

Deep-Sea Life

Issue 7, June 2016

Welcome to the seventh 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.

The photo of the issue is of the handsome crew from NIWA, NZ (Mireille Consalvey, formerly NIWA, Malcolm Clark and Ashley Rowden), sporting their newly-published book – Biological Sampling in the Deep Sea (see article on page 43 for further details). This represents the first comprehensive compilation of deep-sea sampling methodologies for a range of habitats. It is hoped that the book will help to promote international consistency in sampling approaches and data collection, advance the integration of information into global databases and facilitate improved data analysis and consequently uptake of science results for the management and conversation of the deep sea.



Above: Mireille Consalvey, Malcolm Clark and Ashley Rowden, with their new book "Biological Sampling in the Deep Sea"

The management and sharing of valuable deep-sea biodiversity data is the subject of an upcoming funded workshop later this year run by OBIS & INDEEP which will train deep-sea scientists in data management, access and processing. This effort will be the beginnings of establishing a new deep-sea OBIS portal to connect with existing information systems such as WoRDDS (see page 26 for further details).

I always appreciate feedback regarding any aspect of the publication, so that it may be improved as we go forward. Please circulate to your colleagues and students who may have an interest in life in the deep and have them contact me if they wish to be placed on the mailing list for 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. Dr Abigail Pattenden (University of Limerick, Ireland) and Dr Eva Ramirez-Llodra (NIVA, Norway) have once more helped no-end in the production and editing process for this issue, and for that I am truly grateful.

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

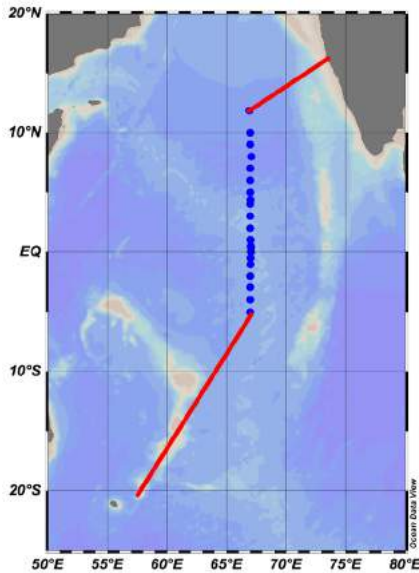
Issue Contents

Cruise News	2	Scientist Profiles	31
Project Focus	4	Wanted	32
News	20	Hot off the Press	33
Meetings and Workshops	23		

Cruise News

IIOE-2 – First Expedition, December 2015

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



The first expedition, on board Research Vessel Sagar Nidhi conducted as a part of the IIOE-2 concluded at Mauritius after exploring the western Arabian Sea for 18 days. The voyage was flagged off by the Hon. Minister of State for Science and Technology and Ministry of Earth Sciences, Mr. Y. S. Choudhary at a function held at Mormugao, Goa on 4 December 2015.

The expedition was led by Prof. P. N. Vinayachandran of the Indian Institute of Science (IISc), Bangalore and Dr. Satya Prakash of the ESSO-Indian National Centre for Ocean Information Services (ESSO-INCOIS), Hyderabad. Twelve Indian Scientists participated, representing IISc, INCOIS, NIOT (Chennai), NCAOR (Goa), NRSC (Hyderabad) and Goa University. In addition to scientists from India, there were participants from Mauritius, Israel, Singapore, Australia and the UK.

The main goal of this multi-disciplinary scientific expedition was to understand the structure of water masses in the western Indian Ocean along 67°E and assess the difference in their characteristics with respect to observations made in the past. The other objective of the cruise was to understand the physical-chemical-biological characteristics in the equatorial Indian Ocean and their inter-relationships. Underwater profiles of currents, temperature, salinity, oxygen, light and chlorophyll were measured during the cruise. In addition, samples have been collected to a depth of 1000 m for various chemical and biological analyses. Samples of zooplankton were collected using nets towed from the stern of the ship.

It is expected that the data collected during this expedition will elucidate the currents and water masses in the western Indian Ocean in detail and, thus, further our understanding of the oceanography of the Indian Ocean.



KuramBio II (Kuril-Kamchatka Trench Deep-Sea Biodiversity Studies II): German Russian deep-sea biodiversity studies in the Kuril-Kamchatka Trench (KKT)

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The German-Russian expedition KuramBio II with RV Sonne will be performed between 16. August – 26 September 2016 to the Kuril-Kamchatka Trench (KKT). There will be 40 scientists on board, mainly from Germany and Russia, but also with participants from Poland, the United Kingdom, France, Switzerland, Mexico Korea and Japan. This expedition follows the SoJaBio expedition to the Sea of Japan in 2010 and the KuramBio expedition to the KKT area in 2012 as well as the SokhoBio expedition to the Sea of Ochotsk in 2015. The goals of these expeditions were to study the biodiversity, biogeography and trophic characteristics of the benthic organisms in different northwest Pacific deep-sea environments. In the KuramBio I samples from depths between 5000-6000 m we could identify more than 1700 benthic species and at least half of these are new for science. The richest samples, however, have been collected at the slope of the KKT, therefore we assume that the v-shaped topography of the KKT might enhance food availability and lead to an even higher biodiversity at larger depths.

During the expedition KuramBio II, we would therefore like to test the following hypotheses:

- 1) The hadal ecosystem of the KKT is characterized by a high number of species (not lower than in the abyssal plain near the KKT).
- 2) The number of endemic species will increase with increasing depth in the KKT.
- 3) The hadal depths of the KKT isolate benthic species of the Sea of Okhotsk from species of the abyssal Northwest Pacific.
- 4) The main food source of epibenthic copepods (which we will use as a model taxon for biochemistry) is detritus, while planktonic copepods feed mainly on diatoms and microzooplankton.



Above: RV Sonne. Photo: Thomas Walter

Project Focus

Pourquoi Pas Les Abysses?

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In May 2016, Ifremer, the French Institute for Research and Exploitation of the Sea, will be launching a new project called “Pourquoi Pas les Abysses”. During the past few years, New Generation Sequencing allowed fast and great advances in the knowledge of the distribution of microbial life on Earth, including prokaryotes and microscopic plankton in the marine realm. This project stems from the recognition that much effort is still required to understand the richness and worldwide distribution of eukaryotic communities (including macro and meiofauna), not only in emblematic ecosystems such as cold seeps, hydrothermal vents and cold-water corals or seamounts, but also in the entire abyssal plain that constitutes the largest ecosystem on Earth. The goal of the project is to contribute to a (re) evaluation of the biodiversity present in the abysses and to improve our understanding of its level and history, as well as of the possible environmental drivers of its distribution. We aim to do so by analyzing the environmental DNA present in the marine sediment and the water layer above. A double approach coupled with the morphological determination of fauna will be performed on several pilot sites in the

Atlantic and the Mediterranean. To gather the most comprehensive set of samples worldwide, following a standardized sampling procedure, and to evaluate as comprehensively as possible the level and distribution of deep-sea biodiversity, we aim at setting up or strengthening collaborations and partnerships with partners interested from the “Deep-sea biology community”. The project is thus divided in two parts: one is based on ongoing and scheduled research cruises where dedicated sampling is planned, and the other on a network of partnerships. For this last part, we chose to standardize the sampling (based on multicore for sediment and Niskin for water samples).

We would like to invite the partners who could be interested in contributing with specific samples from their studied zones to contact us (abyss.friends@ifremer.fr) so that reciprocating interests can be evaluated together. For sites retained as fitting the goals of the project Abyss, we will define a specific agreement for the data sharing with each partner engaged.



INDEEP WG3 Workshop: Biodiversity and connectivity of deep-sea ecosystems in areas targeted by deep-sea mining

Swakopmund, Namibia, 11 – 21 April 2016

The extraction of phosphates from the marine environment has yet to commence anywhere in the world. However, it is of increasing international interest as a strategic reserve of agricultural fertilizer. Representatives from industry see this as a potentially lucrative proposition and are attempting to push forward with instigating their programmes in New Zealand (Chatham Rock Phosphate Ltd), Mexico (Odyssey Marine Exploration), Namibia (Namibian Marine Phosphates), and South Africa (Green Flash Trading & Diamond Fields International). Currently, a high level of scrutiny



of the proposed phosphate mining activities is underway for each of the regions under consideration. The results of the Environmental Impact Assessment for both the projects in both New Zealand and Mexico have resulted in denial of licence applications for these projects by the relevant governmental environmental agencies (in February 2015 for Chatham Rock Phosphate Ltd and in April 2016 for Odyssey Marine Exploration), although appeals may well be forthcoming. In Namibia, a moratorium on phosphate mining has been in place since September 2013 and the governmental evaluation of the recent EIA is about to commence.

INDEEP scientists have been keeping abreast of the marine phosphate-mining situation worldwide and Namibia in particular, largely owing to links with our INDEEP colleague Mrs Bronwen Currie, a biologist in the Namibian Ministry of Fisheries and Marine Resources. We were fortunate enough to meet Bronwen during the 13th Deep-Sea Biology Symposium in NZ in 2012 (her attendance was enabled by the INDEEP-International Seabed Authority travel bursary award). It was during this meeting that our first discussions regarding a potential INDEEP capacity development effort in Namibia took place. Bronwen explained that despite the wealth of fisheries scientists in Namibia, there are almost no deep-sea benthic ecologists. This poses a problem in light of the proposed mining. We subsequently collaborated with Mr Rudi Cloete of the Ministry of Fisheries and Marine Resources to hold a workshop in order to address this limited capacity in Namibia in terms of benthic and pelagic ecosystem effects of mining. The workshop would consider not only the fundamental principles of benthic ecology but also would address the main concerns of a variety of deep-sea anthropogenic activities. We secured funds from the INDEEP grant (funded by Fondation Total) and this was generously matched by funds from the International Seabed Authority. These funds enabled us to invite 28 participants from Namibia, Kenya, Madagascar, Mauritania and Angola to attend the workshop in Swakopmund at the National Marine Information and Research Centre of the Ministry of Fisheries and Marine Resources headquarters. Their experience spanned sectors and disciplines, although most were related to fisheries in some way, and included an Executive Director of the Centre of Studies and Development of Fisheries, Senior Fisheries Biologists, Head of Data Management, PhD Students, Fisheries Research Technicians and Research Scientists.

A diverse range of subjects was taught using a variety of methods. Participants were introduced to benthic environments and the associated fauna, the history of deep-sea exploration, animal-sediment interactions, human impacts, sampling and sampling design, metrics used in characterisation of the benthos, ecosystem function and



Above: A selection of images from the well-attended workshop

services, life-histories, larval dispersal and connectivity, consideration of mining impacts, management strategies and governance. The teaching comprised a combination of lectures, hands-on investigations of benthic fauna (from meio to megafauna) including boat work, sample processing, laboratory observations, data analysis exercises, discussion groups and feedback presentations by participants. The course preparation was a dynamic process with adjustments made by the presenters each evening based on participant requirements in preparation for the following day. All participants were given access to the course presentations, associated key literature and webinar recordings. They were also given course participation certificates. Post-course evaluations were extremely positive, with the majority of participants eager to use their new knowledge in their current roles to varying degrees and to pass on this knowledge to their colleagues. In addition, it is hoped that benthic monitoring becomes incorporated into standard practices in Namibian waters alongside fisheries assessments. Others are now considering a change of career path in order to incorporate or even focus on benthic research. The enthusiasm of the participants was evident throughout and each one is now far more aware of how the benthic and pelagic ecosystems are interlinked and hence should be considered in any marine industrial impact assessments. The INDEEP presenters also gave feedback and each thoroughly enjoyed their experience of teaching in Namibia. The group worked well together and it is envisaged that this new network will be of use to many of the participants and presenters alike. It is hoped that some of the Namibia workshop participants may teach in future INDEEP capacity development efforts. Overall, this workshop was a great success.

The INDEEP course presenters were: Maria Baker (INDEEP/DOSI Lead, University of Southampton, UK), Bronwen Currie (Ministry of Fisheries and Marine Resources, Namibia), Ana Hilário (University of Aveiro, Portugal), Lisa Levin (Scripps Institution of Oceanography, USA), Anna Metaxas (Dalhousie University, Canada), Paul Tyler (University of Southampton, UK) & Verena Tunnicliffe (University of Victoria, Canada). The workshop participants were: Jean Jacques Be (Center of Studies and Development of the Fisheries, Ministry of Fisheries, Madagascar), Josephine Edward (MFMR, Namibia), Tobias Endjambi (MFMR, Namibia), Victoria Ndinelago (MFMR, Namibia), Silvana Faria (National Institute of Fisheries, Angola), Ernest Frans (MFMR, Namibia), Johnny Gamatham (MFMR, Namibia), Stephanus Hamutenya (MFMR, Namibia), Nandi Hjarunguru (MFMR, Namibia), Moses Kalola (MFMR, Namibia), Lessyn Kalwenya (MFMR, Namibia), Deon Louw (MFMR, Namibia), Erich Maletzky (MFMR, Namibia), Said Mohamed Hashim (University of Nairobi, Kenya), Sidi Mohamed (Mauritanian Institute of Oceanographic Research and Fisheries, Mauritania), Leevi Mwaala (MFMR, Namibia), Tomas Nalukaku (MFMR, Namibia), Ester Nangolo (MFMR, Namibia), Suama Niinkoti (MFMR, Namibia), Sarah Paulus (MFMR, Namibia), Allie Samuel (MFMR, Namibia), Malakia Shimhanda (MFMR, Namibia), Beatha Sikongo (MFMR, Namibia), Joseph Shikeva (MFMR, Namibia), Ferdinand Hamukwaya (MFMR, Namibia), Vasani Tutjavi (MFMR, Namibia), Heidi Skrypzeck, (MFMR, Namibia), Beth Waweru (Kenya Marine and Fisheries Research Institute)

Connecting Connectivity in the Clarion-Clipperton Zone

Report written by Dr Adrian Glover, Research Leader, Natural History Museum <http://www.nhm.ac.uk/deep-sea>

Researchers from across the European Union meet at the Natural History Museum in London to discuss and integrate new molecular biodiversity data from the world's largest mining exploration zone.

Over the course of three days in May 2016, thirty-two scientists met at the Natural History Museum in London to work on one of the most difficult problems in deep-sea environmental management: the regional biodiversity, connectivity and biogeography of the Clarion-Clipperton Zone (CCZ).

Jointly organised under the auspices of the "Managing Impacts of Deep-sea Resource Exploitation" (MIDAS) and "Ecological Aspects of Deep-sea Mining" (under the Joint Programming Initiative - Healthy and Productive Seas and Oceans) European Union (EU) projects, with input from the International Seabed Authority (ISA) and the ABYSSLINE consortium, the meeting was developed to bring together principal investigators, post-doctoral researchers and PhD students from recent EU-led projects in the CCZ. The focus was on presenting new molecular-based data that have been collected in a series of recent expeditions linked to the MIDAS and JPI-Oceans projects.

It has been widely recognised that a major problem in the development of environmental guidelines for both mineral exploration and exploitation in the CCZ is the lack of regional-scale baseline data on species-level biodiversity, biogeography and connectivity (e.g. ISA 2014 & 2015, Seascope Consultants 2014). New molecular-based assessments of CCZ biodiversity (e.g. Janssen et al. 2015, Glover et al. 2016a) are starting to offer new data from within contractor exploration zones, and provide an opportunity to integrate data into a synthetic regional-level approach.

