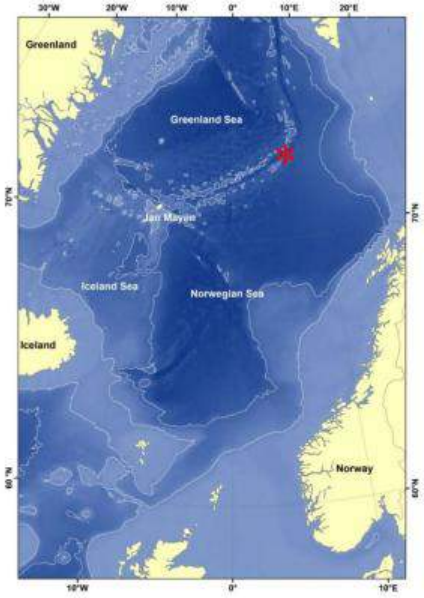
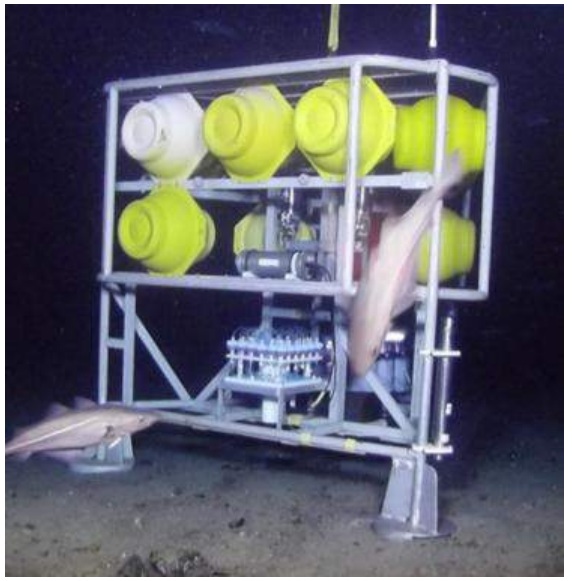
Schultz massif

oceanographic characterization

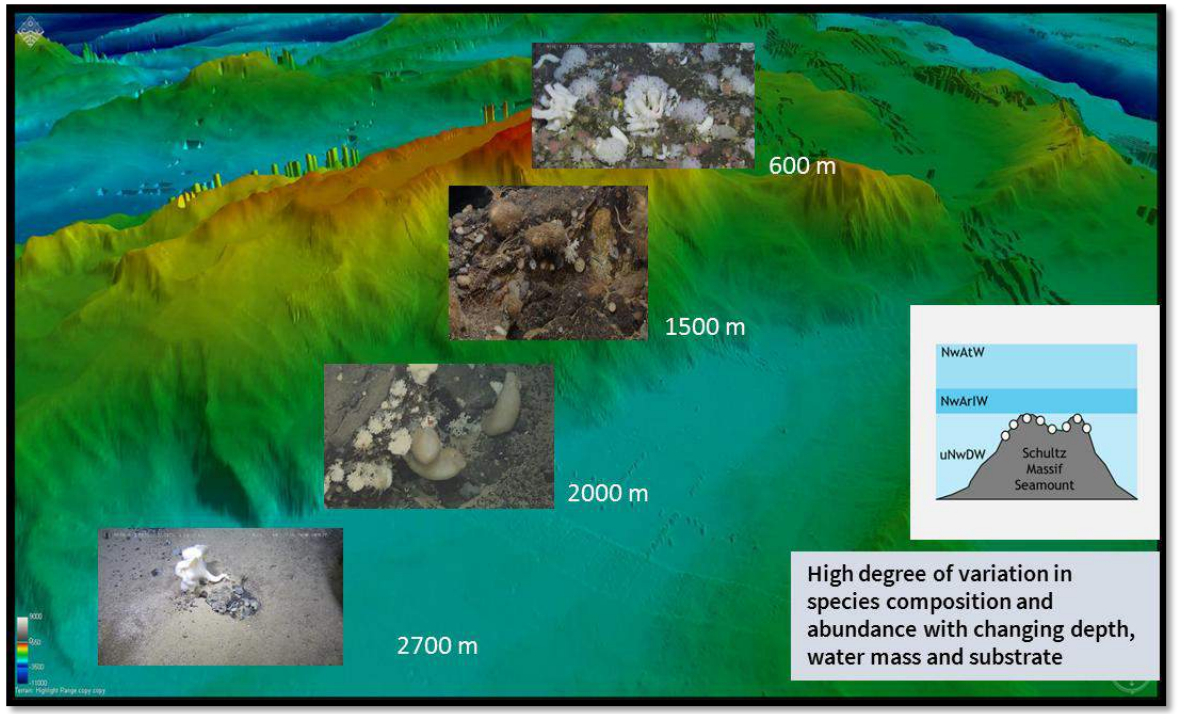




- the summit of the seamount coincides with the lower boundary of **Norwegian Arctic Intermediate Water** (NwArIW) – slightly warmer and more oxygenated

- series of regular fluctuations in water temperature and dissolved oxygen concentration

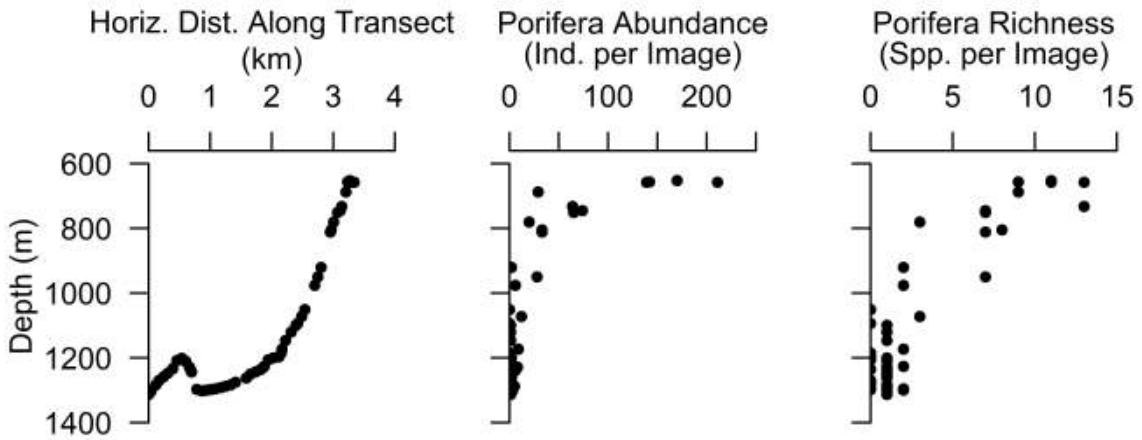
Tidally-forced and
dynamic environment shaping benthic ecosystems

