The Marine Biological Association
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EMODNET Biology: Species Traits Vocabulary Workshop

Suggested citation

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EMODnet
European Marine Observation and Data Network

Summary

On February 12th & 13th, the Marine Biological Association of the United Kingdom (MBA) organised a 2 day workshop at the Ifremer Offices in Paris, France. The aim of the workshop was to progress the development of a unified vocabulary for species traits information, and to ensure engagement with the scientific community. The workshop was organised within the context of the Biology component of the European Marine Observation and Data Network (EMODNET) - http://www.emodnet-biology.eu/. The workshop involved participation from key individuals and organisations who are active in the development and application of biological traits and related analyses.

The workshop aimed to

- highlight progress with the collation of traits and attributes through pilot projects funded by the preparatory EMODNET Biology project;
- share experiences from existing trait-collation projects;
- propose and refine a hierarchical approach to trait categorisation, and
- identify a prioritised list of traits for further research and focussed collation.

Following a series of presentations from EMODNET funded pilot and traits-related projects from workshop participants, the proposed hierarchy was discussed. Two breakout sessions then focussed on 1) which traits should be prioritised to address real-world scientific hypotheses, and 2) the alignment of the proposed hierarchy following feedback from participants and the outcomes of a comparison between the pilot projects.

Finally the group reconvened to discuss next steps with regard to publication and dissemination of the vocabulary, with guidance from GBIF.

Participating Institutes

Introduction

The second phase of the biological component of the European Marine Observation and Data Network (EMODNET) began September 2013, following the preparatory work of the previous 3 years. Led by the Flanders Marine Institute (VLIZ) the biological data actions involve a number of key, interlinked work-packages designed to deliver unparalleled access to marine biological datasets and to ensure their utility for effective, evidence-based decision making.

The project consortium is made up of 23 research agencies, marine laboratories and government agencies, with broad experience in the collation and management of biological data.

The project aims to collect and assemble data for all the European sea basins including the Black Sea, Mediterranean Sea, North East Atlantic, North Sea and Baltic Sea, with attention being specifically applied to coastal data sources. In addition biological marine monitoring data from the Norwegian Sea and Barents Sea will be made accessible.