The workshop was organised around three topics: (1) new molecular data on species taxonomy and distributions within and between CCZ exploration zones, (2) new intra-specific population genetic data on 'target taxa' and (3) broader-

scale (ocean-basin and global) biogeographic data based on both traditional morphological information and molecular data. The scope of the discussions were focussed taxonomically on metazoan animals and foraminiferal protists, in particular on meiofaunal (e.g. copepods and nematodes) and macrofaunal (e.g. polychaetes, isopods and molluscs) size classes for which there are the most data, while some new data are starting to appear on the larger megafaunal animals which are difficult to sample in the CCZ (e.g. holothurians and corals).



Left: Dr Gordon Paterson addresses the London Workshop on the Biogeography and Connectivity of the Clarion-Clipperton Zone, held at the Natural History Museum, London, 10-12 May 2016.

Right: Workshop participants at the London Workshop on the Biogeography and Connectivity of the Clarion-Clipperton Zone, 10-12 May 2016, Natural History Museum. Back row, left to right: Ralph Spickermann, Stefan Brager. Second from back row, left to right: Pedro Ribeiro, Sergio Taboada, Lara Macheriotou, Ann Vanreusel, Magda Blazewicz, Sarah Schnurr, Helena Wiklund. Third from back row, left to right: Andy Gooday, Dan Jones, Lenaick Menot, Pedro Martinez, Steffi Kaiser, Ana Colaço, Sahar Khodami, Marina Cunha, Ana Hilario. Third from back row, left to right: Adrian Glover, Paulo Bonifacio, Kirsty McQuaid, Aurelie Goineau, Heiko Stuckas, Thomas Dahlgren. Front row, left to right: Daniel Kersken, Uwe Raschka, Tasnim Patel, Clara Rodrigues, Gordon Paterson, Amber Cogley. Not present for photo: Andrea Waeschenbach and David Billett.

On 10th May 2016, the workshop convened at lunchtime in the Board Room of the Natural History Museum, with overviews from the main EU-sponsored sampling projects in the CCZ. This was followed by a presentation from the ISA on ongoing policy needs and implications, and a presentation from an industry perspective from UK Seabed Resources Ltd. These latter talks were designed to focus the scientific discussions planned for the second day on stakeholder needs and perspectives. The day ended with an informal social in the Hereford Arms pub where workshop participants were able to continue discussions over local London ales.

The second day got off to a surprising start with the workshop participants having to make their way through a museum filled with a large film production team from Universal Studios filming 'The Mummy' starring US actor Tom Cruise. Several of the workshop group met Mr Cruise acting in the central hall beneath the statue of Charles Darwin and inadvertently found themselves as extras in the production. After this slight delay, the somewhat star-struck group then got down to work, with the main data sessions of the workshop. An impressive array of new data were presented from recent cruises and subsequent analyses, principally from the eastern CCZ focussed around the exploration zones of the UKSRL (UK), BGR (Germany), IFREMER (France), GSR (Belgium) and IOM (Bulgaria, Cuba, Czech Republic, Poland, Russia and Slovakia). New DNA sequence data were presented from all these regions, from a wide range of taxa and across sampling sites at spatial scales of 60 to 1300km.

A common theme from the data sessions emerged that the majority of teams were now using DNA sequences from typical invertebrate genetic markers (e.g. COI, 18S, 16S, 28S) to delimit 'species' based on either 'barcoding-gap' analysis and/or phylogenetic reconstruction using additional published sequences (Glover et al. 2016b). These 'species', referred to by several teams as "Molecular Operational Taxonomic Units" (MOTUs) were then examined for their distributional range, and in some instances particularly abundant species (target taxa) selected for more detailed population genetic study. Examination of morphology within DNA-delimited species was then also providing valuable biogeographic data to enable in some instances comparisons within or even between ocean basins. The second day finished with the workshop dinner held in the famous Polish Club restaurant next to Imperial College in South Kensington.

The final day of the workshop was designed to utilize the combined knowledge at the table to create a matrix of ongoing and planned work activities (e.g. manuscripts in preparation, intended grant proposals and future cruises). An impressive list of planned publications was generated that included 44 planned scientific papers for the next 3 years from the workshop. The creation of this list also highlighted many options for collaboration, including both specimen and data sharing amongst academic and contractor-led projects. In addition, discussion was focused onto the generation of workshop outputs, in particular a published and open workshop report and the potential for a synthetic paper highlighting selected new data. It was agreed to produce a workshop report containing a useful overview of

background, discussion areas, ongoing and planned activities and workshop recommendations of particular value to stakeholders such as regulators (ISA) and Sponsoring States and industry. In a small and short breakout group, Principal Investigators met to discuss the potential for a synthetic paper cutting across several work programs and agreed to produce an outline to circulate amongst the group.

A small side-meeting followed the main meeting to discuss recent data on Mid-Atlantic Ridge connectivity, chaired by Ana Colaço and Gordon Paterson.

Deep sea life at and near the ALOHA Cabled Observatory

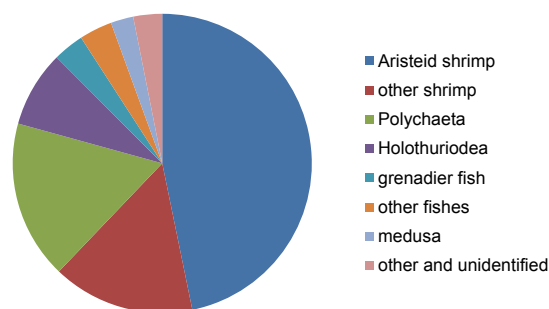
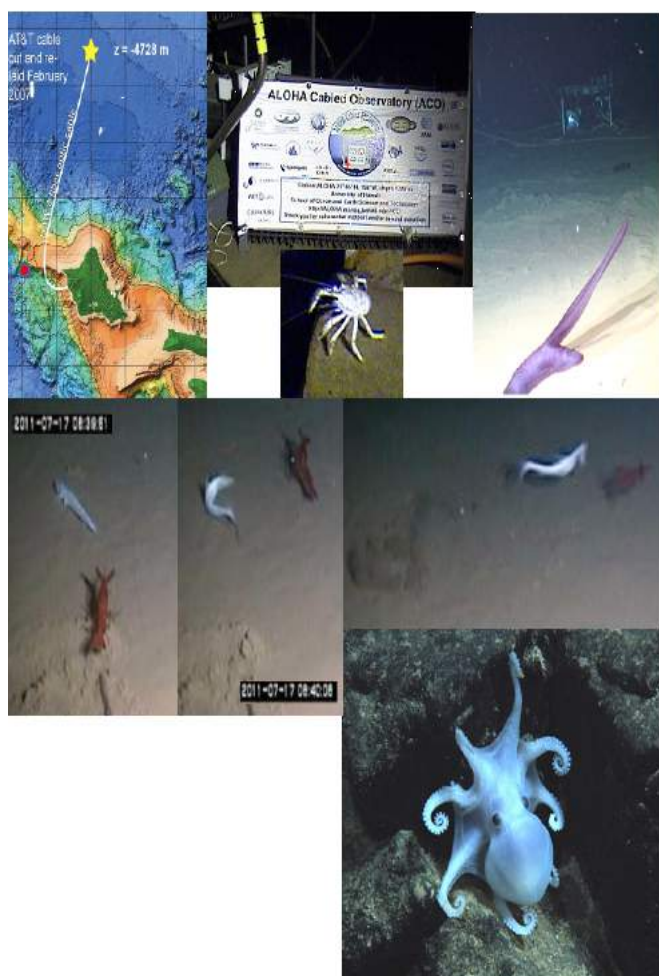
Bruce Howe, Deborah Eason, Jeffrey Drazen, Aharon Fleury, and James Potemra

University of Hawai'i at Manoa

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The ALOHA Cabled Observatory (ACO) is a general purpose “node” for science use at Station ALOHA 100 km north of O'ahu (left). Included are a suite of basic sensors making core measurements, some local and some sensing the water column. At 4728 m deep, it is the deepest scientific outpost on the planet with power and Internet, including cameras and lights. Investigators are encouraged to propose projects using these capabilities. See <http://aco-ssds.soest.hawaii.edu/>.

Deep-sea life has been observed using a camera tripod with a pan/tilt/zoom camera at ~2 m above the seafloor with off-axis lighting. Animals include crabs (*Munidopsis* sp.) crawling over the observatory framework, and the first observation of a lizard fish (*Bathysaurus mollis*) attacking an aristeid shrimp. On average, about one organism per 40 minutes was observed. Analysis of 40 days of video revealed that aristeid shrimp, holothurians, and polychaetes, often ones drifting past in the water column, were the most commonly observed species.



Above: Pie chart showing the distribution of 450 megafaunal animal sightings made with the ACO camera tripod over 40 days of continuous observations.

Other organisms have been observed from remotely operated vehicles (ROVs). A “sail-equipped” sea cucumber was seen while servicing the observatory (*Psychropodes* sp., ROV Lu'ukai, 2015.09.20). What is thought to be a new species of octopus was observed during one of the installation cruises (ROV Jason, 2011.05.28, on Ka'ena Ridge at 3116 m, red dot on map). There have been two other recent sightings of this animal, and a publication is in preparation.

Above (images): Station ALOHA and the ACO are located north of O'ahu. The sign on the seafloor acknowledges sponsors. Behind the purple sea cucumber is the observatory junction box. The fish vs shrimp images were presented in Howe, Eos, November 2014.

DOSI Puts Deep-Sea Science in Focus at UN Negotiations for Biodiversity Beyond National Jurisdiction

Harriet Harden-Davies, Kristina Gjerde and Elva Escobar

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Deep-sea scientific research was in the spotlight at the first Preparatory Committee meeting for the development of an international legally-binding instrument under the 1982 United Nations Convention on the Law of the Sea (UNCLOS) on the conservation and sustainable use of marine biological diversity in areas beyond national jurisdiction (ABNJ). In this vast space covering more than 65% of the ocean, a new instrument will address gaps in the international legal framework for marine life through area-based management tools, environmental impact assessment, marine genetic resources (MGR), capacity development and technology transfer. A DOSI Deep-Sea Genetic Resources (DSGR) Working Group submission highlighted the critical role of deep-sea scientific research in addressing MGR governance issues, including access and benefit sharing.

The submission was made by IUCN on behalf of the DOSI DSGR Working Group, and used in various interventions at the first Preparatory Committee meeting (28 March – 8 April 2016) in New York to highlight the role of marine science in developing options. The submission -which drew from results of a survey of some INDEEP and DOSI members - highlighted that scientific knowledge, data and samples are significant benefits from MGR in ABNJ. It called for support for deep-sea science in ABNJ, enhanced international cooperation and avoiding obstacles to research. It highlighted that existing best-practice approaches in science provide a strong basis to facilitate open-access to data and samples of MGR from ABNJ.

Many science issues were raised in the Preparatory Committee discussions, with delegations broadly agreeing on the need for a pragmatic approach towards equitable benefit sharing in order to bridge divergent views on governing principles for MGR in ABNJ. Some highlighted the need for a 'light' regime that promoted research, development and the sharing of data and knowledge. However, additional support mechanisms would be needed to facilitate access and benefit sharing and strengthen capacity in developing States. Dr Judith Gobin of the DSGR Working Group attended the meeting as part of the IUCN delegation with the financial support of the PharmaSea project, together with Kristina Gjerde. A Chair's overview of this first PrepComm session is now available online: http://www.un.org/depts/los/biodiversity/prepcom_files/PrepCom_1_Chair's_Overview.pdf

We thank the DOSI DSGR Working Group members (especially Maria Baker, Angelika Brandt, Judith Gobin, Tammy Horton, Marcel Jaspars, Roser Puig and Elizabeth de Santo) for their contributions to the development of the submission and we are grateful to all the DOSI and INDEEP members who



Above: The First Preparatory Committee meeting for the new ABNJ instrument, Kristina Gjerde, Judith Gobin (Image credits: Photos by IISD/Francis Dejon)

contributed through the survey.

The second Preparatory Committee meeting will be held 26 August - 9 September 2016. The DSGR Working Group will continue to provide input to the Preparatory Committee process and will further examine issues raised in the survey, including how a new instrument can facilitate, not hinder, marine scientific research. The Working Group welcomes further input from INDEEP and DOSI to contribute to the next phase of DSGR Working Group activities and ensure that the voice of deep-sea science is clearly a part of these historic negotiations.

Coming Soon as part of the Global Ocean Observing System (GOOS): a project focused on the creation of a Deep Ocean Observing Strategy, or DOOS.



Deep ocean observation is a science and technology challenge addressing the grand societal issues of climate change adaptation, ecosystem conservation and sustainable management. Please visit the project website: www.deepoceanobserving.org

DOOS Objective:

Develop a common statement of requirements and an initial strategy for sustained global deep ocean observations; considering all Essential Ocean Variables, regions, and technologies so as to extract high priority, feasibility, and GOOS fit-for- purpose actions for the next 5-10 years.

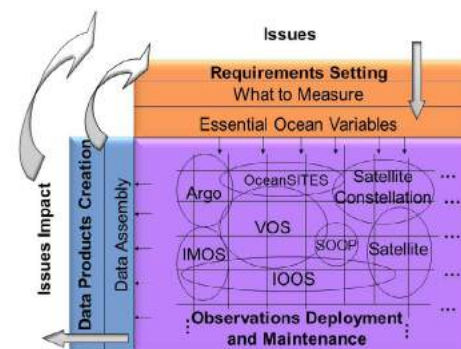


DOOS Approach:

Catalyze coordination among existing efforts and use the Framework for Ocean Observing as our strategic guide. This approach will result in a multi-disciplinary strategy capitalizing on best practices realized across ocean observing systems.

Engagement:

To be successful DOOS will require partnerships, participation, and consultation from the deep-sea observing community. Among these groups are Deep Argo, Go-SHIP, Satellites, Deep Observatories, Moorings, Time Series Stations, Gliders, IOC- GOOS Projects and Regional Alliances, DOSI, and links to other national and international, programs.



