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Reports of Meetings of Experts and Equivalent Bodies

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UNESCO
Group Picture from left to right: David Obura, Raphael Kudela, Pier Luigi-Buttigieg, Lauren Weatherdon, Lisandro Benedetti-Cecchi, Paul Snelgrove, Nic Bax, Valerie Allain, Peter Tyak, Sanae Chiba, Frank Muller-Karger, Sonia Batten, John Quilan, Patricia Miloslavich, Yunne Shin, Daniel Dunn, Albert Fischer, Ward Appeltans, Emmett Duffy.

Executive Summary

The GOOS Biology and Ecosystem Panel (GOOS BioEco) held its Third Meeting at St. Petersburg, Florida in November 2018 hosted by the University of South Florida. The three main goals of this meeting were to (1) update on activities of the panel and on the status of development and implementation of biological essential ocean variables (EOVs), (2) plan the activities to map the current network of ocean biological observations through the PEGASuS project approved by the NCEAS and Future Earth, and (3) discuss the next steps to continue to support the implementation of the biological EOVs, particularly with regards to contribute to international processes and to funding. Discussions of these activities were framed into the new GOOS strategy and related to other high-level initiatives within the Intergovernmental Oceanographic Commission including the UN Decade for Ocean Science and Sustainability. Synergies with the Ocean Sciences Section were also highlighted as opportunities to develop on several topics relevant to biological observations such as ocean acidification, ocean deoxygenation, harmful algal blooms, trends in phyto and zooplankton, and the Blue Carbon Initiative among others.

The BioEco panel will be important in leading the Ocean Health theme within the new GOOS strategy for which partnerships will be essential. The panel stressed out the importance of demonstrating the full value chain along with the need for and the benefits derived from the observations suggesting highlighting some key national examples, or success stories.

(1) Updating on GOOS and on BioEco EOVs

Activities leading to the development and implementation of the biological EOVs varied across EOVs. There were two implementation plan workshops this year, one related to plankton communities and the second related to macroalgal assemblages. The plankton EOV workshop (Plankton-MOB) provided recommendations for the implementation of a sustained, multidisciplinary global observing system of plankton communities. This will benefit from the outcomes of the SCOR working group on “Integration of plankton-observing sensor systems to existing global sampling programs” (P-OBS) which is evaluating the feasibility of installing available plankton survey technologies on GO-SHIP and Ocean-SITES. For the Phytoplankton EOV, partnership with GlobalHAB is progressing towards standardization of protocols and practices for plankton monitoring. Members of the GOOS BioEco panel will develop a plan for project funding, focused on combining plankton imaging with the Continuous Plankton Recorder. The macroalgal workshop provided recommendations for the strategic implementation of macroalgal canopy cover and composition as an EOV and agreed on a data management workflow and associated architecture to integrate existing and future data. The vision is to integrate macroalgal canopy cover and composition into a global observing network and to promote this EOV as a leading indicator of the status and trends of non-tropical rocky reefs worldwide. For the hard coral EOV, following the workshop held in 2017 and two more workshops organized by the UN Environment in 2018, a governance plan to strengthen the Global Coral Reef Monitoring Network (GCRMN) was drafted. The renewal and modernization
of the GCRMN has applied lessons and standards from GOOS and the Group on Earth Observation – Marine Observation Network (GEOBON), and a view on expanding the scope of monitoring to integrate socioeconomic with biophysical elements. The new GCRMN governance and structure is going through a consultation and engagement process. For the *fish EOV*, the panel proposed an inventory of existing databases (metadata and metadata standards) around the world in order to facilitate the use of fisheries independent data and evaluate their global coverage. This would help create incentives to report fisheries independent EOVs and strengthen the linkages between global and national indicator development and reporting and providing "demonstration utilities" through use cases. This will require the collaboration between multiple stakeholders. The *seagrass EOV* scientific and observing communities are engaged and made several recommendations to build a coordinated seagrass observing system including closely integrating existing in situ surveys with remote sensing imagery, and incorporation of environmental DNA and metagenetics approaches for sampling taxa difficult to assess by traditional sampling. They will resubmit their WG proposal to SCOR again in 2019. No panel members representing the *turtle-bird-mammal (TBM)* and *mangrove EOVs* attended the meeting however updates for these EOVs are provided. For the TBM EOV, significant efforts are being carried out in the US through the Animal Telemetry Network (ATN) and the IOOS different regional associations. For mangroves, a time-series of maps of the global mangrove extent was generated and released in 2018 by the Global Mangrove Watch. Maps are currently available for seven annual epochs including 1996, 2007, 2008, 2009, 2015 and 2016 from which losses and gains in any location can be assessed. While these data address the previous information gap on mangrove extent, data are still lacking on mangrove species distribution and habitat type.

The “emerging” *microbial EOV* will initially focus on bacterial and archaeal life but has scope to include viral and fungal components as it matures. Through this EOV, the panel seeks to rally and channel the activity of marine microbial observatories, observatory networks, and sampling campaigns to produce an EOV which captures the rapid, multifaceted, and deeply informative dynamics of microbial life in the ocean. The EOV would provide a basis for the development of microbial indicators of, for example, invasive species, the presence of pathogens and bio-contaminants, and seasonal resilience, supporting the Ocean Health GOOS theme. The other “emerging” EOV, *benthic invertebrate* abundance and distribution will be developed closely with the Deep Ocean Observing Strategy (DOOS) group. GOOS is still to decide how the “pressure” EOVs will be developed. For now, these are limited to *ocean sound* and *marine debris*. The Ocean Sound EOV will be implemented under auspices of International Quiet Ocean Experiment (IQOE). For marine debris, clear terms of reference and partnerships will need to be established.

The panel recognized that the support from OBIS and (national) data systems is critical for the development of all EOVs and will require a more sustainable funding situation and the establishment of partnerships to support data and information product development. The *Ocean Best Practices* (OBP) was also recognized as a useful platform to centralize all GOOS endorsed SOPs.
(2) Mapping the EOV network

The BioEco et al. project "Defining the observing system for the world's oceans - from microbes to whales" was approved under the PEGASuS 2 call on Ocean Sustainability sponsored by Future Earth and the National Center for Ecological Analysis and Synthesis (NCEAS). The project aims to design a monitoring network to answer specific scientific questions on high priority global phenomena in response to calls for guidance from policy makers and managers. The first step will be to develop a baseline map showing status and gaps.

(3) Planning the next steps

The panel is committed to contribute to many international processes and frameworks, including the Decade of Ocean Science for sustainable development, the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES), the World Ocean Assessment (WOA-2), the Biodiversity Beyond National Jurisdiction (BBNJ), and the Global Climate Observing System (GCOS) among others. Three issues for the success of these contributions will be key: improving communication, establishing partnerships and securing funding. Strategies for each of these were discussed.
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1. INTRODUCTION

1.1 Welcome and introduction to the agenda

Nic Bax (BioEco co-chair) opened the meeting and provided some history about the panel. He reminded that our initial goal was developing two EOVs and have at last one EOV at a mature stage by 2019 noting the significant progress advancing the 8 EOVs. He mentioned the 3 implementation plan workshops (coral, plankton, macroalgae; reports available in GOOS website under each event), the publication of several papers (Miloslavich et al. 2018 a,b, Bax et al. 2018, Muller-Karger et al. 2018, Chiba et al. 2018, Boss et al. 2018) and the more than 10 community white papers that are in preparation for OceanObs’19. The panel’s grant proposal PEGASUS (NCEAS/Future Earth) was approved. This project will fund two workshops in 2019 with the aim to address 2 key questions: (i) what does the current observing system look like? and (ii) what is required for an ideal system?

Daniel Dunn was appointed co-chair of the panel in 2017 and this was his first panel meeting. He acknowledged the meeting organizers, host and sponsors. Daniel Dunn is active in the Science-Policy interface, working with management and inter- and intra-specific interactions; understanding social and ecological processes that generate pattern in anthropogenic stressors and biodiversity; and in conservation of areas beyond national jurisdiction (ABNJ). He addresses these topics by developing empirical models using large species observation, fisheries and physical oceanographic datasets and by working with social scientists to understand social-ecological interactions to inform marine policy and governance. The Panel Members and other invitees introduced themselves.

For a list of all acronyms and abbreviations used in this report, see Annex 1. For the full annotated agenda, see Annex 2. For the full list of participants and their affiliations, see Annex 3.

1.2 Secretariat Report

Patricia Miloslavich (BioEco Project Officer) provided an overview of progress achieved in 2017-2018 (Figure 1) and introduced the goals of this meeting. Goals of the meeting were focused on providing an update on the status of development/implementation of the biological EOVs, how the mapping of the EOV network will be achieved (through the PEGASuS project) and to plan the next steps, particularly with regards to contribute to international processes and to funding (Annex 2).
1.3 GOOS 2030 Strategy

Albert Fischer (Head of IOC Ocean Observing and Services Section and director of the GOOS office) briefly presented the status of the GOOS program. GOOS aims to deliver for three broad themes: operational services, climate, and ocean health. It uses the Framework for Ocean Observing as a guiding document for the voluntary collaborative activities. The GOOS 2030 Strategy, which will be launched at the beginning of 2019 (and formally adopted by the IOC Assembly in June 2019), has a broad vision of "A fully integrated global ocean observing system that delivers the essential information needed for our sustainable development, safety, wellbeing and prosperity." The GOOS mission, more specific to the programme, is "to lead the ocean observing community and create the partnerships to grow an integrated, responsive and sustained global observing." Eleven Strategic Objectives fit into three goal areas, in: deepening engagement and impact, system integration and delivery, and building for the future.

The BioEco panel is important in leading the Ocean Health theme of GOOS (Figure 2). An initial view of the partnerships for delivery to end users was presented, for input and discussion by the panel (see below). GOOS is developing a methodology for common approaches to partners across its structures, around the identification of partnership objectives and benefits, assessing the costs and benefits of the engagement, and organizing large partner (like UN Environment) engagement around a lead on the Steering Committee.
The panel suggested GOOS develop some implementation timelines around the different objectives in the 2030 Strategy. It highlighted the importance of giving credit to those taking the observations contributing to GOOS. In demonstrating the full value chain and the need to take observations, one approach was to highlight some key national examples, or success stories.

1.4 Synergies with the Ocean Sciences section of the IOC

Salvatore Arico (Head of IOC Ocean Science Section) reported on the many science activities and working groups at the OS section, that focus on biology and ecosystems and contribute to analytical and product development of BioEco EOVs. These were mainly: ocean acidification (through the Global Ocean Acidification Observing Network, GOA-ON), ocean deoxygenation (Global Ocean Oxygen Network, GO2NE), harmful algal blooms (through Global HAB), trends in
phyto and zooplankton (through TrendsPO), and the Blue Carbon Initiative among others (Figure 3).