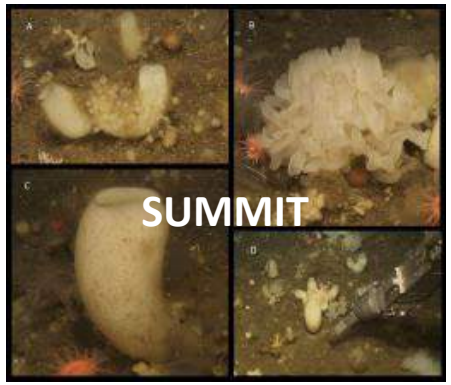


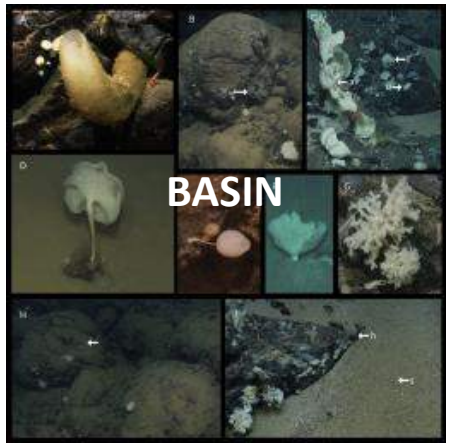
Schultz massif

…sponge communities and stability in time

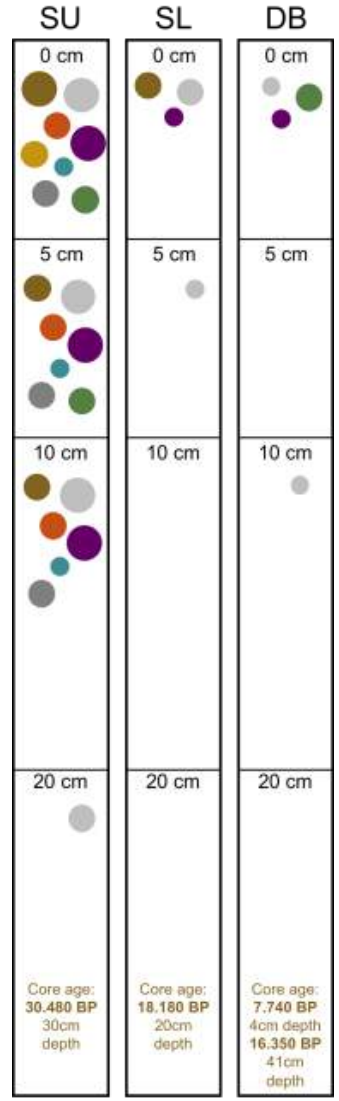
- Around 60 sponge taxa identified
- typical Arctic affinity
- summit core suggest a **'stable' community** likely to have survived through the last glacial maximum (28-22 ka)







AMS radiocarbon dating
Spicule search by SEM



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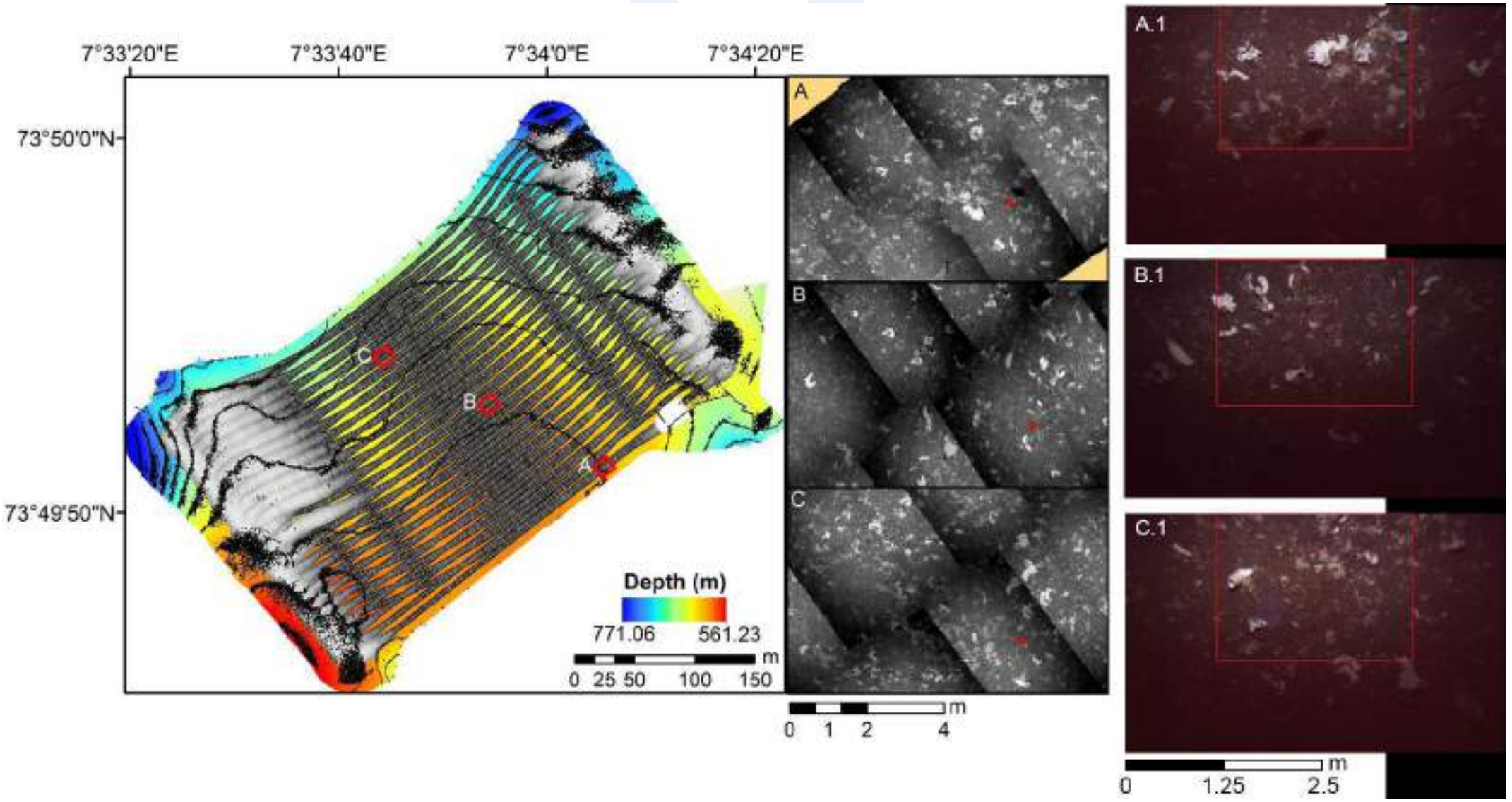
(Roberts *et al.*, 2018) – emyr.roberts@bangor.ac.uk

(Rapp *et al.*, in prep) – Hans.Rapp@uib.no

AUV bathymetry and photomosaics (Hugin)