DOOS Planning Workshop:

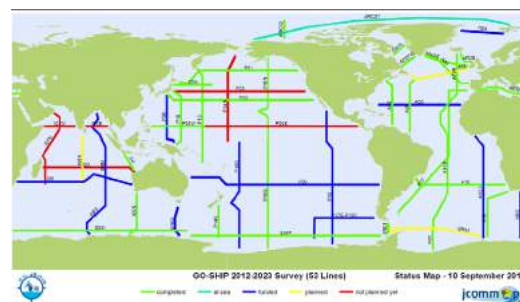
- December 7-9, 2016
- Scripps Institution of Oceanography

To Express Interest Contact:

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Lisa Levin: llevin@ucsd.edu

Kristen Yarincik: kyarincik@oceanleadership.org



New portal for deep-sea discoveries

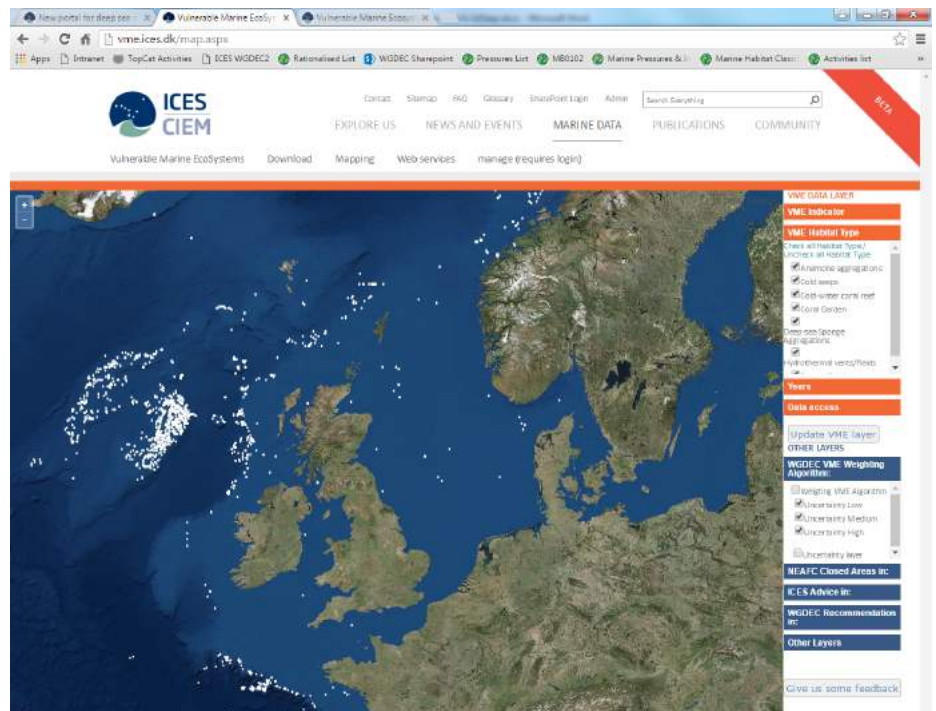
Neil Golding

WGDEC Chair, ICES/NAFO

Contact: Neil.golding@jncc.gov.uk

Portal recently launched by International Council for the Exploration of the Sea (ICES) visualizes all known vulnerable marine ecosystem (VME) data in the North Atlantic.

Vulnerable marine ecosystems (VMEs) are deep-sea ecosystems that can be adversely impacted by bottom-contact fishing gear. VMEs include cold-water coral reefs, coral gardens and deep-sea sponge aggregations. It is quite difficult to positively identify VMEs in deep water without using specialist underwater camera equipment. However, “VME indicators” are a start for investigation. A VME indicator is a species from a broad group of benthos that is found in trawl bycatch, for example sponges, gorgonians, or stony corals. Their presence indicates that there may be an actual VME habitat on the seabed – for example gorgonians may be a component of coral garden VMEs.



The ICES/NAFO Working Group on Deep-water Ecology (WGDEC) evaluates data on the presence of VMEs in the deep sea in the North Atlantic. Over the past few years the group and the ICES Data Centre have been developing a data portal that publicizes all data on the distribution and abundance of VMEs (and species considered to be indicators of VMEs) across the North Atlantic.

Neil Golding, Chair of WGDEC, explains, “People can now map and explore the data from the VME database, and the key thing about the portal is that it differentiates between the VME indicators (often recovered as by-catch) and the VME habitats (observed in situ on the seabed).”

Weighting system

Some VME indicators can be misleading, but the group has developed a weighting system to tackle the issue.

This system looks at the number of VME indicator records for a particular area (presented on the map as a 0.05°x 0.05° c-square). It evaluates how many records there are of particular VME indicators, where the indicators have come from, and the survey method used (trawl, longline bycatch or camera). This evaluation leads to a score as to the likelihood of a VME being present.

Golding feels this new weighting system will be extremely valuable. “In the past, when we (WGDEC) have been requested to provide recommendations on bottom-fishing closures to protect VMEs, it has been difficult to know how much confidence to have in the VME indicators. If it was a video transect then you have high confidence, but if it was a bycatch of some coral then there might not be a VME down there. That’s why this system is really important.”

Transparency

Displaying all VME data being used by the group ensures that all data underpinning WGDEC recommendations (such as bottom fishing closures) is now visible. “The key thing is that users can now see this. The portal represents the first time we have had these data out in the open. People can now click on the different VMEs and the different indicators.

They can look at the recommendations made by WGDEC for bottom fishing closures, formal ICES advice which is provided to ICES clients, and the actual closures enacted by the regional fisheries management organisations. All this can be viewed on the one map as different layers. It makes the process so much more transparent. Advice clients and stakeholders can see what we're doing. I think it's really impressive."

For more information

ICES VME data portal: <http://ices.dk/marine-data/data-portals/Pages/vulnerable-marine-ecosystems.aspx>

ICES Working Group on Deep water Ecology: <http://www.ices.dk/community/groups/Pages/WGDEC.aspx>

Contact the WGDEC Chair: Neil.golding@jncc.gov.uk

Shedding light on deep-sea SponGES

Joana R Xavier¹, Ellen Kenchington², Shirley A Pomponi³ and Hans Tore Rapp¹

on behalf of the SponGES consortium



¹University of Bergen, Norway; ²Fisheries and Oceans Canada, Canada; ³Florida Atlantic University, USA
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Sponge-dominated communities of the deep-sea have been increasingly recognized as important ecosystems providing numerous goods and services to our planet and ultimately to us humans. Yet, sponge grounds have been thus far the most overlooked ecosystem of the deep-sea. For instance, major knowledge gaps exist about basic aspects of their biology and ecology, their contribution to global biogeochemical cycles, their role in supporting economy e.g. through fisheries, and the impact that human activities may have upon them.



Above: The SponGES consortium at its kickoff meeting in Bergen last April (photo courtesy: Sergio Taboada)

This is where a small yet international team of researchers took off. Could they fill in such gaps, deliver innovation and – at the same time – inform management towards sustainability? The core of SponGES was born. Yet it took two more years, and a set of calls in the framework of the European Commission's Horizon 2020 Blue Growth Programme to launch such a project.

Sustainable exploitation started in March 2016 and will run for 4 years pooling together the expertise and facilities of 19 European, Canadian and American partner institutions. SponGES will:

- Strengthen the knowledge-base on North Atlantic sponge ground ecosystems by investigating their distribution, diversity, biogeography, function and dynamics.
- Improve innovation and industrial application by unlocking the biotechnological potential of these ecosystems namely

towards drug discovery and tissue engineering.

- Improve the capacity to model, understand and predict threats and impacts and future anthropogenic and climate-driven changes to sponge grounds.
- Advance the science-policy interface and develop tools for improved resource management and good governance of these ecosystems from regional to international levels across the North Atlantic.

SponGES will use its transdisciplinary consortium and its state-of-the-art operational and technological capacity to study all of the main types of deep-sea sponge ecosystems known to occur in the North Atlantic, all the way from the Arctic southwards to the Azores archipelago, including sites from both the western and the eastern Atlantic. In-situ observation and experimentation will be combined with novel approaches in the fields of experimental ecology and physiology, “omics”, biotechnology and modelling.

With the participation of (and co-coordination by) American and Canadian partners, this project will genuinely work at a trans-Atlantic level, bringing the Galway Statement vision on Atlantic Ocean research cooperation forward.

Want to know more and/or engage with SponGES?

Follow us at:

<http://www.deepseasponges.org>

<https://www.facebook.com/Deep-Sea-Sponges-1101396993244491/>

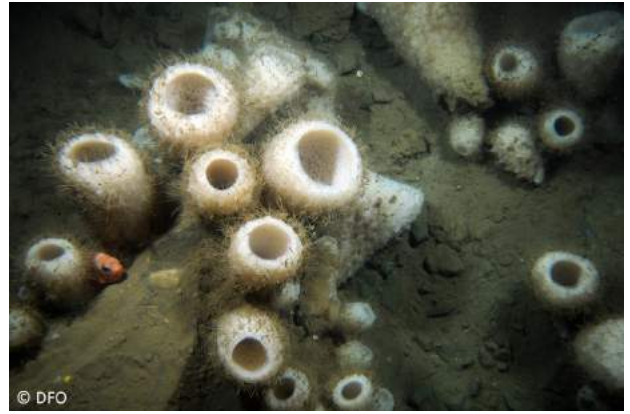
https://twitter.com/DeepSea_Sponges

Or contact the project office:

Hans Tore Rapp (project coordinator) – Hans.Rapp@uib.no

Joana Xavier (scientific manager) – Joana.Xavier@uib.no

Biology Department, University of Bergen, Norway



Above: An aggregation of the hexactinellid sponge known as Russian Hat (*Vazella pourtalesi*) on the Scotian shelf (©DFO Canada)

Deep sea research in the Galapagos: what Darwin never witnessed.

Etienne Rastoin¹, Leigh Marsh², Pelayo Salinas de León¹

¹Charles Darwin Research Station, Galapagos; ²University of Southampton, National Oceanography Centre, UK.

Contact: seamounts@fcdarwin.org.ec

The year 2015 set the stage to one of the most exciting research projects to date in the Galapagos since Charles Darwin visited the islands in 1835. Despite the coastal waters and emerged volcanoes of this remote Eastern Tropical Pacific island chain having received great scientific interest since Darwin’s revolutionary theory, the depths of the Galapagos have remained vastly unexplored. The project “Seamounts of the Galapagos Marine Reserve (GMR)”, has recently gained momentum and international attention due to the unprecedented number of deep-sea research expeditions completed last year. The Charles Darwin Foundation (CDF), with the support of the Galapagos National Park Directorate (GNPD), is working in close collaboration with the Woods Hole Oceanographic Institution, the Ocean Exploration Trust and the National Geographic Pristine Seas Initiative as the main partners in this project.

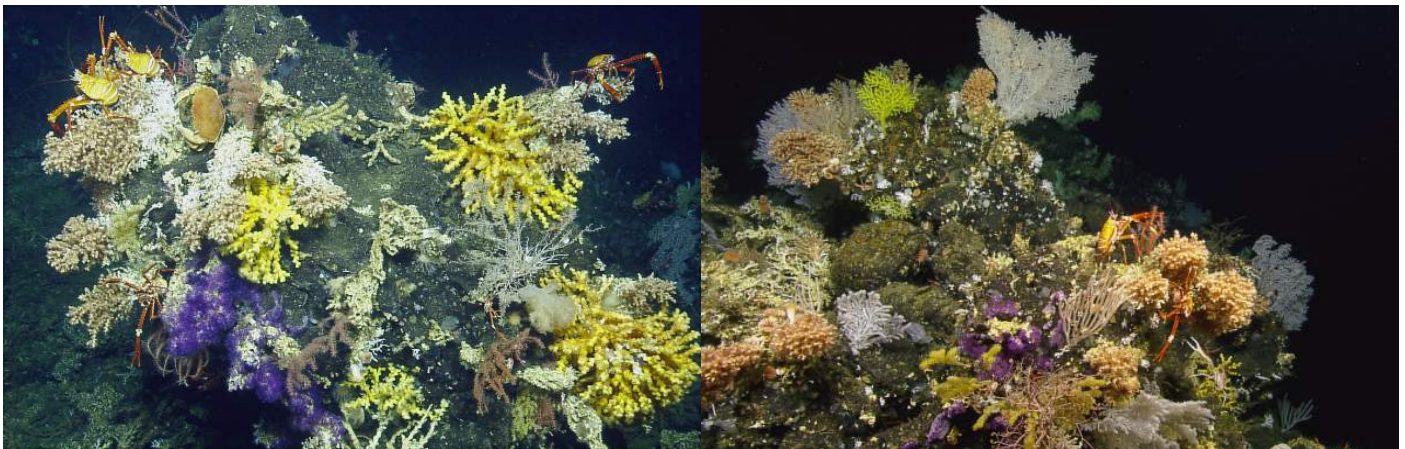
Over the past six months, three deep-sea exploration vessels (M/V Alucia, E/V Nautilus, M/V Argo) with four different submersibles allowed the project partners to conduct 70 submersible dives to depths of up to 3600 m across the different bio-regions of this iconic archipelago. A total of 25 seamounts were explored and sampled, together with a

range of other deep-sea habitats including hydrothermal vents, abyssal slopes and deep lava flows. When it comes to biology, numbers become overwhelming and highlight the great amount of work ahead: 45,000 photos, 200 hours of submersible footage and over 500 samples of unique deep-sea specimens have been collected. This unprecedented dataset constitutes a comprehensive deep-sea biodiversity baseline study for the region. Preliminary reports from taxonomic experts have revealed that many specimens collected are likely to be new species to science.

Individual researchers or institutions interested in deep-sea research are more than welcome to contact CDF to explore ways of collaborating. Graduate student and volunteer positions are opened year round at the Charles Darwin Research Station marine lab for collaborators willing to bring their support to the project and enjoy Galapagos unique lifestyle.

For further information and to discuss possibilities feel free to reach out to: seamounts@fcdarwin.org.ec

This project is supported by The Leona M. and Harry B. Helmsley Charitable Trust, the Ocean Exploration Trust, Woods Hole Oceanographic Institution (WHOI), the Dalio Ocean Initiative/Dalio Explore Fund, the National Geographic Pristine Seas Initiative and an international network of collaborators. The Charles Darwin Foundation would like to take this opportunity to thank the international network of taxonomists and scientists ashore organised by the Ocean Exploration Trust for their work to date and their on-going support with this project.



Above: Seamounts explored revealed stunningly diverse biological communities. (Credits: OET/CDF).

Taxonomy, microevolution, distribution and biology of morid cods *Antimora* spp. (Moridae, Gadiformes, Teleostei) of the world's oceans

Alexei M. Orlov

Contact: orlov@vniro.ru



A new study will assess the current taxonomic composition of the *Antimora* genus, using comparative analysis of external morphological characters and sequences of the CO1 gene. Samples for this analysis have been sourced from various parts of the world's oceans. The analysis of the available databases of catches (records) of *Antimora* spp. will allow us to create a global picture of its distribution in the world's oceans, and to examine its spatial-temporal dynamics. Available material, and material obtained during the project, will allow us to conduct a comparative analysis of age composition and growth rates, and some specific biological features of *Antimora* spp. belonging

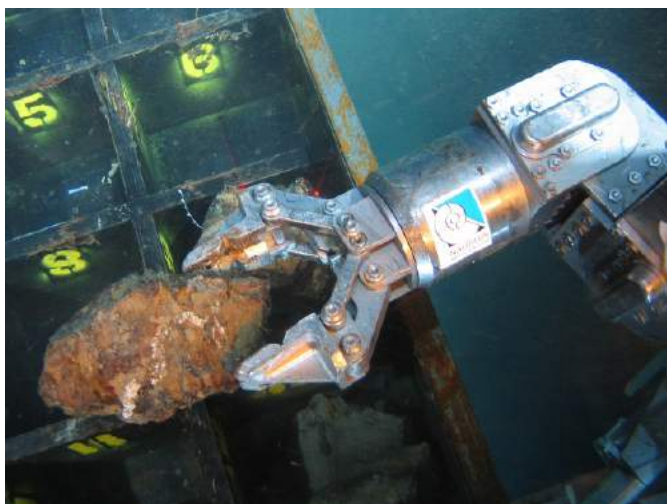
Above: *Antimora microlepis* from Pacific waters off Kuril Islands (Russia) – top, *Antimora rostrata* from Mid-Atlantic Ridge – bottom (photo A.M. Orlov).

to different populations. The use of molecular-genetic methods with the application of various genetic markers (Cyt b, control region, microsatellites, etc.) and modern software will give us an opportunity to investigate intra-species organization of *Antimora* spp. in their main habitation areas (North Atlantic, North Pacific, Antarctic). It will also allow us to study microevolutionary processes that occurred in their populations in recent historical times, including the time of descent from a common ancestor, pathways of subsequent dispersion, and demographic history.

