Deep-Sea Life

Issue 4, November 2014

Welcome to the fourth edition of Deep-Sea Life: an informal publication for the deep-sea biology community. All your interesting contributions make editing this newsletter a real pleasure. We hope you like our choice for "Photo of the Issue". These spectacular colonies of the bubble gum coral, *Paragorgia arborea*, were photographed in Corsair Canyon, Canada, during a joint Canadian/US venture to determine their distribution, abundance, diversity, size, growth rate, genetics and reproduction (see page 15 for report).

Stories regarding activities in our deep oceans are becoming increasingly mainstream. This is clearly illustrated by the fact that a recent paper in our Hot Off the Press section (page 4) about scavenging of jellyfish carcasses (by Andrew Sweetman et al.) made it not only to the October issue of the Proceedings of the Royal Society B, but also into the New York Times and GQ magazine (for men)! Congratulations! Increasing visibility in the deep is also a function of impressive new programmes such as TREET which represents research at the complex interface between scientific fieldwork, new educational opportunities for students, and the expanding use of telepresence technologies to make remote exploration available to scientists, students and the general public (see page 12). Another fine example of bringing deep-ocean science to life is outlined on page 23 with a new "Science on a Sphere" outreach programme as explained by Stace Beaulieu.

Remember to mark the dates for the 14th Deep-Sea Biology Symposium in your diaries for next year – 31st August to 4th September 2015. The beautiful Aveiro in Portugal is the venue and pre-registration is now open. Abstract submission and registration will open in January 2015.

Oh, and I'm getting into the swing of things now with INDEEP tweets so please do feel free to follow me if you like for some interesting deep-sea snippets!

Once again, I would like to sincerely thank all those that have contributed to this issue. And of course, thanks too to Dr Abigail Pattenden (University of Limerick, Ireland) and Dr Eva Ramirez-Llodra (NIVA, Norway) for their invaluable help with editing and production.

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

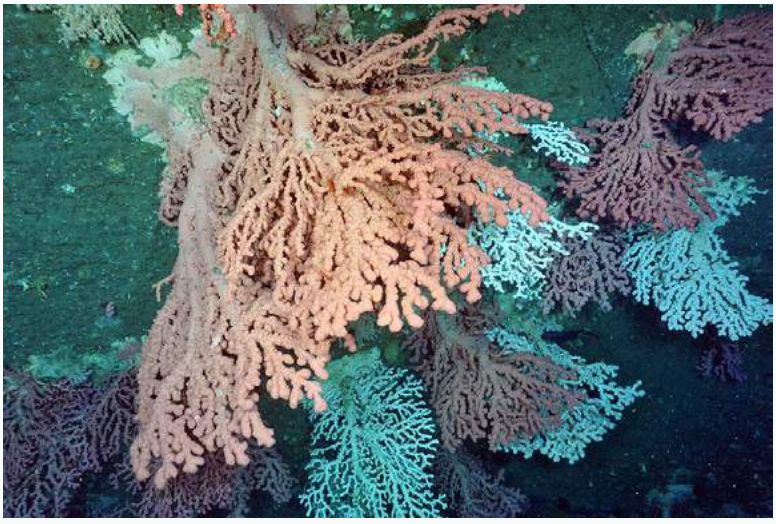

Image taken by CSSF remotely operated vehicle ROPOS. Chief Scientists: Anna Metaxas and Martha Nizinski

Issue Contents

Hot off the Press

Ecosystem function and services provided by the deep sea

Andrew Thurber, Andrew K. Sweetman, Bhavani E. Narayanaswamy, Daniel O. B. Jones, Jeroen Ingels and Roberta L. Hansman (July 2014)

Biogeosciences 11:3941-3963

The deep sea is often viewed as a vast, dark, remote, and inhospitable environment, yet the deep ocean and seafloor are crucial to our lives through the services that they provide. Our understanding of how the deep sea functions remains limited, but when treated synoptically, a diversity of supporting, provisioning, regulating and cultural services becomes apparent. The biological pump transports carbon from the atmosphere into deep-ocean water masses that are separated over prolonged periods, reducing the impact of anthropogenic carbon release. Microbial oxidation of methane keeps another potent greenhouse gas out of the atmosphere while trapping carbon in authigenic carbonates. Nutrient regeneration by all faunal size classes provides the elements necessary for fueling surface productivity and fisheries, and microbial processes detoxify a diversity of compounds. Each of these processes occur on a very small scale, yet considering the vast area over which they occur they become important for the global functioning of the ocean. The deep sea also provides a wealth of resources, including fish stocks, enormous bioprospecting potential, and elements and energy reserves that are currently being extracted and will be increasingly important in the near future. Society benefits from the intrigue and mystery, the strange life forms, and the great unknown that has acted as a muse for inspiration and imagination since near the beginning of civilization. While many functions occur on the scale of microns to meters and timescales up to years, the derived services that result are only useful after centuries of integrated activity. This vast dark habitat, which covers the majority of the globe, harbors processes that directly impact humans in a variety of ways; however, the same traits that differentiate it from terrestrial or shallow marine systems also result in a greater need for integrated spatial and temporal understanding as it experiences increased use by society. In this manuscript we aim to provide a foundation for informed conservation and management of the deep sea by summarizing the important role of the deep sea in society.

Link to the paper: http://www.biogeosciences.net/11/3941/2014/bg-11-3941-2014.html

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Deep-sea Fauna of European Seas:

An annotated species check-list of benthic invertebrates living deeper than 2000 m in the seas bordering Europe

Andrey Gebruk, Halmar Thiel and Michael Thurston (Editors) (2014)

Invertebrate Zoology 11 (1)

This thematic issue is a check-list of European deep-sea fauna has been generated as a follow-up of the joint German-Russian project “Regional patterns and biodiversity on the deep seafloor of European seas” (the Volkswagen Foundation grant 1/73638). Marine basins considered in this work include the central Arctic (up to the Bering Strait), the Greenland and Norwegian Seas, the Mediterranean Sea and the northeast Atlantic with the border along the

Mid-Atlantic Ridge in the west and along the 30°N parallel in the south.

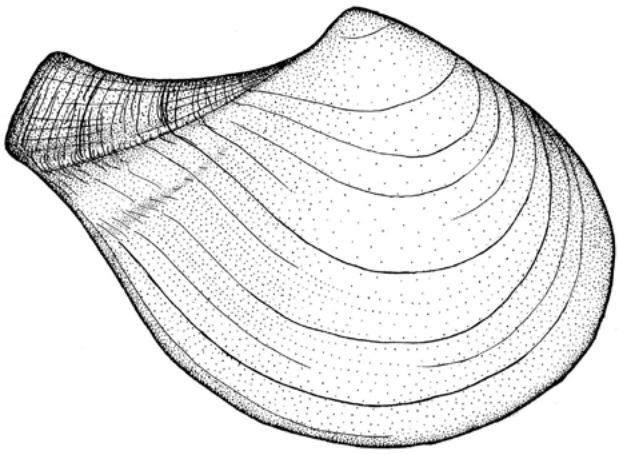


Figure 1: The bivalve Rhinoclama teres *(Jaffreys, 1882), representative of common in the abyssal family Cuspidariidae (from Krylova (1994)). The species features in the contribution to the thematic issue by Janssen and Krylova.*

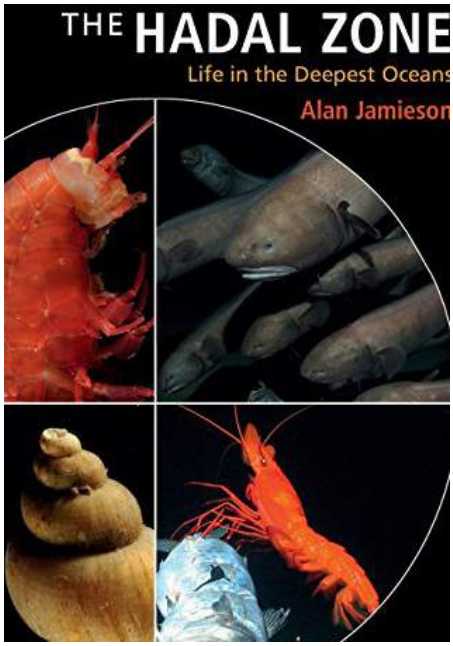
The check-list includes about 1300 species representing the following 23 larger taxa (listed in the alphabetic order): Anthipatharia, Aplacophora, Ascidiacea, Asteroidea, Bivalvia, Brachiopoda, Bryozoa, Ceriantharia, Cirripedia, Crinoidea, Echinoidea, Echiura, Gastropoda, Holothuroidea, Monoplacophora, Mysidacea, Ophiuroidea, Ostracoda, Polychaeta, Porifera, Pycnogonida, Scleractinia and Xenophyophorea. The selection of taxa is based mainly on the availability of experts involved in the mentioned project. All known localities (stations) at depths greater than 2000 m are given for each species (with some exceptions). In addition all corresponding stations sampled deeper than 2000 m are compiled in a separate list. Data on some stations (coordinates and depth) taken by "historical" expeditions vary in different early publications. In this case, for consistency we used modern station data sets of various museums and research centres (Musée Océanographique de Monaco, National Oceanography Centre, Southampton and Institut Français de la Recherche pour l'Exploitation de la Mer - IFREMER). Information given for each species, when available, includes synonymy, remarks on distribution outside European seas and depth range. Comments are also given for many genera, including the total number of species in the genus and its distribution. The check-list will complement such data sets as the the World register for deep-sea species (WORDDS: http://www.marinespecies.org/deepsea/) , the European Register of Marine Species (ERMS) (www.marbef.org/data/erms.php) and it can be incorporated into the Ocean Biogeographic Information System (OBIS) (www.iobis.org).

The Hadal Zone: Life in the Deepest Oceans

Alan Jamieson (Author) (2014)

Cambridge University Press (UK)

£40.98 (Kindle Edition), £45 (Hardcover)



The hadal zone represents one of the last great frontiers in marine science, accounting for 45% of the total ocean depth range. Despite very little research effort since the 1950s, the last ten years has seen a renaissance in hadal exploration, almost certainly as a result of technological advances that have made this otherwise largely inaccessible frontier, a viable subject for research. Providing an overview of the geology involved in trench formation, the hydrography and food supply, this book details all that is currently known about organisms at hadal depths and linkages to the better known abyssal and bathyal depths. New insights on how, where and what really survives and thrives in the deepest biozone are provided, allowing this region to be considered when dealing with sustainability and conservation issues in the marine environment.

A valuable resource for undergraduates, postgraduates and deep-sea researchers, this book offers a comprehensive account of life in the deepest

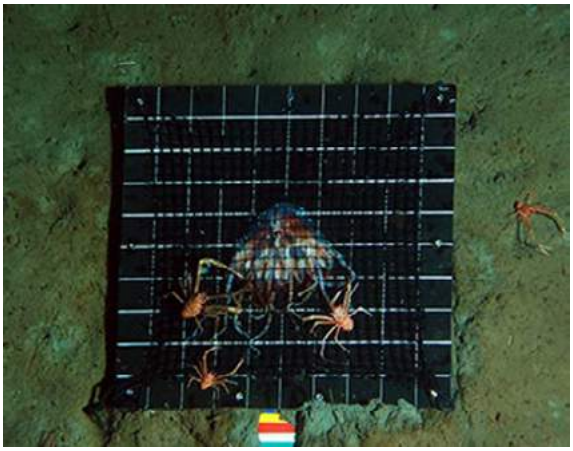
oceans and covers a breadth of topics from geology to ecology to illuminate this otherwise deep and dark area of science.

Link to book purchase: http://www.amazon.com/The-Hadal-Zone-Deepest-Oceans/dp/1107016746

Rapid scavenging of jellyfish carcasses reveals the importance of gelatinous material to deep-sea food webs

Andrew K. Sweetman, Craig R. Smith, Trine Dale and Daniel O. B. Jones (Oct 2014)

Proceedings of the Royal Society B 7 vol. 281: 1796 20142210



Jellyfish blooms are common in many oceans, and anthropogenic changes appear to have increased their magnitude in some regions. Although mass falls of jellyfish carcasses have been observed recently at the deep seafloor, the dense necrophage aggregations and rapid consumption rates typical for vertebrate carrion have not been documented. This has led to a paradigm of limited energy transfer to higher trophic levels at jelly falls relative to vertebrate organic falls. We show from baited camera deployments in the Norwegian deep sea that dense aggregations of deep-sea scavengers (more than 1000 animals at peak densities) can rapidly form at jellyfish baits and consume entire jellyfish carcasses in 2.5h. We also show that scavenging rates on jellyfish are not significantly different from fish carrion of similar mass, and reveal that scavenging communities typical for the NE Atlantic bathyal zone, including the Atlantic hagfish, galatheid crabs, decapod shrimp and lyssianasid amphipods, consume both types of carcasses. These rapid jellyfish carrion consumption rates suggest that the contribution of gelatinous material to organic fluxes may be seriously underestimated in some regions, because jelly falls may disappear much more rapidly than previously thought. Our results also demonstrate that the energy contained in gelatinous carrion can be efficiently incorporated into large numbers of deep-sea scavengers and food webs, lessening the expected impacts (e.g. smothering of the seafloor) of enhanced jellyfish production on deep-sea ecosystems and pelagic–benthic coupling.

Link to the paper: http://rspb.royalsocietypublishing.org/content/281/1796/20142210.abstract

You can see the videos here:

Fresh jellyfish: http://youtu.be/EEF6mIOM6C4

Thawed jellyfish: http://youtu.be/ws3P8cTFFeI

Lion's Mane jellyfish: http://youtu.be/_Dj3yOWcofw

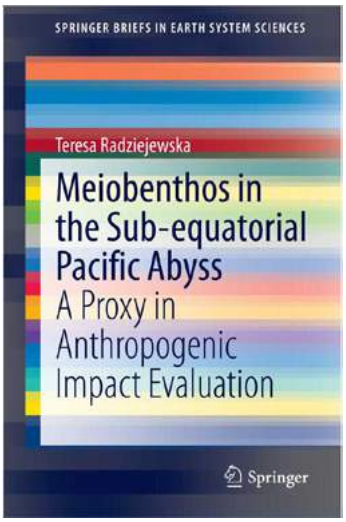
Mackerel: http://youtu.be/3qVJPTomC7Q

Meiobenthos in the sub-equatorial Pacific abyss: A Proxy in Anthropogenic Impact Evaluation

Teresa Radziejewska (Author) (Sept 2014)

Springer Briefs in Earth System Series

£34.62 (Paperback)



This book was intended to provide information on the status of knowledge of metazoan meiobenthos in a deep-sea area intended for commercial mining. Against the backdrop of the environmental setting of the subequatorial NE Pacific abyssal plain, the book characterises the meiobenthos as an ecological category in the deep sea and introduces research lines meiobenthic studies are applied to, including environmental assessments of human-induced disturbance of the deep seafloor. It proceeds to present an overview of the current knowledge on the meiobenthos of the area of concern and will discuss general considerations regarding the use of meiobenthos as indicator of seafloor disturbance. It addresses the question of deep-sea mineral resources development versus benthic communities and presents an overview of field studies ("experiments") aimed at assessing the magnitude of potential impact associated with seafloor resources development (polymetallic nodule mining in particular) in the Pacific.

Link to the book purchase: http://www.amazon.co.uk/Meiobenthos-Sub-Equatorial-Pacific-Abyss-SpringerBriefs/dp/3642414575

The effects of changing climate on faunal depth distributions determine winners and losers

Alastair Brown and Sven Thatje (July 2014)

Global Change Biology; doi:10.1111/gcb.12680

Changing climate is predicted to impact all depths of the global oceans, yet projections of range shifts in marine faunal distributions in response to changing climate seldom evaluate potential shifts in depth distribution. Marine ectotherms' thermal tolerance is limited by their ability to maintain aerobic metabolism (oxygen- and capacity-limited tolerance), and is functionally associated with their hypoxia tolerance. Shallow-water (<200 m depth) marine invertebrates and fishes demonstrate limited tolerance of increasing hydrostatic pressure (pressure exerted by the overlying mass of water), and hyperbaric (increased pressure) tolerance is proposed to depend on the ability to maintain aerobic metabolism, too. Here, we report significant correlation between the hypoxia thresholds and the hyperbaric thresholds of taxonomic groups of shallow-water fauna, suggesting that pressure tolerance is indeed oxygen limited. Consequently, it appears that the combined effects of temperature, pressure and oxygen concentration constrain the fundamental ecological niches (FENs) of marine invertebrates and fishes. Including depth in a conceptual model of oxygen- and capacity-limited FENs' responses to ocean warming and deoxygenation confirms previous predictions made based solely on consideration of the latitudinal effects of ocean warming (e.g. Cheung et al., 2009), that polar taxa are most vulnerable to the effects of climate change, with Arctic fauna experiencing the greatest FEN contraction. In contrast, the inclusion of depth in the conceptual model reveals for the first time that temperate fauna as well as

tropical fauna may experience substantial FEN expansion with ocean warming and deoxygenation, rather than FEN maintenance or contraction suggested by solely considering latitudinal range shifts.

Link to paper: http://onlinelibrary.wiley.com/doi/10.1111/gcb.12680/pdf

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Carbonate-hosted methanotrophy represents an unrecognized methane sink in the deep sea

Jeffrey J. Marlow, Joshua A. Steele, Wiebke Ziebis, Andrew R. Thurber, Lisa A. Levin and Victoria J. Orphan (Oct 2014)

Nature Communications, Volume:5, 5094

The atmospheric flux of methane from the oceans is largely mitigated through microbially mediated sulphate-coupled methane oxidation, resulting in the precipitation of authigenic carbonates. Deep-sea carbonates are common around active and palaeo-methane seepage, and have primarily been viewed as passive recorders of methane oxidation; their role as active and unique microbial habitats capable of continued methane consumption has not been examined. Here we show that seep-associated carbonates harbour active microbial communities, serving as dynamic methane sinks. Microbial aggregate abundance within the carbonate interior exceeds that of seep sediments, and molecular diversity surveys reveal methanotrophic communities within protolithic nodules and well-lithified carbonate pavements. Aggregations of microbial cells within the carbonate matrix actively oxidize methane as indicated by stable isotope FISH–nanoSIMS experiments and $^{14}CH_4$ radiotracer rate measurements. Carbonate-hosted methanotrophy extends the known ecological niche of these important methane consumers and represents a previously unrecognized methane sink that warrants consideration in global methane budgets.

Link to paper: http://www.nature.com/ncomms/2014/141014/ncomms6094/full/ncomms6094.html

Valuing the Deep: Marine Genetic Resources in Areas Beyond National Jurisdiction

Oldham, P; Hall, S; Barnes, C; Oldham, C; Cutter, AM; Burns, N and Kindness, L (2014)

Defra Contract MB0128 Final Report Version One. London: Defra.

The main objective of this UK Valuing the Deep project was to inform UK and wider European and international policy debates on the need for an implementing agreement on the conservation and sustainable use of marine biodiversity in Areas Beyond National Jurisdiction under UNCLOS and, specifically, the possible inclusion of an access and benefit-sharing mechanism for marine genetic resources. The results of the research are also relevant to the programme of work on marine biodiversity under the United Nations Convention on Biological Diversity, regional agreements and the work of the World Intellectual Property Organisation.

This project consisted of four main components:

1. Quantitative analysis and mapping of the scientific literature on the deep sea;

2. Quantitative analysis of patent data on marine genetic resources from the deep sea;

3. An expert Delphi study consultation to examine scientific and stakeholder perspectives on an implementing

agreement on the conservation and sustainable use of marine biodiversity and access and benefit-sharing in Areas Beyond National Jurisdiction (ABNJ);

4. A review of the literature on the actual and potential market value of marine genetic resources with a focus on marketed products.

Link to full report pdf: http://tinyurl.com/valuingthedeep

In Vitro Interaction of Emerging Contaminants with the Cytochrome P450 System of Mediterranean Deep-Sea Fish

Carla Ribalta and Montserrat Solé (Sept 2014)

Environmental Science & Technology 48: 12327–12335

The interactions of emerging contaminants with the xenobiotic and endogenous metabolizing system of deep-sea fish were compared. The drugs diclofenac, fluoxetine, and gemfibrozil belong to different pharmaceutical classes with diverse mechanistic actions, and the personal care products triclosan, galaxolide, and nonylphenol are representative of antibacterial agents, nitro-musks, and surfactants, respectively. The fish compared are representative of the middle and lower slope of deep-sea habitats. The species were adults of *Trachyrynchus scabrus, Mora moro, Cataetix laticeps,* and *Alepocehalus rostratus*. The hepatic metabolic system studied were the activities associated with several cytochrome P450 isoforms (CYPs): 7-ethoxyresorufin-O-deethylase (EROD), benzyloxy-4-[trifluoromethyl]-coumarin-O-debenzyloxylase (BFCOD), and 7-ethoxycoumarin-O-deethylase (ECOD). Results showed differences in baseline activities and sensitivity to chemicals which were species, chemical, and pathway dependent. *T. scabrous* was the most sensitive species to chemical interactions with the xenobiotic and endogenous metabolizing (EROD and BFCOD) systems, especially in the case of diclofenac interference with BFCOD activity (IC50 = 15.7 ± 2.2 μM). Moreover, *T. scabrous* and *A. rostratus* possessed high basal ECOD activity, and this was greatly affected by in vitro exposure to diclofenac in *T. scabrous* also (IC50 = 6.86 ± 1.4 μM). These results highlight the sensitivity of marine fish to emerging contaminants and propose *T. scabrous* (middle slope) and *A. rostratus* (lower slope) as sentinels and the inclusion of ECOD activity as a sensitive biomarker to these exposures.