More synergy and harmonization with GOOS is highly desirable, which can be in the form of helping with aspects of observations, forming research questions, feedback from the research community in evaluation the observing system and identifying gaps in knowledge and data. One of the examples of successful examples is the collaboration with GOA-ON and the development of the SDG14.3.1 indicator. But more can be done in Ocean Acidification impacts on biodiversity, both negative (e.g. on coral, shellfish) as well as positive (e.g. on seagrass/macroalgae).

![Figure 3](image)

**Figure 3.** Projects under the Ocean Sciences Section contributing to the understanding of global ocean phenomena such as acidification, deoxygenation, trends in plankton, and blue carbon (modified from Howes et al., 2015). Abbreviations and acronyms as in Annex 1.

Arico also stressed the need for increased capacity development to further improve international science collaboration. With regards to blue carbon, Nic Bax mentioned that one of the main issues is investment and that Kyoto did not recognize salt marshes, mangroves, and seagrasses as carbon sequestration/sinks. Arico mentioned that the UNFCCC and SBSTTA are making progress on this under the Paris Agreement, but more support is needed in developing
the indices (remain narrative) along with a stronger engagement with the UN statistical committee.

2. UPDATE ON EOV DEVELOPMENT

Patricia Miloslavich introduced this agenda item. Each EOV representative on the panel was asked to report on:

- Partners and collaborators - linkages to other (scientific) organizations including collaboration across GOOS disciplines – mapping the partners
- Engagement with other (non-scientific) stakeholders
- Progress to complete/update specification sheets
- New technologies to help automatize and expand spatial and temporal coverage of measurements
- Capacity development required to engage in these technologies – is any organization currently undertaking similar or applicable capacity efforts? If not, suggestions?
- Funders: current and potential for further development and plan implementation – mapping the funders
- Activities leading to EOV implementation: proposals, workshops, papers, communication (scientific at conferences or others)
- Current data repositories and management practices – what type of data infrastructure would be required to adjust to new technologies (e.g. imaging, audio, genetic sequences, etc.)
- Vision to move forward - planning for 2019-2020: activities, engagement, communication, etc.

Presentations are available at the GOOS website:
http://www.goosocean.org/index.php?option=com_oe&task=viewEventRecord&eventID=2243

2.1 Fish abundance and distribution EOV

Valerie Allain presented an update of the activities carried out by the Pacific Community mostly on oceanic, mesopelagic fisheries independent surveys (Figure 4). Yunne Shin presented an update of the activities of the Indicators of the Seas (IndiSeas) program. IndiSeas aims to evaluate the health status of marine exploited ecosystems basically by carrying out comparative analyses of ecosystem indicators from the world’s marine ecosystems to quantify the impact of fishing and to provide decision support for fisheries management in a context of climate change. A proposal was submitted in September 2018 to the H2020 call on Blue Growth entitled “Atlantic
ECOsystems assessment, forecasting & sustainability” (AtlanECO) aimed to update and contribute new data through time-series to support global assessments (Figure 5).

**Figure 4.** Biological samples collected by the Secretariat of the Pacific Community providing data on food web and ecosystem indicators (http://tagging.spc.int/webtagging/BioDaSys/BioDaSys/Samples)
Discussions on how to approach the Fish EOV followed with the contributions of Mark Dickey-Collas and John Quinlan.

The capacity to monitor the spatial and temporal dynamics of fish EOVs is a basic requirement to the assessment of fish communities in the ocean under the impacts of climate change, fishing and pollution. While most indicators of change are based on commercial fisheries catch data, because of their global coverage, their accessibility and obligation of national reporting to FAO, multiple lines of evidence show the importance of fisheries independent data to provide reliable assessments of fish status in support to management decisions for an ecosystem approach to fisheries (Pauly, Hilborn, & Branch, 2013; Shin et al., 2012; and see references in Miloslavich et al. 2018). Among these data, multispecies trawl survey data, pelagic acoustic survey data, tagging data, and underwater survey data are a rich source of information for coastal and offshore fish communities, including fish EOVs and subvariables. These data are collected in many countries and are the primary source of information for implementing an ecosystem approach to fisheries. Yet, these data are not necessarily standardized nor accessible globally, and only a few European and North American initiatives have coordinated data repositories with access to quality-controlled data, e.g., DATRAS for trawl surveys in European seas (http://www.ices.dk/marine-data/data-portals/Pages/DATRAS.aspx). Besides the existing major routine surveys, a number of new technologies to expand data collection is already used or is under development such as e-monitoring on fishing vessels, acoustic echosounders on fishing aggregating devices (FADs) or gliders, video (BRUVs) and sound monitoring, environmental DNA sampling. However, for most of these methods, the spatial and taxonomic coverage is narrower, and further development is required to automatize and standardise the collection and analyses of data.

In order to facilitate the use of fisheries independent data and evaluate their global coverage, GOOS aims to propose an inventory of existing databases (metadata and metadata standards) around the world as a first step. This would allow in a second step to create incentives to report fisheries independent EOVs and strengthen the linkages between global and national indicator development and reporting and providing “demonstration utilities” through use cases. This step would involve the collaboration between multiple stakeholders such as the Convention of Biological Diversity (CBD) (defining new targets for maintaining exploited ecosystems within safe limits), the Biodiversity Indicators Partnership (BIP) (highlighting indicators for measuring progress in achieving targets), national fisheries departments (conducting the surveys), scientific experts (through e.g., ICES and PICES working groups, CLIOTOP, INDISEAS), fishing industries, NGOs, and regional fisheries management organizations. However, acquisition of funding remains a major issue as human resources would be needed to make a comprehensive inventory of existing databases and time series of fish EOVs in different parts of the world.
2.2 Hard coral cover and composition EOV

The hard coral cover and composition EOV workshop was held in Dar es Salaam, Tanzania in November 2017 as a co-organized event between GOOS and the Global Coral Reef Monitoring Network (GCRMN) with the support of IOC, the International Coral Reef Initiative (ICRI), and UN Environment (See workshop summary and recommendations at: [http://www.goosocean.org/index.php?option=com_oe&task=viewDocumentRecord&docID=20794](http://www.goosocean.org/index.php?option=com_oe&task=viewDocumentRecord&docID=20794). A governance plan to strengthen the GCRMN based on the discussions of this workshop and two more workshops organized by the UN Environment was drafted.

The renewal and modernization of the GCRMN has applied lessons and standards from GOOS and GEOBON, and a view on expanding the scope of monitoring to integrate socioeconomic with biophysical elements. The key elements of redesign include:

- Network design applying the principles of the Framework for Ocean Observations (UNESCO 2012 p. 7);
- Applying the Drivers Pressures Status Impact Responses (DPSIR) model used in many convention processes (Patricio et al. 2016, Miloslavich et al. 2018a);
- Adopting the Essential Ocean Variable (EOV)/Essential Biodiversity Variable (EBV) framework (Muller-Karger et al. 2018) to identify the priority variables for understanding and reporting on the health of coral reefs; and
- Integrated monitoring/adaptive management approach to ensuring local-level management is responsive to pressures, trends and capabilities.

The new GCRMN governance and structure has also been through a consultation and engagement process since 2016 at major conferences (science, conservation, policy/SBSTTA). The regional reporting of the state of coral reefs is ongoing (Figure 6).

![Completed/in progress 2018/19: Western Indian Ocean, Asian Seas, Pacific, Eastern Tropical Pacific, Caribbean (some may need updates for global reporting in 2020)](image)

![Not yet planned: Red Sea/Gulf of Aden, ROPME sea area, South Asia, Australia, Brazil/SE Atlantic (need full compilation of data at a minimum, for global reporting in 2020).](image)

**Figure 6.** Status of coral reef regional assessments. In red those that are either completed or in progress, in yellow those not yet planned.
2.3 Zooplankton biomass and diversity EOV

There have been several simultaneous exercises which contribute to advancing the zooplankton EOV during the past year: Plankton-MOB, P-OBS and GACS with several contributions to OceanObs19 CWPs. Plankton-MOB provided recommendations for the implementation of a sustained, multidisciplinary global observing system of plankton communities (see report at: http://www.goosocean.org/index.php?option=com_oe&task=viewEventRecord&eventID=2258) (Miloslavich et al., 2018c).

The Global Alliance of CPRs (GACs) has agreed that developing the global database is a priority. The SCOR working group on “Integration of plankton-observing sensor systems to existing global sampling programs” (P-OBS) is evaluating the feasibility of installing available plankton survey technologies on GO-SHIP and Ocean-SITES, and POGO, through the Task Force on Ocean Biological Observations has recommended to take innovative approaches for real time observation and ground-truth validation (e.g. microscopic/imaging/genomic techniques) (Figure 7). These exercises combine maintaining and expanding surveys using existing technology with exploring and implementing new technologies on existing observing platforms. Both approaches are required to efficiently monitor zooplankton in the future with essential ground-truthing and integration with existing time series. The Plankton-MOB workshop recommended a pilot project to test the IP (that utilized the output from P-Obs) at a local to regional scale, perhaps by adding plankton-observing instruments to a GO-SHIP cruise. GACS recommends collaborating with groups such as the IOCCG to ground-truth satellite-derived data, for example phytoplankton functional groups and the use of global biogeochemical and ecosystem models that incorporate plankton functional types to inform the design of a global plankton observing system. This could include other traditional zooplankton sampling partners.

All efforts are also paying attention to data management needs, from sensors through processing and products, and recognize that new optical and imaging sensors make this a non-trivial issue. Because there are several approaches to measuring zooplankton it will likely remain as a group of networks each with a particular strength, and would therefore benefit from an over-arching coordinating group to focus on indicators that could specifically contribute to the EOV and a global analysis.
2.4 Phytoplankton biomass and diversity EOV

For the Phytoplankton EOV, partnership with GlobalHAB is progressing towards standardization of protocols and practices for plankton monitoring. The recently held Plankton-MOB workshop identified key challenges and a recommended pilot project as a first step towards full implementation (Figure 8). Members of the GOOS BioEco panel will develop a plan for project funding, focused on combining plankton imaging with the Continuous Plankton Recorder. Related activities include expansion of the NASA SeaBASS database to include plankton species, complimentary workshops on ocean imaging (NOAA, USA), and the Global HAB Report (coordination between IOC, HAEDAT, IPHAB, and OBIS), which represents the development of an end-user product based on GOOS EOV data.
Figure 8. Activities of GlobalHAB are/will be implemented in collaboration with many different entities and approaches. Interaction with international research programmes on HABs is fundamental for the success of GlobalHAB. Accronyms as in Annex 1.