Report on the cost-benefit analysis of deep-sea mining in the Pacific Region

Onorina Saukelo, SPC-EU Deep Sea Minerals Project, Fiji

Contact: onorinas@spc.int



Above: Sampling seafloor massive sulphides during exploration in Papua New Guinea. Photo Credit: Nautilus Minerals

A report on "An Assessment of the Costs Mining Deep-Sea Minerals in the Pacific Island Region" is now publicly available online at http://gsd.spc.int/dsm/images/pdf_files/PIR_CBA_Report

Commissioned by the Pacific Community (SPC) through the European Union-supported Deep Sea Minerals Project, the report aims to assist Pacific Island countries in making sound deep-sea mining related decisions. The report provides information about the potential magnitude of the impacts of deep-sea mining, and offers decision-makers insights into the potential constraints and challenges to achieving positive net benefits if deep-sea minerals mining were to occur under current circumstances.

Cardno, an infrastructure and environmental consultant firm, was contracted to conduct the cost-benefit analysis (CBA) between 23 February and 16 October 2015. For the purpose of the CBA, Cardno assembled a strong team of resource economists and environmental scientists with decades of experience in natural resource economics, impact and risk assessments, sustainable economic development, and ecological restoration in deep-sea and reasonable involvement in DSM related activities.

Based on the resource potential of three of the project countries, the CBA considers the monetary value of all aspects of mining seafloor massive sulphides in Papua New Guinea; manganese nodules in Cook Islands; and cobalt-rich crusts in the Republic of the Marshall Islands.

The report interestingly found that seafloor massive sulphide mining in Papua New Guinea has benefits that significantly outweigh the costs. Also, it revealed the mining scenario in the Cook Islands (where four metals are recovered and the miner owns the operation and the processing facility overseas) has the highest net benefits. However, the report states that crust-mining in the Marshall Islands, under the two scenarios considered, is currently not economically viable due to present metal prices, expected ore recovery and costs of technology.

The report concluded that as long as proper steps are taken to manage the wealth in the long-term and to transfer the environmental risk from the people of the host country to the mining company, there is a higher possibility of the social benefits outweighing the social costs.

Despite the studies limited focus on three countries, the report provides important findings and considerations that are applicable to other Pacific nations with similar deep-sea mineral resources.

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 dsmproject@spc.int or contact us via phone (+679 338 1377)

The Deep-Sea Invertebrate Collection at Texas A&M University

Mary K. Wicksten

Department of Biology, Texas A&M University

Contact: Wicksten@bio.tamu.edu

As part of the Texas A&M University Biodiversity Research and Teaching Collections, the Collection of Marine Invertebrates includes close to 47,000 specimens. Emphasis is on the Gulf of Mexico, western Atlantic and Caribbean. Deep-sea species (collected at 200–3,000 m or more) form a prominent part of the Collection. Included are echinoderms and various lobsters and carideans taken by the cruises of the Oregon and Oregon II, specimens taken by meter net, Isaacs-Kidd midwater trawl, shrimp trawl, and benthic skimmer by the Alaminos and Gyre, and specimens taken recently by remotely operated vehicles. Polychaetes from benthic studies are housed currently at Texas A&M University at Galveston. Particularly interesting specimens include a diverse assortment of deep-sea corals, “flytrap” sea anemones (family Hormathiidae), elasipodid holothurians, giant isopods, deep-sea lobsters, king crabs (*Neolithodes agassizii*), abyssal crustaceans including giant amphipods *Eurythenes* sp., scaled squids (*Pholidoteuthis adami*), vampire squids (*Vampyroteuthis infernalis*), dumbo octopus (*Grimpoteuthis* sp.), and bizarre species of the Cranchiidae and Histioteuthidae. Much earlier work based on the Collections can be found in Pequegnat and Chace (editors, 1971). Later publications include Ammons and Daly, 2008; Firth and Pequegnat, 1971; Pequegnat and Wicksten, 2006; Pequegnat and Pequegnat, 1971; and Wicksten and Packard 2005. On going studies include revision of crabs of the family Palicidae and the coral commensal squat lobster *Uroptychus*. The catalogue of specimens is available on-line and through IDigBio.



Left to right: *Bathynomus giganteus*, the giant isopod. Scale is 150 mm; *Acanthacaris caeca*, a blind deepsea burrowing lobster with long-spine chelae; *Munidopsis geyeri*, described by Pequegnat and Pequegnat (1970); Mary K. Wicksten with one of the largest specimens in the invertebrate collection, the scaled squid *Pholidoteuthis adami*.

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Supported by:



Federal Ministry
for the Environment, Nature Conservation,
Building and Nuclear Safety

based on a decision of the German Bundestag



1 June 2016

Major Push to Conserve Life in the Oceans

The German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) has given the green light to an intensive five-year effort to support conservation of life in the deep seas and open oceans.

The Global Ocean Biodiversity Initiative (GOBI; www.gobi.org), a successful international partnership of more than 30 marine scientific institutions that has been advancing the scientific basis for conserving marine biodiversity since 2008, has been awarded a grant of €5.2m from the German International Climate Initiative¹. GOBI is coordinated by Seascope Consultants, a UK-based company specialising in transformational policy advice for ocean planners and managers, and Prof. Dr Henning von Nordheim of the German Federal Agency for Nature Conservation (BfN) will continue to provide scientific guidance and oversight.

Professor David Johnson, GOBI Coordinator, explains “This is a really exciting opportunity to support Parties to the Convention on Biological Diversity (CBD) who have made commitments to conserve marine biodiversity. To help policy-makers make the right decisions we need to better understand essential ocean processes, functions and interactions. Detailed scientific and technical advice can inform and influence where and what to protect as a top priority”.

GOBI will help CBD² determine the strengths, challenges and limitations of data availability. This includes current and emerging techniques, methodologies and expert knowledge. In data-deficient regions, predictive modelling of the occurrence, abundance, movement and range of species or ecosystem features will play an important role. GOBI will therefore contribute to the CBD’s Strategic Plan for Biodiversity, which established a series of Aichi Biodiversity Targets to be reached by 2020, by working up detailed biological information, ocean biogeographies and by integrating data on migratory species and hydrothermal vent ecosystems.

Working with more than 100 countries over the past five years the CBD has masterminded a process of regional workshops to describe Ecologically or Biologically Significant Marine Areas (EBSAs). With most of the world’s oceans now assessed by this process, the onus is now to balance conservation and human activities, incorporate traditional knowledge and contribute to sustainable livelihoods. GOBI will be working with a range of these countries including Small Island Developing States of the south-west Pacific, developing countries of the Western Indian Ocean, and Central American States including Guatemala, El Salvador, Costa Rica, Panama, Nicaragua and Honduras. Results will feed into the international debate on protecting the ocean including negotiations for a legally binding instrument to protect High Seas biodiversity and Sustainable Development Goal 14. They should also inform global bodies such as the International Seabed Authority and regional organisations such as the Secretariat of the Pacific Regional Environment Programme.

The scientific partners in the project reflect its global nature. They comprise:

- Australia’s national science agency, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), one of the largest and most diverse research agencies in the world;

¹ www.international-climate-initiative.com

² www.cbd.int/marine/

- The Nicholas School of the Environment at Duke University USA, with its world-renowned researchers in the fields of hydrothermal vents and marine spatial ecology;
- The MarViva Foundation, dedicated to enabling the conservation and sustainable use of marine and coastal ecosystems in the Eastern Tropical Pacific;
- BirdLife International, the world's largest conservation partnership with more than 13 million members and supporters;
- The Tethys Research Institute based at the City Aquarium of Milan, specialising in marine mammal conservation with an impressive track record of success in the Mediterranean.

The deep-seas and open oceans are home to a major part of the world's biodiversity. They support an enormous wealth of productive ecosystems, specialised habitats and individual species, which collectively provide humankind with services such as the production of oxygen, food and the regulation of the Earth's climate. However, these ecosystems and the services they provide are under increasing pressure from global-scale issues such as climate change, and from human activities such as resource exploitation, over-fishing, shipping and coastal development.

Area-based management approaches and tools can help address a multitude of threats. These tools include marine protected areas and networks, environmental impact assessments, improved regulation of sectoral activities and broader ecosystem-based marine spatial planning. GOBI will continue to support such work, while improving the scientific basis of CBD Decisions, UN resolutions and other measures through the application of analyses, network design, training and capacity building.

The IKI-funded GOBI project started in May 2016 and will run for a period of five years. Further information is available on the GOBI website at www.gobi.org.

For more information please contact:

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Duke

NICHOLAS SCHOOL OF THE ENVIRONMENT



SO-AntEco (South Orkneys – State of the Antarctic Ecosystem) JR15005

Huw Griffiths*, Louise Allcock, Oliver Ashford, Hilary Blagbrough, Angelika Brandt, Madeleine Brasier, Bruno Danis, Rachel Downey, Marc Eléaume, Peter Enderlein, Claudio Ghiglione, Susie Grant, Oliver Hogg, Melanie Mackenzie, Camille Moreau, Laura Robinson, Estefania Rodriguez, Vassily Spiridonov, Alex Tate, Michelle Taylor, Cath Waller, Helena Wiklund

*hjg@bas.ac.uk British Antarctic Survey, High Cross, Madingley Road, Cambridge. CB3 0ET



Figure 1. A range of animals collected during JR15005. Images by C. Waller, H. Wiklund, B. Danis and C. Moreau.

Background

The South Orkney Islands is a small archipelago located in the Southern Ocean, 375 miles north-east of the tip of the Antarctic Peninsula. The seafloor around the South Orkney Islands has been shown to be an area with exceptionally high biodiversity. The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) closed all finfish fisheries around the South Orkney Islands in 1989, and in 2009 they established the South Orkney Islands Southern Shelf Marine Protected Area (SOISS MPA), the first MPA located entirely within the High Seas anywhere on the planet.

SO-AntEco (JR15005) was a British Antarctic Survey (BAS) led expedition undertaken in conjunction with an international team of scientists from the Scientific Committee for Antarctic Research (SCAR) AntEco research programme. The team included 22 participants from 9 different countries and 16 institutes. The expedition took place on board the *RRS James Clark Ross* in February-March 2016.

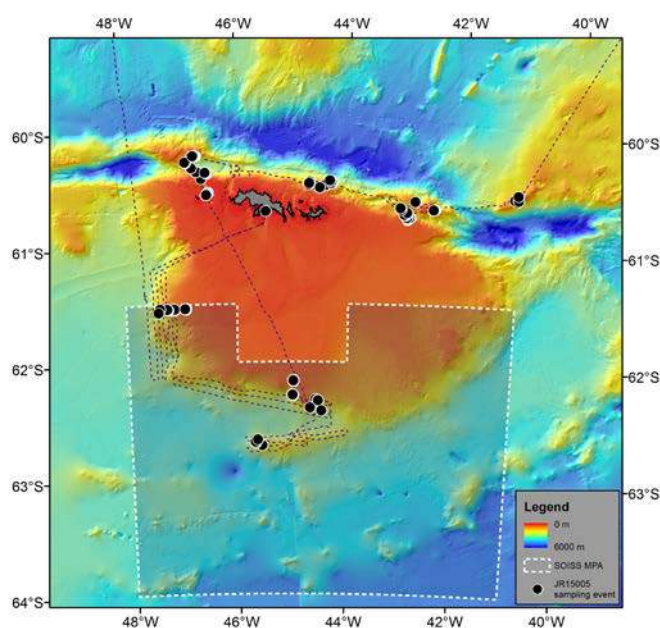


Figure 2. Map of the South Orkney Islands including the Marine Protected Area and the JR15005 cruise track and sampling locations.

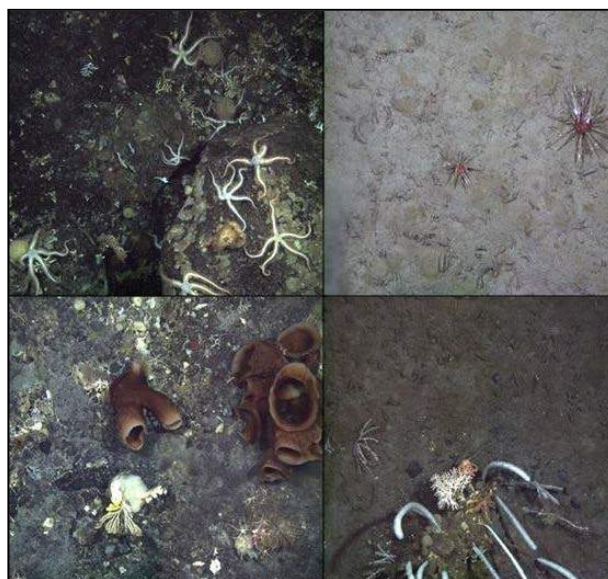


Figure 3. Seafloor habitats photographed during JR15005. Example images include Vulnerable Marine Ecosystem (VME) indicator groups.

News

Outreach at new depths – Live Dive Event at hydrothermal vents between Fiji and Tonga ‘edutains’ the next generation of ocean ambassadors

A group of 70 students and teachers from high schools in Victoria BC and online viewers were ‘edutained’ through a live ship-to-shore connection with a hydrothermal vent expedition in the territorial waters of the Kingdom of Tonga on April 29th 2016.

The event demonstrated the value of collaborating across multiple institutions when it comes to engaging the next generation of ocean ambassadors with deep-sea exploration. The Live Dive was a unique combination of live broadcasting, online participation, and classroom engagement.

High school students participating in the 4th Annual Ocean Science Symposium by Ocean Networks Canada (ONC) were given the opportunity to interact with deep-sea specialists on the Schmidt Ocean Institute’s Research Vessel Falkor via live-link, in an auditorium, and via Twitter. High-definition video footage from the ROPOS Remotely Operated Vehicle on-board RV Falkor was streamed through live-link whilst experts discussed hydrothermal vent science and explained the biological interactions playing out on the screen. Questions from both the physical and online audiences were fielded and answered in real time.

Dedicated classroom materials were prepared for participating schools and made available online prior to the event, enabling teachers to integrate hydrothermal vents into their lessons. The students participating in the auditorium were also given the chance to see actual deep-sea specimens and ask scientists questions informally after the live-link.



Above: A packed auditorium with keen high school students for the Fiji Live Dive. Photo credit: Cathy Sturgeon and Fish Eye Project.

The student reactions to the Live Dive demonstrated the power of live interaction and ‘edutainment’:

«The Falkor live dive was really cool. I found it especially interesting because it followed the hydrothermal vent presentation and the ability to ask questions directly to the researchers”

– High school student

“... the Fiji Live Deep Sea Diving was truly an amazing experience... allowing people online to actively participate in the event is a really practical and efficient way to raise awareness and share the fun! This is the kind of project that could really, in my opinion, bring science ‘field trips’ to a new level. I can’t wait for the next one!”

– Antoine Mathieu, Université de Montréal

To date, the event has been viewed by audiences in 15 countries. If you missed it, you can see the recording at <https://www.youtube.com/watch?v=xiEGlqwcivA>. The classroom materials are also freely available <http://www.fisheyeproject>.

<http://www.fish-eye-project.org/>.
<http://schmidtocean.org/>

The Live Dive was co-ordinated and managed by the Fish Eye Project (<http://www.fish-eye-project.org/>). Shore-side was hosted by ONC at University of Victoria (UVic) BC, with onsite deep-sea biologists Dr Rachel Boschen of UVic and Dr Ben Grupe of Fisheries and Oceans Canada. Ship-side was co-ordinated by the Schmidt Ocean Institute (<http://schmidtocean.org/>) and hosted by deep-sea biologist Dr Cherisse Du Preez of Pennsylvania State University (PSU). The Principle Investigators for the Vent Life Expedition were Dr Chuck Fisher (PSU), Dr Peter Girguis (Harvard University), Dr Roxanne Beinart (Woods Hole Oceanographic Institute) and Dr Vicki Ferrini (Columbia University). Baobab Marine facilitated publicity in Fiji.