Link to the paper: http://pubs.acs.org/doi/abs/10.1021/es5029603

Comparative characteristic of sablefish *Anoplopoma fimbria* in catches with passive and active fishing gear in the northwestern Pacific Ocean

Afanasyev, P.K., Orlov, A.M. and Novikov, R.N. (April 2014)

Journal of ichthyology, 54: 146-164

According to materials of trap, long-line, and trawl fishing, specific features of distribution of sablefish *Anoplopoma fimbria* and some of its biological characteristics in Pacific waters off the southeastern coast of Kamchatka, continental slope of the western part of the Bering Sea, Shirshov Underwater Ridge, and off the Commander Islands are considered. Maximum density concentrations according to data of trap fishing was noted along southeastern coast of Kamchatka and the data of trawl fishing indicated most frequent catches in the western part of the Bering Sea in the area of Koryak coast up to Cape Navarin. The pattern of vertical distribution in different areas considerably

differs. The magnitude of trap catches in different areas is different and determined by the type of trap and the period of soaking. The size composition, fatness, and the sex ratio are different in catches of different fishing gear and differ between regions. On the whole, in Russian Far Eastern waters, females mature in mass at a body length of 71 cm and males at 57 cm.

Link to paper: http://link.springer.com/article/10.1134/S0032945214010019

New data on rare deep-water Mid-Atlantic skate *Rajella kukujevi* (Rajidae)

Orlov, A.M. (July 2014)

Journal of Ichthyology, 54: 317-337

The most complete description and variations of morphometric and meristic characters and coloration of rare deep-water Mid-Atlantic skate *Rajella kukujevi* based on study of all accessible materials are presented. The analyzed relationships between the total length and external morphological characters have a linear pattern. According to several morphological characters, differences between individuals of different length and sex, as well as between individuals caught in different areas of the northern Atlantic were revealed. It was shown that the overwhelming majority of individuals have a light type of coloration, while ashen and dark types occur more rarely. All three types of coloration (except for rare exceptions) are characterized by a dark color of dorsal fins. New data on the range, vertical distribution, and sizes of Mid-Atlantic skate are presented.

Link to paper: http://link.springer.com/article/10.1134/S0032945214030102

Rhythmic behaviour of marine benthopelagic species and the synchronous dynamics of benthic communities

Aguzzi J., Sbragaglia V., Tecchio S., Navarro J. and Company J.B. (Oct 2014)

Deep-Sea Research I, IN PRESS

Light-intensity cycles drive the relentless motion of species in the oceans and water column migrants may cyclically make contact with the seabed, hence influencing the temporal dynamism of benthic ecosystems. Here, we focussed on the occurrence of day-night changes in benthic communities on the western Mediterranean continental shelf (100 m depth) and slope (400 m depth), as a potential result of a behaviourally sustained benthopelagic coupling. We analysed fluctuations in species abundance based on trawling at hourly intervals over a 4-day period as a proxy of activity rhythms at the seabed. We also measured light in situ to assess how the depth-related decrease of its intensity influences species rhythm benthopelagic synchronisation.

Temporal similarities in the catch patterns for different species were screened by dendrogram analysis. On the continental shelf, species performing diel migrations (i.e., over a 24-h period) that were either vertical (i.e., benthopelagic) or horizontal across depths (i.e., nektobenthic) clustered together separately from the more sedentary endobenthic and epibenthic species. At the same depth, waveform analysis showed a significant diurnal increase in the catch of water column species and benthic species at night. Such coupling was absent on the continental slope

where light intensity was several orders of magnitude lower than that on the shelf. Our data indicate that diel activity rhythms, which are well known for vertical pelagic migrators, are also evident in the benthos.

Link to paper: http://www.sciencedirect.com/science/article/pii/S0967063714001861

Whales as marine ecosystem engineers

Joe Roman, James A. Estes, Lyne Morissette, Craig Smith, Daniel Costa, James McCarthy, JB Nation, Stephen Nicol, Andrew Pershing and Victor Smetacek (Sept 2014)

Frontiers in Ecology and the Environment 12: 377–385

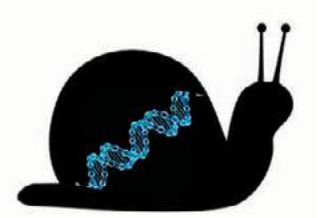
Baleen and sperm whales, known collectively as the great whales, include the largest animals in the history of life on Earth. With high metabolic demands and large populations, whales probably had a strong influence on marine ecosystems before the advent of industrial whaling: as consumers of fish and invertebrates; as prey to other large-bodied predators; as reservoirs of and vertical and horizontal vectors for nutrients; and as detrital sources of energy and habitat in the deep sea. The decline in great whale numbers, estimated to be at least 66% and perhaps as high as 90%, has likely altered the structure and function of the oceans, but recovery is possible and in many cases is already underway. Future changes in the structure and function of the world's oceans can be expected with the restoration of great whale populations.

Link to the paper: http://www.esajournals.org/doi/abs/10.1890/130220

Molecular taxonomy and naming of five cryptic species of *Alviniconcha* snails (Gastropoda: Abyssochrysoidea) from hydrothermal vents

Shannon B. Johnson, Anders Warén, Verena Tunnicliffe, Cindy Van Dover, C. Geoffrey Wheat, Thomas F. Schultz, and Robert C. Vrijenhoek (2015)

Systematics and Biodiversity. In Press



Large symbiont-hosting snails of the genus *Alviniconcha* (Gastropoda: Abyssochrysidae) are among the dominant and conspicuous inhabitants of hydrothermal vent chimneys in the Western Pacific and Indian oceans. The genus was originally described as monotypic, but unique DNA sequences for mitochondrial genes revealed six distinct evolutionary lineages that we could not distinguish based on external morphology. Subsumed under the name *Alviniconcha hessleri* Okutani & Ohta, the distinct allopatric and sympatric lineages have been assigned placeholder epithets that complicate scientific communications. Based on the present multi-gene sequence data, we hereby describe five *Alviniconcha* species. Thus, we restrict application of the name *A. hessleri* to specimens that are genetically similar (≥95% for COI) to those found at localities in the Mariana Trough. Single distinct *Alviniconcha* species inhabit vent fields along the Central Indian

Figure 1: Images of new Alviniconcha species holotypes.

Ridge, the Mariana volcanic arc, and the Mariana back-arc basin, whereas vents in the Manus, Fiji, and Lau back-arc basins may host two or three additional species. Formal recognition of these species facilitates future attempts to assess their physiological differences and symbiont associations. Furthermore, their reported distributions have significant biogeographic implications, affecting estimates of the diversity within and overlap among Indo-Pacific vent localities.

Link to paper here (available shortly): doi:10.1080/14772000.2014.970673

Three new American species of *Munidopsis* (Crustacea: Anomura: Munidopsidae)

Gary Poore (2014)

Collections of squat lobsters in museums in the USA and Brazil were surveyed as a contribution to Museum Victoria's Mapping the World's Oceans project (part of INDEEP WG2 initiative). Several specimens belonging to three new species of Munidopsis were uncovered and described - *M. amapa* and *M. brasilia* from Brazil, and *M. bajacalifornia* from California and the Galápagos Islands). All are small, superficially similar to each other and from shallower depths than is typical of most of the genus. All species have a highly sculptured carapace, triangular rostrum and immovable eyestalks with prominent anterior eyespines.

Link to paper: http://www.scielo.br/scielo.php?pid=S0104-64972014000100006&script=sci_arttext

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A new species of *Naxia latreille*, 1825 (Brachyura: Majidae) from deep water off Brazil

M Tavares & G C Poore (2014)

Zootaxa 11 (3861): 86-90

A new species of spider crab, Naxia atlantica n. sp., is described and illustrated from deep waters off São Paulo (southeastern Brazil). The new species can be separated from its congeners by a suite of characters including shapes of the propodi of the walking legs, rostrum and basal antennal article. This is the first record of the genus outside southern Australia and New Zealand.

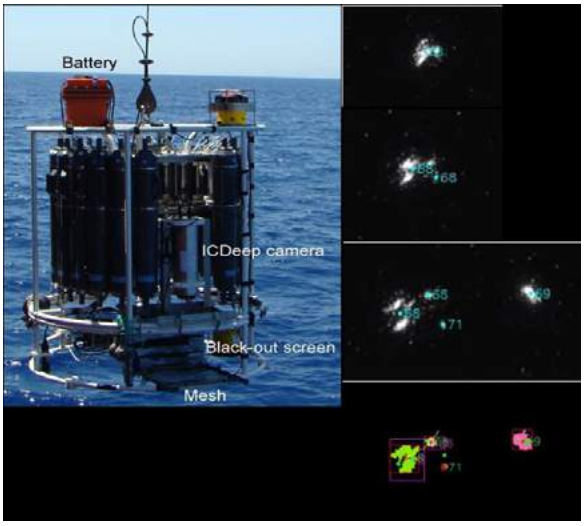
Link to paper: http://biotaxa.org/Zootaxa/article/view/zootaxa.3861.1.5

Automated video imaging for counting bioluminescent organisms

Aguzzi Jacopo, Marini Simone, Craig Jessica, Fanelli Emanuela, Mazzei Luca and Priede Imants G. (Aug 2014)

Computer Vision for Analysis of Underwater Imagery (CVAUI) Workshop Proceedings

Bioluminescence refers to the production of ecologically functional light by living organisms. It is widespread in the marine environment, where it occurs in a broad range of phyla. The deep pelagic ocean is the largest biome on Earth and is chronically under-sampled. Underwater camera systems offer a rapid sampling method for this zone. The ICDeep (Image Intensified Charge Coupled Device for Deep-sea research) profiler is usually used to record digital video of bioluminescent organisms through the deep-water column (fig. 1). In recent years, researchers from ICM-CSIC (studying diel vertical benthopelagic displacements),



Oceanlab-University of Aberdeen (studying the ecology of bioluminescence), ENEA (studying benthopelagic trophic food webs), and finally CNR (aiming to increase video-automation processing efficiency) joined together in order to build a new computer vision algorithm for the automatic detection and counting of bioluminescent flashes (fig. 1). The proposed method is showing good levels of recognition and tracking efficiency and it has been validated by manually analyzed sequences. Over the next few months, this algorithm will be used to automatically quantify the abundance of bioluminescent organisms in stored video material from Atlantic and Mediterranean surveys, conducted over the past five years. Our objective will be to estimate the abundance of different groups of pelagic bioluminescent organisms within the water column, based on the different morphological characteristic of their flashes.

Figure 1. ICDeep camera (left) and examples of image processing of consecutive frames (right; depth and hence time axis increase from above to below), where light blobs of complex shape appear and require to be tracked in order to avoid re-counting.

*Source: Mazzei L., Marini S., Craig J., Aguzzi J., Fanelli E., Priede I.G. (in press). Automated video imaging system for counting deep-sea bioluminescence organisms events. Computer Vision for Analysis of Underwater Imagery (CVAUI) Workshop Proceedings (*http://cvaui.oceannetworks.ca/*)*

Cruise News

Exploring the seafloor from land

Alex Stote

Harvard University, USA

In September-October 2014, marine biology student-author Alex Stote participated "virtually" in a cruise via Telepresence as part of an NSF-INSPIRE project that sought to investigate the methods by which Telepresence can be used to facilitate deep-ocean research and education (*www.whoi.edu/treet*). While the Ocean Exploration Trust's E/V Nautilus was stationed in the SE Caribbean, a science team ashore directed the majority of the research that was conducted, using the Inner Space Center at the University of Rhode Island as their hub, and a second site at Woods Hole Oceanography Institute. Here is Alex's account of the cruise:

I never imagined that my first deep-sea research cruise would be a virtual one. Prior to my involvement, I was unaware that virtual participation was a viable method for scientific research. The 'virtual' aspect seemed like a major roadblock to the scientific process itself, and I was skeptical that I could obtain any valuable data from a deep-sea cruise if I was stationed ashore.

My preconceptions were challenged immediately upon my arrival at the Inner Space Center (ISC) at the University of Rhode Island. When I first entered the 'control van', high-definition videos— live from the seafloor— met my eyes with astounding clarity. In synchronization with the video feeds, I could hear the voices of scientists and engineers at sea communicating their survey plans, in real time, with the investigators on shore. A high-tech intercommunication system between ship and shore allows for these types of direct interactions between investigators on shore and the science team operating the ROV and instruments at sea.

Commands from shore to ship rotated among the principle investigators stationed at the ISC, each of whom led a unique project that required different data sets. While my interests lay primarily with assessing biological diversity at cold seep sites, fellow students and scientists were studying a breadth of physico-chemical processes, from mapping fluid flow at vent sites to tracking gaseous emissions within craters, to understanding the magnetic patterns and geological processes that made up the

Figure 1 (top): Student-scientist Alex Stote and TREET Project Lead PI Prof. Chris German give a virtual tour from the "control van" of the Inner Space Center to Dr. Cindy Van Dover's "Marine Invertebtrates" students at Duke University via Skype. Photo by Ken Kostel; Copyright Woods Hole Oceanographic Institution; Figure 2 (middle): These mussels, Bathymodiolus *sp., were commonly found in dense aggregations at the cold seep sites explored by the E/V Nautilus during a cruise earlier this fall. Copyright Ocean Exploration Trust. Figure 3 (bottom): Several cold seep sites hosted extensive biological communities, such as the site depicted here, later termed SeepC. Copyright Ocean Exploration Trust.*

seafloor itself. The scientists, engineers, and navigators on the ship were equipped to accommodate all individual needs of the scientists ashore, and as a result of the technologies at the ISC, we scientists ashore were able to collaborate with the team at sea to collect the data we needed for our various investigations.

Specifically, my research goal for this cruise was to locate biologically diverse communities at cold seep sites that are located near underwater volcanoes in the Caribbean Sea. Once we had located sites of interest, I needed to collect high-resolution images and conduct ROV-based bathymetric mapping of the sites so that I could examine variations in faunal distribution patterns among and between cold seep sites. From the ISC, I was able to locate several seep sites using the live video feed and navigation data. The ROV operations team aboard the ship was then able to map and photograph those exact areas, providing me with data needed to complete my research objectives.

An obvious success of this cruise was the collection of data that will provide an opportunity to better understand the ecology of these enigmatic communities, but an unexpected success, owed to the virtual dimension, was the convergence of multiple scientific disciplines in one space. Remote participation in the cruise via Telepresence allowed for several scientific teams with varying specialties to collect their data during a single cruise. The multidisciplinary environment not only enhanced the scientific approach to my own research, but also strengthened my aspirations as a budding scientist and explorer.

Not bad for a first 'cruise,' if you ask me.

Author Alexandra Stote can be reached at astote@post.harvard.edu

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Exploring deep benthic communities of Rapa Nui (Easter Island)

Erin E. Easton[1], Carlos F. Gaymer[2], Javier Sellanes[2], Matthias Gorny[3] and the ESMOI science team

[1]Florida State University, USA, [2]Universidad Católica del Norte, Chile, [3]Oceana, Chile

In October 2014, the Ecological and Sustainable Management of Oceanic Islands (ESMOI) had its first expedition to explore the deep, benthic communities of Rapa Nui as part of their primary goal to provide the scientific basis needed to strengthen a sustainable management and biodiversity conservation strategy for the Easter Island ecoregion (including Rapa Nui and Salas & Gómez). Rapa Nui is ~400 km from the nearest island (Salas and Gómez, uninhabited), ~ 2000 km from the nearest inhabited island (Pitcairn), and ~3500 km from the nearest continental land and is considered the most remote inhabited island. It harbors a relatively high marine biomass and diversity; however, these biological resources are being severely impacted by tourism fishing, and climate change. Due to limited studies in this region, we know little about its deep communities and the degree of connectivity within the Easter Island ecoregion and adjacent ecoregions.

Figure 1: Mariscope Comander MKII workclass ROV and the Chilean Navy vessel LSR Tokerau.

On this first expedition, we focused on studying the faunal communities of the Apolo fishing grounds, which are above a subsurface, secondary peak of Easter Island. We deployed moorings to collect data on the physical conditions and collected water samples to determine the nutrient content and to study the microbial, phytoplankton and zooplankton communities. We partnered with OCEANA Chile to investigate the benthic communities, down to 500 m, with a ROV (Figure 1) deployed from the Chilean Navy vessel LSR Tokerau. Video transects from Apolo revealed an abundance of encrusting sponges and

crustose coralline algal to depths nearing 300 m. At times, the rocky substrate was covered in a patchwork of vibrant green and pink algae and sponges and a field of whip corals. We also observed several species of fish that have been poorly or never reported for this region; for example, we obtained video footage of *Antigonia capros* Lowe, 1843 at Easter Island (Figure 2), which was only documented at Easter Island from photographs of two specimens caught, but not saved, by fishermen.

*Figure 2. Deep body Boarfish (*Antigonia capros Lowe*, 1843) at 280 m depth.*

The Easter Island ecoregion may harbor greater biodiversity than previously reported and we look forward to what we will discover with further exploration of deeper seamounts in the Easter Island ecoregion, with planned cruises on the new Chilean research vessel, AGS-61 Cabo de Hornos.

For more information, visit http://www.esmoi.cl/ or contact Carlos F. Gaymer (cgaymer@ucn.cl), Javier Sellanes (sellanes@ucn.cl), or Erin E. Easton (eee04c@my.fsu.edu). The science team on this expedition was Matthias Gorny of OCEANA, Enrique Hay of Rapa Nui, and Carlos Gaymer, Javier Sellanes, Beatriz Yannicelli, Marcel Ramos, Erin Easton, German Zapata, Carlos Varela, and Maria Valladares of ESMOI.

Macrophyte beds fuel deep-sea communities – a pilot study

Eva Ramirez-Llodra[1], Kjell Magnus Nordenghaug[1], Eli Rinde[1], Hartvig Christie[1], Camilla With Fagerli[1], Stein Fredriksen[2], Janne Kim Gitmark[1], Hege Gundersen[1], Karl Norling[1] and Mats Gunnar Walday[1]

[1]Norwegian Institute for Water Research, NIVA, Norway; [2]University of Oslo, Norway

In May 2014, NIVA's Time-Lapse Camera (TLC) was deployed in the outer Oslo fjord, in an area protected from fisheries in the Ytre Hvaler National Park in Southern Norway, to obtain initial insight on the trophic relationship between kelp debris and the deep benthic megafauna, with a particular interest in the commercially fished shrimp *Pandalus borealis*. A recent study suggests that less than 10% of the production in Norwegian kelp forests is consumed within the forest, with 80% lost from kelp systems and exported to shallow- and deep-water systems (Norderhaug et al., 2011). The TLC was deployed to the deep seafloor (430 m) with decaying *Fucus* sp., *Saccharina latissima* and *Laminaria hyperborea* on the bait plate (Figure 1). One photograph was taken every 3 minutes over a 40 hour period. The shrimp *Pandaulus borealis* and un-identified amphipods were attracted to the macrohytes. Shrimp arrived on the bait plate straight away and we observed a higher abundance over the macrophyte areas compared to the adjacent sediment, suggesting some kind of feeding activity. The amphipods arrived 13 hours after deployment and their abundance increased to reach a peak of approximately 600 individuals 30 h after deployment, with a clear preference

Figure 1: TLC bait plate with three species of decaying macrophytes prior to deployment.

for *L. hyperborea* (Figure 2). No amphipods we
being analysed and will be submitted for publica

The results of this pilot study suggest that kelp f
in the Oslo fjord, including commercial species such as *P. borealis*. However, further studies are necessary to confirm the trophic relationship between the crustaceans and the macrophyte debris and the implications that changes on the kelp forest, for example through climate change, may have on the deep-sea benthic communities.