2.5 Macroalgal canopy cover and composition EOV

To develop a global, coordinated strategy for monitoring macroalgal forests, the Partnership for the Observation of the Global Ocean (POGO) supported a Working Group (WG) of international, multidisciplinary experts that met in October 2018 in Hobart to plan the implementation of a standardized, innovative and cost-effective monitoring system. The WG compiled metadata of more than 80 existing programs operating from local to global scales, identifying the strengths of these efforts in addition to the gaps and requirements to achieve global standardization. The WG also reviewed the methods available to monitor macroalgal forests, including visual census, acoustics, laser imaging, remote sensing from satellites, molecular tools (including environmental DNA), and imagery (stills, automated/remote vehicles, drones). The strength and weaknesses of the different methodologies were evaluated and compared with respect to feasibility, training requirements, spatial scale of analysis and taxonomic resolution. A fit to purpose Standard Operating Procedure (SOP) was drafted for each of the different methodological approaches. The requirements for data integration, assimilation and dissemination were discussed and a data management architecture was proposed to provide a centralized repository linked with OBIS under the principles of ‘Findable, Accessible, Interoperable, and Re-useable’ data.

The POGO WG defined a strategic implementation plan to promote macroalgal canopy cover and composition as an EOV, including: 1) formalize a data requesting template and data sharing
agreement to compile an exhaustive inventory of existing datasets; 2) finalize the SOPs for the different methodological approaches to be made available through the Ocean Best Practices platform; 3) develop vocabularies, non-taxonomic categories and units for recorded variables; 4) improve communication and dissemination through papers, presentations, training material and websites. The POGO WG also agreed on a data management workflow and associated architecture to integrate existing and future data. This proposed architecture will allow data and metadata from multiple sources to be uploaded or harvested in a centralized global data repository (Global Macroalgae Data Repository) using standards based metadata (ISO19115) and providing web services [Thematic Real-time Environmental Distributed Data Services (THREDDS), Web Map Service (WMS), Web Feature Service (WFS)] that can be harvested by the OBIS Australia node for aggregation with other EOVs in OBIS international (Figure 9). The vision is to integrate macroalgal canopy cover and composition into a global observing network and to promote this EOV as a leading indicator of the status and trends of non-tropical rocky reefs worldwide. See workshop report at: [http://www.goosocean.org/index.php?option=com_oe&task=viewEventRecord&eventID=2327](http://www.goosocean.org/index.php?option=com_oe&task=viewEventRecord&eventID=2327) (Miloslavich et al., In press)

**Figure 9.** Proposed data workflow and architecture to integrate existing and future macroalgal data. Data from multiple sources to be centralized in a global data repository for aggregation with other EOVs in OBIS international. Acronyms as in Annex 1.
2.6 Seagrass cover and composition EOV

In 2018, researchers and managers from around the world drafted a consensus assessment and recommendations on the current state of, and opportunities for, advancing global marine macrophyte observations, integrating contributions from a community with broad geographic and disciplinary expertise (Duffy et al. in review). Based on review of 19 active, multi-site seagrass monitoring programs and many more local efforts (Figure 10), the group made several main recommendations: a coordinated seagrass observing system will best be built by (1) harmonizing observations and best practices developed by existing networks; (2) identifying a core set of common metrics and a common hierarchical sampling design; (3) actively promoting common standards for taxonomy, data management, and governance; and (4) active capacity building. The group also recognized strong potential for advancing coordinated observations of seagrass ecosystems by more closely integrating existing in situ surveys with remote sensing imagery, and incorporation of environmental DNA and metagenetics approaches for sampling taxa difficult to assess by traditional sampling. Realizing these recommendations will produce more effective, efficient, and responsive observing, a more accurate global picture of change in seagrass systems, and stronger international capacity for sustaining observations. The consensus among global seagrass researchers indicates that the community is engaged and committed to moving these goals forward.

Figure 10. In situ and remote observations of seagrasses by SeagrassNet, Seagrass-Watch, the Marine Global Earth Observatory (MarineGEO), the Zostera Experimental Network (ZEN), the University of South Florida and seagrass researchers worldwide.
2.7 Marine turtles, birds, mammals abundance and distribution EOV

Neither Dan Costa nor Samantha Simmons were able to attend the workshop, however Dan Costa was attending the US Integrated Ocean Observing System (IOOS) Biological Observations Workshop being held at Santa Cruz, California (7-9th November) organized by NANOOS, CeNCOOS, SCOOS, ATN, MBON and OTN. The workshop is intended to implement an animal tracking network (ATN) in the USA and will help implement many of the items to be developed in the mammal and bird EOV. This ATN workshop is critical to help solidify the ATN effort nationally within the US and establish needs for baseline observations on the US west coast. It is one of several regional workshops being held to accomplish this throughout the USA to cover the entire west coast and in addition to include telemetry data, it will include other biological datasets and discuss integration between MBON and ATN. The workshop will examine whether the type and extent of existing telemetry and biodiversity observing assets could adequately satisfy these requirements. The information generated at the workshop will be used to identify regional and national observation priorities to ensure that both are being met, a concise plan for sufficient funding of the envisioned national ATN tagging and MBON programs, and how integration and coordination of these assets will be achieved. Furthermore, the Office of Naval Research (ONR) though Mike Weise has committed funding to such an effort.

There has been a connection between IOOS/ATN and the other networks (via OBIS) through OBIS-USA. Abby Benson from USGS/OBIS-USA is involved in the translation of ATN data into the DwC terms for animal tracking data, developed jointly with the Biologging Society and TDWG: https://github.com/tdwg/dwc-for-biologging/wiki/Data-guidelines (link to report: http://iobis.org/2018/05/18/att/). While a connection between ATN and OBIS/GOOS on the data side has been initiated much remains to be accomplished to firmly establish the ATN in the US and also to better connect/integrate with MBON within the US. Dan Costa’s participation in this workshop will benefit GOOS on several fronts in the long term (Figure 11).

While significant time-series may exist for many of these marine vertebrates, the data have not been collected in a common repository so in most cases they are not accessible while in others even their existence is poorly known. A significant step forward would be to develop a data portal that facilitated the identification of the various data sets that exist and who manages them, with a goal to eventually provide direct access to the data. To accomplish this goal the various communities collecting and using the data must be brought together to identify or establish best practices for data collection, analyses, maintenance, and archiving. The most successful program pursuing best practices to date has been the CCAMLR Ecosystem Monitoring Program or CEMP (Reid et al. 2005, Constable 2011). This program developed a series of metrics that can be used to follow the status and condition of species of seabirds and marine mammals that are krill predators. CEMP established a detailed series of metrics that have been used to monitor krill-eating birds and mammals.
There are a number of exciting technologies under development that lend themselves to routine, operational monitoring of these vertebrate populations. Some examples:

- Passive acoustics has been used to monitor the presence and movement patterns of species that vocalize;
- Satellite images have been used to locate seabird and seal colonies and assess their population numbers;
- Small easily deployed drones or unmanned aerial systems (USA) have been used to assess populations as well as provide estimates of body size and condition;
- Electronic tags are being used to track the movement patterns, fisheries interactions, habitat utilization and distribution of marine organisms on a global scale. These tags have proven to be an extremely effective method for collecting high resolution oceanographic data such as temperature, salinity, and chlorophyll profiles in a very cost effective manner in regions that are difficult, if not impossible (under polar ice) to sample, with other means.

Figure 11. Content of the IOOS Biological Observations Workshop to identify the U.S. West Coast stakeholder needs and observation priorities for animal telemetry and marine biodiversity observations. Acronyms as in Annex 1.
2.8 Mangrove cover and composition EOV

Lisa Maria Rebelo could not attend the Panel meeting, however she was able to attend the Ramsar 13th Meeting of the Conference of the Parties held in Dubai in October 2018. She participated on a Ramsar CoP side event in which she introduced the work of the GOOS BioEco Panel to the attendees and its goals to facilitate the development of coordinated global observing networks around EOVs including mangrove cover.

The scientific community has been active in addressing the gap in information on global mangrove cover. Through the Global Mangrove Watch, an international project set up to provide geospatial information about mangrove extent and changes, a time-series of maps of the global mangrove extent was been generated and released in 2018. Including a 2010 baseline showing the global extent of mangroves in this year, maps are currently available for seven annual epochs including 1996, 2007, 2008, 2009, 2015 and 2016 from which losses and gains in any location can be assessed (Bunting et al 2018, Figure 12). These data provide data needed to report at the national level on mangrove extent to the Ramsar Convention and the Sustainable Development Goals (6 and 14 in particular), as well as Nationally Determined Contributions under the Paris Agreement and the UN Reducing Emissions from Deforestation and forest Degradation scheme (REDD+) under the UN Framework Convention on Climate Change (UNFCCC) (datasets available at https://www.globalmangrovewatch.org/). While these data address the previous information gap on mangrove extent, data are still lacking on mangrove species distribution and habitat type. As numerous information sources exist at the site level, an inventory of existing databases should be the first step in identifying best approaches for addressing EOV requirements. Steps in formulating an implementation plan for a this EOV will involve 1) assessment of the level of maturity of measurements, 2) coordination of observations, and 3) identification of appropriate data standards and management approaches.

![Figure 12](https://www.globalmangrovewatch.org/)

*Figure 12.* Global distribution of mangroves by the Global Mangrove Watch – a new global baseline of mangrove extent (Bunting et al., 2018).
2.9 Microbe biomass and diversity EOV

Pier Luigi Buttigieg presented growing efforts to draft the first release version of the Microbial Diversity and Biomass EOV. This EOV affirms the immense role that microbes - including eukaryotes, bacteria, and archaea - play in the state and functioning of the oceans, where they often make up the majority of resident biomass. The importance of emerging networks focusing on the globally harmonised assessment of microbial communities and their dynamics was stressed, and a need for more interfaces with well-established ocean observation communities underscored. The current draft of this EOV specification will feature cell counting (preferably automated) to estimate microbial biomass and well-used high-throughput sequencing technologies to assess diversity. On this latter aspect, the EOV is likely to rely on amplicon sequencing of the 16S/18S marker gene region and the use of metagenomics to assess the functional capacities of marine microbial assemblages. The next steps in the development include the release of the EOV specification draft and a call for community comment, focusing on the scales, global calibration, core technologies, cost/burden sharing, relation to the Phytoplankton EOV, and the best practices involved in measuring this EOV.

This emerging EOV will initially focus on bacterial and archaeal life but has scope to include viral and fungal components as it matures. Through this EOV, the panel seeks to rally and channel the activity of marine microbial observatories, observatory networks, and sampling campaigns to produce an EOV which captures the rapid, multifaceted, and deeply informative dynamics of microbial life in the ocean. The EOV would provide a basis for the development of microbial indicators of, for example, invasive species, the presence of pathogens and bio-contaminants, and seasonal resilience. These efforts echo and align with calls for developing microbial and multi-omics observational capacity in the wider context of the Marine Biological Observation Network.