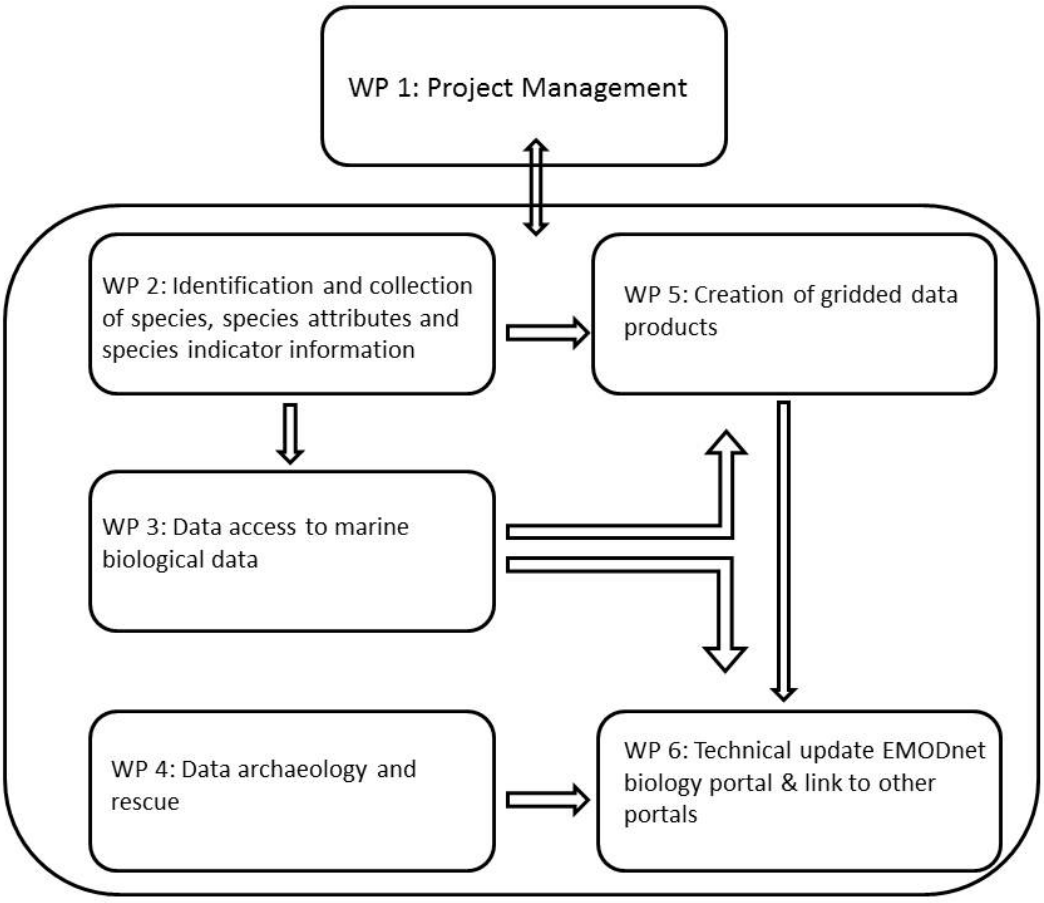

Figure 1. The EMODNET Biology Work Package structure

Work Package 2 (WP2) of EMODNET Biology, the Identification and collection of species, species attributes and species indicator information, has 2 discrete components. The first focuses on the collation of species information relating to legislation and directives, including the Habitats and Birds Directives, IUCN Red Lists, CITES and those species forming part of the proposed indicators within the Marine Strategy Framework Directive (MSFD).

The second aspect of WP2, and the focus of this workshop report, relates to harmonising the collation of species attributes and biological traits, including the development of an agreed vocabulary of trait terms and associated definitions. A standard vocabulary will enable a greater degree of interoperability and facilitate the exchange of trait data between groups.

In addition by linking trait data to the taxonomic backbone of WoRMS we will be able to provide an answer to trait-related biodiversity questions such as:

–Which (macro)benthic species live in the North Sea between 50-100m?

–Which invasive species are known to occur in the Black Sea?

–Which species from the Habitat/Bird Directive are on the IUCN Red List?

The expectations of the workshop were identified as follows:

- Do we need a higher classification of traits? If yes, agreement on overall structure
    - How do we develop vocabulary (definitions of words) of traits?
    - How do we choose which terms (modalities) to choose for a trait?
    - who will manages vocab (editors in chief, categorical editors)
    - how will we manage vocab
- What principles for prioritization data collation (one trait, two traits, more?)
    - Who (trait editors) will collect data
    - How (through subcontracts, call for proposals to editors)
    - How to provide data (excel template, web interface?)
- Where (WoRMS website or separate trait website?) to display the trait data
- Think of demonstration of use case(s) to highlight the value of the collection of this data

Pilot Projects

With funding from the preparatory phase of EMODNET Biology, a number of pilot projects were established to investigate the challenges associated with collating trait information for specific taxonomic groups.

- Planktonic Copepods
- Planktonic Taxa
- Benthic Taxa
- Sea & Coastal Birds
- Macro-algae
- Invasive species

In addition, presentations were given by three participants highlighting relevant work.

- Polychaete traits - http://polytraits.lifewatchgreece.eu/
- Deep sea species traits
- Antarctic polychaetes

Each of the pilot and trait projects outlined their approaches to collating trait information, the challenges they faced and potential solutions.

Common issues identified by the projects included;

Balancing taxonomic coverage against trait coverage. Is it preferential to have a large number of taxa records tagged with a small number of traits, or a large number of traits recorded for a smaller number of taxa? There is a clear requirement for all ascribed traits to be checked, validated and quality assured, if there is going to be sufficient confidence to include them in traits-based analysis. Similarly some traits can be 'inherited' from higher levels of the taxonomic classification. When this occurs the inheritance must be clearly identified, and include the capability to 'override' the inheritance when actual data specific to that taxonomic level is identified. It was recognised that as the taxonomic complexity increases the accuracy of the assigned trait improves, however the utility of that trait for inclusion in meta-analysis decreases, as it is only applicable to a small sub-section of the group or community.

