



National
Oceanography
Centre

DEEPEND PROJECT: SPONGE IDENTIFICATION WORKSHOP

4th - 8th March 2024

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TABLE OF CONTENTS

INTRODUCTION	1
Introduction to THE DEEPEND project	1
PLANNING & PREPARATION FOR THE WORKSHOP	2
Planning the workshop	2
Preparing the catalogue	2
Setting the Aims.....	3
INVITED EXPERTS.....	4
Joana Xavier, CIIMAR, University of Porto, Portugal.	4
Paco Cárdenas, Museum of Evolution, Uppsala University, Sweden.....	5
Pilar Rios, IEO-CSIC, Gijón, Spain.	6
Andreu Santín, CIIMAR - University of Porto, Portugal	7
Javier Cristobo, IEO-CSIC, Gijón, Spain.	8
Christine Morrow, Queens University, Belfast, Northern Ireland.....	9
Celso Domingos, CIIMAR, University of Porto, Portugal.....	10
Julie Light, Glass Artist, UK.....	11
PRIORITY SAMPLES	12
Porcupine Abyssal Plain Sustained Observatory (PAP-SO).....	12
Clarion Clipperton Zone (SMARTEx program).....	13
Mid-Atlantic Ridge (ECOMAR program)	13
Haig Fras/Whittard Canyon/Rockall samples (ROV collected)	14
Crozet Islands Abyssal samples (Benthic CROZEX)	15



OVERVIEW OF THE WORKSHOP	18
RESULTS	19
Identifications	20
CONCLUSIONS	22
REFERENCES	24
APPENDICES	26
Workshop Agenda	27
News Items:	33

INTRODUCTION

INTRODUCTION TO THE DEEPEND PROJECT



DEEPEND

Deep-ocean resources and biodiscovery

The Sponge Identification & Training Workshop was part of DEEPEND ([DEEPEND: Deep-ocean resources and biodiscovery](#)), a project funded by the UK DEFRA [Global Centre on Biodiversity for Climate Programme](#). The DEEPEND project is a collaborative effort to study the societal value of biodiversity in the deep-sea.

Marine organisms are a promising resource for useful natural products such as medicines. The potential use of biodiversity - or marine genetic resources (MGR) - has yet to be thoroughly explored in the deep sea. These organisms offer the exciting potential discovery of new gene clusters that direct the formation of enzymes and small molecules. These could have useful biotechnological and pharmaceutical applications, including the discovery of novel antibiotics, coming at a time when society faces an antimicrobial resistance crisis. Marine sponges are known to be important sources of novel natural products, yet the identification of sponge taxa (many of which are new to science) requires specialist taxonomic expertise.

DEEPEND was initiated in 2022 with an 8-month pilot project with an extension to the project being granted for a further 12 months, bringing the project to a close on the 31st of March 2024. As part of the extension funding, it was recognised that the team lacked expertise in sponge identification, despite this taxon being of utmost importance in biodiscovery. This workshop aims to go some way towards remedying this by providing some trusted identifications for taxa currently under study, and improving the identification of abyssal sponge taxa currently held in the Discovery Collections at NOC, which largely originate from the Porcupine Abyssal Plain, Whittard Canyon, Mid Atlantic Ridge and Haig Fras areas in the North Atlantic, and also selected specimens from the Central Pacific in the Clarion Clipperton Zone (SMARTeX Project).



PLANNING & PREPARATION FOR THE WORKSHOP

Planning the workshop

In preparation for the workshop, contact was made with sponge scientist and coordinator of the SponBIODIV project, Joana Xavier, to discuss the possibility of bringing together a group of taxonomic experts who would be willing to undertake the tasks of providing improved identifications and training for the DEEPEND project at NOC. SponBIODIV is a project co-funded under the European Biodiversity Partnership (Biodiversa+) that brings together 10 partner institutions across Europe, Brazil and South Africa to establish a knowledge baseline on sponge diversity and distribution and deliver tools to improve management and conservation of sponges across the Atlantic and Mediterranean (www.sponbiodiv.org). Joana suggested a particular group who have previously worked together on similar projects. Knowing there was a cohesive team in place we began planning for a suitable time for all the experts to come to the NOC for the workshop. Although this was planned originally to take place in November 2023, difficulties in ensuring everyone's availability meant this was eventually scheduled for March 4th-8th 2024.

Preparing the catalogue. Once the workshop experts had been selected, work was started to prepare for the workshop. It was recognised that there was no comprehensive catalogue of poriferan holdings of Discovery Collections materials. One of the aims of the project was to get a better understanding of the Discovery Collections holdings of deep-sea sponges. Therefore, the team set about to produce a full catalogue of sponge materials available for study, in preparation for the workshop. The Discovery Collections volunteers (Zuhayr Islam, Daniel Hampton, Laura Mcgonagle) were tasked with producing a catalogue of jar lots of Porifera which was lacking. A catalogue of the Crozet, ECOMAR and Porifera Tubs in the Discovery Collections was already available. In study of the newly created catalogue, we realised that the Crozet Island collection jars and tubs had been moved from the Crozet collections rack to the Poriferan section, meaning that the Crozet Islands collection was lacking Porifera, which we have not noticed until now. This probably happened following a visit by glass sponge taxonomist Konstantin Tabachnick, of the P.P. Shirshov Institute of Oceanology, Moscow, Russia, around 2010 who arranged for samples to be sent on loan from the ECOMAR collection. There are a number of sponge samples that have 'BSO' numbers on them which indicate that they have probably been studied/subsampled by him during the visit, as these numbers are used in his publications.



The ECOMAR collection was the focus of his study and the two papers co-authored by Tabachnik (Lopes & Tabachnik, 2013; Tabachnik & Menshenina, 2013) were therefore compared with the ECOMAR holdings. It was discovered during this process that there are holotype materials within the NOC Discovery Collections that we were unaware of. These need to be located, and their identity confirmed, before being sent to the NHM in London, for long-term curation. One of our volunteers, Zuhayr Islam, spent extra time completing the Porifera catalogue and he is thanked for his hard work which was fundamental in support of this workshop. Thank you, Zuhayr!

Setting the Aims

In preparation for the workshop a set of tractable aims and outcomes were decided upon. These were:

- Improved awareness of the DEEPEND program and the Discovery Collections for the Sponge taxonomic community
- Improved identifications for abyssal sponges particularly from the Porcupine Abyssal Plain Sustained Observatory and Clarion Clipperton Zone samples collected during the SMARTERX program.
- Expert identified samples for the DEEPEND program.
- Training for NOC staff in deep-sea sponge spicule preparation and identification.
- New scientific discoveries? New species? New depth records?
- Fun & Friendship!

Training in the correct procedures to be used for identification of sponge taxa will be provided by the invited experts, such that the trainees are able to confidently identify to a particular taxonomic level (to be determined) before consulting with experts is required.

A workshop report will be produced. All participants will contribute to the writing of the report. The report will detail the results of the workshop in improving identifications of the sponge materials held in the NOC Discovery Collections.

INVITED EXPERTS



Joana Xavier, CIIMAR, University of Porto, Portugal.