Early efforts include:
- Creation of an omics observatory registry service – GLOMICON (Figure 13)
- Discussions with GEO BON on an omics thematic network / task force
- Development and exchange of microbial calibration standards (mock communities) and samples between nodes (MBARI/AWI)
- Digitalization and sharing of methodology from sampling to analysis (EMP)
- Coordination of bioinformatic code bases and analysis pipelines for ensemble studies
- Definition of standard (meta)data exchange formats within the network (GSC)
2.10 Ocean Sound EOV

Sound propagates so well in the ocean that it is the most effective way to probe the marine environment and communicate over long distances. Sound is critical for marine life and for seagoing humans. Many marine animals produce sound and acoustic cues are essential for larvae to settle in appropriate environments, for the mating systems of many fish and mammals, for predator-prey relationships, and for social species to maintain cohesion. Most fish and invertebrates sense sound-induced particle movement; some fish and all mammals detect changes in sound pressure, and the primary variables for Ocean Sound are time series of these two components of sound. However, the primary uses of the Ocean Sound EOV are biological...
and ecological. The Ocean Sound EOV will forge major advances in our understanding of how acoustic monitoring can be used to assess biodiversity and ecosystem health, how different sources of anthropogenic sound affect ocean ambient, and the effects sound has on marine life. We know that anthropogenic noise can harm marine life in the short term, but more extended observations are required to define long-term effects on populations and ecosystems. Understanding the effects of ocean noise as a stressor requires (1) estimating how ocean sound has changed historically, (2) mapping sound throughout the oceans on a global scale over decades, and (3) predicting sound fields that result from changes in the use of the oceans.

The Ocean Sound EOV will be implemented under auspices of International Quiet Ocean Experiment (IQOE) which is under governance from SCOR (Scientific Committee on Oceanic Research) and POGO (Partnership for Observation of Global Oceans). The specification sheet for Ocean Sound was drafted in 2016-2017 by an IQOE Working Group funded by POGO and revised in response to review by the GOOS BioEco panel during the fall of 2017 and spring of 2018 (Figure 14). It was approved by GOOS during the summer of 2018. The Ocean Sound EOV has been presented to scientific stakeholders at the Joint American and European Societies for Acoustics in Boston June 2017. Engagement with non-scientific stakeholders included the Comprehensive Test Ban Treaty Organisation, International Maritime Organisation among international organisations, and US agencies including the NOAA Ocean Noise Strategy Group, US Office of Naval Research, and Bureau of Ocean Energy Management. Presentations were given at the World Ocean Council in Halifax, Nova Scotia, Canada, November 2017, at the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea in New York, Jun 2018, and the US Sub-committee on Ocean Science and Technology (SOST) known as the “Ocean Noise and Marine Life Task Force” in Washington DC, August 2018. Future efforts to develop the implementation plan include emailing the EOV spec sheet for review and input, a workshop scheduled for spring 2019 and a session before or after OceanObs’19.
Nic Bax pointed out that while GOOS as a program has yet to decide where and how to deal with “pressure” EOVs, the GOOS program chairs are interested in that the BioEco Panel engages and takes a leading role in developing marine debris as an EOV. Sanae Chiba also pointed out that Japan is very interested in the plastic issue. One of the important issues will be to agree on the definition of marine debris, distinguishing the natural from the human-produced and also considering size range. For a future discussion on what needs to be considered for development of “Marine Debris” as an EOV, it is recommended that we look at the formal policy definitions of marine debris. Currently, every country is agreeing on an “act” on actions to initiate solutions to this problem. Most of the debris enters the ocean through ~12 rivers in South East Asia. Sanae Chiba mentioned that one of the OceanObs19 community white papers is on marine debris. She will contact the authors to explore the possibility of distributing the draft to the BioEco panel. Another action is to contact Peter Kershaw from the Joint Group of Experts.
on the Scientific Aspects of Marine Environmental Protection (GESAMP) Working Group to learn how this WG is tackling the marine debris issue. With regards to how GOOS will deal with the pressure EOVs, it was suggested that since EOVs are a constraining rather than an expanding concept, a better approach will be to have an overarching “pollution” EOV with a set of sub-variables under it (e.g. plastics, marine debris, etc).

2.12 Benthic invertebrate abundance and distribution EOV

The benthic invertebrate EOV discussion was led by Paul Snelgrove who provided some thoughts on the process being developed by the Deep Ocean Observing Strategy (DOOS) to monitor benthic invertebrates. DOOS is building up on GOOS EOVs in the sense of what has GOOS identified and will develop that will be relevant for DOOS. At present, the GOOS BioEco EOVs consider only four coastal ecosystems (coral reefs, seagrass beds, mangrove forests and macroalgae) which leaves a large area of the ocean benthos unattended. A discussion followed which identified the major constraints to sample benthic invertebrates in sediments, both in shallow depths and the deep sea (e.g. use of cores as the traditional approach, sampling cores not possible everywhere, time consuming process, use of metagenomic approaches still need a certain level of pre-sorting of the sample, building a catalog of sequences, use of video for epifauna and the need of standardization, etc.). Benthic ecology has traditionally been more of a spatial discipline rather than a temporal one, with observatories focused on a limited spatial scale. It was also suggested that the benthic invertebrate EOV could be focused on particular habitat forming groups (e.g. sponges, mussel/oyster reefs, etc.). Paul Snelgrove pointed out that in Canada, the subtidal habitats getting the most attention by policy makers are the biogenic habitats, specifically sponges and deep sea corals. Given that these discussions are also being held by the DOOS community, the general agreement was to follow up with the specific DOOS WG on how they will tackle this issue in the deep sea keeping in mind that this development will be potentially used for the shallow ecosystems as well. Another aspect to consider is that benthic data may also include significant fish data. Action item is to contact Henry Ruhl on timelines for DOOS decisions on benthic monitoring.

3. DESIGNING THE OBSERVING SYSTEM OF THE WORLD’S OCEAN

The BioEco et al. project “Defining the observing system for the world’s oceans - from microbes to whales” was approved under the PEGASuS 2 call on Ocean Sustainability sponsored by Future Earth and the National Center for Ecological Analysis and Synthesis (NCEAS).

The project aims to design a monitoring network to answer specific scientific questions on high priority global phenomena in response to calls for guidance from policy makers and managers. More at: http://futureearth.org/news/announcing-winners-pegasus-2-ocean-sustainability
The amount approved was US $111,490 which will support two meetings at the NCEAS in Santa Barbara. NCEAS will also support a part-time post-doc position to work on this project with us. Advertisement for this post-doc position can be found at: http://futureearth.org/news/vacancies-postdoctoral-researchers-santa-barbara-usa

According to our schedule, our next step is to have a first conference call to touch base, and plan for the first meeting, ideally to be held not later than February 2019. Not all members of the group are expected to attend both meetings, as the project team has a core group of 12 members and two subgroups of 6-7 expert members each differing in their skills as required to achieve specific workshop goals. The date for the call will be surveyed through a Doodle Poll (Patricia Miloslavich to set up).

The vision of the project is to have a similar map as ARGO, GO-SHIP, OceanSites and others have for each of the biological EOVs that show what we have, how we are doing, and this is where we want to go. In preparation for the first workshop, we should aim to set a baseline of our current status of knowledge on ocean biological observations and show it on a map. Some additional ideas to feed into the Pegasus project include the development of some products (e.g. summary for policy makers, side events at the BBNJ/CBD/SBSTA, connect to the Ocean Health Index / Ben Halpern, target the Ocean Conference 2020, etc.).

A conference call between the project PI’s (Nic Bax, Daniel Dunn and Patricia Miloslavich) with the NCEAS/PEGASuS team (led by Craig Starger, Research Liaison Officer, Colorado Global Hub, Future Earth) will take place within the next two weeks to clarify better the operational details of how the project will develop and what the expectations are.

4. BEST PRACTICES

The Ocean Best Practices (OBP) discussion was led by Frank Muller-Karger who is part of the OBP WG. One of the main issues of the discussion was how is GOOS going to implement a mechanism of endorsement of the best practices. Some of the suggested ways for endorsement included (1) the publication of the best practice in a scientific journal (and agreement has been made between the OBP and Frontiers of Marine Science) and (2) through a mechanism within GOOS in which the responsible network (e.g. ARGO, GO-SHIP, OceanSites) approves, followed by approval by the Ocean Coordination Group (OCG) and then GOOS approves. For biology, this is not yet clear, as there still needs to be consensus within GOOS of what a biological network is (to adapt from the OCG initial concept, Figure 15). The GOOS panels will play an important role in reviewing/endorsement what is uploaded in the OBP platform. The OBP platform allows anyone to open an account an upload any protocol and obtain a DOI for it. The next meeting of the OBP WG will be on the 2-6th December in Paris. The main message from the BioEco Panel to this group is that a curation process is needed. It is also desirable that filters can be applied in the search system so that only the subset of practices that have been endorsed show up rather than all in the database. Some stats/metrics to consider are how many downloads and how many citations.
It was agreed that the OBP links must be included in the EOV specification sheets (can also hyperlink), and also panel members to upload the metadata and the Standard Operating Procedures (SOPs) to the OBP (similar to protocols.io).

Currently the OBP is a project which derived from Atlantos WG#6, but it is expected that the IOC will adopt it for long term sustainability (through IODE/GOOS).

Figure 15. Observation Coordination Group (OCG) criteria to define a network and how some biological networks apply to the criteria.

5. DATA MANAGEMENT

Ward Appeltans (GOOS BioEco secretariat) introduced this agenda item. In December 2016, GOOS BioEco signed a collaboration agreement with OBIS and GEO BON MBON to join efforts towards a sustained, coordinated global ocean system of marine biological and ecosystem observations. OBIS was identified to play a key role in fostering wider data sharing, curation and aggregation to support EOV data product development. To support this process, many new developments have happened in OBIS in the past 2 years. With the support from IOC, OBIS has a completely new data infrastructure and technology stack (OBIS 2.0, Figure 16). The main difference with OBIS 1.0 is that there is now continuous data harvesting and data quality control processing, providing an instant data quality report back to the data providers (or OBIS nodes), hereby annotating quality issues instead of dropping low quality records. The new fast data portal and two R packages (robis and obistools) are powered by a new API which increased the real-time analytical capabilities of OBIS. The OBIS2.0 website also provides more visibility to the data and institutional network of OBIS.
A new OBIS data infrastructure and technology stack is presented in Figure 16. This upgraded version allows continuous data harvesting and data quality control processing, providing instant data quality report back to the data providers (or OBIS nodes). The new fast data portal and two R packages (robis and obistools) are powered by a new API which increased the real-time analytical capabilities of OBIS.