Figure 3. Example of how inherited traits could be implemented in WoRMS

Storing traits as values or categorically. Some traits (for example depth range) can be stored as numerical values (0-200 metres, <2000 metres etc) or as categorised zones (e.g. Epipelagic, Bathypelagic etc). It is recognised that there are discrepancies in the definitions between the categorical classifications, however categorical data is generally more widely and readily available than specific values. In addition this highlights the requirement for agreed and consistent definitions and associated references for any traits vocabulary to ensure there are no errors in interpretation. Furthermore, it is stated that numerical data should not be transformed into categorical data, thus stressing the importance of metadata during trait documentation.

Trait variability with spatial location and life-stage. The traits of a species can vary with life stage and geographic location. When recording trait information it is therefore vital to include information relating to the life-stage that is referred to, and, where relevant and available, the geographic range where the taxa exhibits the trait. In order to provide full transparency in the provenance of the trait information, each trait modality (value/category recorded) should have a

corresponding citation. Furthermore, traits can vary with time (e.g. for birds), but variability in time and space are difficult to separate when only few studies exist.

The availability of literature. For some taxonomic groups not much is known. Therefore the need arises to make inferences, e.g. based on data from congeners, based on data from mouth parts, expert-based opinion, etc. Furthermore, sometimes it is not known if the trait information is common knowledge but not published, or if this information was indeed published. And if published, sometimes it could take too much effort to try and find the trait information. However, it is also recognized that probably much trait information could be found in taxonomic literature (original descriptions, etc.).

Importance of definitions. Some trait terms (e.g. terms for spawning method [sac spawner, broadcast spawner], feeding method [particle feeder, detritivore]) mean slightly different things for different taxonomic groups (e.g. plankton vs. benthos), which highlights again the need for agreed and consistent definitions and associated references.

Inter-taxa interaction. WoRMS currently represents interactions between parasitic taxa and their hosts, however there is clear benefit to this functionality being extended to include other forms of sociability, for example 'symbiotic with', 'grows on', etc and trophic interactions

Traits framework

Building on the pilot projects, existing databases containing trait information (e.g. BIOTIC, Polytraits, FishBase) and published literature (See Annex 1 for references consulted) a harmonised, hierarchical framework was presented. The framework was shared with workshop participants in advance of the workshop in order to facilitate discussion and ensure all participants had chance to understand the structure.

The concept of a traits hierarchy was explored by Reusser & Lee (http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2699.2011.02515.x/abstract) in relation to an integrated biological information framework. The hierarchy for salinity is shown in Figure 3.

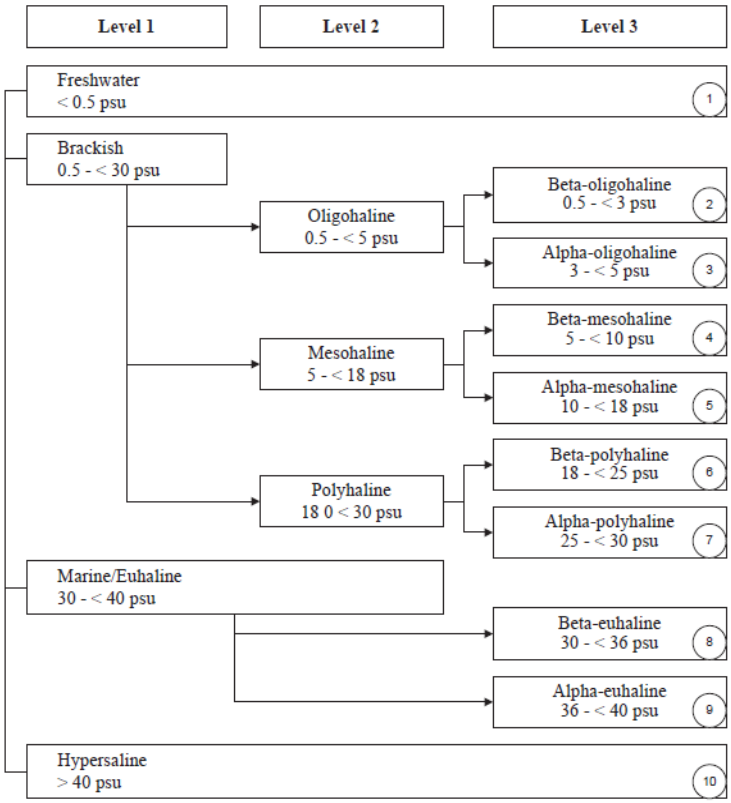

Figure 3.Example of a traits hierarchy from Reusser & Lee, 2011.