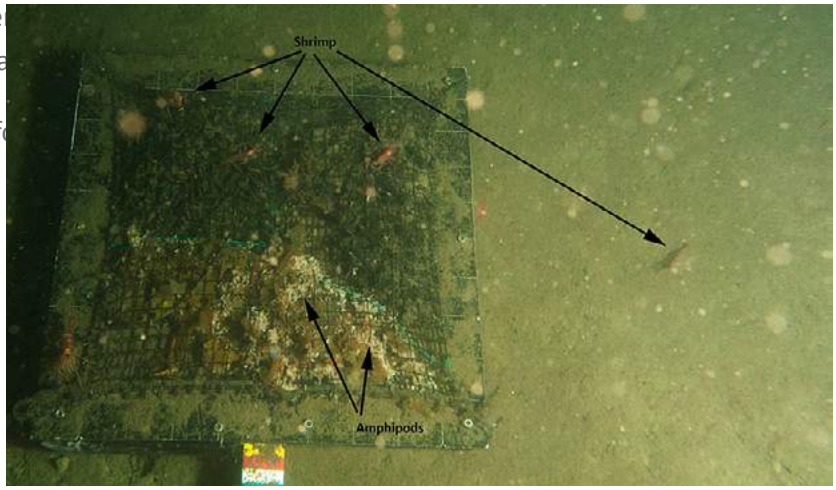

Figure 2. The TLC bait plate on the seafloor after 32 hours of deployment, showing high abundances of amphipods on L. hyperborea *and several shrimp on the bait plate and one on the adjacent sediment.*

Deep-water coral research and conservation crossing the border

Dr Anna Metaxas and Dr Martha Nizinski

Dalhousie University, Canada & NOAA/NMFS Systematics Laboratory, USA

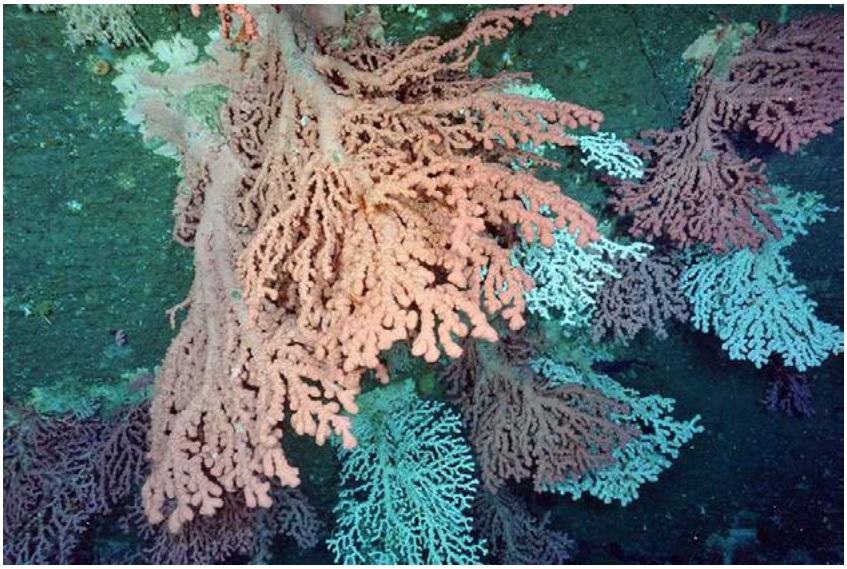

Figure 1: Coral colonies in Corsair Canyon, Canada. Image taken by CSSF remotely operated vehicle ROPOS. Chief Scientists: Anna Metaxas and Martha Nizinski

For more than a decade, Canadian and US scientists have been doing research on deep-water corals in the Gulf of Maine and nearby canyons. The efforts of any one group have been constrained to either, but not both, sides of the USA-Canada border. Our cruise last summer changed that. Martha Nizinski (NOAA/NMFS Systematics Laboratory, USA) and Anna Metaxas (Dalhousie University, Canada) co-led a cruise on the NOAA Vessel Henry Bigelow with the remotely operated vehicle ROPOS. Collaborators included, from the USA, Brian Kinlan (NOAA) and Tim Shank (WHOI), and, from Canada, Paul Snelgrove and Suzanne Dufour (Memorial University), and Peter Lawton (Fisheries and Oceans, Canada). We explored Nygren, Heezen and an unnamed canyon in between in US waters, and Corsair Canyon and the Northeast Channel Coral Conservation Area in Canadian waters. Last stop was at Jordan Basin (Gulf of Maine), shared by the two countries as were our dives (actually crossing the border with the ROV). We will determine the distribution, abundance, diversity, size, growth rate, genetics, and reproduction of deep-water corals. We discovered coral colonies in the canyons, particularly of the bubble gum coral *Paragorgia arborea*, spectacular in size and density. A most exciting outcome is capturing the attention of ocean managers in Canada, who will use our data directly to better inform the design of Marine Protected Areas and the assignment of Sensitive Benthic Areas in the Atlantic Maritime region. For some spectacular images, check out our Twitter feeds at @_AMeta (Jun 17 – Jun 30).

The other, other CO_2 problem: the rapid accumulation of CO_2 in the cold room on the R/V Atlantis

Samuel Georgian[1], Jay Lunden[2] and Erik Cordes[1]

[1]Temple University, USA; [2]University of California, Santa Barbara, USA

Everything was ready to go. Our experimental tanks were set up in the cold room on the R/V Atlantis, and we had carefully retrieved live coral colonies from 500 m. Only one detail was off: the pH in our tanks had plummeted from 8.1 to 7.3 in the space of an hour. The cause – us! Humans exhale about two pounds of CO_2 a day – which can quickly become an issue in a small enclosed space without outside air exchange – like the cold rooms on many ships. To confirm our suspicions, we borrowed a few of the CO_2 sensors that the DSV Alvin group uses to make sure that concentrations in the manned submersible stay within the safe zone, and found that the CO_2 concentration in the ship's cold room was over 1000 ppm - an increase of more than 600 ppm from normal atmospheric levels. A quick calculation revealed that a single researcher is capable of exchanging the entire air supply in a small cold room in just an hour, resulting in the rapid accumulation of CO_2. What happens next is essentially ocean acidification on small scale – the excess CO_2 rapidly dissolved into our tank water with the help of our aquarium air pumps, resulting in a decrease in pH far beyond what ocean acidification is expected to cause over the next 100 years. Keeping the cold room door open while we were working inside helped, but CO_2 levels continued to climb (albeit at a slower pace), and the room had trouble maintaining temperature. In the end, we sealed all of our tanks with plastic sheeting to prevent air exchange, and MacGyvered a makeshift CO_2 scrubber using excess calcium-hydroxide from the Alvin group. As long as we limited our time spent working in the cold room, this allowed us to maintain the pH in our tanks at near-normal levels. Any researchers conducting pH or pCO_2 sensitive work (whether it be experimental tanks, sediment cores, mixing solutions, storing samples, etc.) should be aware of the size and circulation system of the space they are working in, and take necessary precautions to monitor and prevent or counter the accumulation of CO_2, which may severely impact their results.

Figure 1: A handheld CO2 sensor, typically used to ensure safe levels during submerisble dives, is used to measure rising CO2 in the cold room on the R/V Atlantis.

Re-discovery of cold water corals in the Eastern Ligurian Sea (NW Mediterranean)

Fanelli E.[1]*, Delbono I.[1], Peirano A.[1], Ivaldi R.[2], Pratellesi M.[3], Niccolini A.[4], Dialti L. [2], Pellegrini M.[5], Cocito S.[1] and Delfanti R.[1]

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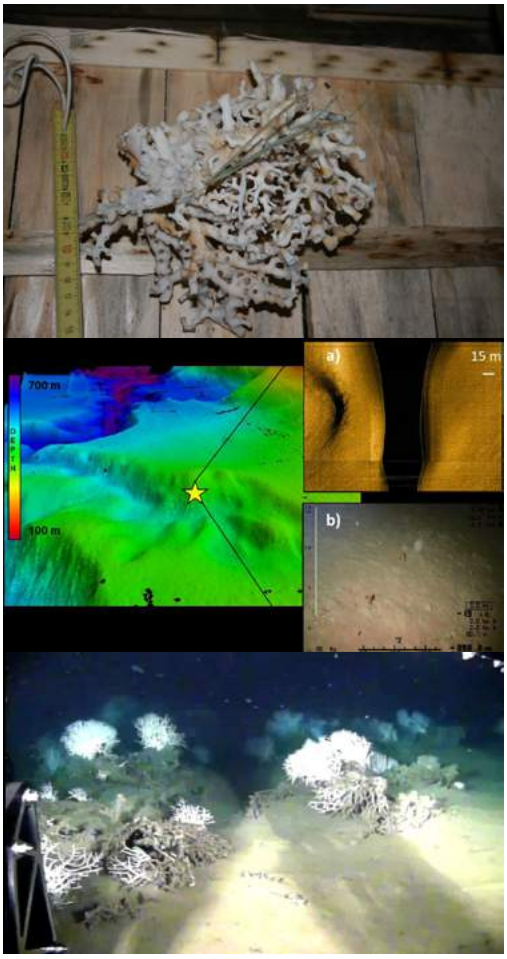
Several colonies of the cold water coral *Madrepora oculata* (Linnaeus 1758) were found on the flanks of the Levante canyon (Eastern Ligurian Sea, NW Mediterranean) in July 2014. In the area, the occurrence of *Lophelia pertusa*



(Linnaeus, 1758) were reported by Rossi (1958) and *M. oculata* banks were mapped by Fusco (1967), at 200-500 m of depth, but no recent indication exists on the presence of living Cold Water Corals (CWC). Still, some surveys carried out near Portofino in 1994 indicated the occurrence of small, sparse branches of living *M. oculata* (Tunesi & Diviacco, 1997) between 210 and 561 m depth. The increase of intense trawl-fishing in the last 50 years raised serious concerns on the existence and health status of CWCs in the Eastern Ligurian Sea. However, in the last few years, local fishermen had accidentally caught coral branches in different sites of the Levante canyon (Figure 1).

First geophysical results, seabed mapping based on high resolution hydrographic data (Delbono et al., 2014; Pratellesi et al., 2014), and ROV surveys carried out between October 2013 and July 2014 by the Italian Navy and the Marine Environment Research Centre of ENEA, proved evidence of the existence of living and extended coral banks in the area. "Historical" colonies found by Rossi (1958) and Fusco (1967) at around 400 m have been seriously damaged by trawl fishery (Figure 2), but deeper healthy CWCs still exist throughout the whole Levante canyon and afferent channels as documented by our preliminary surveys (Figure 3). Future investigations will be devoted to map CWC habitats in the Levante canyon and evaluate degree and type of impact on CWC banks.

Figure 1 (top): Coral branch collected by a trawl-fisherman close to the Levante canyon in December 2013.
Figure 2 (middle) Detail of bathymetric map (multi beam data), from the westernmost upper channel down to the deepest part of the Levante Canyon: a) side scan sonar image (star) showing hard bottom with mixed nature, mound (star: dead colonies of CWC) and tracks of trawl-fishing; b) ROV image of dead colonies in one of the "historical" CWC bank at 398 m of depth.
Figure 3 (bottom): Living colonies of Madrepora oculata *found at 560 m of depth in the Levante canyon.*

***References**: Delbono I., Ivaldi R., Pratellesi M. et al. (2014). Geophys. Res. Abstracts 16, EGU2014-14732; Fusco N. (1967). Ministero Marina Mercantile Carta di Pesca n. 6; Pratellesi M., Ivaldi R., Delbono I. (2014). Hydro International, 18 (7), 26-29; Rossi L. (1958). Ann. Mus. Civ. Storia Naturale G. Doria vol II (92), 1-13; Tunesi L., Diviacco G. (1997). Atti XII AIOL Genoa 1, 61–74.*

Vema-TRANSIT – The first expedition of the new RV SONNE

Torben Riehl and Angelika Brandt

Universität Hamburg, Centrum für Naturkunde (CeNak), Zoologisches Museum, Martin-Luther-King-Platz 3, 20146 Hamburg, Germany

The abyssal deep-sea plains at 3000–6000 m depth account for roughly 60% of our planet's surface. Yet, these are scarcely studied and even more so the still deeper hadal trenches. We know little about life at the deep ocean floor and about how hydrosphere, biosphere and lithosphere interact in this vast realm. The Vema Fracture Zone and the Puerto Rico Trench are two features of the Atlantic deep ocean that are outstanding. These two areas are targeted to be intensively studied during the forthcoming virgin expedition of the new German deep-sea research vessel SONNE (see pages 33-34 for specifications on the new ship).

The Mid-Atlantic Ridge (MAR) is the longest mountain chain on Earth and it is characterized by multiple major fractures along its north–south extend. The Vema Fracture Zone at 10° N is amongst the largest of these fractures and is comprised of a left-lateral offset of the MAR. This area is tectonically active since the initial opening of the Atlantic around 130 mya. Consequently, the region features ocean-bottom and faunal succession at all stages potentially resulting in great diversity. Geothermal habitats can be expected to occur in this region. But at the same time, the transform may provide a connection through which the faunas east and west of the MAR may maintain exchange across the MAR which is otherwise considered a barrier to bottom dwellers which lack extensive swimming capabilities.

Figure 1. Approximate cruise track of the Vema-TRANSIT expedition. Start: Las Palmas, Canary Islands, Spain. Study areas: Vema-Transform (Vema Fracture Zone) and Puerto Rico Trench. Destination: San Juan (Puerto Rico). Map produced with www.flashearth.com.

The Puerto Rico Trench represents one of the deepest spots in the Atlantic Ocean (> 8000 m). About the hadal fauna even less is known compared to the abyss. Knowledge about this depth layer is dominated by megafauna (e.g. fishes, cephalopods and large crustaceans) and the scavenger guild.

An international and interdisciplinary team of scientists led by Scientists from the German institutions GEOMAR (Kiel), the Zoological Museum Hamburg, as well as the University of Cologne will explore the Vema Fracture Zone and the Puerto Rico Trench during the upcoming expedition Vema-TRANSIT (Bathymetry of the Vema Fracture Zone and Puerto Rico Trench and Abyssal Atlantic Biodiversity Study) with logistical support by Senckenberg German Center for Marine Biodiversity Research (DZMB).

The main goals of Vema-TRANSIT are:

- High-resolution bathymetric cartography of the Vema Fracture Zone.
- Analysis of the barrier-effect of the Mid-Atlantic Ridge for the benthic fauna in the fracture zone area
- Faunistic comparison of the Puerto Rico Trench with neighboring abyssal regions
- Photographic exploration of the region in search for chemosynthetic habitats
- Photographic recording of megafauna distribution

Figure 2. The Camera Epibenthic Sledge (C-EBS) is equipped with video and photo cameras. Its small-meshed nets are designed to catch primarily benthic macrofauna. Picture: Angelika Brandt.

- Zoogeographic analysis of common deep-sea taxa in the area
- Sedimentology and pore-water analyses for the characterization of biogeochemical processes
- Measurements of turbulent bottom currents

Figure 3. Various deep-sea invertebrates from the tropical abyssal Atlantic. Pics: Guillermo Diaz Agras, Torben Riehl

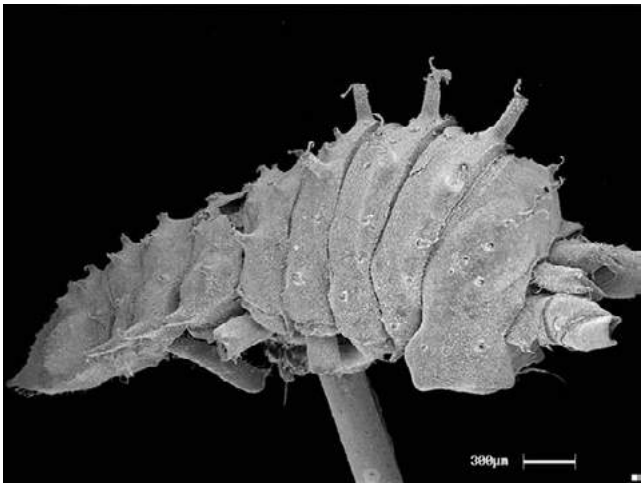
Project Focus

INDEEP/LIFEWATCH successes for WG1

Tammy Horton

National Oceanography Centre, UK

In February 2014 a call was made through LifeWatch and The Flanders Marine Institute (hosts of the World Register of Marine Species database, WoRMS) to financially support projects to address gaps. The INDEEP project provided matched funding to support three such projects with a focus to address specific gaps in the World Register of Deep-Sea Species (WoRDSS). The deliverables were to:



Above: Bathybadistes andrewsi

- Provide taxonomic editorship to WoRMS.
- Provide original description references, depth distribution data and/or confirmation of exclusion or inclusion in the WoRDSS for proposed taxon.
- Provide identification resources including explanatory notes for each reference.
- Provide the best available image for all family level taxa and higher if not already included in the deepsea ID iOS app.

Three projects have now been completed and we are thrilled to be able to summarise the results here. These projects have together added 30 newly published species to WoRMS, added 1391 new deep-sea distributions to WoRDSS, linked or added over 122 identification references to WoRMS and WoRDSS (not including the many original descriptions & context sources added) and made available 74 good quality images for use on WoRDSS and the iOS app. I would like to thank the grant holders Antonina, Kelly and Lenka for all their hard work on this project. Which taxa should we tackle next??

Holothuroidea: Antonina Kremenetskaia

Above: Antonia Kremenetskaia

- WoRDSS Holothurian species were revised:there are now 520 species in WoRDSS.
- 234 species were added to WoRDSS. 214 were added to the context and 20 taxa were newly added to WoRMS. Six species were removed as non deep-sea or duplication.
- 150 species with “unaccepted” status (synonyms) were added to WoRDSS.
- Geographic/bathymetric distribution data were added to 163 species.
- Taxonomic status was edited for 55 species (e.g. authority, references, notes, links).

- Classification was revised for the following genera: *Elpidia, Enypniastes, Mesothuria, Zygothuria, Pseudostichopus.*
- 40 references to published identification sources (keys to families) were linked.
- 43 photographs of holothurians were provided.

Above: Kelly Merrin

Isopoda: Asellota: Kelly Merrin

- WoRDSS Asellota were revised. 1007 asellote species are now included.
- 654 species were added to WoRDSS. 644 species were added to the context and 10 taxa were newly added to WoRMS.
- >600 geographical/ bathymetric distributions were added to 294 species.
- Taxonomic status was edited for >350 species (e.g. authority, references, notes, links).
- 48 references to published identification sources (keys to families & genera) were linked.
- 31 photographs of Asellotes were provided.

Above: Lenka Nealova

Polychaeta: Lenka Nealova

- WoRDSS Polychaeta were revised. 2165 accepted species are now included.
- 503 species were added to WoRDSS context.
- 128 species with "unaccepted" status (synonyms) were added to WoRDSS.
- 1322 species were checked as valid WoRDSS entries with source references.
- 455 were flagged as problematic and provided with note "questionable depth range", but not deleted pending further review by the specialists for the given groups and future work.
- 34 references to published identification sources (keys to class, order, families) were linked.

Additionally, work with the Data Management team at VLIZ has allowed 1257 species from the 24 papers in the thematic volume 'Deep-sea Fauna of European Seas: An annotated species check-list of benthic invertebrates living deeper than 2000 m in the seas bordering Europe. Invertebrate Zoology. Vol.11. No.1: 1–291', to be matched with WoRMS. 301 new taxa were flagged as deep-sea taxa (see page 3 for further information on this publication). References were added as the context source for those 301 taxa and for 821 others that did not have a context source or that had the context source OBIS.

WoRMS World Register of Marine Species

LifeWatch E-Science

IN DEEP

Cabled video-observatories for studying seafloor communities and activity rhythms from coastal areas to the deep-sea

Jacopo Aguzzi, Corrado Costa, Joan B. Company, Carol Doya, Joaquin del Rio, Daniel Mihai Toma, Laurenz Thomsen, Autun Purser, Yoshihiro Fujiwara, Emanuela Fanelli, Simone Marini, Fabio De Leo, Kim Juniper, Henry A. Ruhl, Phil Meredith, Steve Boone and Paolo Favali

Animals display temporal patterns in behavioural, physiological, and molecular functioning, collectively known as biological rhythms. Below the photic zone, in the deep-sea, these rhythms are not controlled directly by light-intensity cycles, but rather can occur in synchronization with inertial (i.e. atmospheric-driven) and tidal currents. Species responses to hydrodynamic cycles (combined or not with depth-dependent light-intensity variations) induce complex populational displacements within the three-dimensional volume of oceans. This phenomenon presently limits our ability to fully understand community composition and diversity variations over space and time, especially when sampling repeatability at statistically relevant frequencies is constrained upon depth. A new technology should be then implemented in order to establish reliable: i. faunal lists, as the core of deep-water ecosystems exploration; ii. cause-effect principles linking animal behaviour to environmental changes; and finally, iii. population assessments, where video stations are coordinated into geographic networks. That technology should also have a social projection by interfacing with the Internet, hence increasing the awareness of the public to the deep sea. Seafloor-cabled observatories with video-imaging capacity installed within international infrastructural programmes (NEPTUNE, Canada; OOI, USA; EMSO, Europe, DONET, Japan), are allowing continuous ecosystem monitoring at sampling frequencies never attained before (from minutes to years). Fluctuations in video-counted species abundances can inform about populations' dynamics as a product of behavioural responses of individuals to environmental factors (e.g. currents, temperature, oxygen, and methane), recorded by oceanographic sensors. In recent years, many institutions (ICM-CSIC, SARTI-UPC, CNR, ENEA, Jacobs University, UCL, NOC, and JAMSTEC), have undertaken a collaborative and multidisciplinary effort of coordinated video and multiparametric environmental monitoring, from shallow waters to bathyal and abyssal domains (e.g. OBSEA, 20 m; VENUS, 90-300 m; NEPTUNE, 400-1000 m; Sagami Bay-JAMSTEC, 1100 m; the EMSO node NEMO-SN1 in Western Ionian Sea, 2100 m) (Fig. 1). As part of this effort, new camera deployments are also foreseen in Europe in the EMSO nodes of Ligurian Sea (500 m depth) and eastern Sicily (2100 m depth), as well as for ONC in the Canadian arctic (Cambridge Bay, 7 m depth). Novel video-imaging protocols are being implemented for each video-source, to aid animal automated classification and counting. Libraries of manually-classified images are being created in order to obtain synthetic morphological models as a reference for classification. A progressive tuning of classification efficiency will be achieved through the reiterative updating of libraries with new species through Citizen Science protocols support.