“Prepare for a dive” – Exhibition on deep-sea biology and geology in the State Darwin Museum, Moscow, Russia

¹Tina Molodtsova, ¹Andrey Gebruk and ²Evgenia Sidorova

¹IORAS, Moscow, ²Darvin State Museum, Moscow

In celebration of the 70th anniversary of the P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences (IORAS), established in January 1946, the State Darwin Museum in Moscow hosted for fifteen weeks, from the 17th November 2015 to the 28th February 2016, a temporary exhibition on the Deep Sea “Prepare for a dive” arranged in collaboration with IORAS and with participation of the Geological Institute RAS, Paleontological Institute RAS, General Bathymetric Chart of the Ocean (GEBCO) and the Moscow State University Marine Research Center. The exhibition encompassed many aspects of deep-sea biology including hydrothermal vents, abyssal plains, trenches, seamounts and Mid-Ocean ridges, history of deep-sea research, and present human activities in the deep-sea. Unique specimens of deep-sea fauna from the IORAS collection were demonstrated for the first time since the 2nd International Oceanographic Congress in Moscow in 1966. Of a special interest was a collection of benthic organisms from the depth of almost 10 km in the Kuril-Kamchatka Trench and an array of species living in the extreme environment of hydrothermal vents. Among most popular exhibition sections were the section on trench (hadal) fauna and the section dedicated to deep-diving manned submersibles “Mir-1” and “Mir-2”. In frames of the exhibition several popular lectures were given by scientists from IORAS in the State Darwin Museum.



Sir George Deacon Medal: Recent Medallists are Drs. Myriam Sibuet and David Billett

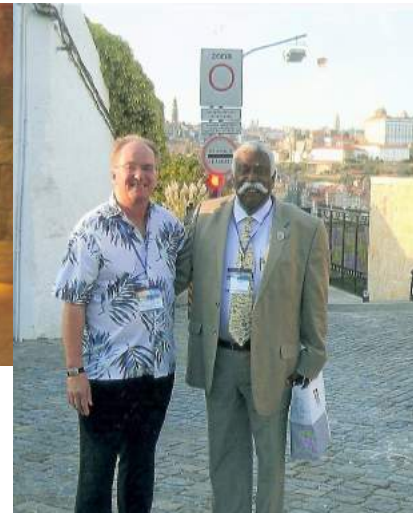
Prof. Bob George

President George Institute for Biodiversity and Sustainability

www.GIBSconservation.org

Amongst the great oceanographers, Sir George Deacon stands tall with other leading sea-going scientists like Roger Revelle (USA), Lev Zenkevitch (Russia) and Anton Bruun (Denmark). Deacon led many expeditions to the Southern Ocean and in fact, described the circumpolar currents and Antarctic water masses. He founded the British Oceanography Centre. In his final years he took interest not only in physical but also biological oceanography. Deacon worked with me closely to organize the 1982 Antarctic krill symposium, In view of his devotion to bridge 2 scientific disciplines, George Institute founded the 'Deacon Medal' that was awarded thus far to Prof. Leonard Pietrafessa (NCSU, USA), Dr. Torben Wolf (Denmark), Dr. Edward O. Wilson of Harvard University, Dr. Jarle Stromberg (Sweden), Dr. Bob George (USA), Dr. Hjalmar Thiel Germany) and most recently at the 14th Deep-Sea Biology Symposium in the university of Aveiro in Portugal, the Deacon medal was awarded to Dr. Myriam Sibuet (France) and Dr. David Billett (UK).

Dr. Sibuet was nominated for the Deacon Medal by Dr. Lisa Levin (Scripps) and Dr. Cindy Van Dover (Duke University) who admired Myriam for her leadership in deep-ocean science and for linking her research to conservation of vulnerable deep-sea ecosystems. Dr. David Billett was recognized by the 'GIBS Medals Nomination Council' of George Institute for Billett's recent work with the International Seabed authority (ISA) on conservation of the deep-sea floor from mining activities in the abyss.



Left: Myriam Sibuet; above: David Billett; right: David Billett with Bob George.

Meetings & Workshops

MASTS Annual Science Meeting: “OUR MARINE ENVIRONMENT - A SHARED RESOURCE”

19 – 21 October 2016, Technology & Innovation Centre, Glasgow



Marine Alliance for Science and Technology for Scotland

The Marine Alliance for Science and Technology for Scotland will hold its sixth Annual Science Meeting (ASM) on Wednesday 19th – Friday 21st October 2016 at the Technology & Innovation Centre, Glasgow

The 2016 ASM will promote the latest advances in marine science, good governance and using sound science responsibly, and describe research that will lead us to achieve a sustainable marine economy and live within environmental limits.

This cross-disciplinary meeting brings together members of the marine science community, with the aim of promoting and communicating research excellence and forging new scientific collaborations. The cross-disciplinary nature of the event as well as the high caliber of the selected talks means that scientists can broaden their knowledge in marine science as well as benefit from expertise and ideas gained in a range of fields other than their own.

Science presentations and e-poster sessions will take place on the first two days (Wednesday 19th October and Thursday 20th October), together with Plenary Speakers and opportunities to network.

What is an e-poster and when does it need to be submitted by? Find out more (http://www.masts.ac.uk/media/3512/e-posters_guidelines_2015.pdf). If you want to see an example of a great e-poster, then please view Thom Linley's e-poster.

On the third day, the venue will host a number of meetings and workshops: If you are interested in hosting one of these, please contact Dr Emma Defew: ecd2@st-andrews.ac.uk.

We also invite you to join us at the conference dinner and ceilidh (music from the Hoochie Coochie band) to be held on the evening of Wednesday 19th October at the Millennium Hotel Glasgow.

Anyone interested in exhibiting at the 2016 event, or anyone wishing to showcase or demonstrate a piece of kit/equipment should email Dr Emma Defew.

We advise delegates to book accommodation for the event as soon as possible. The nearest place to stay is the Premier Inn on George Street.

ASM Organising Committee:

The 2016 MASTS ASM is being organised by: Dr Emma Defew (MASTS Programme Coordinator)

MASTS welcomes the European Marine Board who will be hosting their autumn meeting alongside the MASTS ASM.

The MASTS ASM is endorsed by the International Association for Biological Oceanography.

Course on “THE USE OF PHYLOGENIES IN THE STUDY OF MACROEVOLUTION”

4th edition, September 19th – 23rd, 2016

Registration: now open!

Instructor: Dr. Juan López Cantalapiedra (Museum für Naturkunde, Germany).

Place: Facilities of the CRIP at Els Hostalets de Pierola, Barcelona (Spain).

Organized by: Transmitting Science, the Centre de Restauració i Interpretació Paleontologica and the Institut Català de Paleontologia Miquel Crusafont.

This course is aimed at postgraduate students, postdoctoral researchers and established academics.

First, this course will introduce participants to the use, modification and representation of phylogenetic trees. Then, we will focus on the use of phylogenetic information to reconstruct ancestral characters and biogeographic histories, learning how to apply Phylogenetic Comparative Methods.

This course will also tackle trait evolution modeling and the assessment of phylogenetic signal. Finally, we will learn about the shape of phylogenetic trees and its evolutionary causes and how to estimate the rates of diversification throughout the evolutionary history of groups.

Participants are encouraged to bring their data sets to use in the practical class.

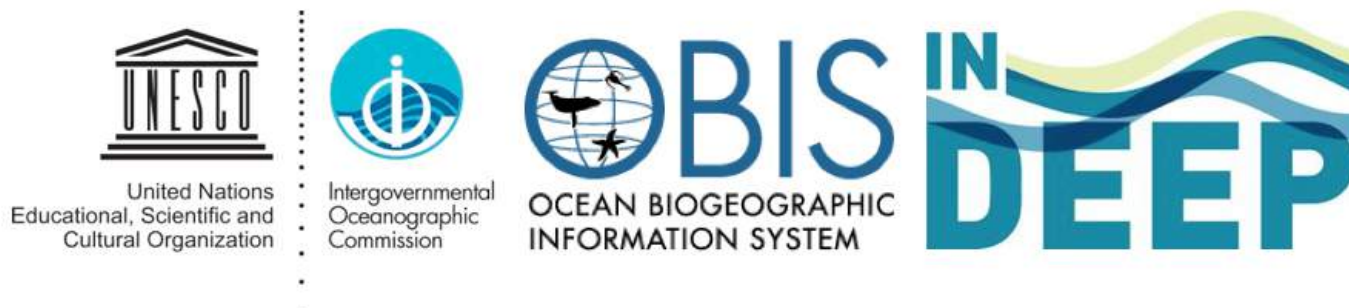
Important note: Please bear in mind that this course is not about reconstructing (building) phylogenetic trees.

Software: Mesquite, FigTree, BayesTraits (using BayesTraits Wrapper in R), RASP and R (ape, TreeSim, TreePar, Geiger, OUwie, BioGeoBEARS).

More information: <http://www.transmittingscience.org/courses/evol/phylogeny-and-macroevo/> or writing to courses@transmittingscience.org

International OBIS-INDEEP training & workshop

25-28 October 2016 – Belgium



Call for applications open until 21 June 2016

Venue: UNESCO-IOC Project Office for IODE, Oostende, Belgium

Dates: 25-28 October 2016

Organizers:

- Ward Appeltans (OBIS Project Manager)
- Maria Baker (INDEEP Project Manager/DOSI Co-Lead)
- Tim O’Hara (INDEEP WG Biodiversity and Biogeography)
- Tammy Horton (INDEEP WG Taxonomy and Evolution)
- Nick Higgs (INDEEP WG Taxonomy and Evolution)
- Leen Vandepitte (WoRMS data manager)

Meeting objectives:

The aim of this workshop is to connect the deep-sea biological community to OBIS, with the aim to establish a deep-sea OBIS node and develop a customised deep-sea OBIS data portal.

This is in response to the call from the OBIS Steering Group meeting (Feb 2015) to liaise with INDEEP and O'Hara et al (2015) to establish a global deep-sea biodiversity data-sharing platform.

Topics of the meeting:

- Training deep-sea scientists in data management (OBIS standards and best practices) and data access and data processing using OBIS
- Hands-on data curation and archeology (digitizing historical datasets and QA/QC of existing datasets in OBIS)
- Design of a new OBIS deep-sea data and information portal (which products would be useful for making it policy-relevant?), connecting OBIS with other information systems (e.g. WoRDDS, Deep-sea species traits, deep-sea vocabs)
- Sustainability (develop a work plan, share responsibilities and tasks, funding)

Funding for participation is available for a limited number of participants.

Applications should be received before 21 June 2016.

Apply: <http://beta.iobis.org/2016/05/17/indeep/>

Short-listed candidates will be informed before end of June. Applicants requiring travel support will be asked to submit a copy of their passport and an endorsement letter from the head of their institution.

References: O'Hara, T.; Tittensor, D.; Baker, M.; Stocks, K.; Appeltans, W. (2015). A global deep-sea biodiversity data-sharing platform. Deep-Sea Life 6: 12

Recent Progress in Deep-Sea Research and Conservation: Lessons from Various Parts of the Globe

Special Poster Session at PICES (North Pacific Marine Science Organization) Annual Meeting, San Diego, USA Nov 2-13 2016

Orlov A, Koslow T, Yamamura O & Pakhomov E

25 Years of PICES: Celebrating the Past, Imagining the Future

November 1-13, 2016
San Diego, USA

North Pacific Marine
Science Organization
2016 Annual Meeting



In recent years, intensive study of deep-sea ecosystems (continental slope, seamounts, trenches, troughs, and mid-water layers) of the global ocean has received increased attention because of the high levels of endemism and extreme vulnerability of their biota to any impact, particularly due to human activities. In the past, deep-sea research was focused mainly on the qualitative and quantitative composition of particular species or component of deep-water ecosystem. Currently, studies of life cycles, evaluation of anthropogenic impact, conservation of biological and genetic

diversity, safe and sustainable exploitation of biological resources and their protection from destruction during human activities (fishing, mining, shipping, etc.) have become increasingly important. Several projects under the “Census of Marine Life (CoML)” program were conducted during recent years, namely CeDAMar, MarEco, CenSeam, ChEss, etc. There were also several local projects focused on deep-water biodiversity studies of the Sea of Okhotsk (SokhoBio), Japan/East Sea (SoJaBio) and Kurile-Kamchatka Trench (KuramBio). Protection of Vulnerable Marine Ecosystems (VME) in deep waters has received increasing attention in FAO and a number of RFMO’s such as NAFO, NEAFC, SEAFO, SPRFMO, etc. In the Southern Ocean, CCAMLR developed Antarctic Benthic Deep-Sea Biodiversity Project (ANDEEP). For the Southern Indian Ocean, IUCN and SIODFA announced Benthic protected areas. Modern significant progress in deep-sea research became possible mainly due to development of new methodologies and technical equipment, including ROV’s, landers, various recorders, etc. This poster session will provide a forum for sharing recent advances in deep-sea research and conservation in various parts of the global ocean in the whole, and the North Pacific in particular. Contributions on recent biological studies and conservation in deep waters of the Pacific, Atlantic, Indian, and Southern oceans are encouraged.

Link to Meeting URL: <http://meetings.pices.int/meetings/annual/2016/pices/scope>

Conserving the other 50% of the world: status and opportunities in area-based management beyond national jurisdiction

A pre-IMCC focus group open to public registration

28-29 July, 2016

St. John’s, Newfoundland

This past June, the UN General Assembly adopted a resolution to establish a Preparatory Committee (PrepCom) to begin negotiations on a new legally-binding instrument for the conservation and sustainable use of marine biological diversity beyond national jurisdictions. This consensus resolution marks both the culmination of a herculean 10-year effort to bring this topic to the floor of the UNGA and, at the same time, the first step in a larger process. The negotiations that will ensue over the next two years will set the stage for the conservation of biodiversity for the other 50% of the planet and represent an enormous opportunity to inform conservation policy and effect change. In this focus group, we will examine the status and opportunities for conservation of ABNJ by reviewing new scientific findings and current sectoral efforts to conserve biodiversity. We will synthesize this information and consider how it can inform a new legally-binding instrument and the role of civil society in the process.

IMCC 4 precedes the second meeting of the BBNJ PrepCom by just a few weeks. The main objective of this focus group will be to develop a high level policy brief describing the status and opportunities for the conservation and sustainable use of ABNJ for that PrepCom meeting. The policy brief will be distributed at a side event at the PrepCom along with a summary presentation of our findings. The focus group will target three of the four elements of the “package” being negotiated at the PrepCom, including: area-based management tools, environmental impact assessments, and capacity building and technology transfer. We will also review scientific evidence for anthropogenic impacts on the open oceans and deep seas to set the stage for the need for the new instrument. While input from the scientific community is critical to this process, we also seek to provide information to scientists and civil society more broadly by providing in depth explanations of the history and relevance of the BBNJ PrepCom negotiations.

We could not be more excited about the line-up of speakers (see draft agenda below) and the potential the workshop has to inform the negotiations of a new international legally-binding instrument. While there are numerous speakers, the main purpose of this focus group is to get feedback from the community on the most important elements to include in the policy brief. As such, have allowed significant time for discussion after each session of speakers. We sincerely hope you will join us for the focus group and contribute your voice to this effort!