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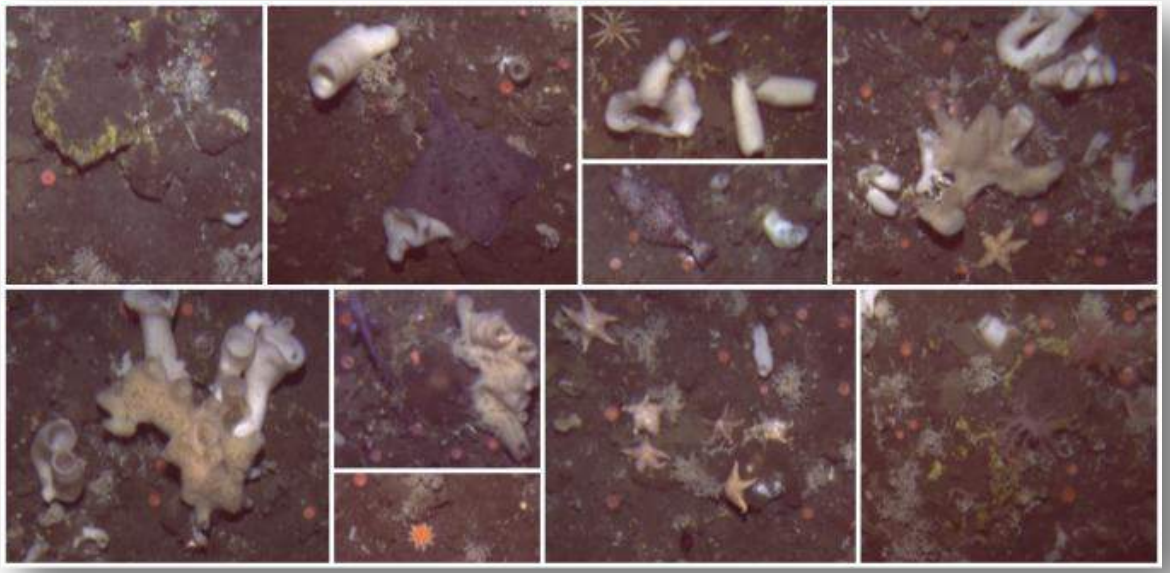
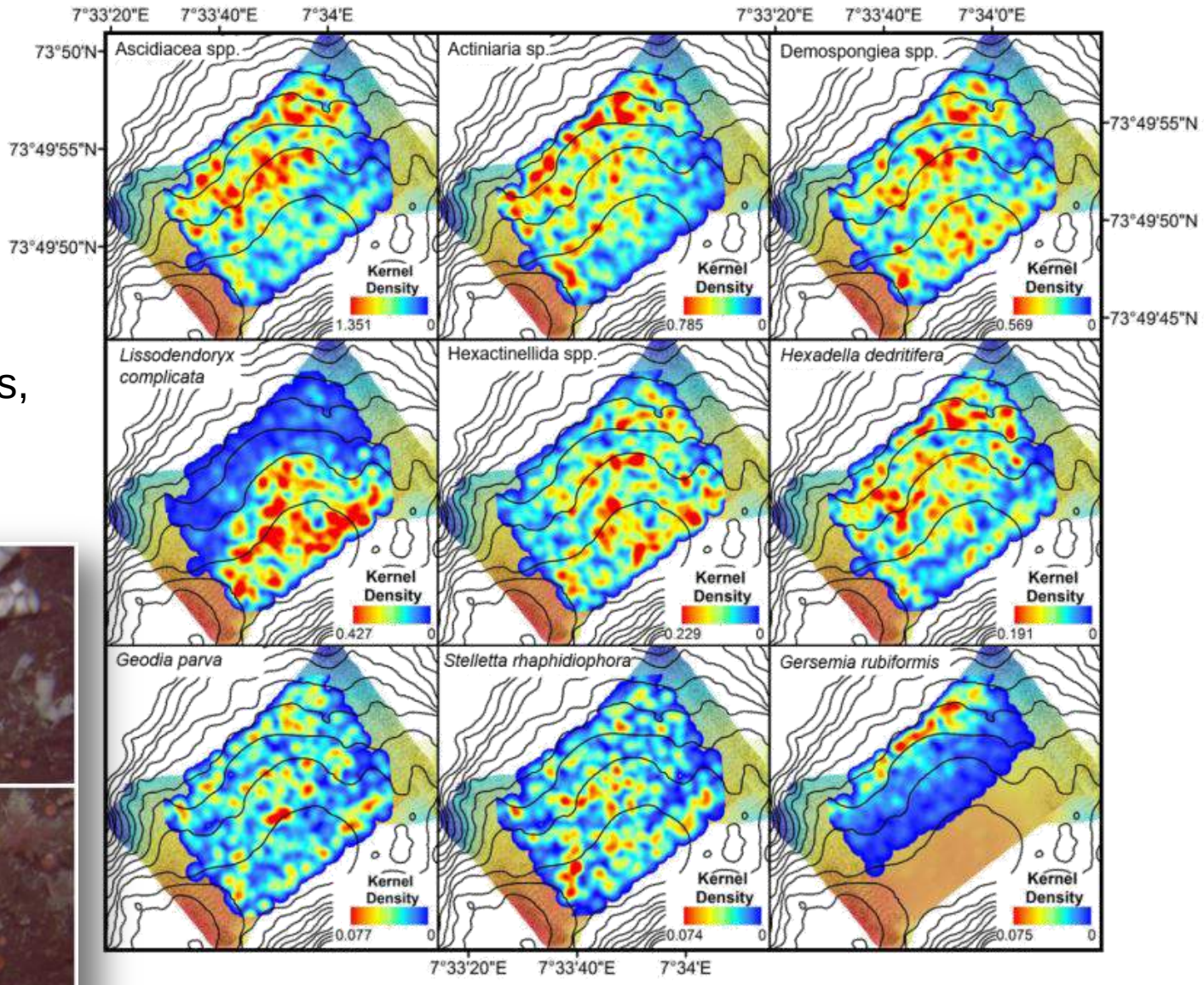
megabenthic fauna

- 5968 AUV images analysed
- over 93.000 individuals (22 morphotaxa) detected
- predominantly demosponges, glass sponges, ascidians, anemones, soft coral





(Meyer *et al.*, in prep) – Heidi.Meyer@uib.no

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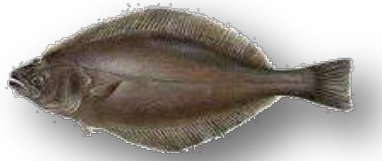
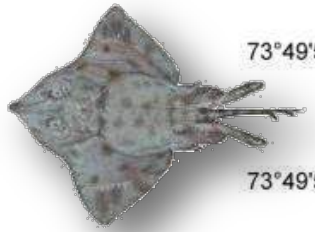
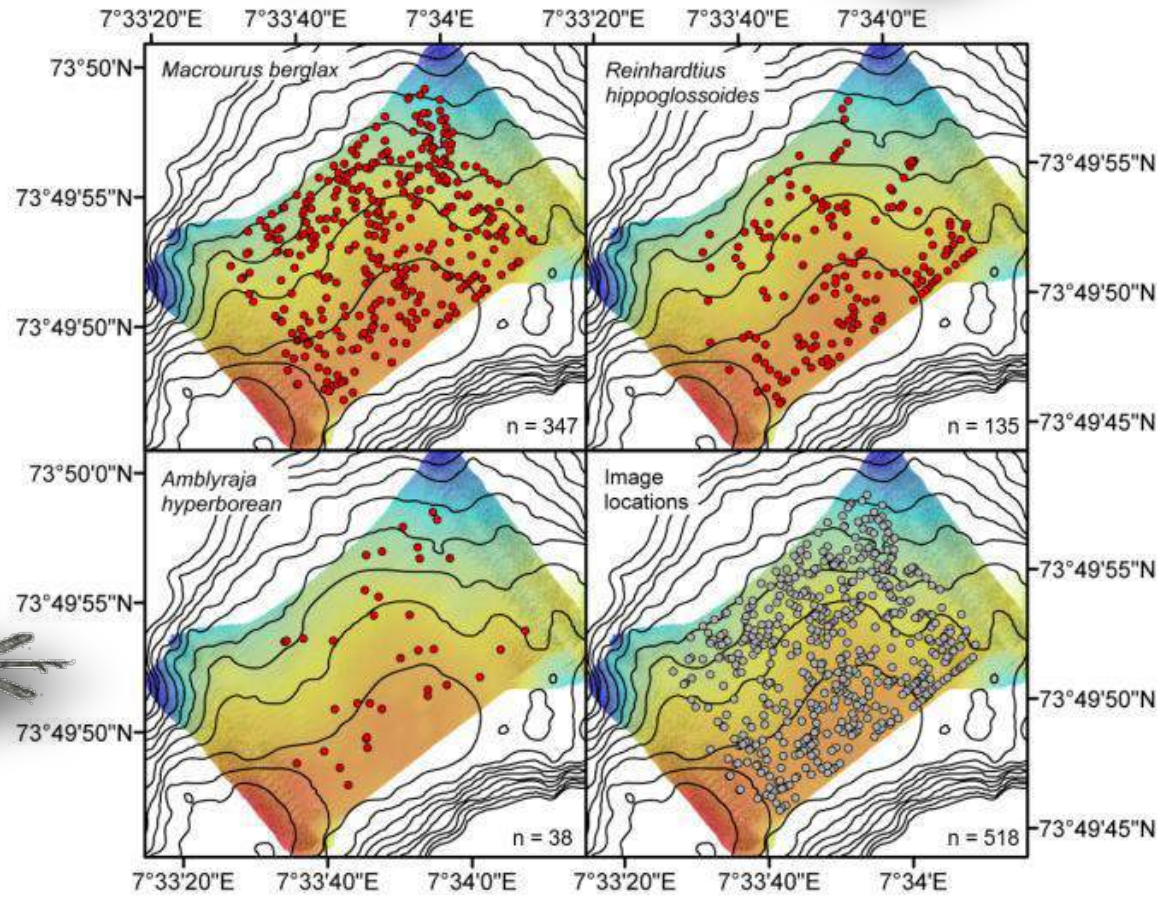
associated fish