Dr Joana Xavier is a principal Researcher and leader of the Deep-Sea Biodiversity and Conservation Team (DEEP) at CIIMAR, University of Porto (Portugal), and an Associate Professor in Deep-Sea Biology at the Department of Biological Sciences of the University of Bergen (Norway). Her research focuses on the understanding of basin-scale diversity, biogeographic, and connectivity patterns of deep-sea species and habitats, with a focus on Porifera, using a combination of disciplines (taxonomy, systematics, ecology and genetics). She founded an international series of Deep-Sea Sponge Taxonomy Workshops, held bi-annually since 2012, and in 2022 she joined the editorial board of the World Porifera Database (part of WoRMS) as a thematic editor for deep-sea sponges. She co-coordinated the Horizon 2020 SponGES project (www.deepseasponges.org), and currently coordinates the SponBIODIV

project (www.sponbiodiv.org) co-funded under the European Biodiversity Partnership (Biodiversa+). Joana has participated in 15 expeditions across the Atlantic, Arctic and Indian Ocean exploring deep-sea habitats on ridges, canyons, and seamounts.



Paco Cárdenas, Museum of Evolution, Uppsala University, Sweden.

Dr Paco Cárdenas started to work on deep-sea sponges in 2005, in the Norwegian fjords. He very quickly specialized in the demosponge order Tetractinellida, which currently holds more than 1000 species and is especially abundant in mesophotic and bathyal depths. He is currently head of the zoology collections at the Museum of Evolution at Uppsala University.



UPPSALA
UNIVERSITET



Pilar Ríos, IEO-CSIC, Gijón, Spain.

Dr Pilar Ríos defended her Doctoral Thesis on Antarctic sponges in 2007, obtaining the "Cum Laude" qualification and the extraordinary doctorate award. Currently Senior Scientist in the Oceanographic Centre of Gijón (IEO-CSIC), she has worked on different projects related to the protection and sustainable use of biodiversity in the Spanish seas by identifying valuable spaces for the Natura 2000 Network. During her research career, she has produced 40 scientific articles and is the co-author of 19 books or book chapters related to the marine environment, ecology, taxonomy, biodiversity or Vulnerable Marine Ecosystems (VMEs). She has worked on 30 research projects and has presented 117 scientific communications at conferences. She has participated in 18 marine research cruises on the coasts of the Atlantic Ocean: SW (Patagonia, Argentina), NW (European

coasts), SE (abyssal basins of the Cape, Angola and Guinea); Antarctica, Arctic and Indian Ocean (Mozambique). She is a professor of interns at the Universities of Málaga and Alcalá, and a reviewer for international journals and an editor of WoRMS (World Porifera Database). In the last five years, her lines of research have been directed to studies related to biodiversity, the characterization and conservation of benthic communities in VMEs.



**Andreu Santín, CIIMAR -
University of Porto, Portugal.**

Andreu is a postdoctoral researcher at the Centro Interdisciplinar de Investigação Marinha e Ambiental (CIIMAR, Portugal). His main line of research focuses on Vulnerable Marine Ecosystem (VME) indicator species, with special emphasis on sponges. Particularly, his aim is to increase our knowledge of the taxonomy, ecology and biogeography of VME species in order to enact effective conservation and management measures for their protection and restoration. To achieve this, in the last five years he has been working on a multidisciplinary approach, taking part in several research projects aimed at deep-sea exploration as well as projects relating to the development and validation of cost-effective active restoration and

mitigation techniques for deep-sea ecosystems. So far, he has published over 25 scientific articles on the topic. Finally, he has also taken part in science outreach projects and dissemination activities, having been interviewed by both local and national radio, newspapers, and TV programs in Spain.





Javier Cristobo, IEO-CSIC, Gijón, Spain.

He is European PhD in Marine Biology, Researcher at the Gijón Oceanographic Centre (Spanish Institute of Oceanography), where he was its director for 12 years. The main focus of his scientific interest is the Phylum Porifera including Taxonomy, Ecology, Sponge Grounds, but also marine invertebrates, deep-sea fauna, Antarctic research, vulnerable marine ecosystems (VME) and marine protected areas (MPA).

He has published over 130 scientific articles and books related to VME, deep-sea habitats, the impacts of fishing, marine diversity, and descriptions of new species, Antarctic research and biodiversity. Recent research programs include H2020 SponGES project (Deep-sea Sponge Grounds Ecosystems of the North

Atlantic: an integrated approach towards their preservation and sustainable exploitation), co-leading the work Package Biodiversity and currently the European project (SponBIODIV) entitled “Marine sponge biodiversity from genes to ecosystems: delivering knowledge and tools for sustainable management and conservation”. He has participated as an investigator in 37 funded research projects, presented more than 185 communications and talks at international conferences, Chief of mission in different scientific expeditions, in Cantabrian Sea, Portugal, Namibia, Patagonia, North Sea, South Africa, Cape Verde, Arctic and eight times in the Antarctic.



**Christine Morrow, Queens University,
Belfast, Northern Ireland.**

Christine Morrow is a post-doctoral research fellow at Queen's University Marine Laboratory in Portaferry, Northern Ireland. The topic of her PhD was Molecular and Morphological Systematics of Heteroscleromorph Sponges. Much of her research has focused on revising the classification of Demospongiae. She has participated as taxonomist on two deep sea research cruises to the Porcupine Bank and Whittard Canyon areas, NE Atlantic. A large part of her work has involved the production of identification guides and online resources for a range of marine invertebrate taxa.



Celso Domingos, CIIMAR, University of Porto, Portugal.

Celso Domingos is a PhD student of the Doctoral Program in Marine Science, Technology and Management at the University of Porto and develops his research activities at the Interdisciplinary Centre of Marine and Environmental Research (CIIMAR-UP). His research interests are on taxonomy and systematics of sponges (Classes Homoscleromorpha and Hexactinellida). He addresses these and other questions on diversity and distribution patterns of these groups using integrative approaches that combine morphological, molecular and ecological data. To date, he has (co-) authored 5 publications in the field and participated in numerous national and international conferences.



Julie Light, Glass Artist, UK.

Julie Light is an artist working in glass, making sculpture on themes about human and animal health and where they intertwine. As part of this she has become increasingly interested in the impact of human activities in the deep ocean, resulting in the ongoing development of an artwork, *The Marine Museum of Lost Potential*, which draws on ideas and research from the DEEPEND project.

Julie has exhibited her work in various settings across the UK and internationally, including galleries, gardens, museums, and hospitals. She has created and curated artwork collaboratively with individuals, scientists and policymakers in organisations including AstraZeneca, The University of Leeds, The London Cancer Hub and The Royal Society as well as at the National Oceanography Centre.

Julie's work has been recognised in several awards and competitions, including the Glass Prize and The Aesthetica Art Prize. She has an MA in Art & Science from

Central St Martins, UAL, and is a member of the Royal Society of Sculptors and the Contemporary Glass Society.

PRIORITY SAMPLES

While a comprehensive catalogue of poriferan samples held at the NOC Discovery Collections was produced, this contained far too many samples (687 lots) to identify in a single week. Therefore, a smaller number of priority samples were selected for identification by the experts during the workshop week. These broadly fell into the following categories and therefore we provide a short overview of these sample collections here.