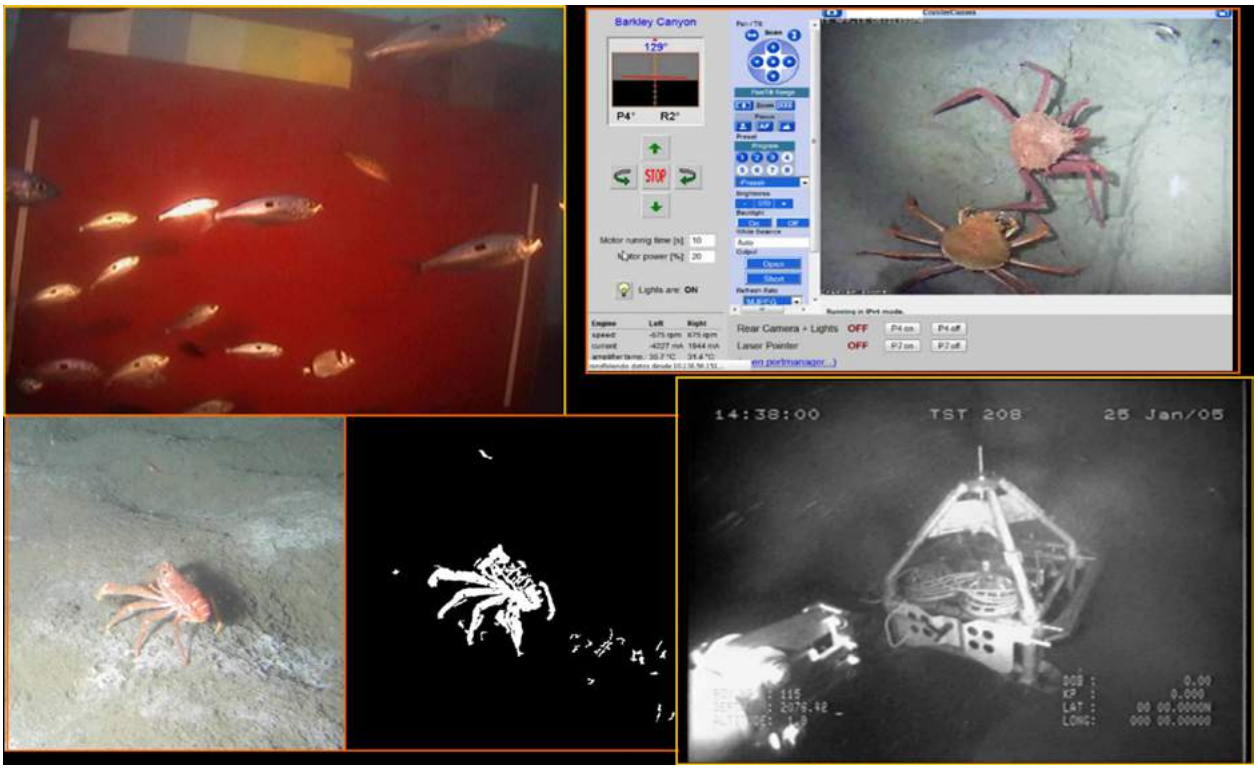


Figure 1. Above left: OBSEA (www.obsea.es). Below left: at VENUS (www.venus.uvic.ca). Above right: Wally crawler driving interface at about 1000 m depth (www.neptunecanada.ca). Below right: the EMSO node NEMO-SN1 (www.emso-eu.org).

Life without Sunlight: Engaging public audiences with the Science on a Sphere

Stace E. Beaulieu[1], Annette Brickley[2], Abbey Spargo[2], Katherine Joyce[1], Tim Silva[1], Kathleen Patterson[1], Katherine Madin[1] and Meredith Emery[3]

[1] Woods Hole Oceanographic Institution, Woods Hole, MA USA (stace@whoi.edu), [2] Ocean Explorium, New Bedford, MA USA, [3] M&E Professional Teacher Consultants, Wareham, MA USA

The "Global Viewport to Deep-Sea Vents" project brought together scientists, educators, graphic artists, and a professional evaluator to create new content for NOAA's Science On a Sphere® (SOS). The SOS is a room-sized digital globe that can be used to tell a story with global datasets (http://sos.noaa.gov/What_is_SOS/). SOS systems are installed at more than 100 science museums in 19 countries around the world. We were particularly interested in educating and exciting the public about geophysical and biological processes and exploration in the deep ocean. We created content using global datasets, including locations of Earth's known deep-sea hydrothermal vents from the InterRidge Vents Database, and imagery from deep-sea vehicles, including HOV Alvin, HOV Shinkai 6500, ROV Jason II, ROV Quest 4000, and more.

Figure 1. The SOS appears to hang in mid-air in a darkened auditorium. Here, you can see the silhouette of the presenter, and the light from bathymetry on the SOS illuminates the audience.

Ultimately, we developed two educational pieces, "Life without Sunlight" and "Smoke and Fire Underwater" – each highlighting three known deep-sea vent fields, and each targeting a set of Earth Science Literacy Principles (http://www.earthscienceliteracy.org/) and Ocean Literacy Principles (OLP) (http://oceanliteracy.wp2.coexploration.org/). The educational pieces were produced as movies matched to interactive, docent-led presentations (Fig. 1). "Life without Sunlight" dives beneath the sunlit ocean to the darkness of deep-sea vents, where food webs are fueled by chemosynthesis, and specifically targets OLP 5.g.: "There are deep-ocean ecosystems that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents rely only on chemical energy and chemosynthetic organisms to support life." Each educational piece was also matched to a hands-on, K-12 field trip program at the Ocean Explorium.

Results from anonymous survey questionnaires indicate that both educational pieces are effective in enhancing scientific literacy and exciting viewers about the deep ocean frontier. We attribute this success to the collaboration between scientists, educators, and artists, and our front-end and formative evaluation in developing the content for public audiences. We are presently compiling our summative evaluation, which will be delivered to the NOAA SOS program, informalscience.org, and at the 2014 AGU Fall Meeting, and summarized in a manuscript for a peer-reviewed journal.

The full package is available for download at the Woods Hole Open Access Server (Beaulieu et al., 2014), and previews for the site-specific and educational compilation movies are posted at YouTube (https://www.youtube.com/playlist?list=PL1CGd4Scv4GJsaaFRzItk-btFI757bH8f). The datasets and movies formatted specifically for the SOS will soon be available from the NOAA SOS Data Catalog (http://sos.noaa.gov/Datasets/index.html). The two compilation movies were also formatted for recent versions of the Magic Planet (http://globalimagination.com/). Additional information and artwork is provided from our project website (http://www.divediscover.whoi.edu/sos).

Acknowledgements

We would like to thank the U.S. National Deep Submergence Facility and many scientific colleagues who helped in selecting imagery and providing information for the educational materials. Please refer to the closing credits in our movies for detailed acknowledgments. Our work was funded by U.S. NSF #1202977.

Reference

Beaulieu, S.E., Brickley, A., Spargo, A., Joyce, K., Silva, T., Patterson, K., Madin, K., and Emery, M. (2014) Global viewport to deep-sea vents: dataset for spherical display systems. 11 September 2014, Version 1. Woods Hole Open Access Server. Accessed: 24 September 2014. URL: http://hdl.handle.net/1912/6867; DOI: 10.1575/1912/6867.

INDEEP NEWS FLASH!

Please remember INDEEP is open to anyone wishing to participate in INDEEP activities or to be informed of progress. Contact WG leads if you wish to contribute your expertise and time to a specific activity (www.indeep-project.org).

INDEEP Office (Maria Baker)

- Keeping the community connected and knowledge transferred via emails, twitter and DSL newsletter. Now reaching over 500 deep-sea biologists around the globe via the INDEEP mailing list
- Continued promotion of INDEEP across the globe
- INDEEP-ONC meeting in Canada to strengthen links between INDEEP science and ONC
- Production of online deep-sea data repository listing
- Updates to www.deepseaexperts.com – now has over 200 experts online
- Contributions to the World Ocean Assessment and helping ensure the deep-sea is covered
- Contributions to the Global Ocean Commission and affiliation with Mission Ocean
- Organization of INDEEP & DOSI meetings at DSBS 2015
- DOSI co-leadership tasks and outputs, ensuring close links between INDEEP and DOSI
- INDEEP-sponsored WCMB session "Anthropogenic impacts on deep-sea biodiversity and their consequences" – led by Telmo Morato

WG1 – Taxonomy & Evolution (Tammy Horton & Adrian Glover)

- INDEEP session at WCMB October 2014 in China: "Evolution in the deep sea: origins, adaptation and diversity" – led by Adrian Glover (details on pages 38-39)
- Deep-sea taxonomist listing now online (http://www.indeep-project.org/documents)
- Three successful projects addressing gaps in WoRDSS – Asellote Isopoda, Holothuroidea & Polychaeta (details on pages 20-21)

WG2 – Biodiversity & Biogeography (Tim O'Hara & Derek Tittensor)

- Global map of ophiuroid species richness soon to be published
- New ophuiroid species descriptions add to mapping project

WG3 – Population Connectivity (Anna Metaxas & Eva Ramirez-Llodra)

- Further frame deployments and recoveries
- Frame-settler analysis following standardised protocols underway in UK, Canada and Brazil
- Planning well underway for African capacity-building workshop (2016) on population connectivity skills for use in decision making and advising for the sustainable exploitation of marine mineral resources.

WG4 – Ecosystem Function (Andrew Thurber & Andrew Sweetman)

- Freezer Science project steams ahead! So far over 100 samples from around the world have had their DNA extracted and sequenced resulting in a total of 9.7 million sequences of the 16s rRNA gene. We are currently seeking additional samples to add to this initial run. Please email Andrew Thurber (athurber@coas.oregonstate.edu) with any sample offers.
- First draft of MS looking at how community patterns relate to function is in progress.

Genetic research on the population structure of sablefish *Anoplopoma fimbria* and skilfish *Erilepis zonifer* (Anoplopomatidae, Scorpaeniformes, Osteichthyes)

Svetlana Yu. Orlova and Alexei M. Orlov (orlov@vniro.ru)

Russian Federal Research Institute of Fisheries and Oceanography (VNIRO), Moscow, Russia

The family of sablefishes (Anoplopomatidae) is represented by two deep-water species that are endemic to the North Pacific, namely the sablefish *Anoplopoma fimbria* and the skilfish *Erilepis zonifer*. Ranges of these species partially overlap. Both species have a number of similar ecological features, i.e. habitation of juveniles within upper ocean layers, settlement to the bottom with growth and maturation, high growth rates and longevity (40-80 years). These species are important fishery targets in Japan, USA and Canada due to high market prices and delicious meat. They are considered as prospective targets for cold-water aquaculture due to their high growth rates (the highest among bony fishes), and their ability to undergo transportation in small volumes of water and changes in temperature and pressure. However, sablefish and skilfish are insufficiently studied. The population structure of sablefish is poorly understood, while that of skilfish has not been studied at all. Phylogenetic relationships and pathways of their dispersal in the North Pacific have not been analyzed, and the date of formation of these species is not known, although the paleontological record of an Anoplopomatidae representative in modern California (USA) has been authentically dated 4 to 5 million years ago. The aim of this project is to identify peculiarities of the formation of the population structure of two species of the Anoplopomatidae family, and to analyze macro- and micro-evolutionary processes using modern molecular genetic methods. Population structures of skilfish and sablefish will be analyzed on the basis of polymorphism of microsatellite loci, control regions of mtDNA (D-loop), and the COI gene. Phylogenetic relationships between representatives of the Anoplopomatidae family will be identified. Time of divergence from the common ancestor will be estimated, pathways of dispersal of both species in the North Pacific will be evaluated, and principles of formation of ranges in light of paleoclimatic changes will be defined. Recommendations on the rational use of sablefish and skilfish resources will be developed.

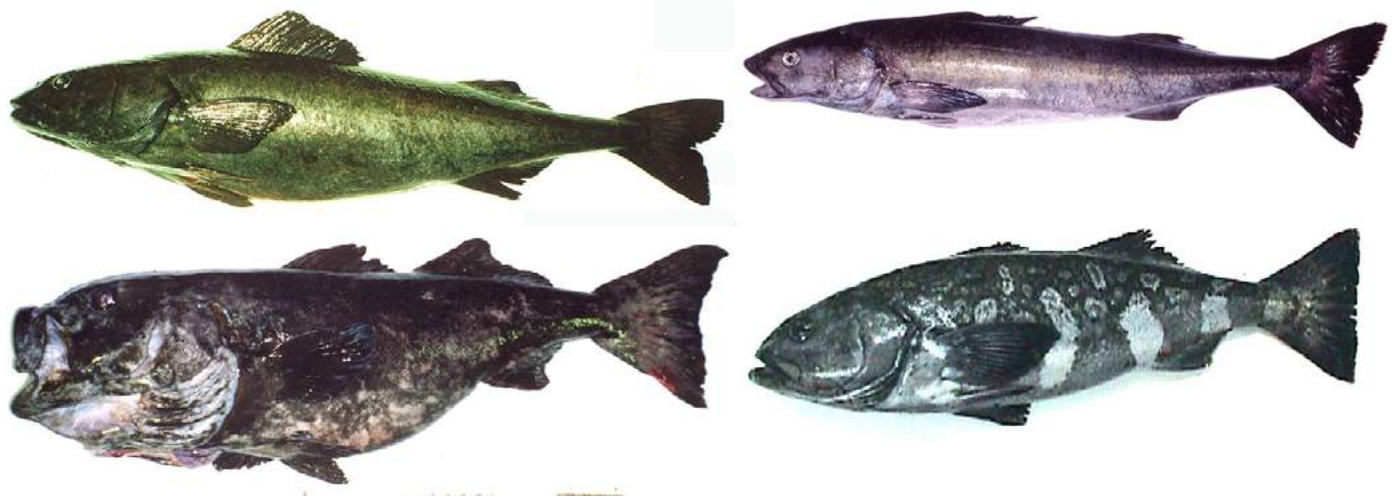


Figure 1 (above left): Anoplopoma fimbria *(adult); (above right):* Anoplopoma fimbria *(juvenile); (below left):* Erilepis zonifer *(adult); (below right):* Erilepis zonifer *(juvenile).*

South West Indian Ocean: Beyond National Boundaries

Aurélie Spadone

IUCN Global Marine and Polar Programme, Switzerland

A scientific expedition will take place in 2015 to the Walters Shoals area within the framework of the IUCN-led project in areas beyond national jurisdiction (ABNJ) of the South West Indian Ocean. The Walters Shoals is an underwater plateau located 700 km south of Madagascar. With shallower parts reaching as shallow as 18 m below sea level (see yellow circle on the situation and 3D maps), this shoal constitutes a unique feature of the seafloor in the typically deep waters beyond national boundaries of the South West Indian Ocean.

The project, funded by the French Global Environment Facility, is being executed by several partners - the National

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

Another project component will explore regional approaches to the conservation of marine biodiversity in ABNJ. The study of lessons learned and best practices will be used to propose potential models and scenarios for the South West Indian Ocean.

In the face of increasing human pressures in remote areas of the ocean, it is clear we need to cooperate at multiple scales and apply multiple tools to achieve the conservation and sustainable use of these fragile, slow-growing ecosystems and protect and preserve their rare and unique biodiversity.

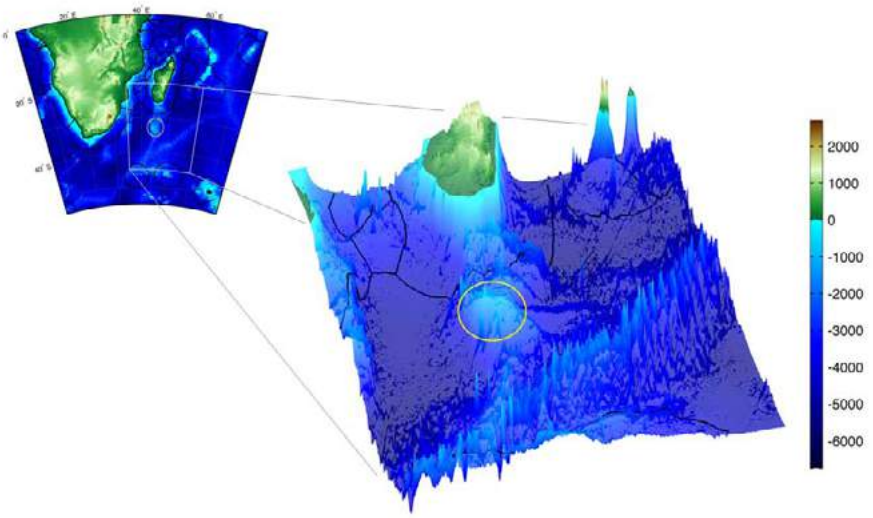


Figure 1: Situation and 3D maps of the South West Indian Ocean. Bathymetry in meters; Exclusive Economic Zones (black lines); Walters Shoals area (yellow circle). Copyright: IUCN Aurélie Spadone.

For more information, please contact aurelie.spadone@iucn.org

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

DOSI

DEEP-OCEAN STEWARDSHIP INITIATIVE

Mission: The Deep-Ocean Stewardship Initiative (DOSI) seeks to integrate science, technology, policy, law and economics to advise on ecosystem-based management of resource use in the deep ocean and strategies to maintain the integrity of deep-ocean ecosystems within and beyond national jurisdiction.

Now in its second year, DOSI continues to engage deep-sea stakeholders through workshops, discussions, and statements, surveys, symposia and other activities. Highlights of this year:

- **DOSI statement to the ISA** endorsed by 93 scientists and 18 organizations
- **Compiled response to ISA stakeholder survey** (http://www.isa.org.jm/files/documents/EN/Survey/Responses/DOSI.pdf)
- **Workshops**: Defining significant impact for deep-sea EIAs (SIO); Biogeographic Classification of the deep sea (UK)
- **Publication**: A Call for Deep-Ocean Stewardship. Mengerink et al. 2014. Science 344: 696-698. Policy Forum.
- **Webinar Series:** Archived presentations by 11 organizations involved in deep-ocean stewardship (available from

www.indeep-project.org/deep-ocean-stewardship-initiative)

- **Symposia 2014**: (i) IORC, Barcelona, Nov; (ii) World Conference on Marine Biodiversity, Qingdao Oct: Anthropogenic Impacts in the Deep-sea; (iii) International Ocean Summit on the Blue Economy: France, Oct: Deep Ocean Biodiversity Challenges; (iiii) AAAS Chicago, February: Deep-Ocean Industrialization
- **Compilations**: Online deep-sea video library, University of Southampton MOOC, Deep-sea Ecology and Stewardship 'speaking textbook' for youtube (underway)

Two new working groups have formed:

WG 8. Deep-Sea Tailing Placement (DSTP), Lead: Eva Ramirez-Llodra (NIVA, Norway), eva.ramirez@niva.no. This group will provide an international platform to plan, design and develop specific activities and promote discussion and communication amongst stakeholders on issues related to deep-sea mine tailings placement. This working group is open to everyone with an interest in technological and environmental issues of DSTP and we hope that the WG will include the active participation of stakeholders from different backgrounds, including ecologists, physical oceanographers, geologists, industry, policy makers, economists, lawyers and environmental organisations. Some initial proposed activities are:

1. International workshop on DSTP
2. Stakeholder communication
3. Collaboration with Chilean programme (Leonel Sierralta)
4. Link with IMO on legal issues
5. Establish links with DOSI WG1 on deep-sea mining

If you would like to be included in DOSI's DSTP WG, contact Eva Ramirez-Llodra.