An important recent change is that OBIS adopted the Event Core format of DarwinCore and developed the Extended MeasurementorFact Extension, making it possible to document the sampling events and link sampling facts and environmental measurements, such as temperature and habitat cover as well as the species occurrences to the sampling event hierarchy. Any biotic measurements (e.g. biomass, abundance, absence/presence, health condition, etc) are linked the occurrence records. This change from a species presence system to embrace any type of measurements structured around the sampling event makes OBIS a much more powerful system to support biological and ecosystem monitoring (Figure 17). In one year, OBIS already received 8 million measurements and sampling facts. In collaboration with the Ocean Teacher Global Academy (OTGA) and other sponsors such as US-IOOS, 9 OBIS training courses were organized in the last 12 months training nearly 200 people around the world. Training people in data contribution as well as data analysis is a core activity of OBIS.
Figure 17. OBIS-ENV-DATA. OBIS has expanded beyond species occurrence to allow the inclusion of other data through the development of a new data standard that combines marine biological and environmental datasets (De Pooter et al., 2017).

A survey was launched among the panel members in advance of this meeting to aid the discussion on (i) where the data is currently stored and archived, (ii) if the data is compatible with international standards, (iii) if indicators are derived from the data and if this feeds into a policy/management framework and (iv) what role OBIS can play to help achieve delivery of the EOV. The responses illustrated a general poor picture of the data readiness level. Most EOV data are fragmented and lack international standardization, are not preserved in long-term archives, and many are not (or not immediately) publicly available. This challenge also means very few monitoring systems currently can develop global indicators that are feeding into a policy framework, with the exception of the CPR data in the EU MSFD. However, OBIS is currently providing data and information products for a number of international processes, such as assessments under IPBES and the UN World Ocean Assessment, and is a primary data source for the identification of Ecologically or Biologically Significant Areas (EBSAs) under the CBD.

The BioEco panel members recognized the role of OBIS as a global data integrator, that operates as neutral broker within an intergovernmental framework, and one that has developed solutions for managing, curating and sharing marine biodiversity and ecosystem data (FAIR
principles). In addition, OBIS provides a well-established network of 30 regional and thematic OBIS nodes that support the data publication process of nearly 1,000 data providers.

Alignment with DarwinCore standards and ultimately feeding the EOV data into OBIS is identified as one of the goals of each EOV. Good examples where progress is being made is with the animal telemetry data, where tracking networks are developing data and metadata guidelines in together with OBIS and the Bio-logging Society as a result of an IOC/IODE funded workshop in April 2018 (http://iobis.org/2018/05/18/att/).

The macroalgae EOV implementation workshop proposed a data architecture system as a global macroalgal repository with OBIS in which the Australian OBIS node plays an important brokering role (fig 20 of report).

Another example that shows the benefit of EOV data is the work of the IOC HAB programme which is currently writing up the Global HAB Status Report drawing from data in OBIS and the Harmful Algal Event Database (HAE-DAT). HAE-DAT is scheduled to merge into the OBIS infrastructure in 2019.

The BioEco panel identified some recommendations for OBIS to support the GOOS BioEco work plan.

- Develop a metadata registry to map the GOOS EOV observing networks (linked to the Pegasus project)
- Further improve the OBIS data portal, making it possible to search and provide views on EOVs (including sampling methods).
- Support the development of DarwinCore guidelines and data protocols for EOV data and publish these as Ocean Best Practices (OBP), in collaboration with a new OBIS Vocab Task Team and the Vocab maintenance working group under Biodiversity Information Standards (TDWG) association managing DarwinCore. It was suggested that the DOIs of these OBPs could be added to the dataset metadata.

The panel recognized that the support from OBIS and (national) data systems is critical and will require a more sustainable funding situation for the OBIS secretariat as well as for the national and thematic OBIS nodes. Establishing partnerships to support the data and information product development, in a win-win relationship, should be taken forward.

6. OceanObs19: BioEco contributions

Panel members are either leading or co-authoring more than 10 community white papers (CWPs) to Ocean Obs19. Some of these are:

- Bax et al. Scientific and Societal Need of Marine Biological Observations
Duffy, Benedetti-Cecchi et al. Observational Needs: Macrophytes
• Boss, Stemmann, Muller-Karger, Kudela, Batten, Chiba et al. Observation Needs: plankton
• Obura et al. Coral Reef Monitoring
• Batten et al. Towards a Global Plankton Diversity Monitoring Program
• Canonico, Appeltans et al. Observational Needs: Biodiversity
• Harcourt, Costa et al. Animal-borne telemetry
• Fischer, Tanhua, et al. Framework for Ocean Observing: Evolution and Future
• Newman, Costa et al. Southern Ocean Observing System
• Bograd, Schmidt et al. Observations for fisheries and ecosystems

http://www.oceanobs19.net/community-white-papers/

The paper led by Bax will be the main contribution of the Panel. The outline/draft of the paper is at the link:
https://docs.google.com/document/d/1B4iiZhY3byaHsA6iBVc0ESbuLL8DHYXt_3vFUPQ3miY/edit?disco=uiAAAACNCVv04&ts=5c050683

In addition, the panel discussed some ideas to put forward for OceanObs19 as well as their expectations. These were summarized within the major themes of Ocean Obs as:

**Perspective**

• Impact
  o Extension of FOO to recognize link between EOVs and global indicators
  o Early development of “proxy indicators” as part of process to develop full indicators
  o A system of ocean data to support evidence-based policy and strategies for sustainability
  o Improved links between observing community and policy makers → impact and funding
  o Clear mandate from users for specific (parts of) EOVs to solve specific issues in particular areas
  o Improved links to blue economy, financing, restoration, insurance, etc. (Thorstein)
  o Information

• Understanding and Delivery
  o Improved understanding including data integration -> better decisions, more effective management, support societies’ transition and capitalisation of future opportunities
  o Improved linking to stakeholders, industry, foundations, etc. (cf, sustainable oceans lab - GIZ)
Innovation

- Technical
  - Increased use of acoustic sensors
  - Engage stakeholders and industry to accelerate innovation in automated monitoring of (macroalgal) EOV

Integration

- Increased support
  - Improved funding for coordination, best practices and evaluation
  - Commitment to funding coral reef monitoring for at least a decade starting 2020
  - Support for funding established methods and cutting-edge development
  - Investment in innovation

- Increased coordination
  - An agreed shared vision for ocean observations to support post-2020 agenda
  - Global/regional/national coordination framework for GOOS
  - Improved remote sensing in coastal environments linked to in situ obs for seagrass, coral reefs, mangroves, marshes
  - Integration of zooplankton networks to develop global analysis and EOV indicator
  - Engagement of different fisheries stakeholders to integrate diverse data sets and information
  - Operationalisation and alignment of microbial measurements -> multiple stakeholders

- Prioritisation
  - Raise awareness of Coral Cover EOV as important ECV and leading indicator of ocean biodiversity change
  - Promote macroalgal canopy as leading indicator of non-tropical marine ecosystems
  - Quantitative linking of climate change to change in plankton groups to define location, precision, and indicators for changes in distribution and productivity
  - Increase visibility of fisheries-independent data sets (for exploited and non-exploited species)
  - More effective use of scientists time and effort

Vision

- Aspirational
  - A revolution in capacity to measure and deliver to biological EOVs to countries, regions, etc., that can be used by all stakeholders - science to policy.
  - Integration of biological EOVs into ocean and coastal observing systems
7. CONTRIBUTING TO THE GLOBAL INDICATOR AND ECV FRAMEWORKS

Global Indicator framework

Lauren Weatherdon provided an overview of how to transform Essential Ocean Variables (EOVs) into indicators as well as the (long) road to inform policy and decision making. She also presented the process by which the Biodiversity Indicator Partnership (BIP) converts raw variables into “information of use” (Figure 18). Weatherdon pointed out that now that the EOVs have been scientifically validated and technical implementation is advancing, there is a need to consult with ‘end users’ such as governments, Regional Seas, and businesses. This will help to increase awareness of the value of EOVs in the run up to the post-2020 biodiversity agenda and the UN Decade of Ocean Science for Sustainable Development (2021-2030), and to ensure that their development aligns with the needs of these decision- and policy-makers. There are many potential products that these EOVs could inform, including improvement of the indicators associated with the Aichi Biodiversity Targets and Sustainable Development Goals (SDGs). Specific suggestions include:

- Stratifying proposed EOV and indicator development based on levels of capacity, with estimated costs associated with each level;
- Reviewing opportunities to submit new indicators to the Biodiversity Indicators Partnership (request template attached), suggesting indicators that the EOVs could inform to raise their profile and signalling that they are in development;
- Exploring whether a ‘summary for policymakers’ or equivalent would be valuable as an output of the PEGASUS project, demonstrating in non-technical language the specific value of EOVs to decision-making (i.e. the simple questions that could be answered);
- Packaging EOVs into a larger, impact-driven (and multi-million dollar) project that could be pitched to philanthropists (e.g. Nippon Foundation, Vulcan) for the UN Decade of Ocean Science for Sustainable Development and post-2020 biodiversity agenda;
- Review the potential to develop an advisory board of national or Regional Seas representatives to help guide the development of the EOVs and strengthen their relevance to policy- and decision-making.
Figure 18. Converting raw variables into “information of use” by the Biodiversity Indicator Partnership (BIP).
Global Climate framework

Albert Fischer introduced the GOOS connection into the Global Climate Observing System, which is managed through our shared panel, the Ocean Observations Panel for Physics and Climate (GCOS-GOOS-WCRP co-owned). GCOS covers atmospheric, oceanic, and terrestrial observations, and its regular process of reporting to the UNFCCC on the adequacy of observations for its purposes, developing an implementation plan, and reporting on progress, are a powerful mechanism to raise the attention of systematic observations to a policy audience focused on climate mitigation and adaptation.

GCOS is for GOOS the manager of our partnership on the value chain focused on developing global policy, involving the WCRP, IPCC’s Working Group 1 focused on climate projections and the physics of climate change, and the UNFCCC’s focus on mitigation. It is increasingly working with a broader audience interested in adaptation, which implies a stronger focus on vulnerability and impacts of climate change and variability, and a stronger link to IPCC’s Working Group 2. At present, the connection between GOOS biological and ecosystem EOVs and GCOS Essential Climate Variables is an aggregate one, with the GCOS ECVs defined as ‘ocean colour’, ‘plankton’, and ‘marine habitat properties’ (encompassing corals, mangroves, sea grasses, and macroalgae).

The IPCC Special Report on a 1.5 °C world identified a large number of impacts in the ocean related to ecosystems and specific GOOS EOVs, with particular attention to corals, the impacts of acidification on a broad range of taxonomic groups, changes in ocean productivity, distributional shifts, and damage to corals and wetlands. There is scope then to increase the number of ocean biological and ecosystems ECVs, disaggregating the marine habitat properties ECV, and better aligning with what has been identified in GOOS. These will be discussed at a GCOS All-Panel (atmospheric, terrestrial, oceanic) meeting in March 2019.

GCOS has a close relationship to the satellite agencies through CEOS and could help develop work around EOV/ECVs that can be inferred from ocean colour and in situ measurements used together to create products. The UNFCCC Parties retain an interest in Blue Carbon and the possibility of accounting carbon stocks in mangroves, seagrasses, and salt marshes.