Porcupine Abyssal Plain Sustained Observatory (PAP-SO)

The Porcupine Abyssal Plain Sustained Observatory (PAP-SO; <https://projects.noc.ac.uk/pap/>) is a multidisciplinary open-ocean time series site in the NE Atlantic (48°50' N 16°30' W, 4850 m water depth; Figure 1 from Hartman et al., 2021).

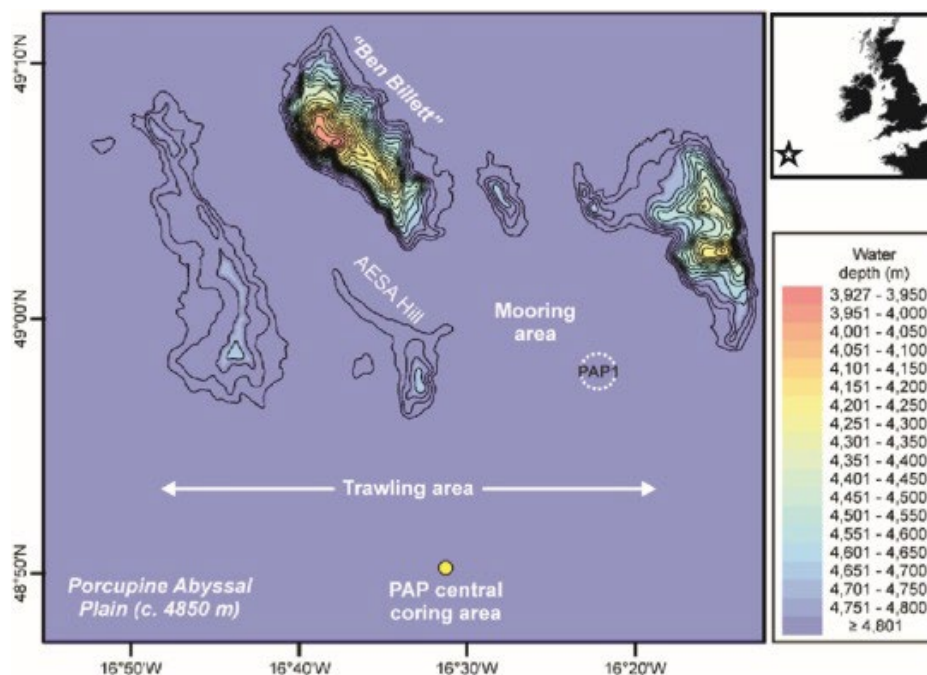


Fig. 1. Location of the Porcupine Abyssal Plain Sustained Observatory (PAP-SO) in the northeast Atlantic Ocean showing the typical working areas at the PAP-SO for a range of operations (demersal trawling, seabed coring, seabed moorings) and the current location of the “PAP1” surface buoy. (From Hartman et al., 2021)



Sampling has been taking place at the PAP-SO site using a variety of methods since 1989, and the samples selected for this workshop were mostly from the Otter Trawl collections (OTSB, Otter Trawl Semi Balloon). From a total of 177 sample lots from the PAP-SO, a smaller number (**36 samples**) that have either been fixed and preserved in ethanol (and thus available for barcoding), carefully collected by ROV, or from more recent research cruises, were chosen to be studied as a priority.

Clarion Clipperton Zone (SMARTEX program)

The SMARTEX program (<https://projects.noc.ac.uk/smartex/>) is a NERC funded research project which aims to provide the critical scientific understanding and evidence-base to reduce risks of deep-sea mining of polymetallic nodules in a 6 million km² region of the central Pacific Ocean. The first SMARTEX expedition (JC241) to the Clarion Clipperton Zone (CCZ) in the Pacific Ocean took place in February-March 2023. The aim was to investigate the recovery and changes at a previous experimental test site by mapping the seabed habitat and assessing geochemical, biological and ecosystem changes. The sponge samples from JC241 (**11 samples**) were already barcoded and spicules had been prepared on slides by the Natural History Museum Team for the sponge experts to check the identifications already proposed based on the closest molecular ID match.

Photographs were provided of the sponge specimens in situ and during collection/on board ship prior to preservation. During the workshop the SMARTEX 2 (JC251) cruise was already underway and photos of the samples being collected were shared with the sponge team to see if they could confirm any of the preliminary identifications being made. It was recognised that without spicule preparations/molecular barcode, a complete identification to the species level would not be possible, but some family/genus level identification was possible.

Mid-Atlantic Ridge (ECOMAR program)

The ECOMAR program was a four-year NERC funded research program designed to investigate the Charlie Gibbs Fracture Zone area of the Mid-Atlantic Ridge (Figure 2, from Priede et al., 2013) which lies approximately mid-way between Iceland and Azores. Owing to its remoteness from land masses this region is not routinely visited by research vessels. Four superstations were defined (two north of the CGFZ and two to the south), at 2500 m, and were revisited during voyages by the RRS *James Cook* and the RRS *Discovery* during the years 2007–2010 to replicate sampling, time-series investigations and flux studies (Priede et al., 2013). This large collection of sponge material has been partially studied with publications on the Hexactinellida (Lopes & Tabachnik, 2013; Tabachnik & Menshenina, 2013) but not the Demospongiae. A number of queries had arisen during the curation of this collection, which required the attention of expert taxonomists to resolve and to confirm suspected identities of the material held. A total of 57 sample lots of Porifera were available from this collection.