- Grenadiers
- Greenland halibut
- Arctic skate
- Many egg capsules

refuge and **nursery** function





(Meyer *et al.*, in prep) – Heidi.Meyer@uib.no

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in progress

Assessment:

- of long-timescale environmental variability
- and quantification of the nutrient fluxes + upscaling to local/regional levels
- of the genetic structure and connectivity of key species
- the recovery potential of an impacted area (experimental trawling)

Ecosystem function, dynamics, resilience

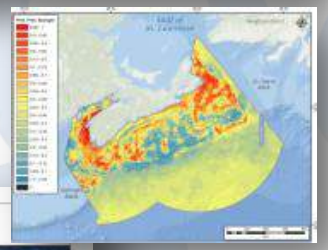
Promoting dialogue between scientists, managers, policy-makers and stakeholders

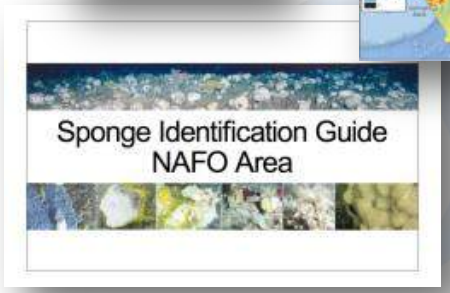
- **Communicate SponGES key science findings**
- **Discuss perceived relevance of the findings and identified gaps that need to be addressed to inform management/policy for the implementation of the EU MSFD, other regional directives and international guidelines**
- **Define steps to facilitate uptake of scientific knowledge to management**

Communication and awareness building materials tailored to managers, policy makers and stakeholders

Management-support tools

DFO





NAFO

EU integrated maritime policy

MSFD, CFP, Galway Statement

International agreements

VMEs, EBSAs

UN sustainable development

SDG 14 – use of oceans, seas and marine resources

EU Blue Growth & Bioeconomy

Marine biotechnology

SponGES

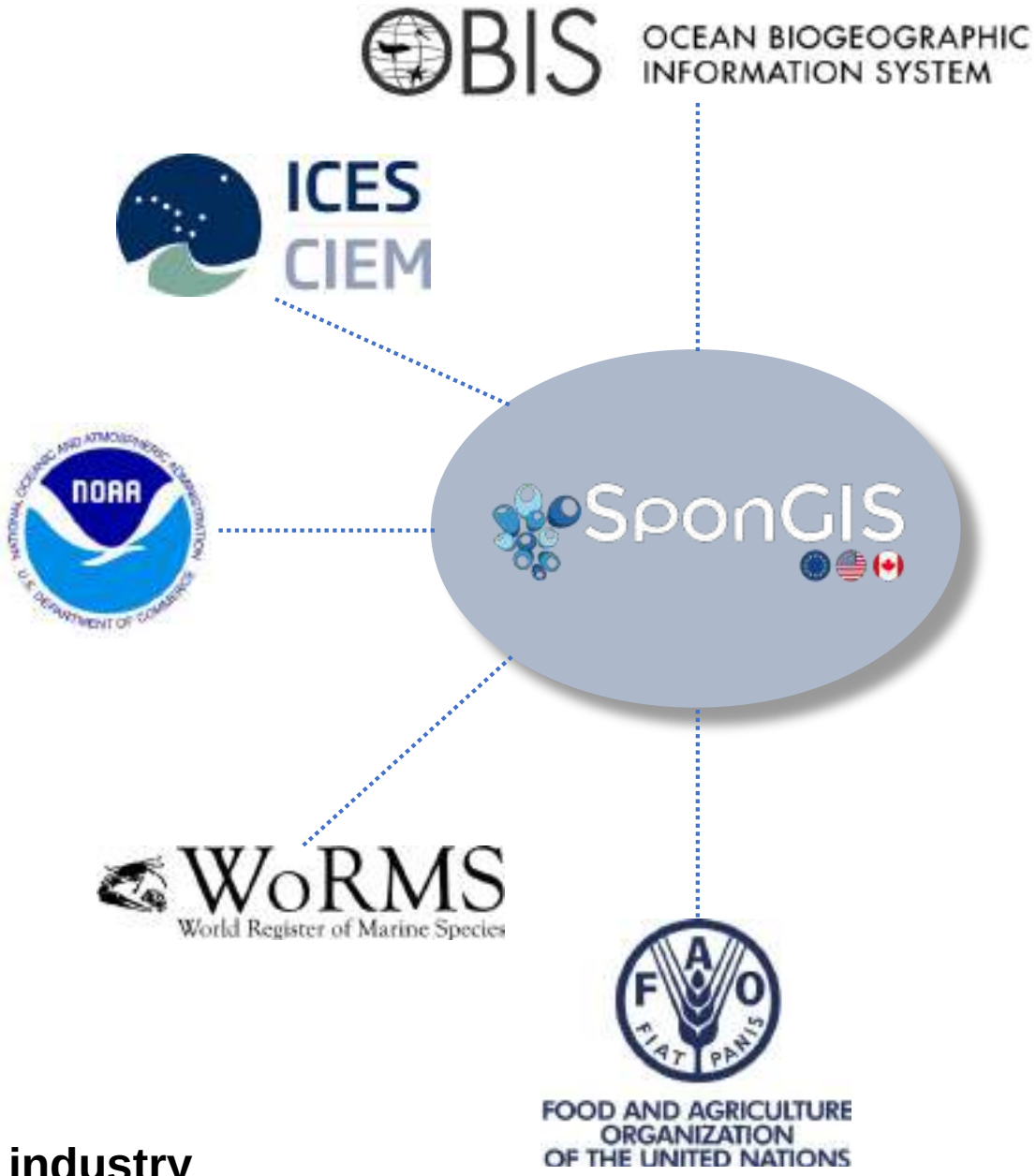
Developing tools

SponGIS

- ✓ follows international standards for biodiversity data (i.e. Darwin Core, Dublin Core)
- ✓ closely follows the OBIS structure
- ✓ all data is curated and quality controlled (e.g. verified by taxonomists)

Types of data

- ✓ environmental data (verified and modelled)
- ✓ species/habitats occurrence (including historical data)
- ✓ species and habitats distribution models



Informing member states, policy makers, RFMOs, industry

Developing habitat descriptions

Describe the sponge-dominated communities of the North Atlantic

- Community composition and structure
- Geographical and bathymetric distribution
- Environmental factors
- Associated fauna

Propose their inclusion in the various habitat classification systems

- CMECS
- EUNIS
- JNCC
- NiN

NOTE: Harmonize terminology use both in scientific, public and policy spheres

- Sponge grounds? Sponge aggregations? Sponge reefs? Fields? Ostur? – **SponGES glossary**