WG 9. Deep-Water Oil and Gas, Lead, Erik Cordes, Temple University, USA (ecordes@temple.edu). This group will discuss a range of issues such as those that have stemmed from the Deepwater Horizon incident in the Gulf of Mexico related to the need for baseline data, the designation of setback distances, the value of and ecosystem services provided by deep-sea ecosystems, and in general the best practices for the stewardship of deepwater oil and gas development. These and many other issues will apply to other EEZs, the developing activity in the Arctic, and in some cases to international waters. One of the first actions of the working group will be to collect various case studies from the interested parties representing a variety of stakeholders and compare the regulations of different nations relative to offshore oil and gas development. If you are interested in joining, please contact Erik Cordes.

Information on all DOSI working groups can be found at: www.indeep-project.org/deep ocean-stewardship-initiative

Sign up to the DOSI mailing list: Send an email to Majordomo@lists.soton.ac.uk (leave subject line EMPTY and type "subscribe dosi-alert" in the main body of the email. Remove all signatures or any other text from the email. You will then receive an automated confirmation email.

Tidal rhythms in deep-sea benthos

Valerio Sbragaglia and Jacopo Aguzzi

Marine science institute (CSIC) – Passeig Marítim de la Barceloneta, 37-49 E-08003 Barcelona (Spain)

The deep sea (>200 m) is a dynamic environment in which tides can modulate the periodic motion of water masses. Species within this aphotic environment are an interesting model to investigate the presence of circatidal behavioral rhythms. We believe that these rhythms may influence our perception of community compositions when sampling is performed at frequencies that do not consider tidal cycles. Light intensity progressively decreases with depth, and tidal currents could gradually replace the photic stimulus as a synchronizing cue for the biological rhythms of benthos on continental margins. Moreover, in places in which tides are not evident, such as the Mediterranean Sea, inertial motion (resulting from wind stress and Coriolis force) of water masses could affect the rhythmic regulation of species' biology. Laboratory experiments with deep-sea species are therefore necessary to characterize the mechanisms governing

biological rhythms when different synchronizing cues are present (day and night cycles, tidal currents, and inertial currents). To achieve this goal, laboratory maintenance of deep-sea organisms and the appropriate technology to track their behavior are very important. We are currently studying the behavioral rhythms of two crustacean decapods exposed to periodic water currents in the laboratory: the Norway lobster *Nephrops norvegicus* and the deep-sea crab *Geryon longipes*. *Nephrops* sp. is distributed from coastal shelf to middle slope, while *Geryon* sp. extends its presence from the middle to the lower slope. Our hypothesis is that the tidal motion of water masses at the sea floor can act as a synchronizer of species' circatidal clock. Moreover, we are investigating the strength of response to light-darkness cycles with the hypothesis that *Geryon* sp. should have a minor response than *Nephrops* sp. in accordance with the bathymetric distribution of the species.

Deep-sea fauna usage of marine litter

Aymà A.[1,2]*, Aguzzi J[1]., Company J.B.,[1] Lastras G.[2], Mecho A.[1] and Canals ,M.[2]

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[2]*GRC Geociències Marines; Departament d'Estratigrafia, Paleontologia i Geociències Marines; Facultat de Geologia; Universitat de Barcelona; Martí i Franquès, s/n; 08028 Barcelona, Spain.*

*e-mail: aaymap@ub.edu

Litter accumulation in the marine environment represents a major alteration of previous natural conditions. The effect of that litter on the fauna is still poorly understood, but it may span from physical damage (e.g. after ingestion) to poisoning by chemical derivates accumulating trough marine food webs, as well as ghost fishing from lost or discarded fishing gear.

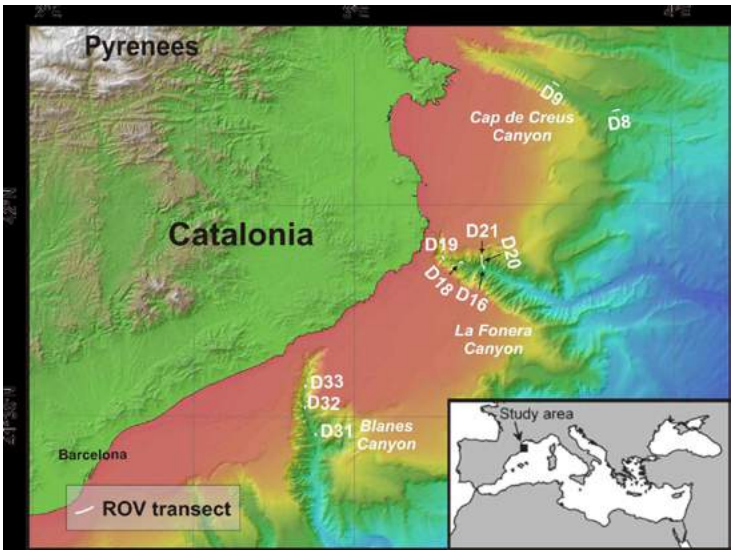

Figure 1. Location of the study area and ROV dives used in analysis

A team of scientists from Marine Geosciences at the University of Barcelona and living resources at ICM-CSIC surveyed the three largest submarine canyons off Catalonia (NW Mediterranean Sea) using the Liropus 2000 ROV from IEO (Fig. 1). Submarine canyons act as preferential conduits in the transfer of matter and energy from the coastal ocean to deep basins, including litter.

Our preliminary observations evidenced different types of interactions of demersal fauna with litter. Hard artificial substratum increases local habitat heterogeneity enhancing the settlement of certain species, such as cold water corals (CWC). Litter apparently favors the development of CWC communities in habitats otherwise dominated by soft-sedimented bottoms. Also, evidence of interactions between litter and motile species has been found involving, for instance, crustacean decapods or fishes, which can use marine litter as a refuge (Fig. 2). Although most individuals of *Munida* sp. were observed in burrows, a significant number of individuals used litter, mainly plastics, as sheltering.

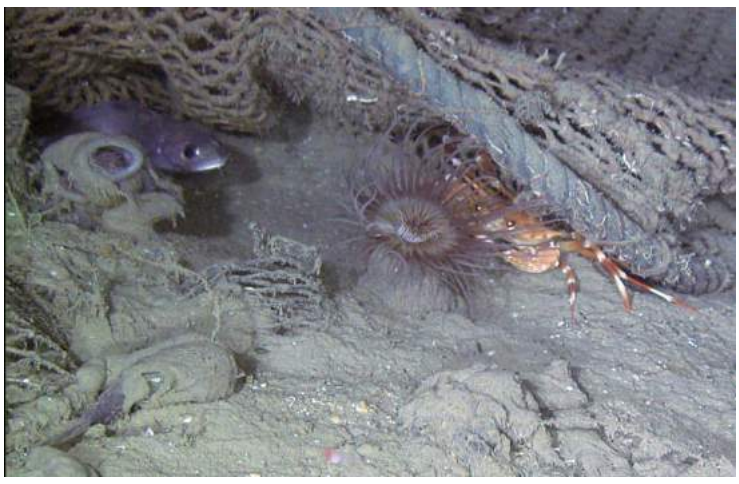

Figure 2. Net with ropes and a cord entanglement with living Phycis blennoides, Bathynectes maravigna *and* Cerianthus membranaceus *in Cap de Creus Canyon floor at 484 meters.*

News

Awash with deep-sea experts!

Maria Baker

University of Southampton, UK

We have an astonishing abundance of knowledge and skills among our deep-sea community and expertise in a wide variety of disciplines. Such knowledge is of ever-increasing importance to the future health and well-being of our planet. An INDEEP initiative started at the end of 2012 has produced an online searchable database of deep-sea experts which is widely used by those within the community to help find international colleagues and increasingly this tool is used by other deep-sea stakeholders such as management organisations, policy makers and NGOs. The intended function of the database is to help "bridge the gap" between accurate scientific information and management of our deep oceans.

We now have over 200 expert profiles. The proactive step taken by so many will ultimately aid in the protection of our deep oceans and we thank you for your efforts.

The database can be accessed at the following address: www.deepseaexperts.org

We would welcome further expert profiles on the database. Please complete this short questionnaire:

https://www.surveymonkey.com/s/INDEEP

Remember to update your profile as you progress in your career. Just send an email with any amendments to mb11@noc.soton.ac.uk

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2015 Ocean 180 Video Challenge!

There are just two weeks remaining to submit entries to the 2015 Ocean 180 Video Challenge!

To enter, ocean scientists are invited to submit a 3 minute video abstract highlighting a recent peer-reviewed publication. Entries which best communicate the meaning, significance, and relevance of the research to non-scientific audiences will be awarded a total of $9,000 in cash prizes. All video abstracts must be submitted by a co-author of the publication. Scientists are welcome to submit as individuals or with a team.

To submit your entry, please visit http://ocean180.org/for-scientist/video-abstract-submission.html

Submission will close on Monday, December 1 at 11:59 pm (PST).

If you are considering submitting a video abstract, we encourage you to view our information session, available here: http://ocean180.org/for-scientist/faq.html

While all videos will be evaluated by a team of science and communication experts, the top 10 finalists will be screened by over 31,000 middle school students in 21 countries. These student judges will evaluate the finalists and ultimately select the winning entries. This is an excellent opportunity to share your work with a broad audience and to practice communicating your research to the public.

Please contact info@ocean180.org with questions. We are looking forward to seeing your submissions this fall!

About Ocean 180

Sponsored by the Florida Center for Ocean Science Education Excellence (COSEE Florida) and funded through a grant from the National Science Foundation, the Ocean 180 Video Challenge is designed to encourage ocean scientists to share their discoveries and excitement for research with teachers, students, and the public.

For full contest guidelines and to view previous winners, please visit http://ocean180.org

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Hydrothermal Vents: What does the future hold?

Film by Joe Fereday, UK and featuring Jon Copley, University of Southampton, UK

BLUE 2014: Emerging Filmmaker Finalist

Hydrothermal Vents: What does the future hold? - BLUE 2014: Emerging Filmmaker Finalist

The BLUE Ocean Film Festival (BLUE) merges the creative energy of filmmakers with the foundation of science and conservation to bring together the very best of the Ocean Arts & Sciences to share the world's most exceptional ocean films, to honour and support the filmmakers and to promote ocean stewardship around the globe. The film competition includes categories for all levels of expertise and provides opportunities to receive international recognition, and mingle with a who's who in ocean filmmaking, photography, science, exploration and conservation. The category finalists were announced in August.

Joe Fereday from the UK (ex-University of Southampton Marine Biology student) entered the competition with his film on hydrothermal vents and was a finalist in the emerging filmmaker category.

Hydrothermal Vent ecosystems have continually captivated the imagination of the world ever since their first discovery on the East Pacific Rise in the late 70's. Since then, an inter-connected global network of sites has been discovered. This alien world, reliant on chemosynthesis, plays host to some of the most unique and specialised organisms known to man, and there's still so much to be discovered. However, unbeknown to most, deep-sea mining contracts are being bought up and sold, in order to exploit the mineral rich properties that the vents also possess.

This film explores the crossroads of these two conflicting themes. In the 21st century, is man capable of approaching this new resource in a way that is both beneficial an ecologically sound?

https://www.youtube.com/watch?v=-I-UVtywgFg&feature=youtu.be

All the film finalists can be viewed here: http://www.blueoceanfilmfestival.org/2014_film_finalist_3.htm

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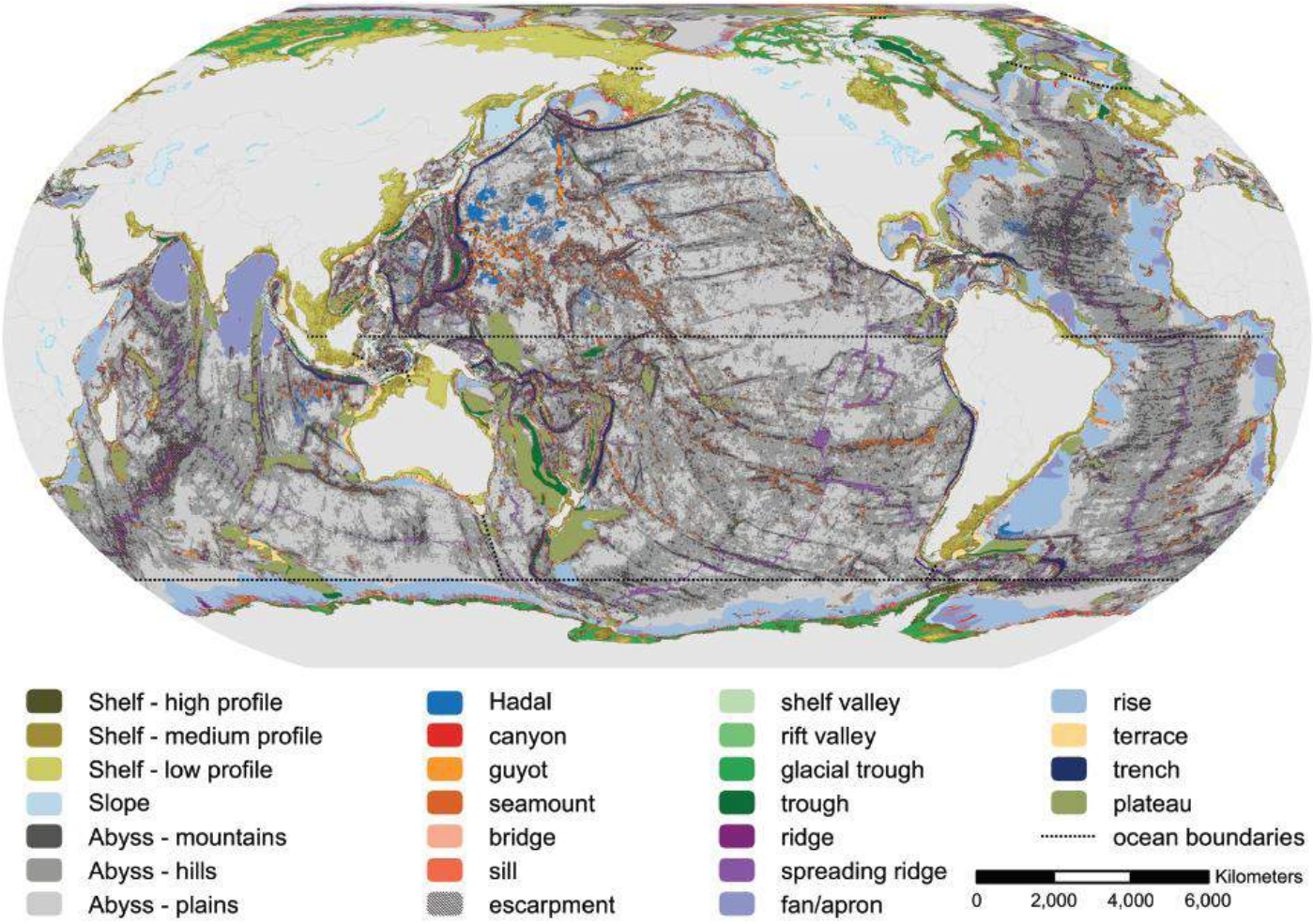
A new digital global seafloor geomorphic features map for science and management is now available for everyone to use…

Jonas Rüpp, Conservation International, Australia

Knowing where seafloor geomorphic features are – such as canyons, seamounts, ridges, trenches – and whether large areas such as continental shelf and abyss are generally flat, hilly or mountainous; can help understand different marine environments, target scientific research, and consider what information might be useful for achieving sustainable development through conservation and management measures – including through marine spatial planning, and development of time/area-based management that is representative of areas of interest in local, regional and global contexts.



A paper in the 50th Anniversary Edition of Marine Geology [352 (2014) 4–24] presents the results obtained from a Partnership project completed by Geoscience Australia / UNEP–GRID Arendal / Conservation International Foundation (CI) Partnership mapping 'Geomorphology of the Oceans'. The paper can currently be downloaded at: http://www.sciencedirect.com/science/article/pii/S0025322714000310

The paper presents maps and analyses of seafloor features globally and across eight major ocean regions as defined by the International Hydrographic Organisation –including Arctic, Atlantic, Indian, Pacific, and Southern Ocean regions. Mapping and analysis of this nature may also assist in considering what could be best practice / conservation and management measures for living and non-living marine resources appropriate to, and bearing in mind existing and possible future, institutional mandates; and various IPCC scenarios regarding effects of anthropogenic emissions of 'greenhouse' gases into the Earth system.

The paper is a contribution by Geoscience Australia to the UN Regular Process / World Ocean Assessment. The mapping provides the basis for an inventory of features in any given area, including at national exclusive economic zone (EEZ), regional and global scales; and thereby provides a basis for analyses of distributions of features, further quantitative and comparative analysis across areas of scientific or management interest – and can be a valuable contribution to supporting capacity–building and technology transfer initiatives. The mapping is freely available and was produced in order to support capacity building and technology transfer, together with coordination and cooperation at relevant scales – such as through marine spatial planning initiatives – and has been mentioned in UNGA debates regarding conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction.

This first-ever global digital map of seafloor features using the International Hydrographic Organisation's definitions of seafloor morphological features can also be viewed and downloaded respectively at http://geonode.grida.no/maps/79 and www.bluehabitats.org (320MB Arc–GIS File together with a QGIS project and styling files). If you use the online viewer you can switch layers on/off – for instance toggling on/off spreading ridges will highlight the locations of those features; and as an aside we found good correlations between our mapping of ridges and data on known hydrothermal vents in the Inter-ridge database.

Identification of other features such as seamounts and guyots, ridges, and canyons can also be of value for fisheries science and management, and can provide information for considering how best to fulfil UNCLOS obligations to conserve and manage living and non-living marine resources – including for identifying possible locations of vulnerable marine ecosystems (VMEs) as defined in relevant FAO guidelines or regional arrangements; and relevant commitments made under the Convention on Biological Diversity, 'biodiversity' related conventions; and other relevant agreements including regional agreements addressing fisheries management.

Marine scientists interested in using the mapping of geomorphology can use it to reconcile various biogeographies, or for policy-relevant activities such as identification of ecologically and biologically significant areas (EBSAs) as part of the work of contracting parties to the Convention on Biological Diversity. The mapping can also make a useful contribution to the work of the Global Ocean Biodiversity Initiative (GOBI) – with the mapping being used in recent EBSA Workshops for the Arctic, Mediterranean and North–west Atlantic regions.

In the Western and Central Pacific Ocean, the mapping is being used in a EU Biodiversity and Ecosystem Services in the Territories (BEST) funded project to support marine spatial planning (MSP) across western and central Pacific Island Countries (PACIOCEA currently being executed by AAMP / SPREP). The mapping was also well received by delegates at meetings of the International Seabed Authority (ISA) held in July 2013 – with the mapping identified as a possible contribution to the process of reviewing the Management Plan for the Clarion-Clipperton Zone covering 12 million square km of the eastern equatorial Pacific Ocean.

The mapping could more generally be used where there is limited ecological information (with appropriate caveats

given that at global, regional and national scales, generally, biological data is patchy and sparse so that it is difficult to predict with certainty what populations and ecosystems will exist, but geomorphology / feature mapping at the scale we have mapped (30 arc–second – approx 1km resolution) can provide useful guidance for more detailed work) as a proxy for habitat mapping work.

Another possible example is to use the mapping as a basis for an analysis/assessment of the representativeness of features as potential habitat types in networks of marine managed areas, such as OSPAR/NEAFC benthic protected areas.

At the very least the mapping will provide a very nice map – providing a background to, and enabling presentation of, marine environments together with science, conservation and management initiatives as part of a larger national, (bio–)regional, or global picture. To learn more please feel free to click on the links below – where you can also find a recorded webinar presentation on possible uses of the mapping. Information in a PowerPoint presentation outlining potential uses of the mapping (presented at JAMSTEC in June 2014) is available at: https://www.dropbox.com/s/gtgbustswz65eku/GFSM-GOLD%20NEOPS%20JAMSTEC%20Japan%20June%202014.pptx. The presentation includes some examples of preliminary analyses of the global mapping of seafloor features as represented in marine protected areas in the UNEP-WCMC 'protected areas' database; and analyses of Pacific 'island' countries complements of geomorphic features. We would also like to build on the publication of the map with further analyses incorporating further physical, biological and ecological information – we call this project conceived for understanding the distribution of life in marine environments (Global Ocean Life Distribution – GOLD) for information – see diagram above.

The seafloor mapping project lead was Dr Peter Harris, a member of the UN World Ocean Assessment Group of Experts - recently appointed as the Managing Director of UNEP-GRID Arendal and he can be reached at Peter.Harris@grida.no.