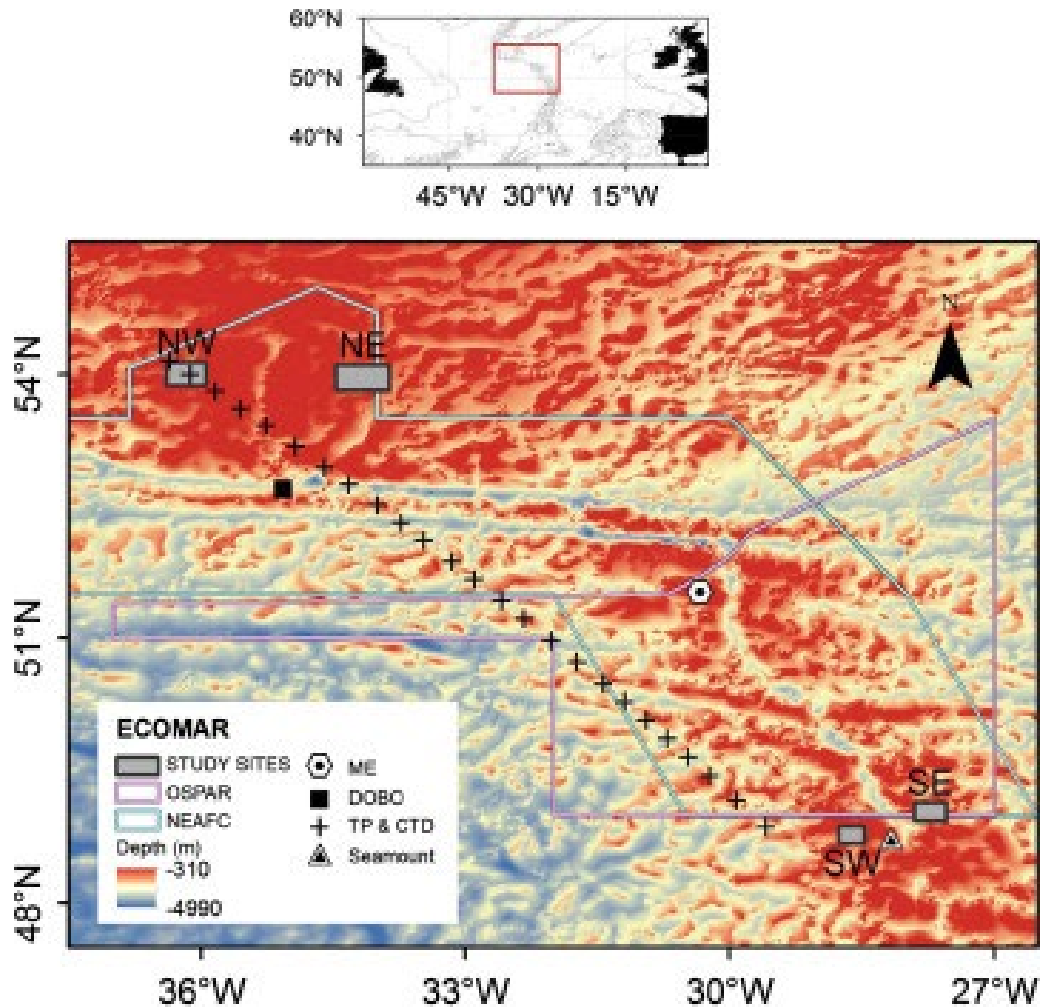


Figure 2. Chart of the North Atlantic Ocean showing the location of the ECOMAR study area and four Superstations. The upper panel indicates the area shown in the main map. (From Priede, et al., 2013)

Haig Fras/Whittard Canyon/Rockall samples (ROV collected)

There were a small number of samples collected during sampling expeditions in the North Atlantic using the ROV ISIS, which has resulted in some high-quality materials from important areas of the North Atlantic with regards to management and monitoring. These were therefore prioritised for identification during the workshop. There were eight sponge samples from Haig Fras, two from the Whittard Canyon area and three from the Rockall region. The Greater Haig Fras Marine Conservation Zone was designated in 2016 under the Marine & Coastal Access Act 2009 (<https://jncc.gov.uk/our-work/greater-haig-fras-mpa/>). The Whittard Canyon is a large submarine canyon system on the Celtic Margin, located over 300 km from shore, and ranging from 200 m to more than 4000 m water depth. It has multiple branches that cut deeply into the continental margin. Previous research has shown that it hosts a wide variety of habitats, including spectacular cliffs covered in cold-water corals. Part of the Whittard Canyon system (the Explorer and Dangaard

Canyon side-branches) is designated as The Canyons Marine Conservation Zone (MCZ; <https://jncc.gov.uk/our-work/the-canyons-mpa/>), and on 13 June 2022, a series of new Byelaws came into force prohibiting bottom contact fisheries in the area, in order to protect habitats such as cold-water coral reefs, coral gardens and seapen and burrowing megafauna. Rockall Bank is also a Special Area of Conservation (SAC) (<https://jncc.gov.uk/our-work/north-west-rockall-bank-mpa/>), and we had a few samples from this site for study.

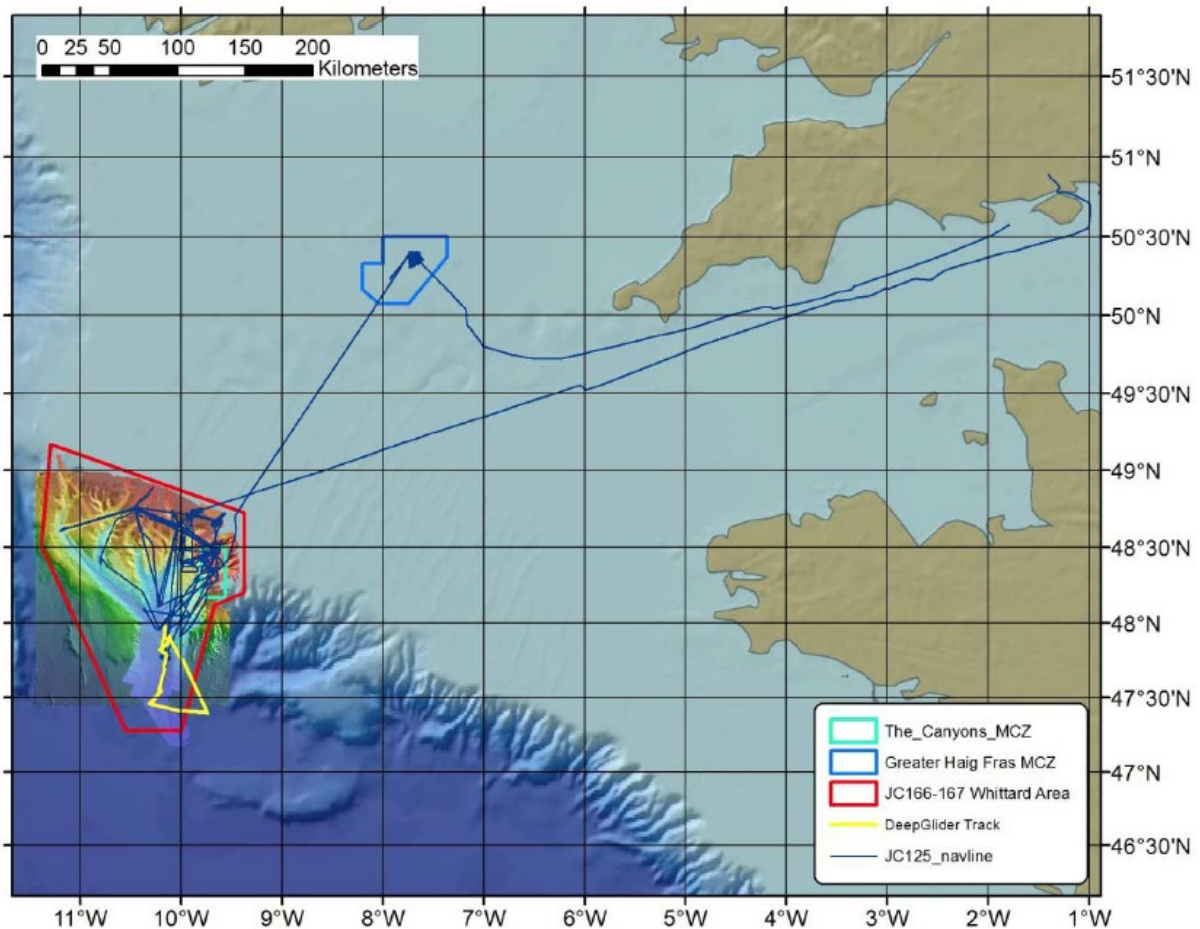


Figure 3. JC166 cruise track showing the location of both Haig Fras and the Whittard Canyon area. (From Huvenne & Furlong, 2019)

Crozet Islands Abyssal samples (Benthic CROZEX)

The Crozet Natural Iron Bloom and Export Experiment (CROZEX), aimed to study the first planned natural iron fertilisation experiment in the Southern Ocean (Pollard et al., 2007). The objective was to repeatedly survey two regions, one north of the islands in the bloom area, the other in a high nutrient low chlorophyll (HNLC) control region south of the islands. CROZEX took place in two legs (D285 and D286) on R.R.S. *Discovery* from early November 2004 to mid-January 2005 (Pollard and Sanders, 2006). *Discovery* cruises 285/286 were precursors to a dedicated benthic cruise carried

out the following year (R.R.S. Discovery cruise 300; Wolff, 2006). A comprehensive account of sampling activities is given in the RRS *Discovery* cruise 300 Cruise Report, together with a narrative and full station list.