Original Articles

The sponge association of the abyssal Norwegian Greenland Sea: Species composition, substrate relationships and distribution

Dagmar Barthel & Ole Secher Tendal

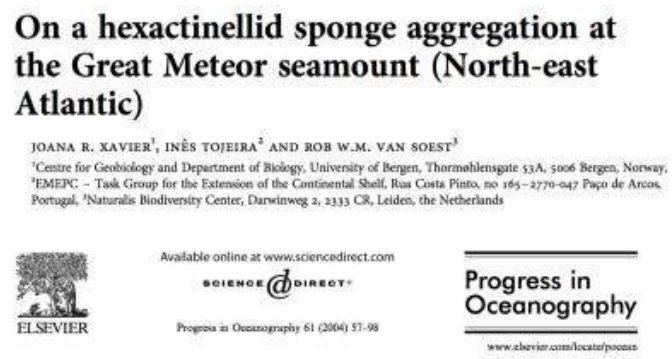
Pages 83-96 | Accepted 19 Apr 1993, Published online: 16 Jan 2012

Download citation http://dx.doi.org/10.1080/00364827.1993.10413524


RESEARCH ARTICLE

Aggregated Clumps of Lithistid Sponges: A Singular, Reef-Like Bathyal Habitat with Relevant Paleontological Connections

Manuel Maldonado[1]*, Ricardo Aguilar[2], Jorge Blanco[2], Silvia García[2], Alberto Serrano[3], Antonio Punzón[3]


On a hexactinellid sponge aggregation at the Great Meteor seamount (North-east Atlantic)

JOANA R. XAVIER[1], INÊS TOJEIRA[2] AND ROB W.M. VAN SOEST[3]

[1]Centre for Geobiology and Department of Biology, University of Bergen, Thormøhlensgate 53A, 5006 Bergen, Norway, [2]EMEPC – Task Group for the Extension of the Continental Shelf, Rua Costa Pinto, no 165–2770-047 Paço de Arcos, Portugal, [3]Naturalis Biodiversity Center, Darwinweg 2, 2333 CR, Leiden, the Netherlands

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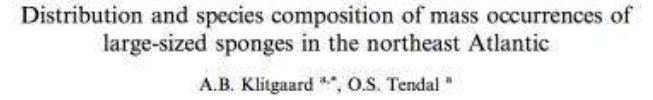
Distribution and species composition of mass occurrences of large-sized sponges in the northeast Atlantic

A.B. Klitgaard [a,*], O.S. Tendal [a]

Food and Agriculture Organization of the United Nations

1 WORK PACKAGE

Ecosystem characterization and mapping

LEAD: Hans Tore Rapp, University of Bergen, Norway and Furu Mienis, Royal Netherlands Institute for Sea Research

Objectives:

The aim of this Work Package is to fill the knowledge gap about the extent and distribution of sponge grounds by collating known distributional data, and by collecting fine scale geological, hydrological, and biological data through in-situ surveys of different types of sponge ground ecosystems in case study areas. To achieve this, the following objectives will be addressed:

- Develop a Geographical Information System for deep-sea sponges – SponGIS;
- Characterize the geological setting;
- Characterize the oceanographic setting;
- Map past and present distribution of deep-sea sponge grounds; and
- Develop ecosystem maps at different spatial scales.

Focus

The Work Package aims to understand the environmental and geological drivers influencing sponge grounds by acquiring new knowledge to determine the factors for sponge ground distribution for the past and present. The Work Package will combine existing data on sponge ground occurrences, and collect new geological, biological, and hydrological data. All data of sponge ground systems in the North Atlantic will be implemented in a new Geographical Information System for deep-sea sponges: SponGIS.

Why is this important?

Very little is known about the past and present distribution of sponge grounds in the North Atlantic. To better predict where sponge grounds occur, more knowledge is needed of the underlying environmental as well as geological drivers of these ecosystems. The analyses and detailed mapping within SponGIS will lead to the production of maps of past and present distributions thereby providing decision makers with the scientific knowledge necessary to improve biodiversity conservation and to achieve efficiency and sustainability in the use of sponge grounds. Knowledge on the environmental and geological settings around sponge grounds will be used for distribution maps of the wider North Atlantic using predictive models, which will support policy makers to manage these vulnerable ecosystems.

What are the key knowledge gaps to be addressed?

Since the distribution and extent of sponge grounds are still largely unknown, we aim to define the underlying environmental and geological parameters that influence sponge growth and therefore the presence of sponge grounds. Furthermore, this knowledge is applied to explain changes in sponge growth in the past through

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2 WORK PACKAGE

LEAD: Javier Cristobo, Spanish Institute of Oceanography, Spain and Ute Hentschel, Helmholtz-Centre for Ocean Research (GEOMAR), Germany

pharmaceutical drugs and provide refuge for mmercial fish.

s Work Package will explore sponge grounds hotspots of biodiversity by studying fauna and crobiome in and out of these habitats.

What are the key knowledge gaps to ddress?

forms of sponge biodiversity, scientists only know out 30% of the expected sponge species and this p in knowledge is wider in the deep-sea sponge und and the currently known microbial biodiversity.

xpected major outputs

s Work Package will increase the number of own species and these will probably house many

onge biodiversity from a June 2017 SponGES cruise lena J. Cristobo / IEO)

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3 WORK PACKAGE

c patterns and

LEAD: Ana Riesgo, Natural History Museum London, UK and Joana Xavier, University of Bergen, Norway

connectivity patterns, all of which are crucial for the development of management and protection measures for these potentially vulnerable habitats, and it will support possible new conservation plans (e.g. design of spatially managed protection areas).

What are the key knowledge gaps to address?

Present knowledge on how deep-sea species reproduce and disperse, and consequently on how their populations are sustained and connected is very limited.

Expected major outputs

Through this WP we will describe the reproductive cycle of the main habitat-forming sponge species.

Boreal sponge ground on the deep Canadian shelf (Photo credit: Fisheries and Oceans, Canada)

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4 WORK PACKAGE

ons, services,

LEAD: Manuel Maldonado, Center for Advanced Studies (CEAB-CSIC), Spain and Jasper de Goeij, University of Amsterdam

grounds are key players in the turnover of energy, organic matter, and inorganic nutrients in the deep-sea. A role that has been overlooked so far, despite these processes being relevant to the health of the entire ecosystem and, indirectly, facilitating the proliferation of both commercially exploitable and non-exploitable deep-sea organisms. While the traditional research perspective has focused on explaining how organisms are impacted by the environment, we also seek to investigate the opposite view: how and how much sponge grounds impact on the surrounding ecosystem from a functional point of view.

Why is this important?

Understanding how ecosystems function is necessary to preserve them efficiently. Determining the biogeochemical and physiological connections of these organisms to ocean conditions is the only way in which the future of the deep sea can be reliably predicted and mathematically modulated to anticipate major changes. These organisms are foreseen as key in designing environmental preservation and restoration strategies. Yet, sponges have remarkable biotechnological interest as sources of biomaterials and chemical compounds with pharmacological potential. Their genomes are also crucial to understanding the origin and early evolution of animals on earth. To understand how these deep-sea sponge communities function is pivotal for future strategies of conservation, sustainable exploitation and known laboratory culturing aimed to subsequent scientific and biotechnological applications.

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5 WORK PACKAGE

al

LEAD: Shirley Pomponi, Wageningen University, The Netherlands and Florida Atlantic University, U.S.A. and Rui L. Reis, University of Minho, Portugal

biotechnological applications. In addition, their chemical and morphological features are being studied, to serve as inspiration for the development of biomaterials for tissue regeneration, in a marine biomimetics strategy.

