworms to enrich the free-living population.

Klose J, Ploz M, Wagner M *et al* (2015)

*Proceedings of the National Academy of Sciences*, Aug, 17, 2015; doi:10.1073/pnas.1501160112

Contact: [julia.klose@univie.ac.at](mailto:julia.klose@univie.ac.at)

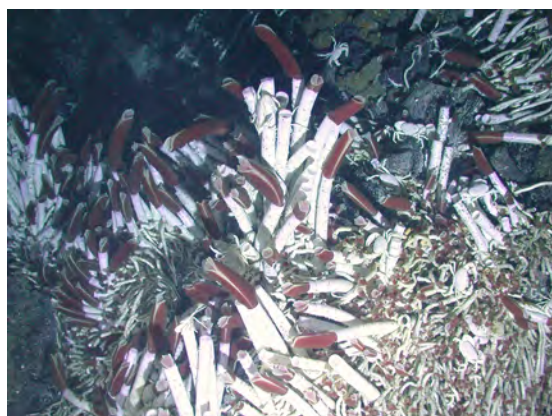


Photo courtesy Monika Bright

The giant tubeworm *Riftia pachyptila* is nourished by a bacterial endosymbiont, which is acquired by each new generation of worm larvae. Maintaining this arrangement requires the symbionts to be able to escape from their hosts and replenish the free-living bacterial population. The article describes the bacterial release from dead host tissue under simulated deep-sea and hydrothermal vent conditions in the laboratory. This suggests that several million to over one billion bacteria escape upon host death of a single tubeworm clump. The escaped bacteria settled on surfaces where they proliferated. Monitoring of tubeworm clumps at a hydrothermal vent field at the East Pacific Rise following a volcanic eruption exhibited rapid turnover within two years, suggesting that large numbers of bacteria could be released over a relatively short time. The connection between the host-associated and free-living bacterial populations might explain how the symbiotic relationship between tubeworms and bacteria has remained stable over evolutionary time scales.

Link to article: <http://www.pnas.org/content/112/36/11300.abstract>

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## First clues on the ecology of whale falls in the deep Atlantic Ocean: results from an experiment using cow carcasses

Hilario A, Cunha M, Génio L *et al.* (2015)

*Marine Ecology*, Volume 36, DOI: 10.1111/maec.12246

Sunken whale carcasses, known as 'whale falls', deliver large pulses of organic material to the seafloor and serve as habitat islands for unique assemblages of deep-sea fauna that include generalist scavenging species, chemosynthetic fauna related to those from hydrothermal vents and cold seeps, and bone-specialist species. Despite the growing interest in this peculiar habitat in the last decade, all long-term studies of deep-sea whale-falls have been restricted to the Pacific and the ecology of these habitats in the Atlantic Ocean has been overlooked. Here we report the first study on large mammal carcasses in the deep Atlantic Ocean. Cow carcasses amounting to 570 kg were deployed at



1000 m in the Setubal canyon, where cetaceans naturally occur. Eighteen months after deployment, all soft tissues had been consumed and the visible remains of the carcasses consisted solely of skeletal material that supported a diverse macrofaunal assemblage distinct from that of the background, including organic-enrichment respondents, sulphophiles and bone-specialists. The trophic structure of this assemblage denotes an overlap of successional stages previously described in whale falls. Our results provide important insights into the contribution of mammal falls to deep-sea biodiversity in the NE Atlantic, species distribution and biogeography of bone specialists, and the potential role of these habitats as dispersal stepping-stones for vent and seep species. Additionally we show that cow carcasses may serve as an accessible model system for the study of ecological processes at deep-sea whale-falls.

Link to article: <http://onlinelibrary.wiley.com/doi/10.1111/maec.12246/full>

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## Biology of Deep-Water Chondrichthyans

Edited by C.F. Cotton and R.D. Grubbs (2015)

*Deep Sea Research Part II: Topical Studies in Oceanography, Volume 115, Pages 1-136*



The symposium “Biology of Deep-Water Chondrichthyans” was held at the 28th Annual Meeting (2012) of the American Elasmobranch Society in Vancouver, British Columbia. The symposium included 26 presenters (20 oral and 6 posters) from 9 countries. This thematic issue of Deep-Sea Research II includes 14 contributed papers from the symposium, covering topics ranging from taxonomy, biodiversity, trophic ecology, life history and demographics, and behavior.