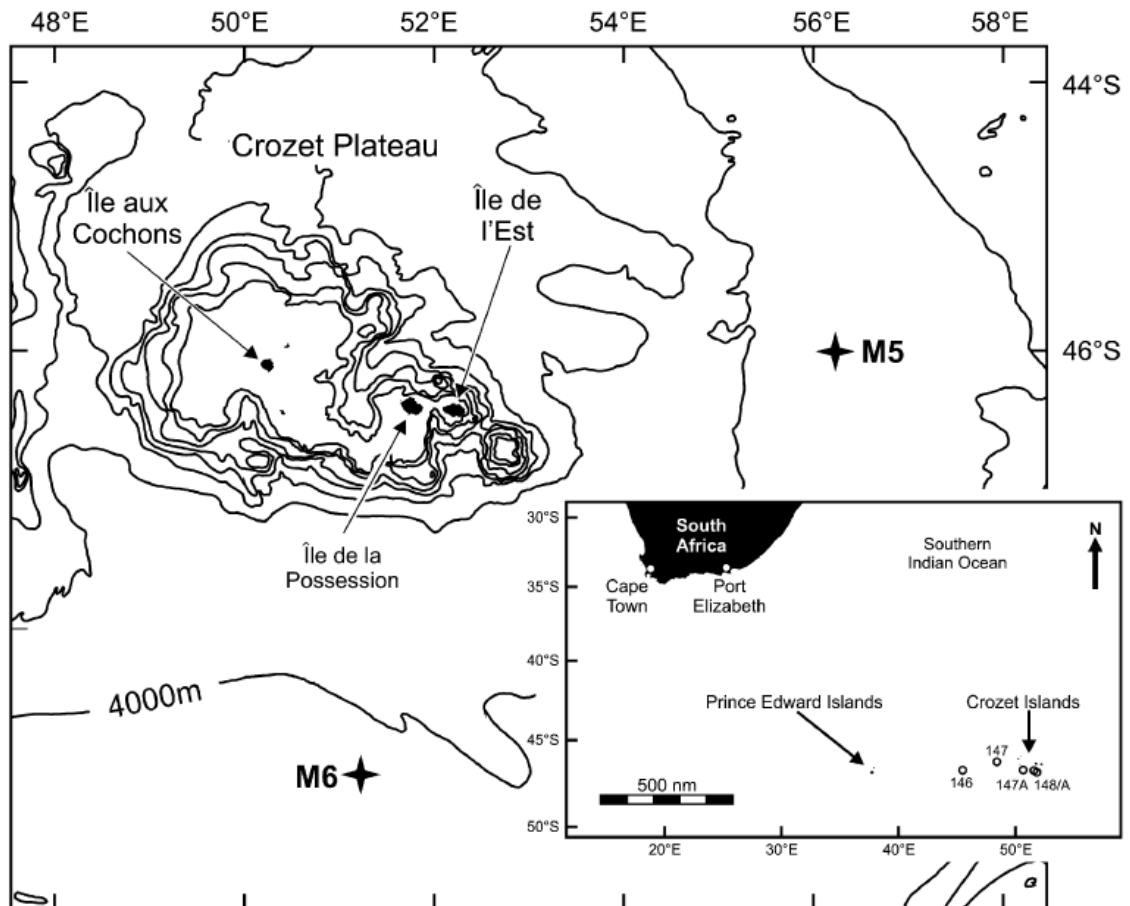


Figure 4. The location of the sampling sites M5 and M6, together with (insert) the location of the stations sampled during the cruise of HMS Challenger. (From Hughes et al., 2007).

Two abyssal sites (~ 4200 m water depth) located under contrasting productivity regimes around the Crozet Plateau, in the Indian Ocean sector of the Southern Ocean, were sampled during the austral summer of 2004/2005. One site (M5), east of the Crozet Isles, was located beneath an area where there was an enduring seasonal phytoplankton bloom. The second site (M6) was located in an oligotrophic high-nutrient low-chlorophyll (HNLC) region to the south of the islands (Hughes et al., 2007).

There is a large collection of this material in the NOC Discovery Collections, and it is of global importance. The samples are from abyssal depths in a rarely visited region and are therefore likely to contain numerous new taxa of interest. This material was lower priority for the aims of the DEEPEND program (as it was formaldehyde preserved so unlikely to be useful for biodiscovery). It was studied towards the end of the workshop week but has certainly sparked the interest of the



experts. There were **66** samples of Porifera in this collection and the four larger buckets of mixed materials were sorted and preliminarily identified during the workshop.



OVERVIEW OF THE WORKSHOP

An Agenda can be found in the Appendices.

The first day was taken up with introductions to the backgrounds and expertise of each of the workshop participants, the DEEPEND Project, and the samples and collection areas. A tour of the laboratories and the Discovery Collections was conducted. This was followed up by an introduction to sponge taxonomy and sponge material preparation methodology. Once these were completed the identification work was started in the laboratory. Each day a presentation was provided by one or two of the taxonomist experts on each of the major sponge groups in addition to the continued identification work in the laboratory.

The following presentations were provided throughout the week:

- The DEEPEND Program, The Discovery Collections & Poriferan samples - Tammy Horton
- Introduction to Porifera and its taxonomy - Joana Xavier
- Methods of identification - Javier Cristobo & Pilar Rios
- Demospongiae systematics - Christine Morrow
- Hexactinellida systematics - Celso Domingos
- Sponge systematics through time - Paco Cárdenas
- Homoscleromorpha systematics - Pilar Rios
- Calcarea systematics - Andreu Santin
- Marine sponge biodiversity from genes to ecosystems: delivering knowledge and tools for sustainable management and conservation (SponBIODIV project) - Joana Xavier

On the final day of the workshop the outcomes of the training and identification work and plans for reporting, and dissemination of results were discussed. This was followed by completion of any final identifications and preparation of loans of sponge materials for the workshop participants.

RESULTS

The workshop aimed to provide training for the Discovery Collections Team and improved taxonomic identifications for abyssal sponge taxa currently held in the Discovery Collections at NOC. These materials largely originate from the Porcupine Abyssal Plain Sustained Observatory, Whittard Canyon, Mid Atlantic Ridge and Haig Fras areas in the North Atlantic, and also selected specimens from the Central Pacific in the Clarion Clipperton Zone, collected during the SMARTER project.

During the week we had presentations from the experts of the [SponBIODIV project](#) on each of the major sponge groups, and hands-on laboratory training in the preparation of sponge spicules for microscopic examination. The aims of the workshop were met with ease, with over 200 identifications made during the week. A number of publications are planned summarising the findings of the workshop. In addition to the incredible science findings, we also enjoyed making new connections and had a lot of fun learning from our new 'sponger' friends. We were all amazed by the microscopic beauty of the sponge spicules, and our resident glass artist, [Julie Light](#), had plenty of inspiration creating some giant glass spicules to delight the participants of the workshop.