The hierarchical approach also facilitates broadly ascribing traits at higher levels of taxonomic organisation and cascading to child taxa as discussed above.

Through a dedicated breakout session the hierarchy was evaluated against the trait categories collated through the Pilot Projects. In addition those workshop participants involved in traits analysis or the management of existing traits resources provided feedback on the overall structure, relationships within the hierarchy and potential areas where further clarity or refinement is required.

As a result of these discussions a second version of the hierarchy is being developed and will be circulated to workshop participants before being disseminated to the wider community.

Real-world application of biological traits – the scientific use case

A second breakout session adopted a 'top-down' approach to the prioritisation of traits, identifying those traits that would be vital in answering some of the key scientific questions raised by Sutherland et al, (2012)[1] and the workshop participants relating to:

- Ecological function in the deep-sea (inc calcification/impacts from ocean acidification)
- Assessment of species richness and body size
- Trophic interactions
- Sensitivity to environmental change/human pressures

[1] http://onlinelibrary.wiley.com/doi/10.1111/1365-2745.12025/abstract

- Relationship between body size and diet in Red List species/invasives/indicator species

The priority traits required to answer these questions were identified and can be seen in Table 1 below.

Trait class	Categories	Numerical
Taxonomic	Phylum to Genus	Not applicable
Environment	Marine, Brackish, Freshwater Terrestrial Pelagic Benthic	
Body size	--	Maximum body length in mm excluding limbs, spines, setae of an individual Maximum total body weight of individual
Depth	Intertidal Subtidal (subdivision required for the pelagic community) Deep-sea (>500 m)	Deepest and shallowest depth recorded in (1) literature and (2) in OBIS
Mobility	Sessile, Mobile	
Body support	Exoskeleton Endoskeleton Cell wall Calcareous (aragonite, calcite) Gelatinous Chitinous Silicious Phosphate Hydrostatic	
Diet	Carnivore, herbivore, omnivore, parasite, detrivore, phototrophic, chemoautotroph	Isotopic signature (tbd)
Reproduction	Sexual Asexual	

Table 1. Prioritised traits for scientific use-case development.

Publication & Dissemination

The use of Semantic MediaWiki (http://semantic-mediawiki.org/) is proposed for the development of the vocabulary. The wiki format provides a platform for discussion as the trait groups, terms and related definitions evolve. The semantic extension allows terms to be related, and the resulting vocabulary to be published in a standard, open format such as SKOS[2] or RDF[3]. One key step in the

[2] SKOS – Simple Knowledge Organization System
[3] RDF – Resource Description Framework

publication of the vocabulary is the development of a namespace and associated Universal Resource Identifiers (URI's). The most important consideration with the namespace and URI's is that they are persistent and do not change, this would be possible using a redirection service such as www.purl.org. The published namespace would, for example, remain as http://purl.org/mst/terms whilst the actual location could change.

By publishing the vocabulary in an open standard (SKOS or RDF) we increase the utility of the vocabulary; these machine-readable formats allow disparate vocabularies to be integrated, with terms and concepts from different namespaces being utilised in a wide variety of applications.

In addition a number of tools exist to visualise SKOS and RDF formatted vocabularies to aid with interpretation and visualise the relationships between the levels and terms within the proposed vocabulary. This would be extremely important in the communication of the proposed traits hierarchy to the wider community. Figure 4 shows a visualisation of a sub-set of the vocabulary rendered from the open-source web-based application SKOS-PLAY (http://labs.sparna.fr/skos-play/about).

In order to ensure the vocabulary and its development and the integration of prioritised traits into WoRMS received the widest possible exposure, two peer-reviewed publications are planned. The first will detail the development of the hierarchical species trait framework for the marine community, its development and publication methods. The second paper will focus on the prioritisation of traits, and how traits can be used to address the scientific use-cases detailed above.