Please note: you need to register for the focus group through the conference website.

DRAFT AGENDA

DAY 1

9:00 Welcome, Overview & Charge (Daniel Dunn)

9:15 Setting the stage: The history and the role of civil society (Moderator: Kristina Gjerde)

1. Progress towards a new treaty for the conservation and sustainable use of marine biodiversity in ABNJ – Susanna Fuller (Ecology Action Centre)

2. Elements of the “package” being negotiated at the BBNJ PrepCom - TBD

3. Comparing transparency in the management of fisheries with mining in ABNJ – Jeff Ardron (Commonwealth Secretariat)

4. Species of cultural importance to Indigenous Peoples and local communities, and what they can contribute to the governance of marine biodiversity beyond national jurisdiction – Yoshitaka Ota (Nereus), Marjo Vierros (UN Univ.)

10:30 Setting the stage: The history and the role of civil society - Bullets & Discussion

11:00 Coffee Break

11:30 Anthropogenic Impacts in ABNJ (Moderator: Lance Morgan)

1. The deep ocean under climate change – Lisa Levin (Univ. of California, San Diego, DOSI)

2. Climate change effects on ABNJ stocks – William Cheung (Univ. of British Columbia/Nereus)

3. What are the environmental impacts of deep-sea mining and can they be reduced – Phil Weaver (Seascope Consultants, MIDAS, GOBI)

4. A review of the impact of fisheries on open-ocean ecosystems – Guillermo Ortuño Crespo (Duke Univ./Nereus)

In absentia: Deep-sea fisheries impacts – Derek Tittensor (Dalhousie University)

12:30 Anthropogenic Impacts in ABNJ - Bullets & Discussion

1:00 Lunch

2:00 Environmental Impact Assessments (Moderator: Telmo Morato)

1. Existing practices and future opportunities for the use of EIAs in Areas Beyond National Jurisdiction - Steve Fletcher (UNEP-WCMC)

2. Exploratory fisheries in ABNJ – Richard Caddell (NILOS/ Nereus)

3. Emerging practice for environmental impact assessments for seabed mining [and other activities] beyond national jurisdiction - Kristina Gjerde (Wycliffe Management/MIDAS)

3:00 Environmental Impact Assessments - Bullets & Discussion

3:30 Coffee Break

4:00 Area-based management of ABNJ: Existing instruments (Moderator: Steve Fletcher)

1. Results and implications of the first intergovernmentally sanctioned effort to describe ecological or biologically important areas (EBSAs) and future directions – Pat Halpin (Duke Univ., GOBI, Nereus)

2. The status of RFMO conservation measures – Matt Gianni (DSCC)

3. The International Seabed Authority’s Areas of Particular Environmental Interest and movement on a Mid-Atlantic Ridge Strategic Environmental Management Plan for deep sea mining – David Johnson (Seascope Consultants, GOBI, MIDAS)

4. Role of a network of MPAs in areas beyond national jurisdiction – Daniel Dunn (Duke Univ., GOBI, Nereus)

5:00 Area-based management of ABNJ: Existing instruments - Bullets & Discussion

5:30 Day 2 Teaser: Data for EIAs and area-based management of ABNJ: Species (Moderator: Sara Maxwell)

1. Important Marine Mammal Areas in ABNJ – Michael Tetley (IUCN Joint SSC-WCPA Marine Mammal Protected Task Force)

5:45 Wrap-up

6:00 End for the day

DAY 2

9:00 Welcome and Summary of Day 1 (Steve Fletcher)

9:15 Data for EIAs and area-based management of ABNJ: Species (Moderator: Sara Maxwell)

1. Global information systems to support environmental management of the ABNJ – (Pieter Provoost, OBIS)

2. Global status of oceanic sharks & rays and priority areas for conservation beyond national jurisdiction –Fred Vanderperre (Univ. of the Azores)

3. Important Bird Areas in ABNJ – Birdlife International

10:00 Data for EIAs and area-based management of ABNJ: Species - Bullets & Discussion

10:30 Coffee Break

11:00 Data for EIAs and area-based management of ABNJ: Biogeographies & Habitats (Moderator: Lisa Levin)

1. Global biogeography of brittlestars – Tim O’Hara (Museum Victoria)

2. New global mesopelagic biogeographies – Gabriel Reygondeau (Nereus, Univ. of British Columbia)

3. Predictive maps of cold-water corals – Marine Conservation Institute

4. Myths and measures of seamount biodiversity – Telmo Morato (Univ. of the Azores)

5. Life in the abyss: species diversity, biogeography and conservation – Tina Molodtsova (P.P. Shirshov Institute of Oceanology)

In absentia: Celebrating and conserving the diversity of chemosynthetic ecosystems – Cindy Van Dover (Duke)

12:15 Data for EIAs and area-based management of ABNJ: Biogeographies & Habitats - Bullets & Discussion

12:45 Lunch

1:45 Technology transfer & Capacity Building through monitoring & surveillance in ABNJ (Moderator: Pat Halpin)

1. Technology Transfer and instrumenting the high seas – Torsten Thiele (Global Ocean Trust)

2. Status of global monitoring of ocean health – Nic Bax (CSIRO)

3. The role of the IOC in capacity development and technology transfer - Harriet Harden-Davies (Univ. of Wollongong, DOSI)

4. The potential contribution of open science to capacity building and tech transfer - TBD

2:45 Technology transfer & Capacity Building through monitoring & surveillance in ABNJ - Bullets & Discussion

3:15 Presentation of all bullet points and identification of gaps and the path forward (Moderator: Daniel Dunn)

3:45 Wrap-up

4:00 End for the day




3rd INCISE International Submarine Canyon Symposium

25-27 July 2016 Victoria BC

JOIN US!

The 3rd INCISE International Submarine Canyon Symposium takes place in beautiful Victoria, BC, Canada, 25-27 July 2016.

Hosted by Ocean Networks Canada (ONC), an initiative of University of Victoria. ONC operates world-leading observatories in the Pacific and Arctic Oceans.



According to recent studies, roughly 10,000 submarine canyons exist worldwide. Only 1% have been studied in any detail.

The exploration of submarine canyons reveals exuberant ecosystems with never-before-seen life forms and habitats. While the scientific understanding of canyons advances, so does the human footprint into the deep-sea, with increasing demands for oil & gas, minerals and fisheries.

The scientific community has a responsibility to prepare an assessment of the role submarine canyons play in generating and maintaining deep-sea biodiversity and ecosystem function, in support of developing marine policies defining clear strategies for conservation.

SEE OVER FOR MORE DETAILS AND REGISTRATION INFO

<http://incise2016.oceannetworks.ca>



6th International Symposium
DeepSeaCorals

September 11-16, 2016

Boston Marriott Long Wharf, Boston, MA

The 6th International Symposium on Deep-Sea Coral is bringing together scientists, industry specialists, students, and managers with recent, state-of-the-art knowledge on the distribution, linkages, ecosystem function and biodiversity of cold-water corals and their habitats. Our current knowledge and outlook of the driving factors and consequences of past and present biogeography and ecological constraints, climate change, natural and anthropogenic impacts, and the conservation and management of cold-water coral ecosystems will be discussed.

IMPORTANT DATES

April 2016

Early Registration Begins

10 June 2016

Abstract Deadline and Early Registration Ends

July 2016

Notification of abstract acceptance

August 2016

Program Announced

DETAILS AND REGISTRATION AT

deepseacoral.org



Scientist Profiles

James Bell

University of Leeds and Natural History Museum, UK

Contact: gyjbb@leeds.ac.uk; james.bell@nhm.ac.uk

@James_chesso



I am a third year deep-sea ecology PhD student in the UK. My general research interests are in the environmental controls that act upon deep-sea benthic assemblages. I have previously worked on the ECOMAR project (Bell et al., 2013; in press) and currently I am studying assemblage and trophic structure in several chemosynthetic ecosystems from the Southern Ocean (Bell et al., 2016; submitted; in prep.). During my PhD research, I am working to establish how environmental variation at deep-sea sediment-hosted chemosynthetic ecosystems structures differences in assemblage and trophic ecology. This project involves a suite of analyses including: community ecology; stable

isotope analysis & mixing models; geochemistry and food web modeling.

I completed my Master of Marine Biology degree (MSci) at Southampton University in 2012 (Bell et al., 2013 DSR II). In 2012 and 2013 I worked on benthic megafaunal structure on steep areas of the Mid-Atlantic Ridge (Bell et al., in press Marine Ecology), after which I began my PhD studies, primarily based at Leeds University. I expect to complete my thesis in February 2017, which will be comprised of four lead author papers, focusing mainly upon the ecology of a sedimented hydrothermal vent system in the Bransfield Strait, Antarctica (see Bell et al., 2016 *Frontiers in Marine Science*), but also investigating the ecological effects of reducing sediments enriched in methane (Bell et al., submitted). I am actively involved in partnerships with the University of Newcastle and the Royal Netherlands Institute of Sea Research, contributing to my PhD thesis papers as well as some additional research (e.g. modeling isotopic characteristics in food webs). I am also active in science engagement and won a UK science engagement contest in 2014, and I have even done academic stand up a couple of times, with mixed success!

I am looking for projects along a deep-sea ecology theme to start in the first half of 2017. If you know of anything, please let me know.

Wanted

Systematics, biogeography, speciation, and phylogeny of the deep-sea gastropod *Scaphander*

Trond Oskars & Manuel Malaquias

University Museum of Bergen, Norway

Contact: Manuel.Malaquias@uib.no

The University Museum of Bergen (University of Bergen, Norway) is starting a new project dealing with the systematics, biogeography, speciation, and phylogeny of the deep-sea gastropod genus *Scaphander* on a global scale. Specimens of East Pacific, Central Pacific and Southern Atlantic origin are especially wanted, but specimens from any region are of interest. We are especially interested in obtaining ethanol fixed specimens for phylogenetic and morphoanatomical analyses with precise data on distribution and depth.

If you have any samples and wish to collaborate, please contact Manuel Malaquias: Manuel.Malaquias@uib.no.

Taxonomy, microevolution, distribution and biology of morid cods *Antimora* spp. (Moridae, Gadiformes, Teleostei) of the world's oceans

Dr. Alexei Orlov

Contact: orlov@vniro.ru

To make the project "Taxonomy, microevolution, distribution and biology of morid cods *Antimora* spp. (Moridae, Gadiformes, Teleostei) of the world's oceans" (see [page 14](#) in Project News) successful, organizers are urgently searching for:

1. Information on distribution *Antimora* spp. (survey data, bycatch during commercial operations, records from underwater videorecorders, etc.);
2. Otoliths (as many as possible) for shape analysis and age readings;
3. Information on general biology and ecology (including data on temperature, salinity, type of bottom grounds, etc.);
4. Tissue samples (50 fin clips from particular area) for genetic analysis;
5. Whole specimens (25 from particular area) for morphometric, parasitologic and biochemical analyses (preferably frozen);
6. Information on any opportunity to take part in any deep-sea research cruise.

Colleagues who are able to provide with any of data requested are invited to take part in joint publications.

If you are interested to assist with this project, please contact directly PI Dr. Alexei Orlov: orlov@vniro.ru

Hot off the Press

Advances in Deep-Sea Biology – Special Issue, Deep-Sea Research II

Marina Cuhuna, Ana Hilario and Ricardo Serrão Santos

Following the 14th Deep-Sea Biology Symposium held last year in Aveiro, Portugal, we received a total of 50 submissions for the Special Issue “Advances in Deep-Sea Biology” to be published in Deep-Sea Research Part II in 2016. We would like to use this opportunity to acknowledge all authors and to express our gratitude to all the reviewers for their availability and outstanding work.

The review process is still ongoing but meanwhile a series of papers are already accepted and available online (see list below). Enjoy your reading and look out for the upcoming publications!

The editors: Marina, Ana and Ricardo

References:

Mercier A, Baillon S, Daly M, Macrander J, Hamel J-F (Available online, 8 February 2016) *Biology of a deep-water sea anemone (Anthozoa: Actiniidae) from eastern Canada: Spawning, development, and growth. Deep-Sea Research II. doi:10.1016/j.dsr2.2016.01.006*

Hestetun JT, Rapp HT, Xavier JR (Available online, 19 March 2016) *Carnivorous sponges (Porifera, Cladorhizidae) from the Southwest Indian Ocean Ridge seamounts. Deep-Sea Research II. doi:10.1016/j.dsr2.2016.03.004*

Xu T, Sun J, Lv J, Watanabe HK, Li T, Zou W, Rouse GW, Wang S, Qian P-Y, Bao Z, Qiu J-W (Available online, 13 April 2016) *Genome-wide discovery of single nucleotide polymorphisms (SNPs) and single nucleotide variants (SNVs) in deep-sea mussels: Potential use in population genomics and cross-species application. Deep-Sea Research II, doi:10.1016/j.dsr2.2016.03.011*

Gubili C, Ross E, Billett DS, Yool A, Tsairidis C, Ruhl HA, Rogacheva A, Masson D, Tyler PA, Hauton C (Available online, 19 April 2016) *Species diversity in the cryptic abyssal holothurians *Psychropotes longicauda* (Echinodermata). Deep-Sea Research II, doi:10.1016/j.dsr2.2016.04.003*

Bourque JR, Robertson CM, Brooke S, Demopoulos AW (Available online, 22 April 2016) *Macrofaunal communities associated with chemosynthetic habitats from the U.S. Atlantic margin: A comparison among depth and habitat types. Deep-Sea Research II, doi:10.1016/j.dsr2.2016.04.012*

Harden-Davies, H (Available online, 13 May 2016) *Deep-sea genetic resources: New frontiers for science and stewardship in Areas Beyond National Jurisdiction, Deep-Sea Research II. doi:10.1016/j.dsr2.2016.05.005*

Papiol V, Hendrickx ME, Serrano D (Available online, 13 May 2016) *Effects of latitudinal changes in the oxygen minimum zone of the northeast Pacific on the distribution of bathyal benthic decapod crustaceans. Deep-Sea Research II. doi:10.1016/j.dsr2.2016.04.023*

Rees D, Byrkjedal I, Sutton TT (Available online, 13 May 2016) *Pruning the Pearlsides: Reconciling morphology and molecules in mesopelagic fishes (Maurolicus: Sternoptychidae). Deep-Sea Research II. doi:10.1016/j.dsr2.2016.04.024*

Billings A, Kaiser C, Young CM, Hiebert LS, Cole E, Wagner JKS, Van Dover CL (Available online, 19 May 2016) *SyPRID sampler: A large-volume, high-resolution, autonomous, deep-ocean precision plankton sampling system. Deep-Sea Research II. doi:10.1016/j.dsr2.2016.05.007*

Brooke SD, Watts MW, Heil AD, Rhode M, Mienis F, Duineveld GC, Davies AJ, Ross SW (Available online, 19 May 2016) *Distribution and habitat associations of deep-water corals Norfolk and Baltimore canyons, Mid-Atlantic Bight, USA. doi:10.1016/j.dsr2.2016.05.008*

Cutting the Umbilical: New Technological Perspectives in

Benthic Deep-Sea Research

Brandt A, Gutt J, Hildebrandt M et al. (2016)

J. Mar. Sci. Eng. 4(2): 36; [doi:10.3390/jmse4020036](https://doi.org/10.3390/jmse4020036)

Many countries are very active in marine research and operate their own research fleets. In this decade, a number of research vessels have been renewed and equipped with the most modern navigation systems and tools. However, much of the research gear used for biological sampling, especially in the deep-sea, is outdated and dependent on wired operations. The deployment of gear can be very time consuming and, thus, expensive. The present paper reviews wire-dependent, as well as autonomous research gear for biological sampling at the deep seafloor. We describe the requirements that new gear could fulfil, including the improvement of spatial and temporal sampling resolution, increased autonomy, more efficient sample conservation methodologies for morphological and molecular studies and the potential for extensive in situ real-time studies. We present applicable technologies from robotics research, which could be used to develop novel autonomous marine research gear, which may be deployed independently and/or simultaneously with traditional wired equipment. A variety of technological advancements make such ventures feasible and timely. In proportion to the running costs of modern research vessels, the development of such autonomous devices might be already paid off after a discrete number of pioneer expeditions.