News and outputs from our digital Global Seafloor Geomorphology Mapping project: http://geoiq.grida.no/maps/1136

Seamounts, ridges, trenches: http://www.grida.no/marine/news.aspx?id=5290

Submarine canyons on passive and active margins: http://www.grida.no/marine/news.aspx?id=5643

Arctic glacial troughs: http://www.grida.no/marine/news.aspx?id=5694

"In Press Manuscript" see http://www.sciencedirect.com/science/article/pii/S0025322714000310; http://dx.doi.org/10.1016/j.margeo.2014.01.011.

Ecosystem-based Management Tools Network 'webinar': http://www.ebmtools.org/webinar-new-global-seafloor-geomorphology-map-and-management-areas-beyond-national-jurisdiction-pe-0

ESRI Arc-GIS 'StoryMap' 'Marine Geology – A new map for marine science and management': http://bit.ly/Xdmz6w

Germany has a new RV SONNE for deep-sea research in the Indian and Pacific Oceans

In August 2011, the contract for the construction of the new German deep-sea RV SONNE was signed and keel laying was done in the Meyer Werft in Papenburg on 20th April 2013. On 11th June 2014, the new ship was christened in the Neptun Werft in Rostock Warnemünde by the Federal Chancellor Dr. Angela Merkel.

The new RV Sonne is now being tested for capabilities of the navigation system, winch capacity and various research applications and the first expedition crossing the Atlantic (Vema-TRANSIT) will take place from December 15th 2014 to

January 26th 2015 (see page 16, DSL Issue 3 for article). The new RV SONNE replaces the 36 years old research vessel SONNE. She is extremely energy efficient and especially eco-friendly and measures 116 m in length, 20.6 m in width and can accommodate up to 40 scientists and 35 crew members. The new RV SONNE has a speed of 12 kts, a capacity of 6,480 kW, a draught of 6.4 m and weights 8,600 gt. The ship provides space for up to 25 twenty-foot containers with material. She is constructed to serve all disciplines of earth sciences. The Indian Ocean and the Pacific will be the main research areas for the new vessel. The home port of the new RV SONNE is Wilhelmshaven.

Above: The new deep-sea research vessel SONNE *(left: © Meyer Werft, Papenburg; middle and right: © Holger Freiherr von Neuhoff)*

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The United Nations World Ocean Assessment and the Deep Sea: An important Opportunity

Maria Baker, University of Southampton, UK

The first UN World Ocean Assessment to be published early next year aims to provide an integrated, world-wide view of what is happening to the oceans and seas and our uses of them, building on the many previous assessments already carried out by States and international organizations. The aim is to provide a sound, scientific basis for decisions at the global level on the world's oceans and seas, and a framework for national and regional assessments and management decisions.

Representatives from all regions of the world have carried out the first World Ocean Assessment providing expertise in a wide range of areas and subjects. The result is a comprehensive report comprised of 47 chapters.

If you are an expert in any of the subject areas listed in the World Ocean Assessment (WOA) final outline document and are not already in the pool of experts, I would urge you to at least scan over (~15 page) chapter that is relevant to your field that is to be published in the first World Ocean Assessment early next year. You have from 1st – 31st December (maybe subject to change) to make any comments on the text therein. A few examples of chapters that may be relevant to members of the deep-sea community are:

Chapter 23 - Offshore mining industries
Chapter 24 - Solid waste disposal
Chapter 25 - Marine debris
Chapter 29 - The use of marine genetic resources
Chapter 30 - Marine scientific research
Chapter 31 - Conculsions on other human activities
Chapter 33 - Introduction to Assessment of marine biological diversity and habitats
Chapter 34 - Scale of marine biological diversity
Chapter 35 - Extent of assessment of marine biological diversity
Chapter 36 - Overall status of major groups of species and habitats
Chapter 42 - Cold-water corals
Chapter 45 - Open-ocean deep-sea biomass
Chapter 46 - Hydrothermal vents and cold seeps
Chapter 52 - Seamounts and other submarine geological features potentially threatened by disturbance
Chapter 53 - Significant environmental, economic and/or social aspects in relation to the conservation of marine species and habitats
Chapter 55 - Summary on marine biological diversity
Chapter 56 - Overall assessment of human impact on the oceans
Chapter 57 - Overall value of the oceans to humans

You may submit comments for review via the US Department of State, in coordination with the National Ocean Council, using this website link:

https://review.globalchange.gov/

It is important to note that you are able to sign up and participate regardless of nationality. However, please be aware that other UN member states may be conducting similar review processes. They are NOT doing any further reviewing within the UK (DEFRA) so all UK scientists should use the US system. If you do know if your country has an open review process, I would be delighted to hear of it and I will be sure to pass on this important information to the community. Otherwise, you are all welcome to use the US system.

I hope it is surely our collective desire to make this first WOA as accurate and credible as possible. Patricio Bernal of the IUCN in his 2011 Science paper (attached) puts it well:

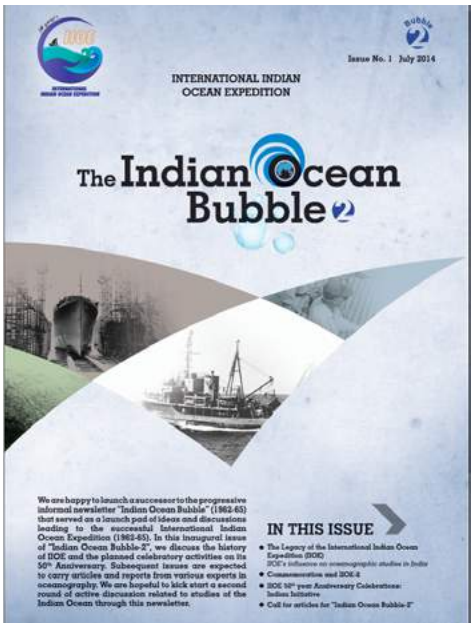
“A science-based assessment cannot be purely politically driven. I urge the marine scientific community to become acquainted and engaged with this ongoing process, reaching out through scientific societies and academies to the national representatives overseeing it in the UN General Assembly. The group of 25 experts designated by the UN to help with the technical scientific tasks estimates that between 1500 to 2000 experts will be needed to properly conduct the assessment and the subsequent peer review. The relevance, saliency, and credibility of the assessment ultimately depend on the involvement of many scientists and experts all over the world”.

In addition, Elizabeth Tirpak, U.S. Department of State, Washington states:

“All countries will benefit from the regular release of WOA reports. WOA will promote sharing marine data to assist

regional and specialized assessment processes to improve data analyses and future data collection. The expansion of knowledge of global and coastal marine areas will lead to improved identification of gaps in observations, modeling, and understanding, leading to improved scenarios for research and observations. WOA syntheses of ecological and biodiversity effects of increasing ocean temperature, acidification, hypoxia, river runoff, and sea level will enhance sustainability of ocean and coastal economies, improve understanding and capacity to respond to change, and maintain and restore the health of the ocean".

The Indian Ocean Bubble-2 - Launch and Call for Articles



The conception and planning of the International Indian Ocean Expedition (IIOE): 1962-1965 was critically shaped by the informal newsletter "The Indian Ocean Bubble" through which oceanographers voiced their opinions and freely brainstormed . "Bubble" generated extensive international interest in IIOE that directly contributed to its success; over 13 countries participated and collected useful data about all aspects of the Indian Ocean. Biological aspects in particular were studied through collection of biota, examination of high productivity upwelling features & nutrient content of fronts and vertical oxygen profiling.

IIOE gave an immense boost to oceanography in India, through active international collaborations, cruises and numerous seminars. The completion of IIOE culminated in the establishment of the National Institute of Oceanography (NIO), India and 2013 -15 marks the 50th anniversary of both IIOE and NIO, India.

As part of the 50th anniversary celebrations, a sequel expedition IIOE-2 is being conceived to achieve a more extensive study. To enable a vigorous exchange of ideas for IIOE-2 , a sequel newsletter "The Indian Ocean Bubble-2" was launched (during the Foundation Day celebrations of the Ministry of Earth Sciences, Government of India) in July 2014, accessible at -http://www.incois.gov.in/documents/IndianOceanBubble2.pdf

For our upcoming issues in December 2014 and June 2015, we would like to invite contributions of around 1500 words with accompanying figures, which could describe topics relevant to study of the Indian Ocean or report related events.

Meetings & Workshops

INDEEP Working Group 1 - Taxonomy and Evolution – Meeting Report

Dr Adrian Glover, Natural History Museum, London, UK

At the 3rd World Conference on Marine Biodiversity held in Qingdao, China between 12-16 October 2014, INDEEP WG1 were awarded a special session entitled 'Evolution in the Deep Sea: Origins, Adaptation and Diversity'. The session was successful in attracting 14 oral presentations and an audience of 60-80 people for the entire duration. The session was organised and co-chaired by Dr Adrian Glover (Natural History Museum, UK), Dr Moriaki Yasuhara (University of Hong Kong, China) and Dr Holly Bik (University of Birmingham, UK).

The concept of the meeting was to bring together palaeontologists, molecular systematists and deep-sea biologists to focus on the fundamental question of the origin, age and adaptation of deep-sea fauna over evolutionary time.

Figure 1: Dr Adrian Glover and co-chairs Dr Moriaki Yasuhara and Dr Holly Bik introducing the INDEEP Special Session on Evolution in the Deep Sea at the 3rd World Conference on Marine Biodiversity (Photos: T Dahlgren).

INDEEP-sponsored Keynote presentations were made by Prof Yukio Isozaki (University of Tokyo), Prof Andy Gooday (National Oceanography Centre, UK), Dr Moriaki Yasuhara, Dr Holly Bik and Dr Adrian Glover. Thanks to the sponsorship of INDEEP, partially-supporting attendance of these speakers, the event was extremely well attended and the talk programme completely filled.

The meeting started with an overview of the palaeoceanography and palaeoecology of ancient Palaeozoic and Mesozoic oceans from Prof Gooday, with an outline of the major shifts in species composition and anoxic events over time. This was followed by Prof Isozaki, speaking on the 'memories of pre-Jurassic lost oceans'. Prof Isozaki outlined the geological underpinning of our knowledge of exactly what deep-sea sedimentary features, such as accretionary complexes, are available to study given that almost any ocean floor older than early Jurassic is likely to have been subducted. Dr Yasuhara then continued the palaeontological part of the session with a discussion of the more conventionally-preserved sedimentary record from ocean drilling, with emphasis on the Cenozoic evolutionary history as presented by the Ostracoda. The palaeontological section of the session was concluded by PhD student Magdalena Georgieva (Natural History Museum, London), who gave a preview of new analyses of ancient hydrothermal deposits from the Silurian, suggesting that the development of hydrothermal vent faunas could have been very early in the history of deep-sea evolution.

Figure 2: A packed audience of ~80 people at the INDEEP WG1 Special Session on Deep-Sea Evolution

The meeting then shifted to discussions of genetic data and how these can inform our knowledge of evolution. Hiromi Watanabe (Japan Agency for Marine Earth Science and Technology) showed new data highlighting how

tectonic events have influenced speciation of deep-sea faunas in the western Pacific. Dr Holly Bik followed this with an update on the latest methods in high-throughput sequencing applied to the study of the microbial deep-sea, which was followed by Dr Tim O'Hara (Museum Victoria, Australia) showing how these methods are being used in a large study of 400+ genes across a range of deep-sea ophiuroids. PhD student Jin Sun (Hong Kong Baptist University) then presented an exemplar study of how high-throughput sequencing can be used to analyse adaptation in deep-sea molluscs, in particular with regards the protein composition of their shells.

After coffee, the final session of the meeting got underway with Dr Adrian Glover presenting an overview of the role of organic falls in driving evolution and adaptive radiation of deep-sea faunas. This was followed by a talk from Dr Haibin Zhang (Sanya Institute of Deep-sea Science and Engineering, China) who moved the focus of the meeting onto current speciation, as exemplified by a new and comprehensive study of the genetics of tubeworm Tevnia from the East Pacific Rise. This was followed by an update from Dr Tina Molodtsova (PP Shirshov Institute of Oceanology, Russia) on the latest biogeographic and adaptation studies of the deepest known corals in the order Antipatharia (black corals). PhD student Chong Chen (University of Oxford, UK) showed how new genetic data is increasing our understanding of cryptic species diversity in deep-sea gastropods, again relevant to understanding the process of speciation in our modern oceans. PhD student Marie Portail then followed this with an overview of recent discoveries from the remarkable Guaymas Basin site, where hydrothermal vents and cold seeps exist close to each other. Finally, Dr Marcelo Melo (Oceanographic Institute, University of Sao Paulo, Brazil) concluded the oral presentations with a fascinating insight into the sex life of deep-sea swallower fishes (Chiasmodontidae) and their speciation and adaptation in the deep sea

Figure 3: The INDEEP WG1 meeting on Evolution in the Deep Sea was concluded with an excellent meal for all the participants at the restaurant No.1 Zhongshan Road.

World Conference on Marine Biodiversity: Life in the Changing Ocean

Deep-Sea Session Review

12-16th October 2014, Qingdao, China

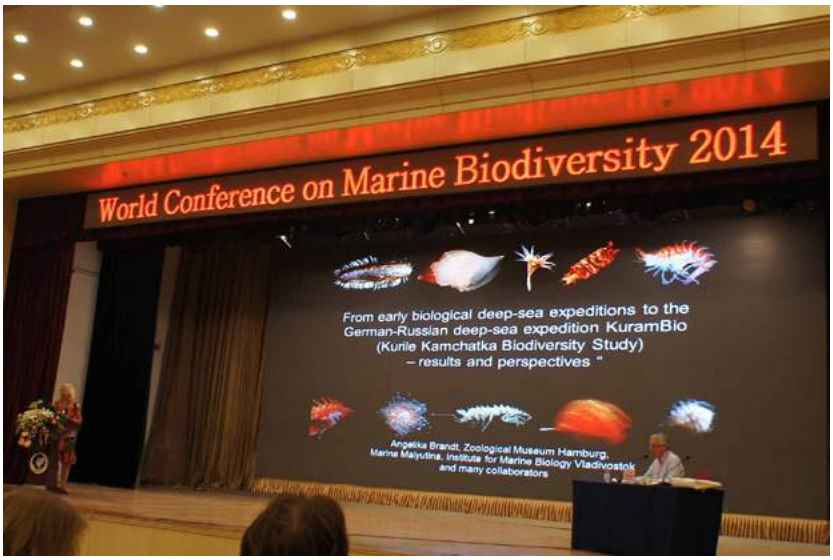
Phillip J Turner

In mid-October the Institute of Oceanology, Chinese Academy of Sciences, hosted the third World Conference on Marine Biodiversity in Qingdao, China. Under the theme of 'Life in the Changing Ocean', the three day conference included a series of deep-sea sessions that explored the most up-to-date research in deep-sea evolution, biodiversity and the impacts of anthropogenic disturbance on the deep-sea environment.

The conference started at the very beginning; that is, a keynote presentation by Dr. Andrew Gooday (NOC, UK) summarised the last 600 million years. His current work, alongside Dr. Hiroshi Kitazato (JAMSTEC), investigates the factors that may have facilitated a faunal shift in deep-sea foraminifera during the Mesozoic era as well as evidence that some modern assemblages may precede the 'Mesozoic revolution'.

The INDEEP WG1 session on evolution in the deep-sea discussed a broad range of topics (see article above for detail). These included the recent efforts in adapting DNA/RNA sequencing techniques to investigate the evolution of microbial eukaryotes (Dr. Holly Bik, University of Birmingham) and to begin to answer questions related to the origin and spatial distribution of marine fauna (Dr. Timothy O'Hara, Museum Victoria). In addition to the use of microfossils to understand

macro-evolutionary history (Dr. Moriaki Yasuhara, JAMSTEC) and the nature of interactions between microorganisms and hydrothermal vent fauna (Magdalena Georgieva, Uni of Leeds, UK).



Encompassing the Palaeozoic to present day, the conference continued with discussions on the current threats to deep-sea biodiversity. Following a summary of anthropogenic influences by Dr. Telmo Morato (Uni of the Azores, Portugal) and Dr. Lisa Levin (Scripps, USA), a discussion was held on current governance structures and the lack of scientific representation in governing bodies, such as the International Seabed Authority. Attention was drawn to the requirements of future research, including the importance of discussing the cumulative effects of climate change and human disturbance in impact assessments, as well as the need for tools to predict, manage and mitigate impacts. The importance of baseline studies to assess such impacts was highlighted by the summaries presented for work within the ABYSSLINE project by Dr. Andrew Gooday (NOC, UK) and the discussion by Dr. Thomas Dahlgren (Uni Research, Norway). The ABYSSLINE project is currently working towards an assessment of the microbial community associated with sediments and nodules found within the UK mining-claim area of the Clarion-Clipperton Fracture Zone (CCFZ), whilst Dr. Dahlgren discussed the use of express-taxonomy to address the lack of taxon lists in areas such as the CCFZ. Presentations also included an assessment of the impacts of long-line fishing in comparison to bottom trawling by Christopher Pham from the University of the Azores, as well as research highlighting the use of environmental metagenomics and environmental DNA (eDNA) in assessing micro- and meio-benthic diversity (presented by Dr. Jan Pawlowski, Uni of Geneva, Switzerland). Dr. Frederic Sinniger (JAMSTEC) further discussed these techniques as a potential tool in deep-sea environmental impact assessments.

The deep-sea element of the conference concluded with a session dedicated to research in biodiversity and biogeography. The key note presentation by Dr. Angelika Brandt (Uni of Hamburg, Germany) documented the latest results from a cruise series to the Kurile–Kamchatka Trench, where >1,780 species were identified with ~50% found to be new to science. The work, dedicated to analysing the biodiversity and biogeography of the North-West Pacific, is to be released as a collection of 34 manuscripts early next year and highlights the extent of new discoveries within the field of deep-sea biodiversity. Research into the biodiversity and community structure across different deep-sea habitats was also presented. Comparisons made by Dr. Malcolm Clark (NIWA, NZ) across the diverse environmental setting of New Zealand, analysis of trophic interactions among cold seep communities by Dr. Hsuan-Wien Chen (National Chiayi University, China) and a range of presentations from students across the globe, illustrated that the field of deep-sea biodiversity research continues to grow. Current research is exploring new areas and increasing our knowledge of the history, the current state and future threats to deep-sea biodiversity.

Congratulations go to all the presenters who attended the WCMB 2014; it is extremely encouraging to see the developments in deep-sea biodiversity research and the range (or should that be 'diversity') of on-going research topics.

European Geosciences Union

General Assembly 2015

Vienna | Austria | 12 – 17 April 2015

Aims & Scope

The EGU General Assembly 2015 will bring together geoscientists from all over the world to one meeting covering all disciplines of the Earth, planetary and space sciences. The EGU aims to provide a forum where scientists, especially early career researchers, can present their work and discuss their ideas with experts in all fields of geoscience.

BG9.2

Natural and anthropogenic disturbances in deep-sea ecosystems

Convener: Andrew K. Sweetman, International Research Institute of Stavanger, Norway

Co-Convener: Dick van Oevelen, Royal Netherlands Institute for Sea Research, Netherlands

The deep sea covers approximately 60% of our planet and, until just a few decades ago, was considered to be stable on multi-decadal time scales. This view has changed radically following technological advances that fostered the discovery of the arrival of pulses of fresh phytoplankton at the abyssal seafloor, active mudflows at cold seeps and migrating seepage sites along mid-ocean ridges. However, how these natural disturbance events affect the functioning of this vast ecosystem still remains largely unknown. Over the next decades, the deep sea will be increasingly impacted by anthropogenic disturbances due to climate change, deep-sea fisheries, oil and gas exploitation and deep-sea mining. The latter will, for example, disturb extensive areas of seabed through material and habitat removal and generate near-bottom and mid-water sediment plumes. An approach in which natural dynamics and anthropogenic impacts are viewed as perturbation events will not only generate a better understanding of this unique ecosystem, but will also allow estimates of ecosystem resilience and recovery rates, which are sorely needed for environmental impact studies. In this session, we welcome novel experimental, empirical and modeling studies that shed new light on the impact and dynamics of natural and anthropogenic disturbances on the deep sea.

http://meetingorganizer.copernicus.org/EGU2015/provisionalprogramme

Canada-EU marine cooperation in cabled observatory science

Aguzzi J. and García I.

The growing socio-economic concern over the best practices for the exploration, catastrophic event detection and sustainable management of marine ecosystems has driven the implementation of highly interdisciplinary, fixed monitoring platforms, integrating biological, geological and oceanographic sensors. As a result, the cabled observatory technology is a rapidly growing discipline, the appeal of which goes beyond oceanography and geophysics, including also marine ecologists. In fact, a growing number of these platforms are being updated with video cameras. Cameras can provide data at different levels of ecological complexity (from the individual up to species, population and community). These can be used to measure the real-time response of animals to environmental changes (characterized by the multiparametric set of platform sensors) form coastal areas to the abyss. Further technological development is now required in order to transform video-observatories in smart and reliable ecological monitoring tools. That implementation should occur in relation to: i. automated acquisition, storage and processing of complex multiparametric biological and environmental data; ii. coordinated measurement of seabed and water column parameters by stations integrated into networks that spread over larger geographic areas and depth ranges; and, finally, iii. social participation on derived observations via Internet interfacing and social networking.