8. CONTRIBUTION TO NATIONAL AND INTERNATIONAL PROCESSES

Albert Fischer introduced the UN Decade of Ocean Science for Sustainable Development, including its history as an idea promoted by the IOC, its adoption by the UN General Assembly in December 2017, and the early planning process including a roadmap with proposed vision and broad objectives:

• A clean ocean
• A healthy and resilient ocean
Planning for the decade and its contributions would have to be a strong mix of top-down guidance and bottom-up proposals and community-building (Figure 19). Observations and data were identified as strong contributors. Fischer stated a personal view that GOOS and its parts should propose ideas that could be championed under the banner of the decade, focused on: 1. observing system innovation, and 2. improving the partnerships and flow from observations to transformation of observations into information. He introduced the timeline of planning for the decade, which would focus on a number of regional workshops in 2019 as well as a few global thematic events that could provide input, such as OceanObs’19. An international executive planning group of 19 high-level people has just been named (names are available in the presentation at website).

![Figure 19. Preparing for the Decade for Ocean Science and Sustainable Development: next steps.](image)

### 9. FUNDING AND COMMUNICATION STRATEGY

Several funding opportunities to support GOOS BioEco activities were discussed. Some of these included:

- **POGO Call for Working Groups / 14th December / Euros 10K** ([http://ocean-partners.org/proposals](http://ocean-partners.org/proposals))

- **NIPPON Foundation** – funds pressing issues on persistent problems. Daniel Dunne to follow. Important to have which will be the “big ask” for a big program. Ideally to wait until we have completed the mapping of the EOV network. The idea could be flagged as the “new era of GOOS” supporting marine ecosystem health. NIPPON is also a strong supporter of capacity development (through POGO)
- SCOR WG Proposals / 2019 / US$ 45 k in 3 years / https://scor-int.org/ - Emmett Duffy will resubmit the seagrass proposal.
- Prince Albert II Foundation – Monaco – Ward Appeltans to follow up (Monaco is also co-hosting ICRI with Australia and Indonesia)
- King Abdullah University of Science and Technology (KAUST) – Emmett Duffy to follow up with Carlos Duarte
- Gordon and Betty Moore Foundation – interested in innovation (e.g. microbial work). Pier Luigi Buttigieg to follow up.
- Vulcan Foundation – supporting Global FinPrint
- US Department of Energy / Joint Genome Institute (JGI) – Pier Luigi Buttigieg to follow up
- Schmidt Ocean Institute: https://schmidt-ocean.org/apply/apply-for-support/
  Oceanographic technology research and development (https://schmidt-ocean.org/apply/expression-of-interest/ocean-tech-rnd/)
  Advancing coral reef conservation (https://schmidt-ocean.org/apply/expression-of-interest/advancing-coral-conservation/) - Expressions of interest by 28th December
- Collaborative Research Action (CRA): Belmont Forum, Future Earth, and the Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI Oceans) call for proposals. 31 January 2019 – closing of call for pre-registration: through development of research consortia, supported financially by at least three participating partner agencies established in three different countries.
- NASA - Biological Diversity / Ecological Forecasting Programs (Woody Turner) – need to have link to GEOBON EBVs
- Linking to programs under the Ocean Sciences section of the IOC (e.g. Global HAB, Blue Carbon)
- Partnerships (e.g. with WCMC): WCMC/UN Environment cannot provide funds but can be a partner in a proposal and be the recipient of the funding (e.g. GEF) in a project that shows the roadmap between observations to application in solving specific problems in a few countries. Lauren Weatherdon pointed out that the ambitions and mandate of the GOOS BioEco Panel aligns well with those of the WCMC, and they would be interested in continuing to contribute to/support this process (particularly given our existing involvement with the seagrass and coral networks). Following discussions internally, she believed a collaboration agreement would be the best way forward. As an action item, Patricia will send the document signed between GOOS, MBON and OBIS to start moving this along at WCMC (Neville Ash – Director WCMC/UN Environment). Ocean+ website to be launched in a week (https://www.oceanplus.org/#/).
10. ACTION ITEMS

Actions for Panel members

1. **OceanObs19**
   a. Review, modify and/or add to expectations listed above – 13/11/18
   b. Provide ideas on topics and spokesperson for Plenary, Panels and Breakout groups – Sanae and Frank

2. **Provide text for BioEco OceanObs white paper – 13/11/18**
   a. Text for each EOV (status, gaps, needs, vision) ~300 words
   b. Dot points for conclusion
   c. Specific recommendations
   d. [https://docs.google.com/document/d/1B4iiZhY3byaHsA6iBVC0ESbuLL8DHYXt3vFUPQ3miY/edit?usp=sharing](https://docs.google.com/document/d/1B4iiZhY3byaHsA6iBVC0ESbuLL8DHYXt3vFUPQ3miY/edit?usp=sharing)

3. Comments to Albert on “Partnership for delivery” flowchart, especially identifying missing applications and users plus middle bits

4. Summary on presentations to Patricia for workshop report (re-use for BioEco white paper?)-

5. Identify which of the UN Decade regional planning workshops panel members can attend (to Patricia)

6. For PEGASuS, prepare inventories of important monitoring networks (datasets) for each EOV with the aim of having the area of activity of each network mapped and available for first Pegasus workshop – February 2019. Ward may provide some technical advice/support to upload to OBIS. Albert to identify potential resources from JCOMM-OPS. Patricia to summarise outcomes from existing network review relevant to each EOV.

7. Map each EOV to Aichi targets and SDGs at level of objectives rather than indicators (Secretariat)

8. Panel members identify “phenomena” (cf. coral bleaching) suitable to develop strategic maps (e.g. HABs)

9. Panel members to prepare short 1 page proposals ready for funding opportunity

10. Continue to develop funding opportunities
   a. Secretariat to develop one-pager for an ocean health monitoring network suitable for someone like the Nippon Foundation
   b. Individuals to investigate additional funding opportunities – SCOR, Schmidt Ocean Institute, others linking back through Patricia to avoid duplication
   c. Ward to follow up with Monaco Foundation.
   d. Emmett to follow up with Carlos Duarte
   e. Pier Luigi to follow up with for George and Betty Moore Foundation
   f. Pier Luigi to follow up with NGEE of DOE
   g. Sonia to follow up on Plankton-Mob proposal to NSF

11. Request timeline for development of invertebrate EOV – Henry Ruhl (DOOS)

12. Expand links with OSS for IOC (Patricia)

13. Best practices:
   a. Identify best practices for each EOV platform where available and upload to OBP (or protocols.io)
   b. Add links to Ocean Best Practices for each specification sheet (Patricia)
14. Develop links to GCOS – looking for a volunteer with climate interest over the longer term
15. Identify terms of engagement with Oceans+ (Lauren)
16. Identify role of Global Harmful Algal Bloom Status Report as GOOS product with Gustav Hallegraeff / Henrik Enevoldsen (Nic)