Link to article: <http://www.mdpi.com/2077-1312/4/2/36/>

Improving the estimation of deep-sea megabenthos biomass: dimension to wet weight conversions for abyssal invertebrates

Durden JM, Bett BJ, Horton T, et al. (2016)

Marine Ecology Progress Series, [doi: 10.3354/meps11775](https://doi.org/10.3354/meps11775)

Deep-sea megafaunal biomass has typically been assessed by sampling with benthic sledges and trawls, but non-destructive methods, particularly photography, are becoming increasingly common. Estimation of individual wet weight in seabed photographs has been achieved using equations obtained from measured trawl-caught specimens for a limited number of taxa. However, a lack of appropriate conversion factors has limited estimation across taxa encompassing whole communities. Here we compile relationships between measured body dimensions and preserved wet weights for a comprehensive catalogue of abyssal epibenthic megafauna, using ~47,000 specimens from the Porcupine Abyssal Plain (NE Atlantic) housed in the Discovery Collections. The practical application of the method is demonstrated using an extremely large dataset of specimen measurements from seabed photographs taken in the same location. We also collate corresponding field data on fresh wet weight, to estimate the impact of fixation in formalin and preservation in industrial denatured alcohol on the apparent biomass. Taxa with substantial proportions of soft tissues lose 35 to 60% of their wet weight during preservation, while those with greater proportions of hard tissues lose 10 to 20%. Our total estimated fresh wet weight biomass of holothurians and cnidarians in the photographic survey was ~20 times the previous estimates of total invertebrate biomass based on trawl catches. This dramatic uplift in megabenthic biomass has significant implications for studies of standing stocks, community metabolism, and numerical modelling of benthic carbon flows.

Link to article: <https://goo.gl/rPfbCo>

Bathymetric and regional changes in benthic macrofaunal assemblages on the deep Eastern Brazilian margin, SW Atlantic

Bernardino AF, Berenguer V & Ribeiro-Ferreira VP (May 2016)

Deep Sea Research I, 111: 110-120; doi: [10.1016/j.dsr.2016.02.016](https://doi.org/10.1016/j.dsr.2016.02.016)

Deep-sea continental slopes have valuable mineral and biological resources in close proximity to diverse and fragile marine benthic ecosystems. The eastern Brazilian Continental Margin is an important economic region for both fishing and oil industries, but is poorly understood with respect to the structure of the soft-sediment benthic fauna, their regional distribution and their bathymetric patterns. In this paper we quantified spatial and temporal patterns of benthic macrofaunal assemblages on the slope (400 to 3000 m), across 42 stations as part of the Espirito Santo Basin Assessment Project (AMBES, coordinated by Cenpes-Petrobras). We reported bathymetrical and regional (within-depth) changes in assemblage structure and describe previously unknown water mass influences on the deep-sea Espirito Santo Basin. In general, we reported that macrofaunal assemblages on the slope of Espirito Santo Basin are similar to other areas of the SE Brazilian margin, but regional changes in response to productivity and depth need to be considered for management strategies in the face of increasing economic activities off-shore. We intend to use the knowledge produced in this study to help the spatial management planning on the deep-sea Brazilian margin.

Link to article: <http://dx.doi.org/10.1016/j.dsr.2016.02.016>

RAD sequencing enables unprecedented phylogenetic resolution and objective species delimitation in recalcitrant divergent taxa

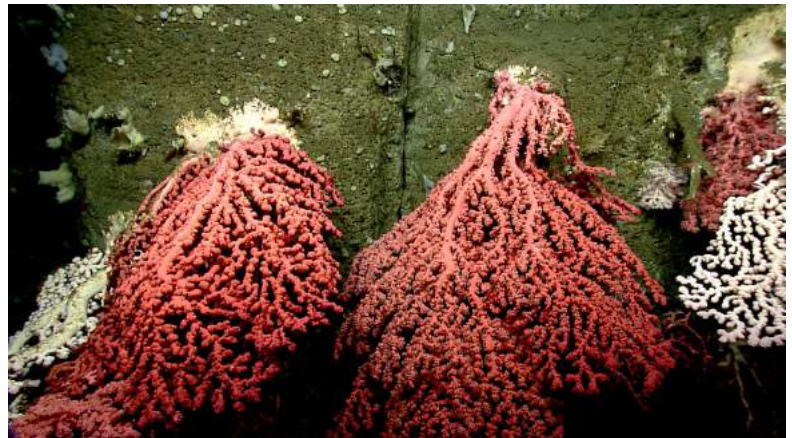
Herrera S & Shank TM (2016)

Molecular Phylogenetics and Evolution. 100: 1055-7903; doi: [10.1016/j.ympev.2016.03.010](https://doi.org/10.1016/j.ympev.2016.03.010)

Contact: sherrera@alum.mit.edu

Highlights

- Unambiguously resolved phylogenetic relationships among recalcitrant deep-sea coral taxa from the general *Paragorgia*, *Sibogorgia*, *Corallium*, *Hemicorallium*, *Anthomastus* and *Heteropolypus* with divergences >80 million years.
- Objectively inferred robust species boundaries in the deep-sea octocoral genus *Paragorgia* by testing alternative delimitation hypotheses.
- Present substantial evidence rejecting the current morphological species delimitation model for the genus.
- Inferred the presence of cryptic deep-sea species associated with environmental variables.
- Argue that the suitability limits of RAD-seq for phylogenetic inferences are contingent on taxon-



Above: Image courtesy of NOAA Okeanos Explorer Program, 2013 Northeast U.S. Canyons Expedition

specific factors.

Link to article: <http://www.sciencedirect.com/science/article/pii/S1055790316300021>

Report of the Joint ICES/NAFO Working Group on Deep-water Ecology (WGDEC)

15–19 February 2016 Copenhagen, Denmark

On 15th February 2016, the joint ICES/NAFO Working Group on Deep-water Ecology (WGDEC), chaired by Neil Golding (UK) and attended by eleven members, met at ICES HQ, Copenhagen, Denmark.

WGDEC was requested to provide all new information on the distribution of vulnerable marine ecosystems (VMEs) in the North Atlantic. A total of 487 new records, from within the NEAFC and NAFO Regulatory Areas (RA) and areas within the EEZs of member states, were submitted and appended to the ICES VME database. The new data were from a range of sources including fisheries and scientific visual seabed surveys. No recommendations were made for the modification of existing, or creation of new bottom fishing closures.

WGDEC sought to refine the VME indicator weighting system developed through 2014 and 2015. In addition, WGDEC consolidated a number of approaches for the delineation of bottom fishing closures, providing some 'guiding principles' in order to help standardise the delineation of closures when considering a range of different data types.

The new ICES VME Data Portal was launched. For the first time, users can view and download data on VME indicators and habitats used by WGDEC.

Finally WGDEC contributed to a request from the European Commission's Environment Directorate-General (DGENV) to ICES, to provide guidance on the interpretation of bottom fishing pressure maps in relation to impacts on benthic habitats and the related indicators across an EU regional scale. Specifically, WGDEC collated habitat sensitivity information for each deep-sea benthic habitat to fishing pressure, for presentation at WKFBI (ICES Workshop on Fisheries Benthic Impacts).

Link to report: <http://goo.gl/Wga0wy>

Surfing the vegetal pole in a small population: extracellular vertical transmission of an 'intracellular' deep-sea clam symbiont

Ikuta T, Igawa K, Tame A *et al* (2016)

Royal Society Open Science; [doi: 10.1098/rsos.160130](https://doi.org/10.1098/rsos.160130)

Contact: teikuta@jamstec.go.jp

Transmission of symbionts is a key event in ecological success of the symbiotic systems and in the genome reductive evolution of symbionts. However, despite their biological significance, mechanisms of symbiont transmission are not well understood. Deep-sea vesicomyid clams, including the genus *Calyptogena*, harbour sulphur-oxidizing intracellular symbiotic bacteria, which have a reduced genome, in their gill epithelial cells, and nutritionally depend on their symbionts. It has been believed that the symbionts of vesicomyid clams are vertically transmitted with occasional horizontal mode,



Above: A colony of *Calyptogena* clams in Sagami Bay.

and that a small population size of the symbiont transmitted via eggs affected their genome reduction. However, the question how the symbiont associates with the spawned eggs has remained unanswered, and the population size of the symbionts transmitted via eggs has not been determined. In this paper, we show that the symbionts are located on the outer surface of the egg plasma membrane at the vegetal pole and that each egg carries approximately 400 symbiont cells, each of which contains close to 10 genomic copies. Our results explain longstanding enigmatic problems in the deep-sea clam symbiosis, i.e., the leakiness of the vertical symbiont transmission, and narrowness

of the bottleneck of the symbiont population size during the transmission process. Our findings shed light on the mechanisms of symbiont transmission and the population dynamics underlying genetic drift and genome evolution in microorganisms, and also bring a new dimension to the embryological study of chemosymbiotic animals.

Link to article: <http://rsos.royalsocietypublishing.org/content/3/5/160130>

The lowest of the low: first record of a parasite in a hadal trench

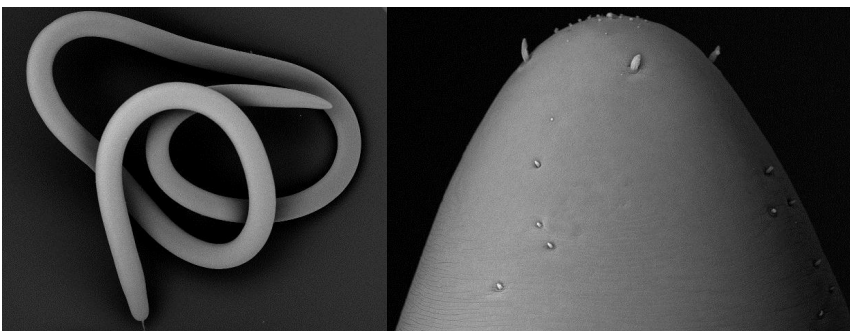
Leduc D & Wilson J (2016)

Parasitology Research 115: 1675-1692, [doi: 10.1007/s00436-016-4907-7](https://doi.org/10.1007/s00436-016-4907-7)

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Parasitic nematodes have evolved to exploit a wide variety of hosts living in a range of marine environments. Benthimermithid nematodes occur deeper than any other nematode parasites (down to 5880 m depth) but are mostly known from free-living adult stages living in the sediments, and parasitic juveniles are seldom encountered. In the present study, the benthimermithid *Trophomera* cf. *marionensis* was discovered in the body cavity of the lysianassoid amphipod *Hirondellea dubia* sampled between 7018 and 10,005 m depths in the Kermadec Trench. The nematode specimens, which could be readily observed through the transparent exoskeleton of freshly caught amphipods, were up to twice the length of *T. marionensis* specimens described from the Atlantic and East Pacific Oceans but were otherwise morphologically identical. Because of its wide geographical and water depth distribution (almost 10,000 m), *T.*

marionensis likely consists of several cryptic species. The prevalence of *Trophomera* parasites among the host population was estimated to be less than 1 %; such a low proportion of parasitised hosts could help explain why so few *Trophomera* specimens have been obtained from their host so far. The present study demonstrates that parasites can occur throughout the entire ocean depth and that they likely occur in



Above: SEM images showing entire specimen (left) and head of *Trophomera* cf. *marionensis* (right)

other hadal trenches where *H. dubia* and other lysianassoid amphipods also dominate. This research was conducted as part of the HADES project and was funded by the National Science Foundation (NSF-OCE 1130712, 1130494 and 1131620) and the National Institute of Water and Atmospheric Research through the project 'Impact of resource use on vulnerable deep-sea communities'.

Link to article: <http://link.springer.com/article/10.1007/s00436-016-4907-7>

Development of an ecotoxicological protocol for the deep-sea fauna using the hydrothermal vent shrimp *Rimicaris exoculata*

Auguste M, Mestre NC, Rocha TL, et al. (2016)

Aquatic Toxicology 175: 277–285, [doi: 10.1016/j.aquatox.2016.03.024](https://doi.org/10.1016/j.aquatox.2016.03.024)

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In light of deep-sea mining industry development, particularly interested in massive-sulphide deposits enriched in metals with high commercial value, efforts are increasing to better understand potential environmental impacts to local fauna. The aim of this study was to assess the natural background levels of biomarkers in the hydrothermal vent shrimp *Rimicaris exoculata* and their responses to copper exposure at in situ pressure (30 MPa) as well as the effects of depressurization and pressurization of the high-pressure aquarium IPOCAMP. *R. exoculata* were collected from the chimney walls of the hydrothermal vent site TAG (Mid Atlantic Ridge) at 3630 m depth during the BICOSE cruise in 2014. Tissue metal accumulation was quantified in different tissues (gills, hepatopancreas and muscle) and a battery of biomarkers was measured: metal exposure (metallothioneins), oxidative stress (catalase, superoxide dismutase, glutathione-S-transferase and glutathione peroxidase) and oxidative damage (lipid peroxidation). Data show a higher concentration of Cu in the hepatopancreas and a slight increase in the gills after incubations (for both exposed groups). Significant induction of metallothioneins was observed in the gills of shrimps exposed to 4 μ M of Cu compared to the control group. Moreover, activities of enzymes were detected for the in situ group, showing a background protection against metal toxicity. Results suggest that the proposed method, including a physiologically critical step of pressurizing and depressurizing the test chamber to enable the seawater exchange during exposure to contaminants, is not affecting metal accumulation and biomarkers response and may prove a useful method to assess toxicity of contaminants in deep-sea species.

This work was developed under the MIDAS project (managing impacts of deep-sea resource exploitation), funded by the European Commission 7th Framework Programme under the theme "Sustainable management of Europe's deep sea and sub-seafloor resources" (Grant Agreement 603418).

Link to article: <http://dx.doi.org/10.1016/j.aquatox.2016.03.024>

The potential for climate-driven bathymetric range shifts: sustained temperature and pressure exposures on a marine ectotherm, *Palaemonetes varians*

Morris JP, Thatje S, Cottin D, *et al.* (Nov 2015)

Royal Society Open Science 2: 150472

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Range shifts are of great importance as a response for species facing climate change. In the light of current ocean-surface warming, many studies have focused on the capacity of marine ectotherms to shift their ranges latitudinally. Bathymetric range shifts offer an important alternative, and may be the sole option for species already at high latitudes or those within enclosed seas; yet relevant data are scant. Hydrostatic pressure (HP) and temperature have wide ranging effects on physiology, importantly acting in synergy thermodynamically, and therefore represent key environmental constraints to bathymetric migration. We present data on transcriptional regulation in a shallow-water marine crustacean (*Palaemonetes varians*) at atmospheric and high HP following 168-h exposures at three temperatures across the organisms' thermal scope, to establish the potential physiological limit to bathymetric migration by neritic fauna. We observe changes in gene expression indicative of cellular macromolecular damage, disturbances in metabolic pathways and a lack of acclimation after prolonged exposure to high HP. Importantly, these effects are ameliorated (less deleterious) at higher temperatures, and exacerbated at lower temperatures. These data, alongside previously published behavioural and heat-shock analyses, have important implications for our understanding of the potential for climate-driven bathymetric range shifts.