Link to article: <http://www.sciencedirect.com/science/journal/09670645/115>

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## No barrier to emergence of bathyal king crabs on the Antarctic shelf

Aronson R, Smith K, Vos S et al. (2015)

*PNAS, Volume 112 (42) 12997-13002, DOI: 10.1073/pnas.1513962112*

Cold-water conditions have excluded durophagous (skeleton-breaking) predators from the Antarctic seafloor for millions of years. Rapidly warming seas off the western Antarctic Peninsula could now facilitate their return to the continental shelf, with profound consequences for the endemic fauna. Among the likely first arrivals are king crabs (Lithodidae), which were discovered recently on the adjacent continental slope. During the austral summer of 2010–2011, we used underwater imagery to survey a slope-dwelling population of the lithodid *Paralomis birsteinii* off Marguerite Bay, western Antarctic Peninsula for environmental or trophic impediments to shoreward expansion. The population density averaged  $\approx 4.5$  individuals  $\times 1,000$  m<sup>2</sup> within a depth range of 1,100–1,500 m (overall observed depth range 841–2,266 m). Images of juveniles, discarded molts, and precopulatory behavior, as well as gravid females in a trapping study, suggested a reproductively viable population on the slope. At the time of the survey, there was no thermal barrier to prevent the lithodids from expanding upward and emerging on the outer shelf (400- to 550-m depth); however, near-surface temperatures remained too cold for them to survive in inner-shelf and coastal environments (<200 m). Ambient salinity, composition of the substrate, and the depth distribution of potential predators likewise indicated no barriers to expansion of lithodids onto the outer shelf. Primary food resources for lithodids—echinoderms

and mollusks—were abundant on the upper slope (550–800 m) and outer shelf. As sea temperatures continue to rise, lithodids will likely play an increasingly important role in the trophic structure of subtidal communities closer to shore.

Link to article: <http://www.pnas.org/content/112/42/12997>

## Submarine and deep-sea mine tailing placements: a review of current practices, environmental issues, natural analogs and knowledge gaps in Norway and internationally.

Ramirez-Llodra E, Trannum H, Evenset A *et al* (2015)

*Marine Pollution Bulletin* 97, 13–35

The mining sector is growing in parallel with societal demands for minerals. One of the most important environmental

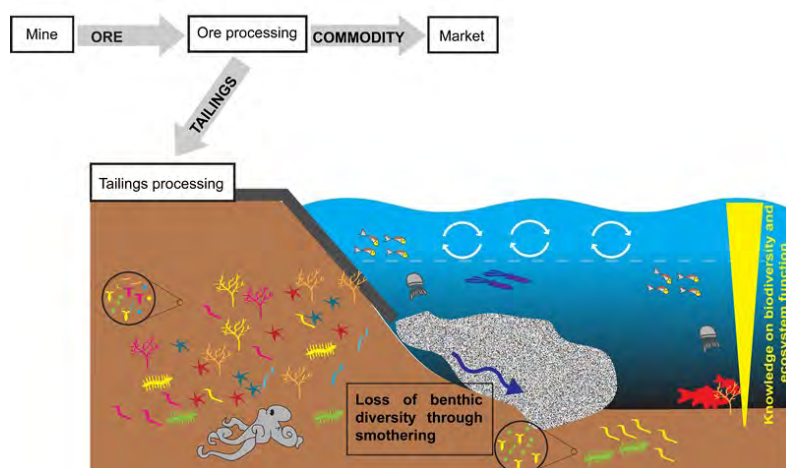


Diagram of a deep-sea tailing placement and related environmental issues. Modified from Ramirez-Llodra *et al*, 2015, *Marine Pollution Bulletin*, by Ana Hilario.

issues and economic burdens of industrial mining on land is the safe storage of the vast amounts of waste produced. Traditionally, tailings have been stored in land dams, but the lack of land availability, potential risk of dam failure and topography in coastal areas in certain countries results in increasing disposal of tailings into marine systems. This review describes the different submarine tailing disposal methods used in the world in general and in Norway in particular, their impact on the environment (e.g. hyper-sedimentation, toxicity, processes related to changes in grain shape and size, turbidity), current legislation and need for future research. Understanding these impacts on the habitat and biota is essential to

assess potential ecosystem changes and to develop best available techniques and robust management plans.

Link to article: [10.1016/j.marpolbul.2015.05.062](https://doi.org/10.1016/j.marpolbul.2015.05.062)