Overall, did we achieve the aims?

- ✓ *Improved awareness of the DEEPEND program and the Discovery Collections for the Sponge taxonomic community*
- ✓ *Improved identifications for abyssal sponges particularly from the Porcupine Abyssal Plain Sustained Observatory and Clarion Clipperton Zone samples collected during the SMARTER program.*
- ✓ *Expert identified samples for the DEEPEND program.*
- ✓ *Training for NOC staff in deep-sea sponge spicule preparation and identification.*
- ✓ *New scientific discoveries? New species? New depth records?*
- ✓ *Fun & Friendship!*

The workshop was an incredible success, and despite only a week of focused work there were plenty of scientific outcomes. The major work will continue within NOC in collaboration with the individual experts to produce scientific publications including:

- The Sponge fauna of the Porcupine Abyssal Plain Sustained Observatory
- Demospongiae of the Mid-Atlantic Ridge at the Charlie Gibbs Fracture Zone, collected as part of the ECOMAR program
- A preliminary analysis of the Porifera collected during the Benthic Crozex program (Crozet Islands Abyss)
- Porifera from UK Marine Protected Areas (Haig Fras & Whittard Canyon & Rockall Bank)



Attendance at the next Sponge conference in Portugal is also planned where the outcomes of this workshop will be presented, to further highlight the value of such taxonomic workshops and to improve awareness of the availability of samples from the Discovery Collections.

IDENTIFICATIONS

At the beginning of the workshop we provided a full catalogue of the 392 sample lots available in the Discovery Collections, many of which were unsorted or mixed lots at this stage, and of these only 122 were provided with an identification beyond the level of Phylum Porifera (the majority to class level only). By the end of the workshop the sample collection had grown to 664 sample lots. Of these, 258 samples had been provided with an updated identification. The identifications provided varied from Class level to species level but all 258 were considered improved identifications, fulfilling the aims of the workshop.

Almost 100 sample lots from the PAP-SO, were provided with improved identifications, and all (two carnivorous sponges and nine hexactinellids) of the SMARTEX sponges were studied and provided with trusted identifications, although many samples from both study areas could not be identified to the species level as they may be new to science or require further study to confirm. Spicule preparations were made and subsamples provided on loan to the experts where needed, and these will be available for future study to confirm identifications or aid in new species descriptions. Both carnivorous sponges identified from the SMARTEX material were previously poorly known and represent new records for the area, while amongst the nine hexactinellids there are potentially new species.

The majority of the ECOMAR samples were identified with at least seven new records of demosponge taxa reported in the collection that had not previously been recorded from the region of the Charlie Gibbs Fracture Zone on the Mid Atlantic Ridge. One or two species are potentially new for science. Also, since some specimens were preserved in ethanol, they will provide much needed barcodes from species and populations for which no molecular data currently exists.

All of the samples from Haig Fras, the Whittard Canyon area and the Rockall region were provided with improved identifications.

A special mention should be made of the collection of sponges identified within the family Cladorhizidae. The species of this group have lost their filter-feeding mode and rely on carnivory of relatively large prey, mostly crustaceans. This strategy allows cladorhizids to reach deep-sea areas such as abyssal and also hadal zones (Vacelet, 2006). Eight very interesting specimens have been sampled at PAP, belonging to the genera *Chondrocladia* and *Cladorhiza*. Of these, the finding of *Chondrocladia* (*Chondrocladia*) *guiteli* Topsent, 1904, is the third time in history that it has been recorded (Topsent, 1904, Cristobo et al 2005) and with this record its latitudinal distribution limit is considerably increased. The rest of the specimens could be new species for science, including one specimen identified as belonging to the genus *Cladorhiza* that doesn't seem to be conspecific with the species known in the Atlantic. This will, however, require further examination and re-assessment in light of the recently established *Abyssosdiskos* genus (Ekins et al. 2020).



The sponge collection from the Crozet Islands abyss, which consists of at least 124 specimens, is dominated by sponges of the class Hexactinellida and family Cladorhizidae. This collection is of great value as there are hardly any records of porifera from this archipelago and the collection deserves special attention. The results are expected to be presented at the next World Sponge Conference (Porto, Portugal, 2025). Multiple specimens of *Caulophacus* (*Caulophacus*) *latus* Schulze, 1886, the type species of the *Caulophacus* genus, were discovered. Previously, only a single specimen of this species had been documented within the same region, at a depth of 2880 m. The recent findings extend the species' distribution to a depth of 4200 m. These newly found individuals will be redescribed and genetically sequenced. This marks a significant advancement in comprehending this significant sponge group within a largely uncharted territory.

CONCLUSIONS

This workshop has been an incredible success, achieving all of the proposed aims and more. The format of an identification & training workshop such as this one is feasible and could be repeated for other taxa for which we have little to no expertise and a large amount of material available.

The format worked particularly well for training purposes in exposing the Discovery Collections team to the methods of producing suitable materials for identification. Owing to the limited time available for identification after producing the spicule preparations (which can take a couple of days), there was less time available for identification of the specimens, so it would be preferable to sort and prepare slides in advance in the future. This could be managed via student training sessions/projects to sort and prepare sponge spicule slides.

The aim of improved awareness of the Discovery Collections holdings was certainly achieved but it was agreed that work is needed to give a more in-depth understanding of the collections through the website e.g. through published catalogues/lists. A conference paper is planned for the World Sponge Conference in Portugal next year, which will further advertise the materials to interested scientists.

The improved awareness of the DEEPEND project network among sponge scientists and other groups undertaking biodiscovery was another aim of the workshop that was well met. During the workshop we also discussed the importance of reporting negative results and how these findings may impact the target taxa for further biodiscovery, e.g., learning that Hexactinellida do not produce much interesting chemistry (yet!), while these sponge taxa are very important in abyssal ecosystems. There is scope to learn more from the sponge taxonomic community regarding target taxa and depth ranges of these target taxa, and how this information would benefit the DEEPEND program.

Internally to the NOC Discovery Collections Team, we recognised once again the importance of unique specimen numbers. There is a legacy issue within the Discovery Collections whereby historic materials and those collected in bulk have not been provided with specimen numbers and are indicated in data catalogues only by the station number and identification label. This makes tracking subsamples e.g. for genetic sequencing, back to the original specimen difficult. The team are working on this for all new sampling in preparation for the ratification of the BBNJ treaty, and the methodology implemented during this workshop worked well. All sponge samples were provided with a unique number in the following format: Cruise_Station_POR_### (e.g. JC231_52_POR_023).



This provides a human readable unique alphanumeric for each sponge specimen from a particular sampling cruise and station.

It was particularly interesting to discover that two of the ECOMAR samples we held had already been subsampled for genetics by Paco Cárdenas, who had been provided with a subsample by another scientist who had been on the research expedition in 2007. The results were already published and available, but neither the Discovery Collections Team, nor Paco had made the connection to the specimen itself until the workshop. This illustrated the importance of improved record keeping on where subsamples are sent, and of reporting findings from subsampled materials back to the collection for updating of information held.