Link to article: <http://www.ncbi.nlm.nih.gov/pubmed/26716003>

Spatial distribution, size composition, feeding habits, and dynamics of abundance of Alaska skate *Bathyraja parmifera* in the North Pacific

Grigorov IV, Orlov AM & Baitalyuk AA (Sep 2015)

Journal of ichthyology 55 (5): 644-663

New data on sexual dimorphism and features of reproductive biology of Alaska skate *Bathyraja parmifera* from the western Bering Sea and the northern Sea of Okhotsk are presented. Based on comparative analysis of 11 external morphological characters, the males differ from the females in the length of the disc and snout length (to the eyes, to the mouth, and to the nostrils). In the western Bering Sea, 50% of the females and 50% of the males reach the first sexual maturity at 84.5 cm TL and 85.2–90.2 cm TL, respectively; in the Sea of Okhotsk, 50% of the males reach their first sexual maturity at 80.8–83.8 cm TL (the assessment depends on the features of the method). Among smaller skates (less than 45 cm TL), the males prevail, but the proportion of the females increases in larger size groups; the sex ratio becomes equal in the exemplars 60–80 cm TL, but the males prevail again among the largest fishes (more than 80 cm TL).

Link to paper: <http://link.springer.com/article/10.1134/S0032945215050069>

Distribution, biology, and stock condition of the Pacific black halibut *Reinhardtius hippoglossoides matsuurae* based on data of various fishing gears in the western Bering Sea and off the eastern coast of Kamchatka

Maznikova, O.A., Afanasiev, P.K., Datsky, A.V., Orlov, A.M., Antonov N.P. (2015)

Trudy VNIRO 155: 31-55

Based on the analysis of trap, trawl, longline, bottom gill net, and Danish seine fisheries, spatial and vertical distributions and some biological features (size, weight and sex compositions) of the Pacific black halibut *Reinhardtius hippoglossoides matsuurae* in catches in the western Bering Sea and waters off the eastern coast of Kamchatka are considered. Stock assessment and depredation of captured fishes by amphipods are also reported. Since mostly large specimens are caught by bottom nets, it is recommended to fish for Pacific black halibut by bottom longlines and to use bottom nets and trawls for scientific purpose only.

Link to paper (in Russian): http://www.vniro.ru/files/trydi_vniro/archive/tv_2015_t_155_article_4.pdf

Jawless Fishes of the World – Volumes 1 and 2

Orlov AM, Beamish RJ eds. (2016)

Cambridge, UK, Cambridge Scholars Publishing:

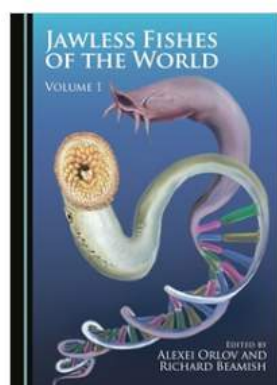
Vol. 1: xvi + 385 p. + xxxii pls.; Vol. 2: 328 p. + xxiv pls.

Hagfishes and lampreys, both examples of jawless fishes, are elongated, eel-like animals lacking paired fins, and are the only living representatives of ancient creatures that gave rise to current species of fish and, eventually, humans.

This volume provides an overview of the current status of knowledge on a variety of topics related to jawless fishes, including their taxonomy, zoogeography, phylogeny, molecular biology, evolution, life history, role in the ecosystem, and fisheries and management of hagfishes and lampreys worldwide. This is the first book dealing exclusively with the various aspects of jawless fish species throughout the world.

It brings together a number of papers providing new data on jawless fishes, and offers readers a range of useful information within a single reference, reflecting the growing appreciation for hagfishes and lampreys worldwide.

Links to books: <http://www.cambridgescholars.com/jawless-fishes-of-the-world>; <http://www.cambridgescholars.com/jawless-fishes-of-the-world-2>



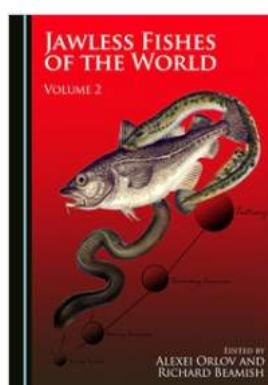
Jawless Fishes of the World

Volume 1

Editor(s):
Alexei Orlov, Richard Beamish

Subject: Science

RECOMMEND TITLE



Jawless Fishes of the World

Volume 2

Editor(s):
Alexei Orlov and Richard Beamish

RECOMMEND TITLE

Soft Robotic Grippers for Biological Sampling on Deep Reefs

Galloway KC, Becker KP, Phillips BT et al. (2016)

Journal of Soft Robotics, 3(1): 23-33

This article presents the development of an underwater gripper that utilizes soft robotics technology to delicately manipulate and sample fragile species on the deep reef. Existing solutions for deep sea robotic manipulation have historically been driven by the oil industry, resulting in destructive interactions with undersea life. Soft material robotics relies on compliant materials that are inherently impedance matched to natural environments and to soft or fragile organisms. We demonstrate design principles for soft robot end effectors, bench-top characterization of their grasping performance, and conclude by describing in situ testing at mesophotic depths. The result is the first use of soft robotics in the deep sea for the nondestructive sampling of benthic fauna.

Link to article: <http://online.liebertpub.com/doi/full/10.1089/soro.2015.0019>

Global diversity and biogeography of deep-sea pelagic prokaryotes

Salazar B, Cornejo-Castillo FM, Benítez-Barríos V, et al. (2016)

The ISME Journal 10, 596–608; [doi:10.1038/ismej.2015.137](https://doi.org/10.1038/ismej.2015.137)

The deep-sea is the largest biome of the biosphere, and contains more than half of the whole ocean's microbes. Uncovering their general patterns of diversity and community structure at a global scale remains a great challenge, as only fragmentary information of deep-sea microbial diversity exists based on regional-scale studies. Here we report the first globally comprehensive survey of the prokaryotic communities inhabiting the bathypelagic ocean using high-throughput sequencing of the 16S rRNA gene. This work identifies the dominant prokaryotes in the pelagic deep ocean and reveals that 50% of the operational taxonomic units (OTUs) belong to previously unknown prokaryotic taxa, most of which are rare and appear in just a few samples. We show that whereas the local richness of communities is comparable to that observed in previous regional studies, the global pool of prokaryotic taxa detected is modest (~3600 OTUs), as a high proportion of OTUs are shared among samples. The water masses appear to act as clear drivers of the geographical distribution of both particle-attached and free-living prokaryotes. In addition, we show that the deep-oceanic basins in which the bathypelagic realm is divided contain different particle-attached (but not free-living) microbial communities. The combination of the aging of the water masses and a lack of complete dispersal are identified as the main drivers for this biogeographical pattern. All together, we identify the potential of the deep ocean as a reservoir of still unknown biological diversity with a higher degree of spatial complexity than hitherto considered.

Link to article: <http://www.nature.com/ismej/journal/v10/n3/abs/ismej2015137a.html>

First evidence of bioluminescence on a 'black smoker' hydrothermal chimney

Phillips BT, Gruber DF, Vasan G et al. (2016)

Oceanography, 29-2; [doi: 10.5670/oceanog.2016.27](https://doi.org/10.5670/oceanog.2016.27)

News article: Blackbody radiation and visible light emission from deep-sea hydrothermal vents has been measured using various methods, but until now, no direct observations of biologically-sourced luminescence have been made in

such environments. Using methods described in Phillips et al. 2016 (also listed in this issue of Deep-Sea Life), mobile luminescent sources were imaged at a 'black smoker' chimney located at approximately 1640m on the Galapagos Spreading Center. While accurate identification of the bioluminescent animal was unfortunately impossible, based on video recorded directly prior to the low-light recordings it is hypothesized to be a free-swimming shrimp. These observations are placed in context with previous work on light at deep-sea hydrothermal vents, and stimulate further interest in researching the role of bioluminescence among chemosynthetic ecosystems.

Link to article: <http://dx.doi.org/10.5670/oceanog.2016.27>

Observations of in situ deep-sea marine bioluminescence with a high-speed, high resolution sCMOS camera

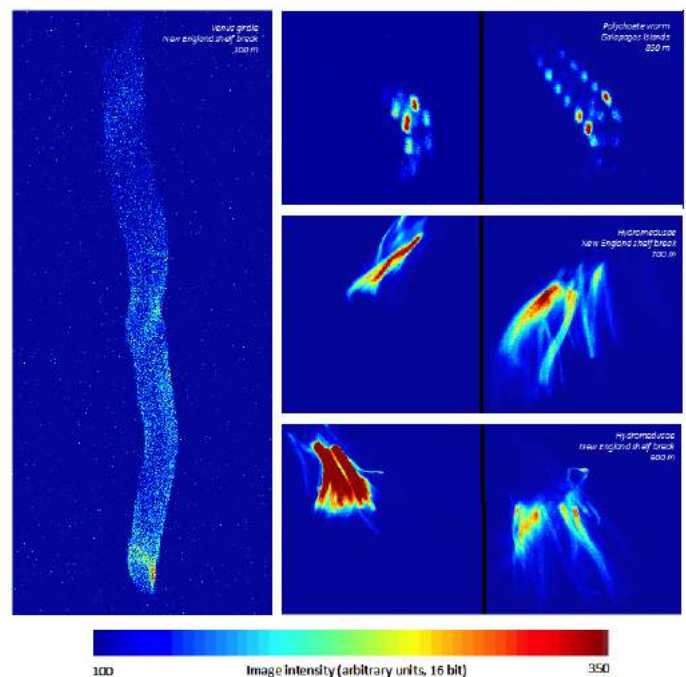
Phillips BT, Gruber DF, Vasan G et al. (2016)

Deep-Sea Research I, 111, 102-109; [doi:10.1016/j.dsr.2016.02.012](https://doi.org/10.1016/j.dsr.2016.02.012)

Observing and measuring marine bioluminescence in situ presents unique challenges, characterized by the difficult task of approaching and imaging weakly illuminated bodies in a three-dimensional environment. To address this problem, a scientific complementary-metal-oxide-semiconductor (sCMOS) microscopy camera was outfitted for deep-sea imaging of marine bioluminescence. This system was deployed on multiple platforms (manned submersible, remotely operated vehicle, and towed body) in three oceanic regions (Western Tropical Pacific, Eastern Equatorial Pacific, and Northwestern Atlantic) to depths up to 2500 m. Using light stimulation, bioluminescent responses were recorded at high frame rates and in high resolution, offering unprecedented low-light imagery of deep-sea bioluminescence in situ. The kinematics of light production in several zooplankton groups was observed, and luminescent responses at different depths were quantified as intensity vs. time. These initial results signify a clear advancement in the bioluminescent imaging methods available for observation and experimentation in the deep-sea.

Link to article:

<http://dx.doi.org/10.1016/j.dsr.2016.02.012>



Above right: Cover photo of DSR1 Issue 111. Pictured are light-stimulated bioluminescent responses of pelagic zooplankton recorded with a highly sensitive scientific CMOS camera. Images are colorized by pixel intensity. Left image: venus girdle (Phylum Ctenophora) at 100 m depth off the New England shelf break, recorded from a towed instrument platform. Top row: *Tomopteris sp. polychaete* worm at 850 m near the Galapagos Islands, recorded from an ROV; time between frames is 0.233 seconds. Middle and bottom rows: hydrozoan tentacles at 700 m and 900 m off the New England shelf break; time between frames is 0.033 seconds. Image courtesy of Brennan T. Phillips.

Biological Sampling in the Deep Sea

Clark M, Consalvey M, Rowden A Eds.



A new book on Biological Sampling in the Deep Sea has been published by Wiley-Blackwell. This was an initiative dating from 2009 under the Census of Marine Life programme, originally devised by the CenSeam (Census of Marine Life on Seamounts) project, but ultimately involving people from all the deep-sea Census projects. The book represents the first comprehensive compilation of deep-sea sampling methodologies for a range of habitats. The 19 chapters review the real life applications of current, and in some instances developing, sampling tools and techniques. These cover a wide range of sampling gear, giving information on the variety of equipment used, their pros and cons, and operational details. Chapters are included on survey and sampling design, as well as the handling and processing of samples, information management, and data analysis advice. The book has involved 60 authors, and draws upon the experiences of those at the “coal face” of deep-sea sampling, expanding on the existing methodological texts whilst encompassing a level of detail often omitted from journal publications. It is hoped that the book will promote international consistency in sampling approaches and data collection, advance the integration of information into global databases, and facilitate improved data analyses and consequently uptake of science results for the management and conservation of the deep-sea. The book release started in the UK in March, and was launched in New Zealand on NIWAs deep-sea research vessel Tangaroa by the three editors (Malcolm Clark, Mireille Consalvey, Ashley Rowden) in April (see photo). More details from:

Link to book: <http://au.wiley.com/WileyCDA/WileyTitle/productCd-0470656743.html>

Environmental Drivers of Benthic Flux Variation and Ecosystem Functioning in Salish Sea and Northeast Pacific Sediments

Belley R, Snelgrove PVR, Archambault P, Juniper SK (2016)

PLoS ONE 11(3): e0151110

The upwelling of deep waters from the oxygen minimum zone in the Northeast Pacific from the continental slope to the shelf and into the Salish Sea during spring and summer offers a unique opportunity to study ecosystem functioning in the form of benthic fluxes along natural gradients. Using the ROV ROPOS, we collected sediment cores from 10 sites in May and July 2011, and September 2013 to perform shipboard incubations and flux measurements. Specifically, we

measured benthic fluxes of oxygen and nutrients to evaluate potential environmental drivers of benthic flux variation and ecosystem functioning along natural gradients of temperature and bottom water dissolved oxygen concentrations. The range of temperature and dissolved oxygen encountered across our study sites allowed us to apply a suite of multivariate analyses rarely used in flux studies to identify bottom water temperature as the primary environmental driver of benthic flux variation and organic matter remineralization. Redundancy analysis revealed that bottom water characteristics (temperature and dissolved oxygen), quality of organic matter (chl a:phaeo and C:N ratios) and sediment characteristics (mean grain size and porosity) explained 51.5% of benthic flux variation. Multivariate analyses identified significant spatial and temporal variation in benthic fluxes, demonstrating key differences between the Northeast Pacific and Salish Sea. Moreover, Northeast Pacific slope fluxes were generally lower than shelf fluxes. Spatial and temporal variation in benthic fluxes in the Salish Sea were driven primarily by differences in temperature and quality of organic matter on the seafloor following phytoplankton blooms. These results demonstrate the utility of multivariate approaches in differentiating among potential drivers of seafloor ecosystem functioning, and indicate that current and future predictive models of organic matter remineralization and ecosystem functioning of soft-muddy shelf and slope seafloor habitats should consider bottom water temperature variation. Bottom temperature has important implications for estimates of seasonal and spatial benthic flux variation, benthic–pelagic coupling, and impacts of predicted ocean warming at high latitudes.

Link to article: <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0151110>