Why is this important?

Sponges are the most prolific source of marine-derived chemicals with pharmaceutical applications; some of these chemicals are in clinical development as drugs to treat diseases such as cancer. How and why they produce these chemicals, and what role microbial

The scanning electron microscopic (SEM) observation of the biocarmics obtained after calcination (at 800°C) of deep-sea sponge, *Geodia barretti* (P. Tiago Henriques da Silva, University of Minho).

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6 WORK PACKAGE

to sponge

LEAD: Ana Colaço, Institute of Marine Research (IMAR), Portugal and Ronald Osinga, Wageningen University, The Netherlands

North Atlantic and beyond. The Work Package osely with and is supported by other work under the SponGES project.

s this important?

are known to be long-lived and slow- so they are likely to be vulnerable to physical ce and environmental change. Furthermore, grounds are key habitats that provide ecological such as shelter and food, and are part of nt cycles. Understanding the impacts of genic activities will help to mitigate and sponge grounds, and to maintain the services

ratch in the Barents Sea (P. University of Bergen). ge spp. ground in the North Atlantic (P. Fisheries s, Canada).

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7 WORK PACKAGE

redicting ges

LEAD: Andrew Davies, Bangor University, UK and Jack Middelburg, University of Utrecht, The Netherlands

cus

Work Package aims to improve our understanding here sponges live, where they lived in the past, how ant they are to changes in their environment, where might live in the future under predicted climate ge scenarios, and what their ecological role is in deep-sea (e.g., their role within food webs, and the they play in important nutrient cycles). The Work age will produce models that will be used to make dictions about each of these elements of deep-sea ge ecology. The models will be informed by and ated with the very best existing data, and with new collected during the SponGES project.

y is this important?

little is currently known about deep-sea sponge unds. To gain a sufficient depth of understanding rticularly difficult in the deep sea because of the stics and expense of scientific sampling in such te and challenging conditions. For this reason, hematical and ecological models are essential ictive tools that help scientists to 'fill in' some of gaps in understanding left by sparse and sporadic pling of the deep sea.

nges are known to be long-lived and slow-growing, hey are likely to be vulnerable to physical disturbance environmental change. They also present exciting ntial for biotechnological and biomedical discovery. need to conserve sponge grounds, whilst facilitating

outputs

competent authorities, makers about sponge ound, science based

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8 WORK PACKAGE

ed, Food and Agriculture Organization Nations (FAO) and Ellen Kenchington, es and Oceans Canada (DFO), Canada.

ligations and results of the dialogue with stakeholders such makers to provide knowledge o develop options for better risk ment of the vulnerable marine ystems.

rtant?

wledge about the economic logical role of sponge grounds. ng human induced impacts on m, informs management and improves implementation of es.

y knowledge gaps to

nowledge about the economic ded by deep-sea sponges. dge development about the to sponge grounds are needed nt and protection of these mponents of the sea.

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Food and Agriculture Organization of the United Nations

Scoping study on economic linkages and options for ecosystem valuation of deep-sea living marine resources and habitats in ABNJ

Summary of the current state of knowledge and further information needs for valuing deep-sea sponge ground ecosystem services

Why was the study carried out and what did it involve?

This scoping study contributes to two major projects in the FAO Deep Sea Programme: the ABNJ Deep Seas Project and the SponGES project. The study contributes to Output 2.1.1 (Biological, ecological and economic analyses of deep-sea fisheries and associated biodiversity in the ABNJ) as carried out, in consultation with stakeholders, to identify risks and threats and identify VMEs of the ABNJ Deep Seas Project, and to Task 6.1 of Work Package 6 of the SponGES project (Support for economic valuation of the goods and services provided by sponge grounds).

The scoping study was carried out to ascertain what information and data are available on the economic value of ABNJ ecosystem services, and to assess whether (and how) a quantitative/monetary valuation might be possible. Its objective was to **document and critically review current knowledge on deep-sea ecosystem-economic linkages, so as to identify needs, niches and options for undertaking a study to assess the economic value of ABNJ deep-sea ecosystem services.** While the study considered sponges and sponge grounds alongside other deep-sea species and habitats, it did not focus solely on them.

What is the current state of knowledge on the economic value of ecosystem services?

This study uncovered modest, and by no means comprehensive, literature on the economic value of ABNJ and deep-sea resources and habitats. Forty-two documents were found which dove with the economic value of deep-sea ecosystem services in one way or another. Of these, 30 provide original monetary estimates, while 12 collate or synthesize information from other sources and/or apply existing (and non-quantitatively) with economic valuation in relation to deep-sea resources and habitats.

Overall, the **literature on the economic value of ABNJ and deep-sea ecosystem services remains limited in size and scope** (although, it should be emphasized, contains a number of extremely useful

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Food and Agriculture Organization of the United Nations

Global and regional policies and strategies for identification and protection of VMEs

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Food and Agriculture Organization of the United Nations

Procedure for processing and preserving sponge samples

For genetics, metabolomics, and taxonomy on commercial vessels

PREPROCESSING CATCH:

1. Take pictures of unsorted sponge catch. A label containing the mission and time ID should be included, as well as a ruler to judge scale. Wear thick rubber gloves when handling the sponges to avoid being pierced by their small skeletal structures (spicules).
2. Sort the catch and pool similar-looking sponges (species and/or morphotypes) into groups. Place on tray.
3. Add label beside each sponge species/morphotype group that will uniquely identify them. Label should include the mission and time ID, as well as general identifier for the different sponge species/morphotype groups (e.g. Sponge 1, Sponge 2, etc.). See example image below. A ruler should be added to trays for scale. Take pictures of sorted catch with labels and ruler for scale.

Unsorted sponge catch

Sorted sponge catch

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Food and Agriculture Organization of the United Nations

Identification of sponge species

Species identification is important for ecological, evolutionary, systematic, and biodiversity studies, many of which contribute to the development of conservation and management plans.

Many marine species can be identified using pictures guides that highlight their main physical characteristics. However, there are also many marine species of lesser-known groups, such as sponges, that are hard to identify with photographs or illustrations due to their lack of complex morphological characters, and thus require specialized techniques.

Common features used to identify sponges are the following:

- **Spongin fibres** – organic silicate-symmetric mesh of collagen and forming very complex networks in many sponges
- **Glycosaminoglycan filaments** – skeletal material found in all sponges
- **Spicules** – inorganic elements present in almost all sponges' skeleton and made of either calcium carbonate or silica

The composition, geometry and arrangement of these components can be diagnostic at different

taxonomic levels. For example, the classes of known sponges are separated based on these characteristics: the Calcarea have calcium carbonate spicules, the Hexactinellida, siliceous spicules and the Demospongiae, siliceous spicules and spongin fibres or both.

Still, many observable morphological characters can be used to aid in sponge identification including overall shape, distribution of surface pores, colour, texture and size. Knowledge of other non-morphological characteristics, such as the ecological traits of the different species can also be useful in sponge identification. Several texts, such as posters and field guides, are designed to be used by non-specialists/ individuals while at sea have been developed. A selection of these is provided in the FAO Vulnerable Marine Ecosystems webpage (**www.fao.org/in-action/vulnerable-marine-ecosystems/background/vme-tools/en/**). New tools, including the ones developed through SponGES will be incorporated in the FAO VME webpage.

Identifying sponges

The identification of sponges is very difficult due to their unique morphological traits and intraspecific variability in shape and colour. Therefore, proper identification often requires collection and microscopic examination of their skeletons.