In this framework, the Canadian Embassy in Madrid (Dr. I. Garcia) and the Marine Sciences Institute of Barcelona (ICM-CSIC; Dr. J. Aguzzi) are organizing a meeting in Barcelona (Spain) to be held on 21 of November 2014 with Dr. K. Juniper (Executive Director, Science & User Engagement of Ocean Network Canada-ONC). Dr. Juniper will give a talk entitled:

“Ocean Networks Canada: Partnering scientific and technological innovation in Canada’s three oceans”

Other participants will expose also their case studies with the objective of establishing a suitable and pleasant environment for discussing collaborative scientific initiatives within the HORIZON 2020 programme and other actions (e.g. EUREKA). This meeting will provide an opportunity to exchange and share experiences, discussing future potential partnership under Horizon 2020, EUREKA and/or projects of mutual interest.

Canada joined forces with EU and US partners in May 2013 through the Galway Declaration and agreed to create the Transatlantic Marine Research Alliance. The Alliance members have a shared vision of an Atlantic Ocean that is healthy, resilient, safe, productive, understood and treasured so as to promote the well-being, prosperity, and security

of present and future generations. As result of the Alliance, Canadian researchers have priority access to key parts of "Horizon 2020" (e.g. Calls for Proposals under "Blue Growth" BG 8, BG 14, BG 15 and others).

Participating Entities: ICM-CSIC (Barcelona, Spain), CEAB-CSIC (Blanes, Spain), IMEDEA-CSIC (Palma de Mallorca Spain), SOCIB (Palma de Mallorca Spain), CRG Marine Geosciences-UB (Barcelona, Spain), SARTI-UPC (Villanova I la Geltrù, Spain), 1000001 Labs (Barcelona, Spain), IEO (Vigo, Spain), PLOCAN (Las Palmas, Canary Islands), TECNALIA (Bizkaia, Spain) MINECO (Madrid, Spain), SmartBay (Galway, Ireland), CRA (Rome, Italy), INGV (Rome, Italy), EMSO (Rome, Italy), Jacobs University (Bremen, Germany), IRD (Banyuls sur Mer, France), KAUST (Thuwal, Saudi Arabia), COST.EU (Brussels, Belgium), and finally UNESCO.

IABO Executive Committee, 2014

The International Association for Biological Oceanography (IABO) Executive Committee met on 15th October 2014 at the World Conference of Marine Biodiversity in Quingdao, China. Ten delegates from developing countries (Sanna Durgappa (India); Girish Beedessee, Nadeem Nazurally (Mauritius); Mhairi Alexander, Tammy (Tamara) Robinson (South Africa); Fernando A. Zapata (Colombia); Joel Kareithi Gatagwu (Kenya); Olesia Vishchuk (Russia); Hoang Dinh Chieu (Vietnam); Junior Vitor (Peru)) received travel grants from SCOR to attend WCMB 2014 as this was the IABO General Assembly. A call for new committee members resulted in six new members. Thus the present committee of David Paterson (Scotland, convenor WCMB II), Patricia Miloslavich (Venezuela), Annelies Pierrot (Past-President, Netherlands); Michael Thorndyke (Sweden), Sun Song (China, convenor WCMB III, SCOR Vice-chair), Mark Costello (President, New Zealand, WoRMS, GEO BON) is joined by Eulogio Soto (Chile), Tina Molodtsova (Russia), Isabel Sousa Pinto (Portugal) (IPBES, GEO BON), Suchana Apple Chavanich (Thailand, IOC/WESTPAC), Siew Phang Moi (Malaysia), Philippe Archambault (Canada, the next WCMB convenor).

The International Association for Biological Oceanography is a constituent Section of the International Union of Biological Sciences. The objects of the Association are to promote the advancement of knowledge of the biology of the sea, by providing opportunities for communication between marine biologists and co-operating with organizations and individuals with similar aims and interests. Further information about IABO and reports of the IABO Executive Committee can be found at http://www.iabo.org/

Request for workshop topics for IMBER IMBIZO IV

IMBER (Integrated Marine Biogeochemistry and Ecosystem Research) will hold the fourth in its IMBIZO series at the International Centre for Theoretical Physics (ICTP) in Trieste, Italy, from 26-30 October 2015 (IMBIZO is a Zulu word meaning a 'meeting or gathering').

Overall Theme of IMBIZO IV:

Marine and human system: Addressing multiple scales and multiple stressors

Summary

Marine ecosystems are amongst the most productive ecosystems in the world, providing benefits that humans depend on for survival, food, livelihoods and well-being. The interactions between humans and marine systems are complex and are continually evolving as they mitigate and adapt to the cumulative effects of global change.

The multiple stressors and drivers of global change in the marine and human systems differ geographically, depending on whether they occur in coastal areas, the continental shelf, or the open ocean, and moreover, vary at temporal scales.

The challenge for ensuring sustainable governance of marine ecosystems and human societies in the future is the development of systems level understanding of the effects of global change at multiple scales. IMBIZO IV will explore

the interactions of multiple drivers and stressors at different spatial and temporal scales. Of interest will be the global implications (and scaling up) of the responses of marine biogeochemistry, ecosystems, and social and governance structures observed at these different spatial and temporal scales.

Meeting Format

IMBIZO IV will follow the format of three concurrent and interacting workshops, with joint plenary and poster sessions. This has proved to be an effective format for stimulating discussion between interdisciplinary experts and also to provide linkages between biogeochemistry, ecosystem and social science research. To facilitate effective discussion, each workshop will be limited to about 40 participants. The participants will be selected on the basis of their active interests in the topic. The aim is also to provide balance in scientific disciplines represented at the workshops as well as the geographic origin of the participants.

Workshops

Each of the three workshops will include oral and poster presentations to showcase the current state of knowledge in marine and human systems and their governance. Discussion sessions will synthesize current knowledge and identify key questions to be addressed by the IMBER research community. It is expected that each workshop will produce a scientific product, for example a synthesis paper or special issue.

We invite members of the community to submit proposals for the topics of the three workshops. Please include a title, short description of the workshop topic, including key points that address the overall IMBIZO theme, and conveners for the workshop. The proposals will be reviewed by a selection committee and notifications of successful proposals will sent by mid-December 2014.

Please send workshop proposals to Lisa Maddison (lisa.maddison@imr.no) before 24 November 2014.

INCISE2014: Biologists, Geologists and Physical Oceanographers gather to discuss Submarine Canyons

Jaime Davies[1] and Veerle Huvenne[2]

[1]University of Plymouth, UK, [2]NOC, UK

From 28 September till 1 October 2014, 65 scientists from various disciplines gathered in Edinburgh for the 2nd International Symposium on Submarine Canyons. Hosted by the British Geological Survey, the aim of the meeting was to stimulate interdisciplinary discussions on major topics in Submarine Canyon research. And there certainly was a lot of discussion! All participants did a major effort to make their presentations and posters accessible for other disciplines (i.e. no excessive use of equations by the physical oceanographers; limited amounts of Latin names in the biological presentations). The result was a beautifully interactive meeting, a very good team spirit and the initiation of many new initiatives and research collaborations. NOAA sent a strong delegation presenting their extensive submarine canyons programme, and we even had a live link with the NOAA research vessel Okeanos Explorer, which was carrying out ROV surveys in submarine canyons and seamount areas offshore the US East Coast.

The four themes of the symposium (Canyon processes in space and time; New technologies to investigate canyons; Patterns and heterogeneity in canyons; Canyon disturbance and conservation) also formed the basis of break-out discussion sessions and are the topics of newly initiated Working Groups. The Working Groups will gather scientists interested in these specific aspects within Submarine Canyons, and will develop a range of outputs over the coming year(s) to tackle the main scientific questions. If you are interested, keep an eye on the website (www.incisenet.org) and the LinkedIn Discussion Group, or send us an email on incise@gmail.com. The next INCISE symposium is planned for 2016, and will be hosted by Ocean Networks Canada.

8th Course

International School on Foraminifera

Urbino - 3rd-22nd June, 2015

The 8th Course on Foraminifera is designed to provide an overview of the Taxonomy, Ecology, Biodiversity, and Geological History of Benthic and Planktonic Foraminifera. This intensive course is intended for students interested in Micropalaeontology, Palaeoceanography, Palaeoecology, Climate History, Biology, and Environmental applications. The aim is to provide a primer on the study of foraminifera and examples of how foraminifera can be used as (paleo)environmental and (paleo)oceanographical proxies. We review the current classification schemes of the foraminifera, discuss their ecology and life history, review their usefulness for biostratigraphical applications, and use case studies to investigate the geological history of the group with lab and practical sessions. The entire course consists of approximately 60 hours of lectures and 60 hours of practicals.

Course Structure

Four distinct courses are planned: *Foraminiferal Introduction* (4-8 June), *Larger Benthic Foraminiferal Course* (9-12 June), *Smaller Benthic Foraminiferal Course* (14-18 June) and *Planktonic Foraminiferal Course* (19-22 June).

Teaching format

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

Correspondence and information

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

How to make an application

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

Lectures

Prof. Michael A. Kaminski, King Fahd University of Petroleum & Minerals (Saudi Arabia)
Dr. Fabrizio Frontalini, Urbino University (Italy)
Prof. Laia Alegret, University of Zaragoza (Spain)
Dr. Antonino Briguglio, University of Brunei Darussalam (Brunei)
Dr. Claudia Cetean, Robertson Ltd (UK)
Prof. Rodolfo Coccioni, Urbino University (Italy)
Dr. Danielle Foy, Blue Phoenix Geological Ltd. (UK)
Prof. Felix Gradstein, Natural History Museum of Oslo (Norway)
Prof. Johann Hohenegger, University of Vienna (Austria)
Prof. Geraint Wyn Hughes, King Fahd University of Petroleum & Minerals (Saudi Arabia)
Dr. Sev Kender, British Geological Survey (UK)
Prof. Michal Kucera, MARUM & University of Bremen (Germany)
Prof. Jeno Nagy, University of Oslo (Norway)
Prof. James Ogg, Purdue University (USA)
Prof. Cesare Andrea Papazzoni, University of Modena e Reggio Emilia (Italy)
Prof. Jan Pawlowski, University of Geneva (Switzerland)
Prof. Maria Rose Petrizzo, Milano University (Italy)
Dr. Anna Sabbatini, Marche Polytechnic University (Italy)

For more information please visit our website at www.isf.tmsoc.org

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It's Your Opinion

Biodiversity baselines in the deep sea

Appeltans Ward[1] and Thomas J. Webb[2]

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A number of global assessment processes are underway, which also deal with marine biodiversity, such as the 1st World Ocean Assessment (WOA) under the United Nations (see p. xx), the Transboundary Water Assessment (TWA) under the Global Environment Facility, the 1st assessment of the recently established Intergovernmental Science-policy Platform on Biodiversity and Ecosystem Services (IPBES) is scheduled for 2018, and the 4th edition of the Global Biodiversity Outlook (GBO) under the Convention on Biological Diversity was recently launched in October in Pyeongchang, Korea.

These processes benefit from open-access online databases such as the Ocean Biogeographic Information System (OBIS) to determine biodiversity baselines against which change can be measured. OBIS was the data and information component of the decade-long Census of Marine Life (2000-2010) and now runs under the auspices of the International Oceanographic Data and information Exchange (IODE) programme of the Intergovernmental Oceanographic Commission (IOC) of UNESCO. OBIS currently provides access to >40 million distribution records of 115,000 marine species integrated from >1,600 datasets provided by 500 institutions in 56 countries and thanks to the continued support from many scientists and data managers continues to grow at a rate of ±2 million records per year.

IOC is coordinating the Global Ocean and Large Marine Ecosystem components of TWA and used OBIS in one of the TWA chapters, providing an overview of our current biodiversity stocktaking (Appeltans et al, 2015 in press). We cannot share with you all the results of this assessment yet, but are happy to share some figures on sampling effort that should be of interest to the deep-sea biodiversity community. A message on the INDEEP/DOSI mailing list related to this topic posted by Ward Appeltans sparked a lot of reactions.

Much of the deep-sea data published in OBIS were collected by 5 projects under the Census of Marine Life (ChEss, CenSeam, COMARGE, CeDAMar and MAR-ECO) united under SYNDEEP. An overview of the number of records per ocean depth in OBIS is provided in table 1. Note that not all data in OBIS have depth or sampling day and could not be included.

The seas above the continental shelf (0-200m) are clearly the most heavily sampled, followed by the mesopelagic continental slope (200-1,000m deep). In contrast, there are only 2 species records for every 100,000km3 above the abyssal plain (4,000-6,000 m), a zone which represents 70% of the ocean volume. In fact, all zones with bottom depth deeper than 1,000 m (zones C, D, E in Table 1) are severely under-sampled. Together these zones make up 98.7% of the total ocean volume.

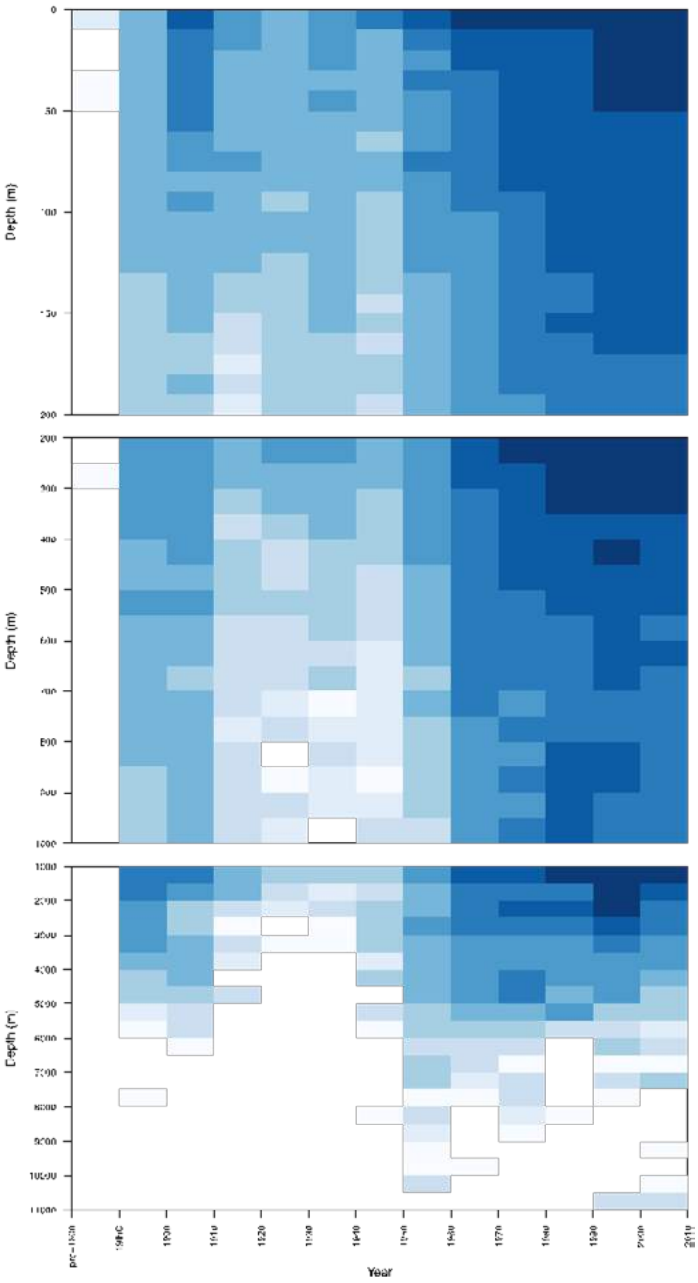

Figure 1. Three plots showing the number of species distribution records for depths of <200m, 200-1000m, and >1000m. The colour scale is re-set for each plot, so that dark blue means many more records in the <200m plot than in the >1000m plot. The depth resolution changes too (10m -> 50m -> 500m) (from Appeltans et al, 2015).

Figure 1 shows how species distribution records have accumulated through time by depth. Although the deep sea remains poorly sampled, sampling the shelf (i.e. 500-1,500m) has increased through time, with 70x more records in the 1990s (c.170,000) than in the 1950s (c. 2,500). Sampling between 3,000-5,000m peaked in the 1970s (c. 7,500 records), dropping to c. 1,600 records in the 2000s, and sampling between 1,000-3,000m peaked in the 1990s (c. 78,000 records), down to c. 37,000 records in 2000s.

Zone	Sampling days	Records	Species	% Ocean Volume
A: Continental shelf (0-200m)	529,248 (13,471)	10,154,841 (258,467)	89,418 (2,276)	0.31
B: Mesopelagic continental slope (200-1,000m)	266,846 (1,961)	2,086,305 (15,330)	42,200 (310)	1.07
C: Bathypelagic continental slope (1,000-4,000m)	339,696 (100)	2,428,958 (713)	43,743 (13)	26.77
D: Abyssal plain (4,000-6,000m)	103,038 (12)	778,213 (87)	17,650 (2)	70.32
E: Hadal zone (>6,000m)	1,790 (10)	21,039 (106)	1,749 (9)	1.56

Table 1: Number of sampling days, species distribution records and species within each depth zone of the global ocean. Actual counts are followed in parentheses by numbers normalized per 105 km3. The contribution of each zone to the volume of the global ocean is also shown (data from OBIS, June 2014 in Appeltans et al, 2015).

The peaks in the 1970s likely correspond with the origins of quantitative deep-sea ecology (Sanders & Hessler 1969) and the discovery of hydrothermal vent communities (Spiess et al. 1980). However, we are not certain about the reasons for the recent drop-offs in the areas below 1,000m. An obvious reason could be due to the time lag between sampling events and transfer of data to OBIS, but why would this be different from more shallow areas? The drop-off may as well reflect a shift in sampling efforts or methods (e.g. more image data which are not automatically translated into point observation data useful for sharing via OBIS).

Surprisingly is also that while there are a lot less species per volume in the deep-sea compared to the continental shelf, the number of species per sampling day is more or less the same for all zones A to D (between 0.13 and 0.16), except for the Hadal zone where 9 species are observed on average per sampling day. This may be due to more targeted sampling methods or different sampling volumes in the deep-sea for which these numbers are not corrected.

In conclusion, an analysis on the current status of our knowledge of deep-sea biodiversity would benefit from a global inventory of all deep-sea expeditions and data holdings, which could be coordinated under INDEEP or DOSI. Furthermore, efforts are underway to have a closer cooperation between IOC (OBIS) and the International Seabed Authority to create a global deep-sea biodiversity data-sharing platform. Publishing these data via open-access repositories like OBIS would benefit all scientists and resource managers as well as science as a whole.

The TWA biodiversity chapter also provides many more basic indicators of global biodiversity, so watch this space: http://onesharedocean.org.

For more information on OBIS and how you can publish your data via OBIS contact Ward Appeltans at info@iobis.org or w.appeltans@unesco.org.

References

- Appeltans W., Dujardin F., Flavell M., Miloslavich P., Webb T. (2015). Biodiversity Baselines in the Global Ocean. In: Fischer A. et al (Eds). Open Ocean Technical Assessment Report for the GEF Transboundary Water Assessment Programme (TWAP). UNEP, IOC-UNESCO. In press.-- Sanders, H.L. and Hessler, R.R. (1969). Ecology of the Deep-Sea Benthos. Science, 163(3874), 1419-1424. DOI:-1424f the Deep-Sea Benthos. - Spiess, F.N., Macdonald, K.C., Atwater, T., Ballard, R., Carranza, A., et al. (1980) East Pacific Rise: hot springs and geophysical experiments. Science 207(4438) 1421–1433.

COML Deep-Sea projects

Census of Diversity of Abyssal Marine Life (CeDAMar)
Continental Margin Ecosystems (COMARGE)
Mid-Atlantic Ridge Ecosystems (MarEco)
Global Census of Marine Life on Seamounts (CenSeam)
Biogeography of Deep-Water Chemosynthetic Ecosystems (ChEss)
Towards a first global synthesis of biodiversity, biogeography and ecosystem function in the deep sea (SYNDEEP)

Scientist Profiles

Johanne Vad

Environmental assessment of deep-water sponge fields in relation to oil and gas activity: a west of Shetland case of study.