The NOC Discovery Collections team wish to express our particular thanks to all participants for sharing their expertise and passion for sponge taxonomy. We have all learned so much from you and look forward to our continued collaboration and future publications.

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APPENDICES



Workshop Agenda:



DEEPEND

Deep-ocean resources and biodiscovery

NOC DEEPEND PROJECT: SPONGE IDENTIFICATION WORKSHOP

4th-8th March 2024

Background: The DEEPEND project was initiated in 2022 with an 8-month pilot project funded by the UK DEFRA GCBC Program. An extension to the project was granted for a further 12 months bringing the project to a close on the 31st March 2024. As part of the extension, it was recognised that the team lacked expertise in sponge identification, despite this taxon being of utmost importance in biodiscovery. This workshop aims to go some way towards remedying this by providing some trusted identifications for taxa currently under study, and improving the identification of abyssal sponge taxa currently held in the Discovery Collections at NOC which largely originate from the Porcupine Abyssal Plain, Whittard Canyon, Mid Atlantic Ridge and Haig Fras areas in the North Atlantic, and also selected specimens from the Central Pacific in the Clarion Clipperton Zone (SMARTEX Project).

Outcomes:

Training in the correct procedures to be used for identification of sponge taxa will be provided by the invited experts, such that the trainees are able to confidently identify to a particular taxonomic level (to be determined) before consulting with experts is required.

A workshop report will be produced. All participants will contribute to the writing of the report. The report will detail the results of the workshop in improving identifications of the sponge materials held in the NOC Discovery Collections.

Venue: (See map) National Oceanography Centre, Southampton.

European Way

Southampton

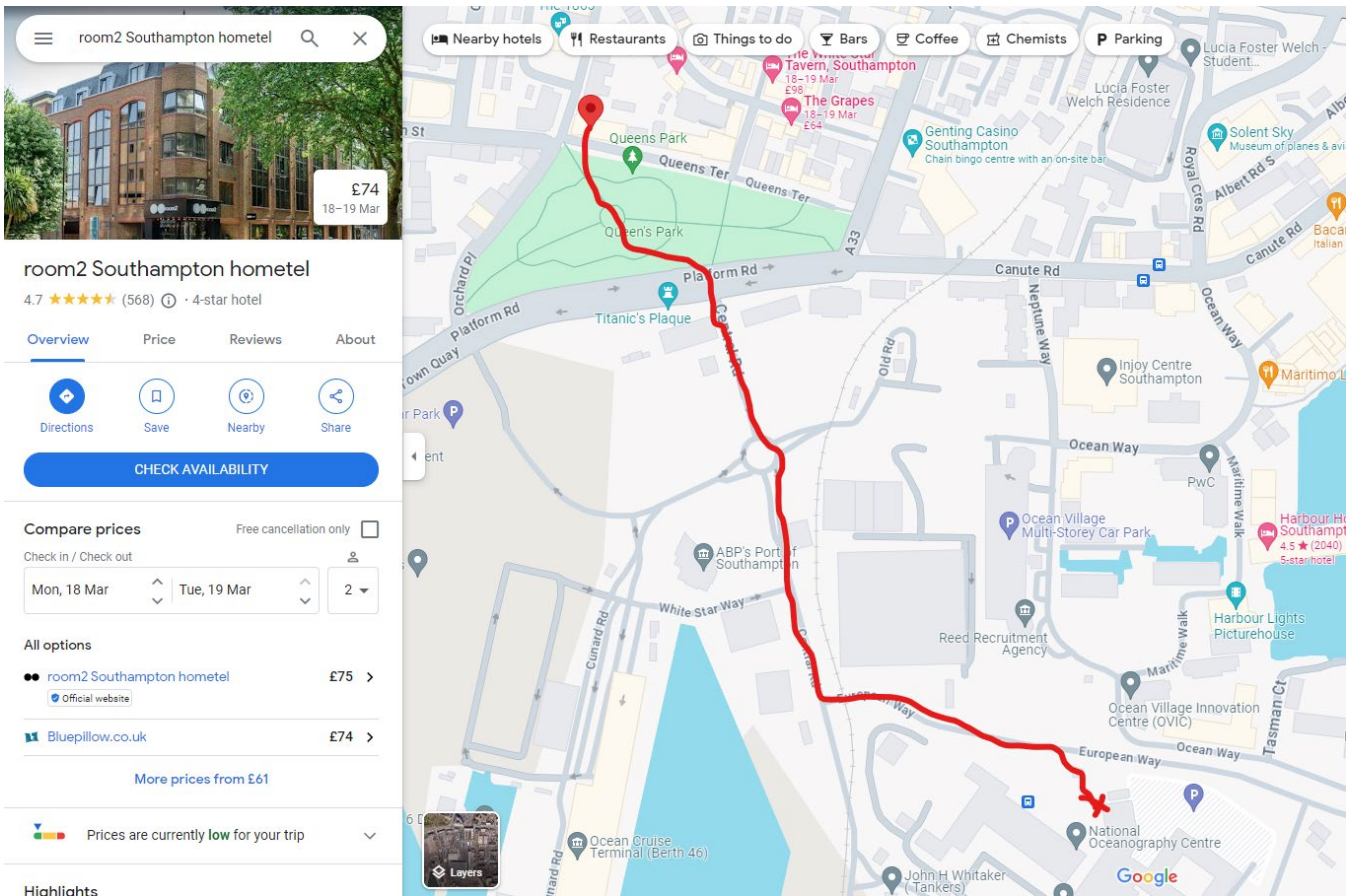
SO14 3ZH

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<https://noc.ac.uk/about-us/contact-us>

Your hotel is Room2 <https://room2.com/southampton/> indicated by the dropped pin on the map overleaf.



By Rail Southampton is less than one and a half hours from London by rail. SouthWest Trains run approximately four trains every hour from Waterloo station, London to Southampton Central station. Southampton Central railway station is well connected to NOC via the UniLink Bus Service (see below), taxis and local pedestrian routes (approximately a 30-minute walk). A taxi rank is located outside both station entrances. Timetables can be found on the National Rail Enquiries website.

By Bus UniLink Bus Service: The U1C to Dock Gate 4 starts at Southampton Airport Parkway and travels directly to NOCS. The U1A to Southampton Airport starts at NOCS, for Southampton Central Station alight at Asda. Timetables are available via the [Unilink Bus website](#). All bus tickets are available to buy using cash or contactless, or on the app.

Quayconnect: A bus service that runs from Southampton Central railway station via Asda and West Quay to Town Quay (alight at the first stop on Town Quay), it is approximately a 15-minute walk to NOC from Town Quay. Please view the following [walking directions](#) for more information. More information on this service can be found on the [Bluestar](#) website.

By Air If you arrive by air from overseas at Southampton Airport there are three ways to reach NOC. Take a taxi (see 'By road'), take the U1C City Centre & NOC Unilink bus (see 'By bus' journey



time about 1 hour) or take a train to Southampton Central (see 'By train'; about 8 minutes) from Southampton Airport Parkway station, which is immediately adjacent to the airport.