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Food and Agriculture Organization of the United Nations

Sponges and their role in the marine environment

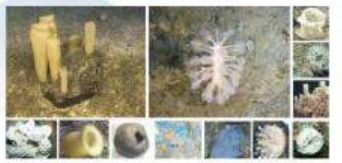
Sponges are multicellular organisms that have porous bodies with channels, allowing water to circulate through them

They consist of a jelly-like layer between two thin layers of cells. Sponges may have a skeleton of spicules, made of silica, calcium carbonate and spongin, a protein. Sponge species may be identified by examining size and shape of their spicules, and only a few can be identified from outward appearance alone.

Sponges do not have nervous, digestive or circulatory systems. Most sponges feed on bacteria and organic matter by drawing water in through the pores. Collar cells line the channels in the pores.

The collars of these cells surround a flagellum that beat to create water currents. There are a few species of carnivorous sponges that feed by using their spicules to capture prey such as small crustaceans.

In general, sponges are not eaten by other organisms. They can contain toxins and their spicule structures probably do not make them very easy to digest. However, hawksbill sea turtles and nudibranchs are known to eat sponges, as are a few fish species.



SponGES

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Food and Agriculture Organization of the United Nations

What are vulnerable marine ecosystems?

Vulnerable marine ecosystems (VMEs) are groups of species, communities, or habitats that may be vulnerable to impacts from fishing activities.

The vulnerability of an ecosystem is related to the vulnerability of its constituent species, communities, or habitats.

The International Guidelines for the Management of Deep-sea Fisheries in the High Seas (FAO, 2009) are designed to provide tools, including guidance towards sustainable use of marine living resources exploited by deep-sea fisheries, and the protection of VMEs and the marine biodiversity these ecosystems contain (Paragraph 42). The Guidelines provide detailed criteria for identifying VMEs (Paragraph 42), which include certain life history traits such as:

- Maturation of relatively old age
- Slow growth rates
- Long life expectancies
- Low or unpredictable recruitment

This means that these organisms have low productivity and they can only sustain low exploitation rates, and recovery can be slow and uncertain. Common risks and habitats with these characteristics could be considered for VMEs and should be reviewed for identification of protective measures.

The key concepts related to VMEs are vulnerability and significant adverse impacts.

Vulnerability relates to the likelihood that a population, community or habitat will experience substantial alteration from short-term or chronic disturbance, and the likelihood that it would recover and in what time frame.

Significant adverse impacts are those that compromise the ecosystem integrity (structure and function) so it ceases the ability of populations to replace themselves, jeopardizes the long-term natural productivity of the habitat, or causes significant loss of species richness, habitat or community type on more than a temporary basis.

The concept of VMEs is applied in the context of a management response to impacts from deep-sea

Web Sources

The FAO VME Database is a global inventory of fisheries resources protected in areas beyond national jurisdiction to prevent significant adverse impacts from bottom fisheries on VMEs: **https://www.fao.org/in-action/vulnerable-marine-ecosystems/vme-database/en/**

The ICES Data Portal on VMEs contains data on the distribution and abundance of VMEs, and organisms considered to be indicators of VMEs, across the North Atlantic: **http://www.ices.dk/marine-data/data-portals/Pages/vulnerable-marine-ecosystems.aspx**

SponGES is a data portal for deep-sea sponge data built under the SponGES project: **http://sponges.org/**

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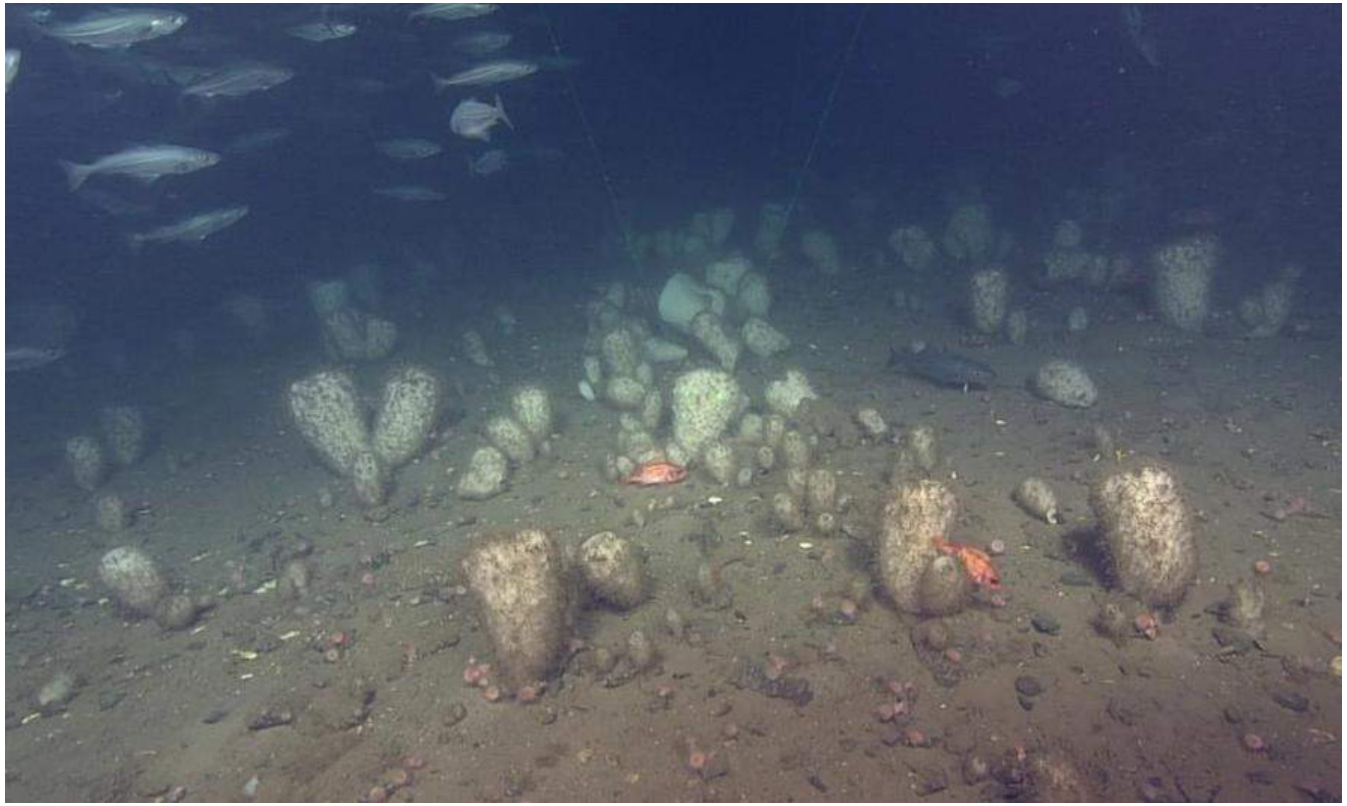
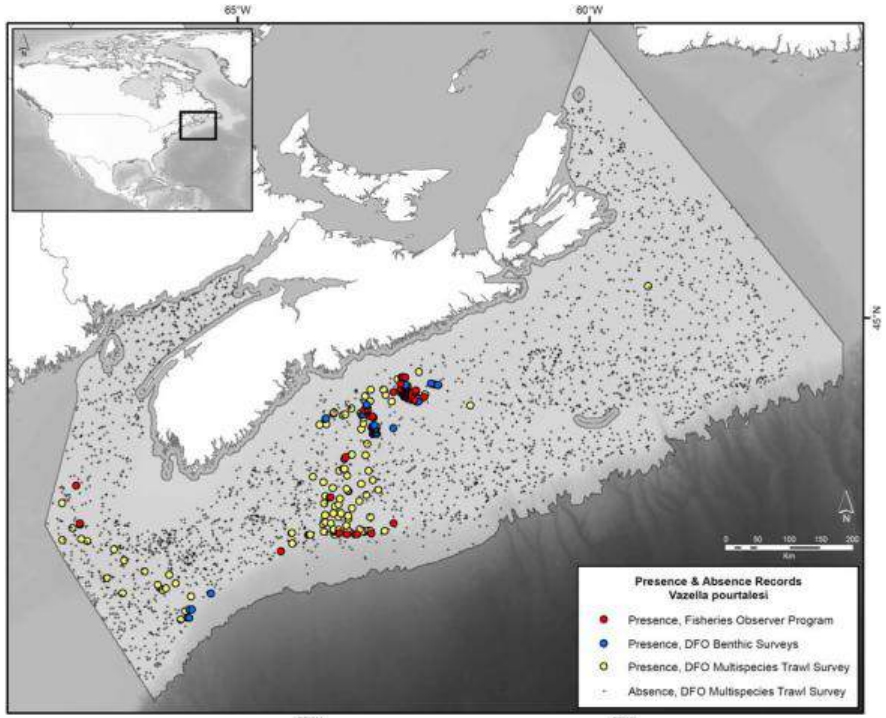
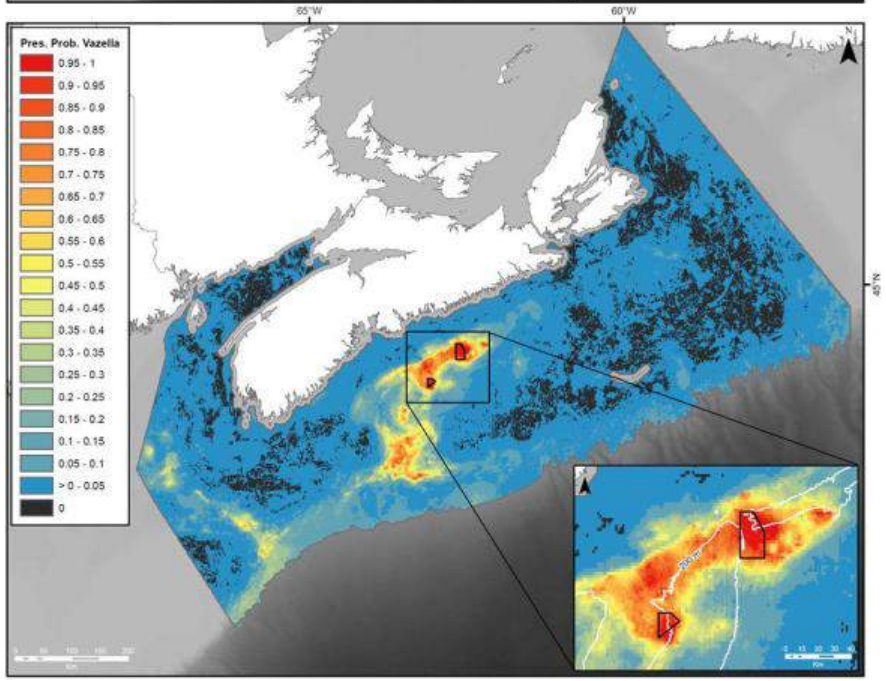
SponGIS as basis for models