10. REFERENCES (in bold those authored by the Panel in 2018)


<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ABNJ</td>
<td>Areas Beyond National Jurisdiction</td>
</tr>
<tr>
<td>ANCA</td>
<td>Algas Nocivas en el Caribe (Caribbean Regional IOC HAB program)</td>
</tr>
<tr>
<td>API</td>
<td>Application Program Interface</td>
</tr>
<tr>
<td>ARGO</td>
<td>Global array of profiling floats measuring ocean variables</td>
</tr>
<tr>
<td>AtlanECO</td>
<td>Atlantic ECOSystems assessment, forecasting &amp; sustainability</td>
</tr>
<tr>
<td>ATN</td>
<td>Animal Telemetry Network</td>
</tr>
<tr>
<td>AWI</td>
<td>Alfred Wegener Institute</td>
</tr>
<tr>
<td>BBNJ</td>
<td>Biodiversity Beyond National Jurisdiction</td>
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<tr>
<td>BGC</td>
<td>Biogeochemistry</td>
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<tr>
<td>BIP</td>
<td>Biodiversity Indicator Partnership</td>
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<tr>
<td>BRUVS</td>
<td>Baited Remote Underwater Video Stations</td>
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<tr>
<td>CBD</td>
<td>Convention on Biological Diversity</td>
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<tr>
<td>CCAMLR</td>
<td>Commission for the Conservation of Antarctic Marine Living Resources</td>
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<tr>
<td>CEMP</td>
<td>CCAMLR Ecosystem Monitoring Program</td>
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<tr>
<td>CenCOOS</td>
<td>Central and Northern California Ocean Observing System (of IOOS)</td>
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<tr>
<td>CEOS</td>
<td>Committee on Earth Observation Satellites</td>
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<tr>
<td>CIESM</td>
<td>Mediterranean Science Commission</td>
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<tr>
<td>CLIOTOP</td>
<td>Climate Impacts on Oceanic Top Predators</td>
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<tr>
<td>CPR</td>
<td>Continuous Plankton Recorder</td>
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<tr>
<td>CRA</td>
<td>Collaborative Research Action</td>
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<tr>
<td>CWP</td>
<td>Community White Paper</td>
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<tr>
<td>DATRAS</td>
<td>Database of Trawl Surveys</td>
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<tr>
<td>DOE</td>
<td>Department of Energy</td>
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<tr>
<td>DOI</td>
<td>Digital Object Identifier</td>
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<tr>
<td>DOOS</td>
<td>Deep Ocean Observing Strategy</td>
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<tr>
<td>DPSIR</td>
<td>Drivers-Pressure-State-Impact-Response</td>
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<tr>
<td>DwC</td>
<td>Darwin Core</td>
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<tr>
<td>EBV</td>
<td>Essential Biodiversity Variable</td>
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<tr>
<td>ECV</td>
<td>Essential Climate Variable</td>
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<tr>
<td>EEZ</td>
<td>Economic Exclusive Zone</td>
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<tr>
<td>EHI</td>
<td>Ecosystem Health Indicator</td>
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<tr>
<td>EML</td>
<td>Ecological Metadata Language</td>
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<tr>
<td>EMP</td>
<td>Earth Microbiome Project</td>
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<tr>
<td>EOOS</td>
<td>European Ocean Observing System</td>
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<tr>
<td>EOV</td>
<td>Essential Ocean Variable</td>
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<tr>
<td>ETN</td>
<td>European Tracking Network</td>
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<td>EU</td>
<td>European Union</td>
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<tr>
<td>FADs</td>
<td>Fish aggregating (or aggregation) device</td>
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<tr>
<td>FAIR data</td>
<td>Findable, Accessible, Interoperable, Re-useable</td>
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<tr>
<td>FANSA</td>
<td>Floraciones Algas Nocivas en Sudamérica (Southamerican IOC HAB program)</td>
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<td>FAO</td>
<td>Food and Agriculture Organization</td>
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<tr>
<td>FOO</td>
<td>Framework for Ocean Observing</td>
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<tr>
<td>GACs</td>
<td>Global Alliance of Continuous Plankton Recorders</td>
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<tr>
<td>GBIF</td>
<td>Global Biodiversity Information Facility</td>
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<tr>
<td>GCOS</td>
<td>Global Climate Observing System</td>
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<tr>
<td>GCRMN</td>
<td>Global Coral Reef Monitoring Network</td>
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<tr>
<td>GDAC</td>
<td>GEOTRACES International Data Assembly Centre</td>
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</table>
GEF   Global Environmental Facility
GEO   Group on Earth Observations
GEO BON Group on Earth Observations – Biodiversity Observation Network
GESAMP Group of Experts on the Scientific Aspects of Marine Environmental Protection
GIZ Gesundheits-Informations-Zentrum (Health Information Center)
Global FinPrint Global shark and ray survey
GLOMICoN Global Omic Observatory Network
GO:NE Global Ocean Oxygen Network
GOA-ON Global Ocean Acidification – Observation Network
GODAE Global Ocean Data Assimilation Experiment
GO-SHIP Global Ocean Ship-based Hydrographic Investigations Program
GOOS Global Ocean Observing System
GOOS BioEco GOOS Biology and Ecosystem Panel
GRAs GOOS Regional Alliances
GSC Global Standards Collaboration
HABs Harmful Algal Blooms
HAEDAT Harmful Algal Event Database
IAEA International Atomic Energy Agency
ICES International Council for the Exploration of the Sea
ICRI International Coral Reef Initiative
IGMETS International Group for Marine Ecological Time Series
IMBER Integrated Marine Biosphere Research project
IMOS Integrated Marine Observing System (Australia)
IndiSeas Indicators for the Seas
IOC Intergovernmental Oceanographic Commission
IOCCG International Ocean-Colour Coordinating Group
IODE International Oceanographic Data and Information Exchange (IOC)
IOOS Integrated Ocean Observing System (USA)
IP Implementation Plan
IPBES Intergovernmental Platform for Biodiversity and Ecosystem Services
IPCC Intergovernmental Platform for Climate Change
IPHAB IOC Intergovernmental Panel on Harmful Algal Blooms
IQOE International Quiet Ocean Experiment
ISA International Seabed Authority
ISSHA International Society for the Study of Harmful Algae
IWC International Whaling Commission
JCOMM Joint Technical Commission for Oceanography and Marine Meteorology
JCOMM-OCG JCOMM – Observation Coordination Group
JCOMMOPS JCOMM - Observing Programmes Support Centre
JGI Joint Genome Institute (US Department of Energy)
JPI Oceans Joint Programming Initiative Healthy and Productive Seas and Oceans
KAUST King Abdullah University of Science and Technology
LME Large Marine Ecosystem
MarineGEO Marine Global Earth Observatory (Smithsonian)
MBARI Monterey Bay Aquarium Research Institute
MBON Marine Biodiversity Observation Network
MEAP-TT Marine Ecosystem Analysis and Prediction Task Team (from GODAE)
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>NANOOS</td>
<td>Northwest Association of Networked Ocean Observing Systems</td>
</tr>
<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration (USA)</td>
</tr>
<tr>
<td>NCEAS</td>
<td>National Center for Ecological Analysis and Synthesis</td>
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<tr>
<td>NGEE</td>
<td>Next Generation Ecosystem Experiment (from DOE)</td>
</tr>
<tr>
<td>NGOs</td>
<td>Non-Governmental Organizations</td>
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<tr>
<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration (USA)</td>
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<tr>
<td>NSF</td>
<td>National Science Foundation (US)</td>
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<tr>
<td>OBIS</td>
<td>Ocean Biogeographic Information System</td>
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<td>OBP</td>
<td>Ocean Best Practices</td>
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<tr>
<td>OceanSITES</td>
<td>Worldwide system of deepwater reference stations</td>
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<tr>
<td>OCG</td>
<td>Observation Coordination Group (JCOMM)</td>
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<tr>
<td>OMZ</td>
<td>Oxygen Minimum Zones</td>
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<tr>
<td>ONR</td>
<td>Office of Naval Research</td>
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<tr>
<td>OSS</td>
<td>Ocean Sciences Section (IOC)</td>
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<tr>
<td>OTGA</td>
<td>Ocean Teacher Global Academy</td>
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<tr>
<td>OTN</td>
<td>Ocean Tracking Network</td>
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<tr>
<td>P-OBS</td>
<td>Integration of Plankton-Observing Sensor Systems to Existing Global Sampling Programs</td>
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<tr>
<td>PICES</td>
<td>North Pacific Marine Science Organization</td>
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<tr>
<td>Plankton-mob</td>
<td>Plankton multidisciplinary observations</td>
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<td>POC</td>
<td>Particulate Organic Carbon</td>
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<tr>
<td>POM</td>
<td>Particulate Organic Matter</td>
</tr>
<tr>
<td>POGO</td>
<td>Partnership for the Observation of the Global Ocean</td>
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<tr>
<td>QA/QC</td>
<td>Quality Assessment / Quality Control</td>
</tr>
<tr>
<td>REDD+</td>
<td>Reducing Emissions from Deforestation and Forest Degradation (+conservation, sustainable management of forests and enhancement of forest carbon stocks)</td>
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<tr>
<td>RFMOs</td>
<td>Regional Fisheries Management Organizations</td>
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<tr>
<td>RLS</td>
<td>Reef Life Survey</td>
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<tr>
<td>SBA</td>
<td>Seabed Authority (correct acronym is ISA – International Seabed Authority)</td>
</tr>
<tr>
<td>SBSTTA</td>
<td>Subsidiary Body on Scientific, Technical and Technological Advice</td>
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<tr>
<td>SCCOOS</td>
<td>Southern California Coastal Ocean Observing System (SCCOOS)</td>
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<tr>
<td>SCOR</td>
<td>Scientific Committee on Oceanic Research</td>
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<tr>
<td>SDG</td>
<td>Sustainable Development Goals</td>
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<tr>
<td>SeaBASS</td>
<td>SeaWiFS Bio-optical Archive and Storage System (NASA)</td>
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<tr>
<td>SOP</td>
<td>Standard Operating Procedure</td>
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<td>SOST</td>
<td>US Sub-committee on Ocean Science and Technology</td>
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<tr>
<td>TBM</td>
<td>Turtle-Bird-Mammal (EOV)</td>
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<tr>
<td>TDWG</td>
<td>International WG on Taxonomic Databases (Biodiversity Information Standards)</td>
</tr>
<tr>
<td>THREDDS</td>
<td>Thematic Real-time Environmental Distributed Data Services</td>
</tr>
<tr>
<td>ToRs</td>
<td>Terms of Reference</td>
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<tr>
<td>TrendsPO</td>
<td>Working Group on Climate Change and Global Trends of Phytoplankton in the Oceans</td>
</tr>
<tr>
<td>UNGA</td>
<td>United Nations General Assembly</td>
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<tr>
<td>UNEP</td>
<td>United Nations Environment Programme</td>
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<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
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<tr>
<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
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<tr>
<td>USGS</td>
<td>US Geological Survey</td>
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<tr>
<td>US HAB</td>
<td>US National HAB Committee</td>
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<tr>
<td>UTAS</td>
<td>University of Tasmania</td>
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<tr>
<td>WCMC</td>
<td>World Conservation Monitoring Centre (UN Environment)</td>
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<td>WCRP</td>
<td>World Climate Research Programme</td>
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<td>Acronym</td>
<td>Full Form</td>
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<tr>
<td>WD</td>
<td>Water Directive (EU)</td>
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<td>WestPac</td>
<td>Western Pacific</td>
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<td>WFS</td>
<td>Web Feature Service</td>
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<td>WG</td>
<td>Working Group</td>
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<tr>
<td>WHO</td>
<td>World Health Organization</td>
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<tr>
<td>WMO</td>
<td>World Meteorological Organization</td>
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<tr>
<td>WMS</td>
<td>Web Map Service</td>
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<tr>
<td>WOA</td>
<td>World Ocean Assessment</td>
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<tr>
<td>ZEN</td>
<td>Zostera Experimental Network</td>
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ANNEX 2 – Agenda

GOOS – Biology & Ecosystems Panel
Third Panel meeting
7-9 November 2018
Sirata Hotel, St. Petersburg, Florida, USA

PARTICIPANTS

**GOOS Executive and Secretariat:** Nic Bax, Daniel Dunn, Patricia Miloslavich, Ward Appeltans, Albert Fischer

**GOOS BioEco Panel:** Valerie Allain, Sonia Batten, Lisandro Benedetti-Cecchi, Pier Luigi Buttigieg, Sanae Chiba, Emmett Duffy, Raphael Kudela, Frank Muller-Karger, David Obura, Yunne Shin

**Other invitees:** Samantha Simmons (MMC), Peter Tyak (IQOE), Lauren Weatherdon (WCMC), John Quinlan (NOAA) (TBC), Paul Snelgrove (DOOS) (TBC), Mike Heithaus/Demian Chapman (BRUVs) (TBC), Mark Dickey-Collas (ICES) (Remotely), Salvatore D’Arico/Kirsten Isensee (IOC Ocean Sciences) (Remotely)

**Event website:**
http://www.goosocean.org/index.php?option=com_oe&task=viewEventRecord&eventID=2243

GOALS OF THE MEETING

1. **Update on GOOS and on BioEco EOVs**
   - Present the GOOS Strategy
• Update on links across GOOS panel disciplines
• Update on status of EOV development: implementation plan workshops (hard coral, plankton, macroalgae) and follow up, proposals, Working Groups, etc.
• Discuss how to approach the other EOVs (e.g. Fish)
• Discuss how to approach the emerging EOV Benthic distribution and abundance
• Update on other EOVs: sound and color – how to strengthen the link with related EOVs (e.g. fish and TBM abundance and distribution, phytoplankton)

(2) Map the EOV network
• Plan activities (workshops) for the mapping of the EOV network (planning for the Pegasus WG if approved or how to accomplish these objectives if the proposal is not funded) – what other collaborations/partnerships are needed
• To further discuss the GOOS "phenomena" aiming to help describe stories (and focused on indicators)
• Discuss on Standard Operating Procedures (SOPs) for EOVs – how will GOOS BioEco endorse SOPs to include in the Ocean Best Practices platform (OBP)
• Update on OBIS developments to incorporate the EOV data
• Discuss on how the EOVs will contribute to the global indicator framework (https://unstats.un.org/sdgs/indicators/indicators-list/) and to the ECV (GCOS) framework

(3) Plan the next steps
• Discuss our contribution to international processes, including the Decade of Ocean Science for sustainable development, the BBNJ or others.
• Discuss funding and communication strategies
• Based on discussions, update work plan (including governance): goals, activities, challenges, strategy at short (12 months), medium (24 months), and long term (5 years). Membership composition and rotation.