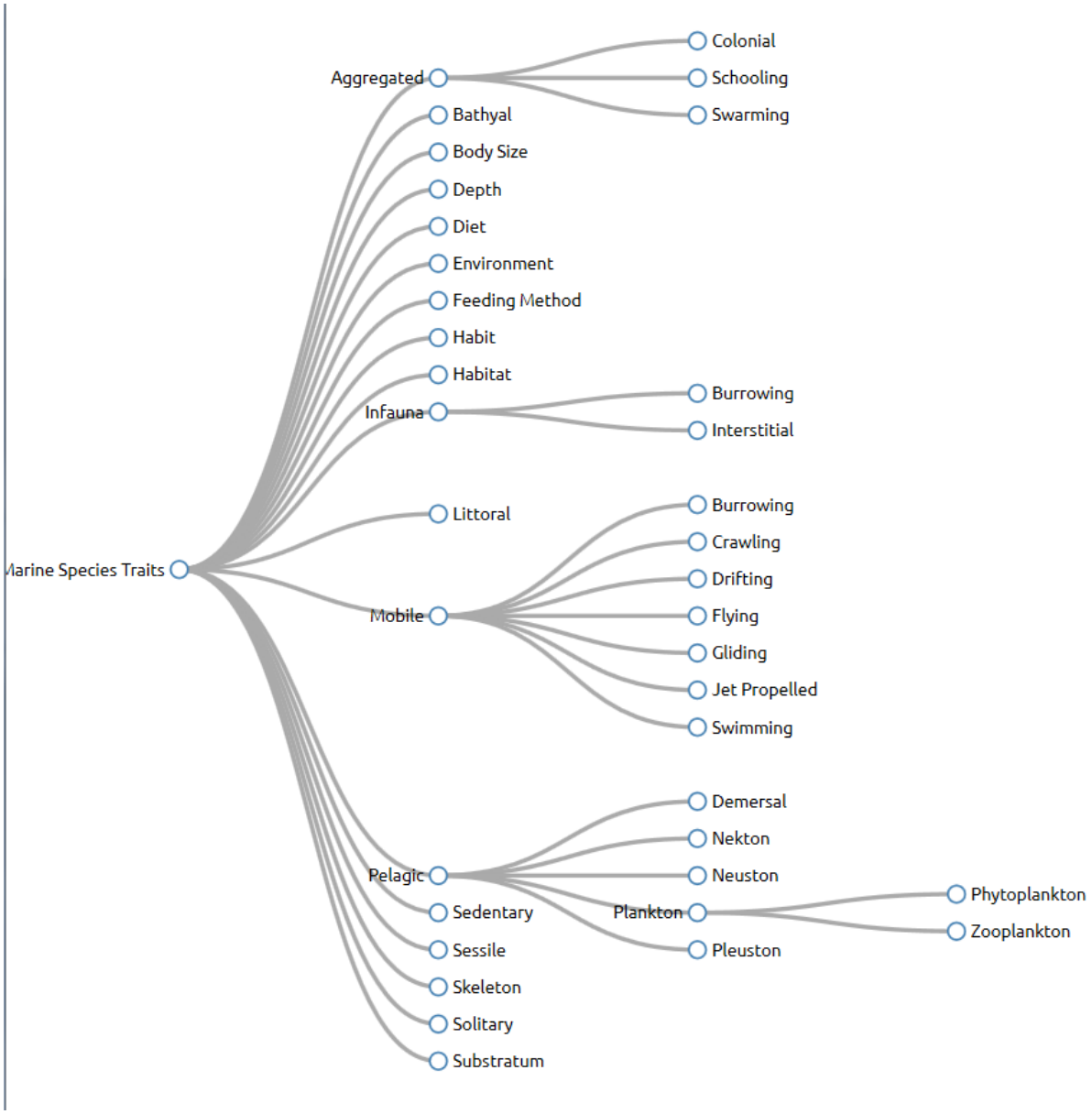

Figure 4. Example output transformed from traits vocabulary in SKOS format.