Centre for Marine Biodiversity and Biotechnology, Heriot-Watt University

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My PhD project (supervised by Prof J Murray Roberts, Dr Tony Gutierrez and Dr Mark Hartl and advised by Dr Lea-Anne Henry and Dr Ted Henry) will be focusing on the impact of oil extractions on deep-sea sponges. Although these filter-feeder organisms are proven to perform a wide range of ecological functions, they remain largely under-studied. Widely distributed and highly diverse, they can form high density fields, supporting diverse macrofaunal communities. Most sponges are also host to a large array of microorganisms including bacteria, archaea, fungi, diatoms or microalgae.

Deep-water sponge fields are thus now considered as Vulnerable Marine Ecosystems (VMEs) and Ecologically and Biologically significant Areas (EBSAs). Their sensitivity to oil extraction activities in the North East Atlantic where sponges are present in the vicinity of oil rigs therefore needs to be investigated.

My project includes three main objectives: (1) complete visual surveys of sponge density and occurrence in the vicinity of BP's installations west of Shetland; (2) conduct experimental exposures to determine sponge response to oil/oil dispersant mixtures; (3) analyse microbial symbionts of deep-water sponges to test for the presence of oil-degrading taxa via CARD-FISH (Catalysed Reporter Deposition and Fluorescence In-Situ Hybridization) protocols.

This project is funded by NERC and Oil&Gas UK and in collaboration with BP. Hopefully this project will conclude with recommendations to oil industries on impact of oil-linked activities on deep-sea sponges and their ability to recover from a putative oil spill.

Mari Heggernes Eilertsen

Evolution and biogeography of vent and seep fauna

PhD student, Centre for Geobiology and Department of Biology, University of Bergen, Norway

http://www.uib.no/en/geobio/52249/vent-and-seep-biota

I am interested in the biogeography and evolutionary history of deep-sea animals, particularly in the relationship between reducing ecosystems (vents, seeps and organic falls), and genetic connectivity across ocean barriers. To investigate this I am working on two different animals, the calcareous sponge *Sycon abyssale*, and polychaete worms of the family Ampharetidae.

Sycon abyssale is distributed throughout the Nordic Seas between 1500-4000 m depth, and is also found in the North-Atlantic. It is hypothesised that the Greenland-Iceland-Faroes (GIF) ridge is a barrier to dispersal between the Nordic Seas and the North Atlantic, and I will test that hypothesis by looking into the genetic connectivity between populations of S. abyssale. If there is a barrier-effect of the GIF ridge, this will probably also affect the vent and seep fauna in the Arctic.

Ampharetid polychaetes are known from vents and seeps in the Pacific and Atlantic. In my study area, the Arctic Mid-Ocean Ridge (AMOR), we have found two new ampharetid species at the Loki's Castle

vent field (~2500 m water depth). Using a set of nuclear and mitochondrial markers, I am building a time-calibrated phylogeny of the subfamily Ampharetinae to learn more about the evolutionary origin of the Arctic vent and seep fauna. Are the species found here closer related to species in the Atlantic or the Pacific? How does the hydrothermal vent fauna relate to that found on cold seeps? When did the speciation into the Arctic system happen? These are some of the questions I want to answer with this project.

In addition we are exploring the global biogeographic position of the AMOR vent fields using multivariate statistics. Their communities appear quite distinct from others of the North Atlantic and North Pacific and may therefore constitute a new zoogeographical province for vent fauna.

I am very excited to continue my research on deep-sea animals, and I am looking forward to finding out more about what happens down there in the dark. Please feel free to contact me: Mari.Eilertsen@bio.uib.no

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Rachel Boschen

Environmental effects of deep-sea mining

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I am a PhD student in the final year of my deep-sea ecology studies investigating the environmental effects of deep-sea mining. The New Zealand Exclusive Economic Zone (EEZ) has various mineral, oil and gas resources of commercial interest. My research focusses on the potential effects of Seafloor Massive Sulfide (SMS) mining on the deep-sea benthic fauna. This research has provided many opportunities to be involved in cruises, workshops, conferences and stakeholder meetings, both within NZ and abroad. The multidisciplinary nature of the project has required using techniques as varied as molecular tools for population genetics and video analysis to assess faunal distribution patterns and community structure. The ultimate aim is to bring this knowledge together to produce an Ecological Risk Assessment for the impact of mining activities on the benthic fauna.

Researching deep-sea mining can be a complex task. The deep sea is a fascinating environment that at times we seem to know frustratingly little about. Exploitation within this environment faces many challenges; both technologically and financially but also from the moral aspect. Society needs these mineral resources but it also needs to protect the organisms that live at the habitats where minerals are found. My research will hopefully provide some of the missing information required to make responsible management decisions about SMS mining in the NZ EEZ.

As part of my PhD, I co-authored an open access review on SMS mining (http://www.sciencedirect.com/science/article/pii/S0964569113001671) and I am actively involved in VentBase, having co-ordinated the 2014 workshop held at NIWA earlier this year. VentBase aims to develop consensus on managing the mining of SMS deposits and publish best practice documentation, for more information see the INDEEP-hosted website http://www.indeep-project.org/ventbase.

I am also the student representative for the emerging Deep-Sea Biology Society and would welcome any suggestions that students may have for what benefits they would like the society to provide.

Stephanie Sharuga

Benthic megafaunal ecology using imagery-based platforms

Louisiana State University, USA

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I have recently completed my PhD in Oceanography and Coastal Sciences at Louisiana State University, specializing in deep-sea benthic ecology. My research was part of a BP-funded project focusing on deep-sea benthic megafaunal

ecology in the northern Gulf of Mexico (GoM), as well as evaluating the use of ROVs and AUVs for environmental monitoring activities. In part, my research involved establishing an approach for quantifying abundances and biodiversity, along with evaluating natural and anthropogenic factors that may impact benthic megafaunal community characteristics in the deep-sea GoM. Over the years, I have worked extensively with ROV and AUV seafloor data through independent research projects using ROPOS data collected during NEPTUNE surveying in Canada, and as a guest scientist during a Sentry AUV telepresence cruise. I have also participated in numerous other telepresence research cruises as a Scientist Ashore and I am very interested in the role of telepresence technologies in furthering scientific research and education. My background and research interests are very interdisciplinary – along with my PhD, I have a Bachelor of Science in Biology and Earth and Ocean Sciences and a Master of Science in Environmental Management and Sustainability. Overall, my research interests lie in exploring natural and anthropogenic drivers of change in benthic environments. I am interested in exploring what natural environmental factors affect biodiversity and community characteristics, as these types of studies help provide information critical in deep-sea environmental monitoring programs. Further, I am particularly interested in assessing human impacts to the deep sea, including from offshore industries and fisheries activities. I am a proponent of developing better methodologies for less "invasive" sampling technologies like AUVs and ROVs to be used in conjunction with traditional physical sample collection for habitat evaluation and monitoring studies.

At this point in my career, I am looking for an opportunity where I can broaden my research horizons and work with a wide range of collaborators on interdisciplinary projects. If anyone knows of any postdoc or other opportunities, I would greatly appreciate if you would contact me! Feel free to contact me or request further info, my email is ssharuga@att.net.

Phillip J Turner

Impacts of anthropogenic disturbance on deep-sea biodiversity

Division of Marine Science and Conservation, Marine Laboratory, Nicholas School of the Environment, Duke University, USA

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I am a first year PhD Student at Duke University, USA, under the supervision of Dr. Cindy Van Dover. My research is focused upon the impacts of anthropogenic disturbance on deep-sea biodiversity, primarily from deep-sea mining. With advancing technology and depleting terrestrial resources, deep-sea mining is becoming a reality; therefore, informing pre-industrialization policy and assessing potential management mechanisms are priorities for deep-sea biologists. Rare species are often described as being disproportionally affected by anthropogenic disturbance and, with the deep-sea characterised by a high proportion of rare species, the initial phase of my research is to assess current knowledge in rare species environmental management for shallow water and terrestrial environments. Knowledge gained from management practices within these environments may provide useful insights for the deep sea.

I am particularly interested in the methods used to assess rare species populations using variables other than abundance. For example, occupancy has been used to construct multi-seasonal models that assess the detection history of rare species and provide estimates of the proportion of sites occupied by the species, the probability of sites being colonized and the probability of the species going locally extinct. In July 2015, I will join a cruise to the Blake Ridge cold seeps, on the Blake Plateau, to unexplored cold seeps within the Norfolk and Hudson Canyons and off the coast of New England. Using a combination of habitat mapping, still imagery and video systems, I hope to test the practicalities of applying occupancy models to the deep-sea environment.

By posing the question 'what proportion of the landscape is inhabited by a species' and using models to make inferences about these distributions, population assessment and monitoring may be made more efficient. Such information may prove useful in developing deep-sea management mechanisms and, as part of the Van Dover lab group, I have the opportunity to work in the boundary between biological research and policy discussions.

If you would like to discuss my research further, please do not hesitate to contact me:
e-mail: phillip.turner@duke.edu
LinkedIn: uk.linkedin.com/pub/phillip-turner/76/2a8/563/

Opportunities

Duke | NICHOLAS SCHOOL OF THE ENVIRONMENT

MARY DERRICKSON McCURDY VISITING SCHOLAR
AT THE DUKE UNIVERSITY MARINE LABORATORY, BEAUFORT, NC

The Nicholas School of the Environment at Duke University invites outstanding candidates for the Mary Derrickson McCurdy Visiting Scholar position at the Marine Laboratory in Beaufort, on the North Carolina coast. This opportunity is open to early career scientists and sabbatical researchers. McCurdy Scholars engage in the intellectual life of the Marine Laboratory, including research, teaching (at least one course), and mentoring in an intimate, world-class multidisciplinary research and teaching environment. Our ideal candidate for the position is a gregarious natural, social or interdisciplinary science scholar in the field of Ocean Science and Conservation, broadly construed. We strive to understand marine environmental processes, human behavior in coastal systems and their interactions (e.g. marine biology, oceanography, biogeochemistry, social-ecological systems, fisheries management, marine conservation, human-environment interactions, coupled human and natural systems, resilience). The term of the appointment is for one or two semesters (preferably the nine-month academic year), with the possibility of expansion to one full year in the case of an early career scientist. Financial support for salary and research is negotiable

Interested individuals should send curriculum vitae, summary of research interests, reprints of three recent papers and names of three references to Brian Silliman. Electronic submission is required.

Brian Silliman
Chair, Search Committee, McCurdy Visiting Scholar
135 Duke Marine Lab Road
Beaufort, NC 28516-9721
Brian.Silliman@Duke.edu

The search committee will begin reviewing applications on December 15, 2014.
The search will remain open until the position is filled.

Duke University is an Affirmative Action/ Equal Opportunity Employer.

Graduate positions in larval ecology and development

Rutgers University, New Brusnwick, NJ, USA

Adviser: Diane Adams

The Adams lab in the Dept of Marine and Coastal Sciences, Rutgers University, is seeking applicants for up to two PhD positions to begin summer or fall of 2015. Our lab has interdisciplinary interests in the acclimation and adaptation of marine invertebrates to environmental variability through developmental plasticity and population connectivity. We focus on early life history stages of deep-sea and shallow water invertebrates, including sea urchins, corals, and gastropods, in highly variable or disturbed environments. Students joining the lab will have the opportunity to develop their own research projects in consultation with Dr. Adams, with topics ranging from molecular, developmental, and physiological mechanisms of phenotypic plasticity and settlement, to larval aggregation and transport within oceanographic features. Independent thinking and integrative approaches are strongly encouraged.

The ideal candidate will have an outstanding record and background in biology or life sciences, with experience in marine ecology, developmental biology and/or evolutionary biology. Enthusiasm, excellent written and oral communication abilities, and strong quantitative skills are necessary. In-progress applications to external fellowships are also viewed favorably. Interested candidates should send an email to diane.adams@rutgers.edu with a concise description of their motivation and research interests along with a CV, GPA, and GRE scores (if available). Qualified candidates will be contacted and encouraged to apply to the Rutgers graduate programs (http://gradstudy.rutgers.edu/) in Oceanography (due Jan 15th) and/or Ecology & Evolution (due Jan 10th). For more information on the lab go to http://adams.marine.rutgers.edu

Rutgers University

Situated in New Jersey, a crossroads of American enterprise, commerce, and culture, Rutgers has a vibrancy that derives from its location and a history entwined with that of the nation. Chartered in 1766, the university is the only one in the United States that is, at once, a colonial college, a land-grant institution, and a state university. Located within an easy drive of New York City, there are nonetheless an exceptionally wide array of marine, freshwater, and terrestrial ecosystems nearby. Within a single day, one can visit and study habitats of the continental shelf, estuaries, barrier islands, coastal plains, the piedmont, Precambrian highlands, and ridge and valley geological provinces.

The Department of Marine and Coastal Sciences serves as the hub for Rutgers' research programs in marine and coastal sciences and provides a focus for the education of marine scientists in biological, chemical, geological and physical oceanography. The department maintains a tradition of pioneering research through integrative, inter-disciplinary approaches to ocean science, education and public service. The state-of the-art research building in New Brunswick, NJ includes seawater, molecular biology, imaging, remote sensing, and ocean modeling facilities. Field stations provide convenient access to the local marine ecosystems.

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MASTS Deep-Sea visiting Fellowship

Are you due a Sabbatical? Need a change of scene to try and come up with new proposal ideas, write new papers? Have you ever thought of coming to Scotland to do this but just not found the right mechanism or funding opportunity to do so? If so, carry on reading!

The Marine Alliance for Science and Technology for Scotland – Deep Sea Forum has announced its first call for a Deep-Sea Visiting Fellow. The call is open to anyone **EXTERNAL** to the UK who wishes to come and work (in any deep-sea discipline) with colleagues in MASTS Institute (must be at least 2 partner Institutes) for a period of between 1 – 6 months. The Institutes hold vast arrays of specimens and data and members are keen to hear from anyone who wishes to come and work with them. We are particularly keen to hear from people who are interested in collaborating on research proposals and producing joint papers.

The Deep Sea Forum is able to pay travel and subsistence costs up to a total of £4,000, however, funds unfortunately cannot be used for salary or research costs.

Some of the MASTS Partner Institutions in the Deep-Sea Forum are:

- SAMS – as part of the University of the Highlands and Islands
- University of Aberdeen
- Marine Scotland Science
- British Geological Survey
- University of Glasgow

A full list of MASTS institutes can be found at this link here http://www.masts.ac.uk/about/partner-institutions/

The deadline for applications is Friday 12th December 2014, 4pm UK time and the application form can be found at this link here (http://www.masts.ac.uk/about/funding/). Application forms should be submitted to masts@st-andrews.ac.uk

If you would like any further information, please don't hesitate to contact Bhavani Narayanaswamy (Bhavani.Narayanaswamy@sams.ac.uk) before the 30 November 2014.

Above: Images just to prove that it doesn't always rain in Scotland!

Mapping the deep: the application of predictive modelling to European spatial planning. PhD Project Offered.

Kerry Howell

Plymouth University, UK

Maps have proved to be a useful method of summarising biological information concerning the seabed. Mapping at the level of species or assemblages is a major problem in the deep sea, where sampling is expensive and logistically challenging due to its remoteness, depth and relatively poor ecological knowledge of the residing fauna. Recently the use of species distribution modelling (SDM) has been applied to assemblages to produce maps of their distribution over large spatial scales (Howell et al. 2011; Rengstorf et al. 2013; Ross & Howell 2013). Predictive modelling is a promising tool in this area potentially reducing the cost of comprehensive field surveys by allowing targeting of important areas, and filling data gaps for large areas of un-sampled seabed (Galparoso et al. 2009; Elith & Leathwick 2009; Dambach & Rodder 2011; Robinson et al. 2011). However there remain a number of questions around the utility of these approaches and the reliability of the outputs. We propose a PhD study to test the following hypotheses:

H1: Predictively modelled habitat maps provide an accurate reflection of the distribution of the benthic assemblages considered.

H2: Models constructed using high resolution multibeam bathymetry data perform significantly better than those constructed using coarser resolution GEBCO bathymetry data.

H3: Models which incorporate hydrodynamic variables perform significantly better than those that do not.

This PhD is offered in collaboration with the University of Ghent in Belgium and the University of Aveiro in Portugal. The successful candidate would be required to spend time at all three institutes. For further details please see http://www.mares-eu.org/index.asp?p=2174&a=1853&mod=phd&id=210

Wanted

WANTED! *Sycon abyssale* and Ampharetid polychaetes

Mari Heggernes Eilertsen

Marine Biodiversity Research Group/Centre for Geobiology, University of Bergen, Norway

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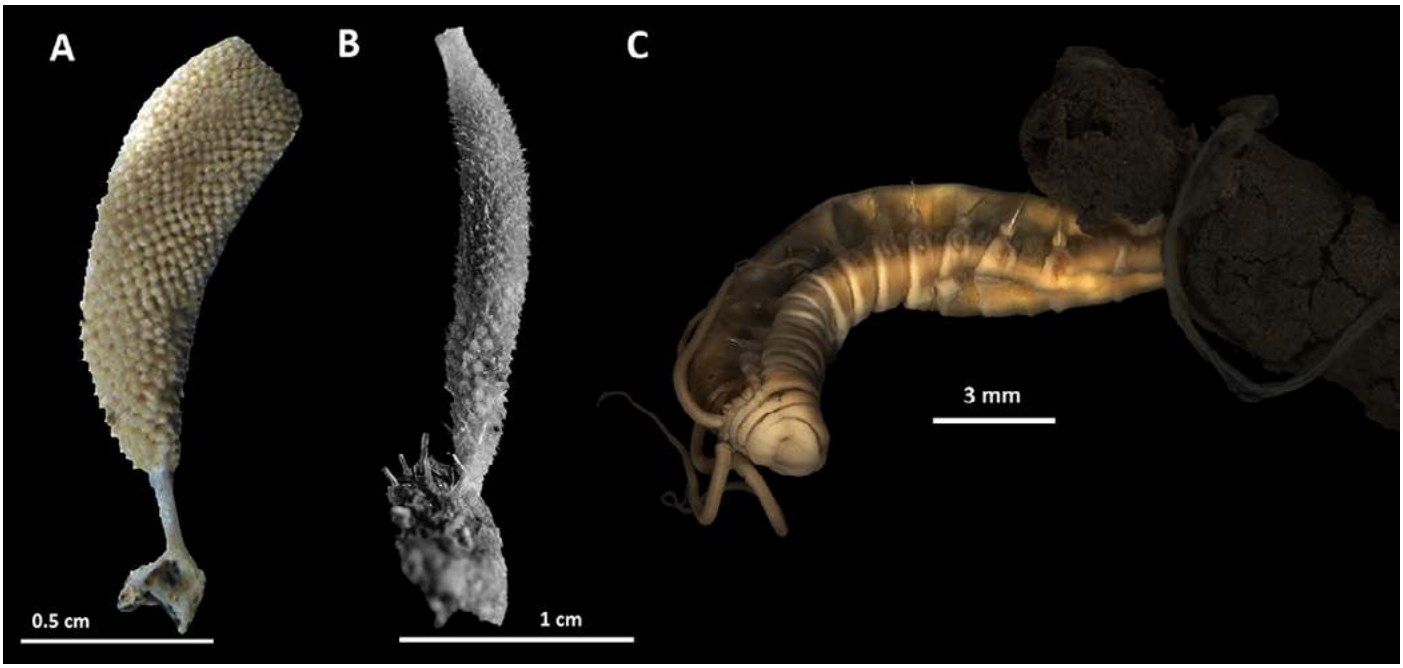
I am interested in material fixed in 96% ethanol (suitable for DNA extraction) from the calcareous sponge *Sycon abyssale*, and polychaetes in the family Ampharetidae. Of *Sycon abyssale* I am interested in material from the North Atlantic (south of Iceland) and north of Svalbard (Fram Strait and further north). This species is often found sitting on small rocks, foraminiferans, or on other sponges between 1500-4000 m water depth. I am interested in Ampharetid worms from all over the world, but in particular from the Atlantic, Indian Ocean and the Antarctic. Specimens from deeper localities (>1000 m) and from hydrothermal vents, seeps or organic falls are especially welcome.



A and B: Sycon abyssale. Photo: H.T. Rapp. C: Ampharetid polychaete. Photo: K. Kongshavn.

Wanted: Images of deep-sea taxa!

Nick Higgs[1], Adrian Glover[2] and Tammy Horton[3]

[1]University of Plymouth, UK, [2]NHM, UK, [3]NOC, UK

We are preparing an update to the popular Deep Sea ID app and have over 100 new images, but we still have significant gaps. We are eager to find images of the following taxa: Acanthocephala, Chaetognatha, Chephalochordata, Gastrotricha, Phoronida, Platyhelminthes & Rotifera.

Collections of some more familiar groups such as molluscs are comparatively under populated so we would be very grateful to receive any further images of deep-sea life. If you feel that you can help or even point us in the direction of a specialist who may have access to species images, please contact Adrian, Tammy & Nick via email: deepsea@marinespecies.org.

Above: Prionospio ehlersi*, courtesy of Adrian Glover*