Confirmed participants:

<i>Christine Morrow</i>	<u>christinemorrow@gmail.com</u>	<i>Queens University, Belfast</i>	<i>Ireland</i>
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<i>Javier Cristobo</i>	<u>javier.cristobo@ieo.csic.es</u>	<i>IEO-Gijón, Gijón</i>	<i>Spain</i>
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<i>Celso Domingos</i>	<u>bio.celso.domingos@gmail.com</u>	<i>CIIMAR - University of Porto</i>	<i>Portugal</i>

To be joined by Tammy Horton, Amanda Serpell-Stevens, Georgina Valls Domedel and Julie Light (Glass Artist).

Monday 4th March 2024 (day 1)

9h:

- Meet In NOC Reception – to Ray Beverton Room.
- Welcome & practical information [Tammy Horton]
- Round table [all]
- Introduction to the DEEPEND Program [Tammy Horton]
- Introducing the samples/programs [Tammy Horton]
- Tour of NOC Discovery Collections [Tammy Horton]

10h: coffee / tea break (30')

10h30: Ray Beverton Room

- Taxonomic expertise [Invited Experts]
- Introduction to Porifera and its taxonomy - Joana Xavier
- Methods of identification - Javier Cristobo & Pilar Rios
- Demospongiae systematics - Christine Morrow



12h30–13h30: Lunch – NOC Canteen

13h30–15h30

- Laboratory induction: Health & Safety overview.
- Begin hands-on sponge identification! :-)

15h: coffee / tea break (30')

15h30:

- Hands-on sponge identification (continued)

18h: end of day 1

Tuesday 5th March 2024 (day 2)

9h:

- Hands-on sponge identification (continued)

10h: coffee / tea break & Talk (Library Red Room)

- Hexactinellida systematics - Celso Domingos
- Sponge systematics through time - Paco Cárdenas

11h:

- Hands-on sponge identification (continued)

12h30–13h30: Lunch – NOC Canteen - Group photo by the Challenger figurehead in Reception

13h30:

- Hands-on sponge identification (continued)

14h45: coffee / tea break (15')

15h:

- Hands-on sponge identification (continued)

Wednesday 6th March 2024 (day 3)

9h:

- Hands-on sponge identification (continued)



10h: coffee / tea break & Talk (Library Yellow Room)

- Homoscleromorpha systematics - Pilar Rios
- Calcareia systematics - Andreu Santin (tbc)

11h:

- Hands-on sponge identification (continued)

12h30–13h30: Lunch – NOC Canteen

13h30:

- Hands-on sponge identification (continued)

14h45: coffee / tea break (15')

15h:

- Hands-on sponge identification (continued)

18h: Walk to Padharo (<https://padharo.co.uk/>) for Workshop dinner

Thursday 7th March 2024 (day 4)

9h:

- Hands-on sponge identification (continued)

10h: coffee / tea break & Talk (Library Yellow Room)

- Marine sponge biodiversity from genes to ecosystems: delivering knowledge and tools for sustainable management and conservation (SponBIODIV project) - Joana Xavier

11h:

- Hands-on sponge identification (continued)

12h30–13h30: Lunch – NOC Canteen

13h30:

- Hands-on sponge identification (continued)

14h45: coffee / tea break (15')

15h:

- Hands-on sponge identification (continued)

Friday 8th March 2024 (day 5)

9h: Ray Beverton Room



- Discussion of findings, new analyses and proposed publications [all]
- Outreach: promoting the DEEPEND project & Sponge ID Workshop [all]
- Report writing - a proposed action plan [Tammy/All]
- Short and long-term goals and planning [all]

10h30: coffee / tea break (30')

11h:

- Hands-on sponge identification (continued)

12h30–13h30: Lunch – NOC Canteen

13h30:

- Hands-on sponge identification (continued)

14h45: coffee / tea break (15')

15h:

- Hands-on sponge identification (continued)

16h: Closure of workshop (departure of Joana and Andreu)

Possibility for participants to stay later and continue working (18h)

Some important practical information for the Workshop

Please bring your own dissection tools and laptop if possible. We will have some dissecting equipment available, but I am sure there are special personal tools you prefer to work with.

Microscopes etc.

We have available 7 Compound and 7 Stereoscopes available. There are a variety of makes and models (and ages and quality!). We do have access to photography on both stereo and compound microscopes, but this will need to be shared, as not all microscopes have this capability.

We have camera lucida available, and slide graticules etc.

Access to a Fume Hood, Nitric Acid, thin bleach and DPX mountant are available.

Large numbers of slides, coverslips, stickers, slide boxes etc are available.



News Items:

Internal to NOC News item published on intranet.

External to NOC – account of the week published on NOC website BLOG pages:

<https://blogs.noc.ac.uk/ocean-horizon/successful-week-deepend-project-sponge-identification-training-workshop>

Twitter (X) posts published during the week of the workshop (daily) and post workshop.

A fantastic week of collaborative work took place from the 4th-8th March 2024, with seven invited taxonomic experts attending to share their knowledge of the Porifera (Sponges) with the Discovery Collections Team at the National Oceanography Centre, Southampton. The Sponge Identification & Training Workshop was part of DEEPEND ([DEEPEND: Deep-ocean resources and biodiscovery](#)), a project funded by the UK DEFRA [Global Centre on Biodiversity for Climate Programme](#). The DEEPEND project is a collaborative effort to study the societal value of biodiversity in the deep-sea.

Marine organisms are a promising resource for useful natural products such as medicines. The potential use of biodiversity - or marine genetic resources (MGR) - has yet to be thoroughly explored in the deep sea. These organisms offer the exciting potential discovery of new gene clusters that direct the formation of enzymes and small molecules. These could have useful biotechnological and pharmaceutical applications, including the discovery of novel antibiotics, coming at a time when society faces an antimicrobial resistance crisis. Marine sponges are known to be important sources of novel natural products, yet the identification of sponge taxa (many of which are new to science) requires specialist taxonomic expertise.

The workshop aimed to provide training for the Discovery Collections Team and improved taxonomic identifications for abyssal sponge taxa currently held in the Discovery Collections at NOC. These materials largely originate from the [Porcupine Abyssal Plain Sustained Observatory](#), Whittard Canyon, Mid Atlantic Ridge and Haig Fras areas in the North Atlantic, and also selected specimens from the Central Pacific in the Clarion Clipperton Zone, collected during the [SMARTEX](#) project.

During the week we had presentations from the experts of the [SponBIODIV project](#) on each of the major sponge groups, and hands-on laboratory training in the preparation of sponge spicules for microscopic examination. The aims of the workshop were met with ease, with over 200 identifications made during the week and a workshop report is now in preparation detailing the results. A number of publications are also planned summarising the findings of the workshop. In addition to the incredible science findings, we also enjoyed making new connections and had a lot of fun learning from our new 'sponger' friends. We were all amazed by the microscopic beauty of the sponge spicules, and our resident glass artist, [Julie Light](#), had plenty of inspiration and even created some glass spicules to delight the spongers!

DEEPEND <https://www.nhm.ac.uk/our-science/research/projects/deep-sea-systematics-ecology/deepend.html>

@SponBIODIV <https://sponbiodiv.org/>

#DiscoveryCollections @tammy_horton <https://noc.ac.uk/facilities/discovery-collections>



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