…hind- and forecasting of ecosystem distribution

and function in the face of a changing ocean







In summary

SponGES is

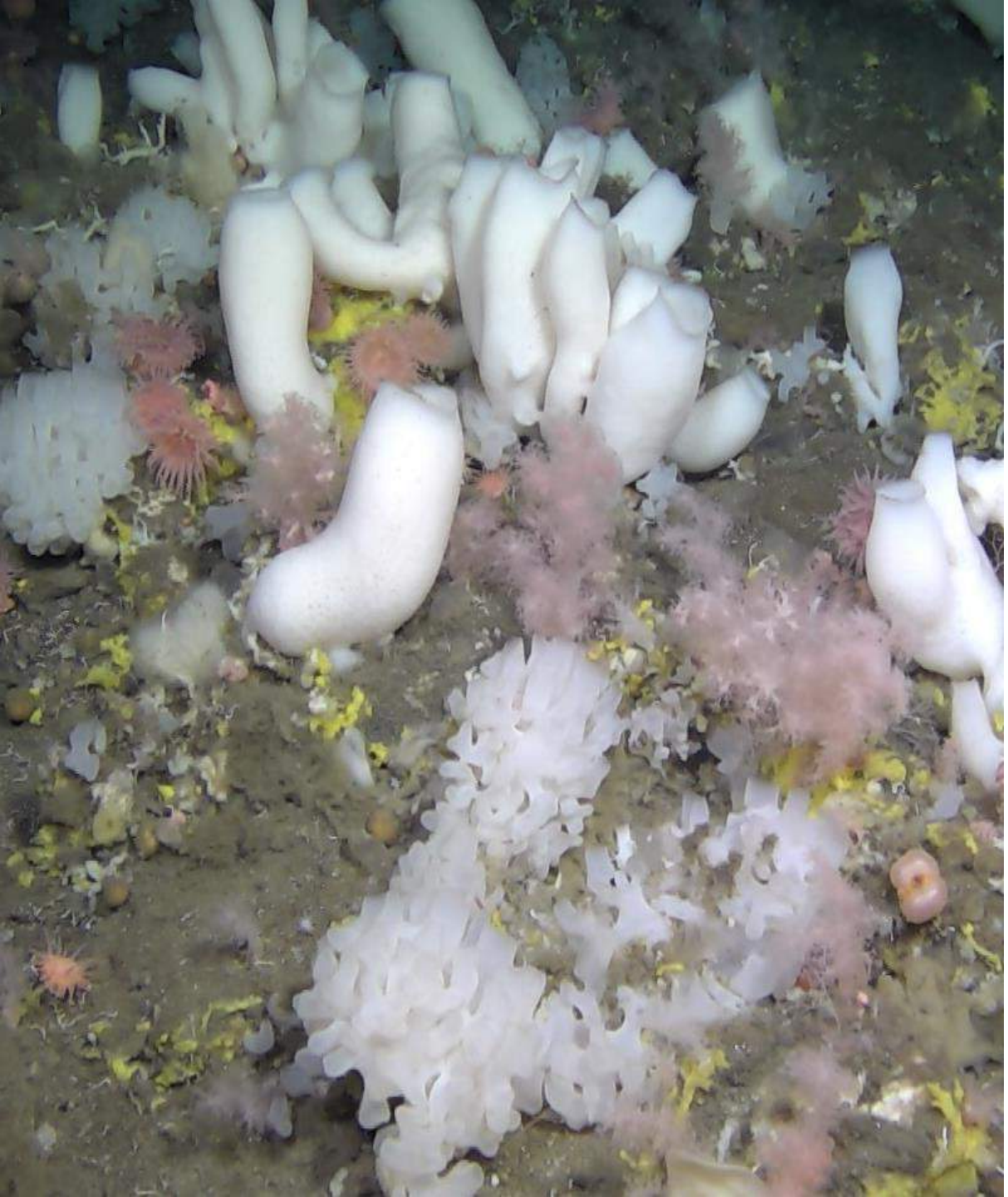
DELIVERING NEW KNOWLEDGE
on the diversity, distribution, function and dynamics

INNOVATION
in the field of drug discovery and tissue engineering through a sustainable bio-inspired approach

PRACTICAL TOOLS
such as species and habitat maps, distribution and ecosystem models, identification tools, etc

CONSERVATION AND MANAGEMENT
adaptive, precautionary, and articulated at (inter)national levels

Anything else that you would like to see? Communicate with us!



SponGES

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