Next steps

The workshop was extremely successful in engaging the academic community and those involved in the development of traits databases and applications. All participants agreed to continued involvement in the next iteration of the overall traits hierarchy and in contributing traits to the resulting traits catalogue. Workshop participants will be invited to develop the trait terms and definitions through the Semantic MediaWiki application, and contribute to the development of the two peer reviewed publications.

Over the next six months the EMODNET WP2 team will:

- Agree a namespace for the marine species traits
- Update the traits hierarchy based on the workshop discussions
- Populate the Semantic MediaWiki with terms and definitions

- Prepare two peer reviewed publications (prioritization of traits; a common ontology for marine traits)

Furthermore we will inform the WoRMS network of these ongoing activities, will add the finished pilot data, for which the definitions have been agreed, to the database and will initiate new pilots to collect data on some of the defined priority traits (i.e. body size and body support).

Annex 1. References consulted in hierarchy development

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Annex 2. Agenda

Wednesday 12th February 2014

9.30 – Arrival & Coffee

10.00 – Welcome & Introductions (10 mins) (Lear)

10.10 - Introduction to EMODnet Biology -10 min +10min discussion (Claus)

10.30 - Goals of Work Package 2 – 5 min (Lear)

10.35 - Background to traits databases – rationale and options – 15 min + 40 min discussion (Costello)

11.30 – Presentations (10 mins + 10 mins discussion each)

Planktonic Copepods (G. Boxshall)

Planktonic Taxa (D. Johns)

Benthic Taxa (T. Webb)

Sea & Coastal Birds (M. Tasker)

12.50-14.20 - Lunch

14.20 - Presentations (10 mins each + 10 mins discussion)

Macro-algae (O De Clerck)

Invasive species (M. Costello)

Polychaete species (S. Faulwetter)

Deep Sea species (A. Glover)

Antarctic polychaetes (M. Brasier)

16.00 – Policy/Governance traits – 10 mins (Lear)

16.10 - Introduction to trait vocabulary – draft template from pilots, scope, sources, comments – 30mins (Tyler-Walters)

16.40 - Discussion of general structure 60 mins open discussion

17.40 – end session

Workshop Dinner

Thursday 13th February 2014

8.30-Arrival & Coffee

9.00 - Summary of Day 1 (10-15 mins)

Breakout groups –

- In-depth discussion of applicability of proposed traits and classification to particular taxa or guilds
- compiling additional traits into the vocab
- Identification of databases or traits for inclusions – either within expert groups or identification of others to pursue.
- Technical implementation

13.00-14.30 - Lunch

14.30-16.00 - Plenary - Continuation of discussion of vocab (inc approach in breadth/coverage & application of hierarchical traits)

Potential plans to manage the terms /definitions – 10 mins discussion. (Ó Tuama)

Interfaces: linkages/display of trait, taxonomic and distributional information. (VLIZ)

Publication/implementation methods

- Paper on rationale, scope, classification (Costello)
- Paper on vocabulary
- What will be implemented in WoRMS and by whom, who enters vs approves
- How to discuss/present/publish the vocabularies online – Semantic Media Wiki
- Role of TDWG and developing standards

16.00 - Timetable and next steps- 30 min

16.30 – Meeting close and depart

Annex 3. Participants

Adrian Glover	NHM
Andreas Kroh	NHM-WIEN
Anna Törnroos	ABO
Bart Vanhoorne	VLIZ
Dan Lear	MBA
David Johns	SAHFOS
Eammon O Tuama	GBIF
Geoff Boxshall	NHM
Harvey Tyler-Walters	MBA
Jan Vanaverbeke	University Ghent
Jen Hammock	EoL
Leen Vandepitte	VLIZ
Madeleine Brasier	NHM
Mark Costello	University Auckland
Mark Tasker	JNCC
Olivier de Clerck	University Ghent
Pelin Yilmaz	MPI-Bremen
Sarah Faulwetter	HMCR
Simon Claus	VLIZ
Sofie Vranken	VLIZ
Stefanie Dekeyzer	VLIZ
Stéphane Pesant	MARUM
Tammy Horton	NOC
Tom Webb	Sheffield University