EXPECTED PRODUCTS OF THE MEETING

• Implementation strategy and plans (1 and 5 years) for every EOV to feed into the GOOS BioEco plans and the general GOOS strategy
• Mapping the partnerships to advance in the GOOS theme “Ocean Health”
• Workshop report

TUESDAY, 6 NOVEMBER
Venue: Sirata Beach Hotel
5300 Gulf Blvd, St Pete Beach, FL 33706, USA. Phone: +1 727-363-5100 (https://www.sirata.com/?NCK=7278975200)
Arrival in St. Petersburg (Tampa airport) and check-in at hotel.
Transportation from Tampa Airport to St. Petersburg: UBER (cost ~US 60)
Restaurants are available at walking distance (from 100 m to 1-2 km) from the Sirata Hotel.
DAY 1. WEDNESDAY, 7 NOVEMBER: UPDATE ON STATUS

I. INTRODUCTION (8:30-10:30) (Moderator Daniel Dunn)

- Welcome by GOOS BioEco chairs Nic Bax and Daniel Dunn
- Introduction of panel members and guests
- Secretariat report (P. Miloslavich): Review progress of program in 2017-2018, goals of this meeting
- GOOS Strategy (Albert Fischer) – to focus on partnerships (expertise of the group to provide feedback on their networks)
  - Identify the most important
  - How to approach them
  - How are they used
  - What resources are needed
- Synergies with the Ocean Sciences section of the IOC (Salvatore D’Arico - remotely)

What other partnerships need to be established to support GOOS theme on Ocean Health? E.g. The Committee on Earth Observation Satellites (CEOS)? CEOS coordinates civil space-borne observations of the Earth. Interested in how their outputs are used / applied in connecting to target indicators, on on-site calibration processes, etc. Several of the BioEco EOVs may be monitored through remote sensing – how to initiate/strengthen /focus collaboration with CEOS?

Break 10:30-11:00

II. UPDATE ON EOV DEVELOPMENT (11:00-18:00) (Moderator Patricia Miloslavich)

For this overview discussion, each EOV representative to prepare/report on:

1. Partners and collaborators - linkages to other (scientific) organizations including collaboration across GOOS disciplines – mapping the partners
2. Engagement with other (non-scientific) stakeholders
3. Progress to complete/update specification sheets
4. New technologies to help automatize and expand spatial and temporal coverage of measurements
5. Capacity development required to engage in these technologies – is any organization currently undertaking similar or applicable capacity efforts? If not, suggestions?
6. Funders: current and potential for further development and plan implementation – mapping the funders
7. Activities leading to EOV implementation: proposals, workshops, papers, communication (scientific at conferences or others)
8. Current data repositories and management practices – what type of data infrastructure would be required to adjust to new technologies (e.g. imaging, audio, genetic sequences, etc.)
9. Vision to move forward - planning for 2019-2020: activities, engagement, communication, etc.

Time allotted to each EOV will be variable. We anticipate that those that still lack a clear way forward will require more time than those with a clearer path to implementation.
Overview of biological EOVs

- Coral – David Obura
- Phyto and zooplankton – Batten, Chiba, Kudela, Muller-Karger
- Macroalgae – Lisandro Benedetti-Cecchi
- Seagrass – Emmet Duffy
- Mangrove – Lisa Maria Rebelo (to connect remotely – potentially)
- Fish – Shin, Allain [to contribute to discussions: Quinlan – BRUVs – Mark Dickey-Collas (remotely)]
- Turtle-birds and mammals – Costa, Simmons (to be postponed)
- Microbes – Pier Luigi Buttigieg (to be discussed on the 8th of November)
- Benthic invertebrates – general discussion and brainstorming

Other related EOVs

- Ocean Sound – Peter Tyack
- Ocean Color – Frank Muller-Karger
- Marine debris – Nic Bax

Lunch 12:30-13:30
Break 15:00-15:30

18:00 Adjourn for the day

DAY 2. THURSDAY, 8 NOVEMBER: MAPPING THE EOV NETWORK

Overview of Microbe EOV – Pier Luigi Buttigieg (8:30-9:15)

III. DESIGNING THE OBSERVING SYSTEM OF THE WORLD’S OCEAN (9:15-11:30)
(Moderator Nic Bax)

Planning for the PEGASuS/NCEAS Workgroup

- Global mapping of the observing network for biological EOVs
- Gap analysis
- Essential “phenomena” to be monitored
- Metrics for policy advise and useful for policy indicators
- Mapping the recommendations to relevant targets (e.g. SDG, Aichi)

Guiding questions (within GOOS “Phenomena”)

1. What are the changes in production\(^{(1)}\) - including oceanic, shallow water and coastal primary production and the quality and extent of marine habitats?
2. What are the changes in biological communities \(^{(1)}\) - including community shifts, regime shifts and persistent changes in species composition, trophic structure, species range and phenology?
3. What are the impacts of these changes - such as population loss, mass mortalities and bleaching due to diseases, heat stress, acidification, deoxygenation, pollution, etc.?
4. What is the potential for populations and ecosystems to recover – how can we measure resilience and recovery of populations and of ecosystems, especially degraded ones?

(*) Also related to Essential Climate Variables (ECVs) from GCOS: “Plankton” and “Marine Habitat Properties"

Break 10:30-11:00

IV. BEST PRACTICES (11:30-12:30) (Moderator Frank Muller-Karger)
Establishing a mechanism to endorse “Best practices” and/or Standard Operating Procedures (SOPs) for the EOVs
Using the Ocean Best Practices Platform (https://www.oceanbestpractices.net/)

Lunch 12:30-13:30

V. DATA MANAGEMENT (13:30-15:00) (Moderator Ward Appeltans)

OBIS developing capabilities to incorporate EOV data
Potential joint Task Team IBIS/GOOS to develop vocabularies
How to make the best use of OBIS
- Which requirements do we need?
- Which requirements OBIS needs from the networks?

Discussion to be based in information provided in the GOOS BioEco Data Mind Map by panel members with regards to:
1. Where the data is currently stored and archived
2. If the data is compatible with OBIS standards
3. If indicators are derived from the data and if this feeds into a policy/management framework
4. What role you think OBIS can play to help achieve your EOV

Information to be completed at: https://docs.google.com/document/d/1EJzA-TjDWdN5v66NWeI2BuYnTscBGxFGyW_uThfs/edit#heading=h.fzg3y1tu7nk5
See data architecture model proposed for the macroalgal EOV (in macroalgal workshop report)

VI. BioEco OceanObs19 draft (15:00-16:30) (Moderator Nic Bax)
Draft for contribution posted at:
https://docs.google.com/document/d/1B4iiZhY3byaHsA6iBVc0ESbuLL8DHYXt_3vFUPQ3miY/edit?usp=sharing

Break 15:00-15:30

VII. CONTRIBUTING TO THE GLOBAL INDICATOR AND ECV FRAMEWORKS (16:30-18:00) (Moderator Daniel Dunn)

Introduction to the process of developing indicators – Lauren Weatherdon
Connection to the Essential Climate Variables (ECVs) of the Global Climate Observing System (GCOS) (Albert Fischer)
Discussion:
How can the BioEco Panel contribute to these processes and frameworks
Why partnership with GCOS is important (e.g. to link with the IPCC) – note that connection between the IPCC and GCOS is not strong in all areas.

18:00 Adjourn for the day

DAY 3. FRIDAY, 9 NOVEMBER: Next steps

VII. CONTRIBUTION TO NATIONAL AND INTERNATIONAL PROCESSES (8:30-10:30)
(Moderator Nic Bax)

Introduction to the UN Decade for Ocean Science and Sustainable Development (Albert Fisher)
Discuss our contribution to international processes, including the Decade of Ocean Science for sustainable development, the BBNJ or others.
What role do we want to play in the Decade? What are the potential “entry” points for the panel?
Update on OceanObs19 – Sanae Chiba (and panel member) contributions

Break 10:30-11:00

VIII. FUNDING AND COMMUNICATION STRATEGY (11:00-12:30) (Moderator Patricia Miloslavich)

- Mapping of (potential) funders, partners and collaborators (*)
- New opportunities and partnerships as identified on Day 1
- Reaching out (improving communication) to all stakeholders: science, policy, industry
- E.g. “Bleaching” strategic mapping – any other that could be developed across GOOS multidisciplinary phenomena? Is it useful?

(*) Funding opportunities
POGO Call for Working Groups / 14th December / Euros 10K (http://oceanpartners.org/proposals)
SCOR WG Proposals / 2019 / US$ 45 k in 3 years / https://scor-int.org/
Schmidt Ocean Institute: https://schmidt-ocean.org/apply/apply-for-support/
Oceanographic technology research and development (https://schmidt-ocean.org/apply/expression-of-interest/ocean-tech-rnd/)
Advancing coral reef conservation (https://schmidt-ocean.org/apply/expression-of-interest/advancing-coral-conservation/)

Expressions of interest by 28th December
NCEAS / Future Earth (PEGASuS) Calls on Ocean Sustainability (Call in 2019?)
Collaborative Research Action (CRA): Belmont Forum, Future Earth, and the Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI Oceans) call for proposals. 31 January 2019 – closing of call for pre-registration: through development of research consortia, supported financially by at least three participating partner agencies established in three different countries.


NASA - Biological Diversity / Ecological Forecasting Programs (Woody Turner) – need to have link to GEOBON EBVs

Programs under the Ocean Sciences section of the IOC? Others?

Lunch 12:30-13:30

IX. UPDATING THE WORKPLAN (13:30-16:00) (Moderator Patricia Miloslavich)

Based on discussions, update work plan: goals, activities, challenges, strategy at short (12 months), medium (24 months), and long term (5 years).

Panel governance:
- Member composition and rotation
- Person to be the liaison between the BioEco Panel and GCOS

Next meeting: to determine date and venue – offers for hosting?

16:00 Meeting adjourn

BACKGROUND DOCUMENTS

All documents are posted (with sharing restrictions) at:
https://drive.google.com/drive/folders/175suEXKr6g86DeAi-r5hYYvAr0FD0v7vH?usp=sharing

Public documents are posted at GOOS event website
http://www.goosocean.org/index.php?option=com_oe&task=viewEventRecord&eventID=2243

OPEN documents

- Meeting agenda
- Meeting logistics document
- Acronym list
- GOOS Strategic Plan (draft) and Strategic Objectives
- GOOS SC#7 Report
- BioEco Panel: highlights and calls’ summaries
- Updated GOOS BioEco Mind map
- Presentations on progress for each of the EOVs
- Implementation Plan Workshop Reports for Coral, Plankton, Macroalgae
• Macroalgal “pledge” for EOOS
• “Coral Bleaching” strategic mapping
• Ocean Sound EOV – specification sheet (www.goosocean.org/eov)
• ToR OBIS Vocabulary Task Team
• GCOS ECV fact sheets (plankton and marine habitat properties)
• POGO_Biological_Observations_TaskTeam-Report
• Belmont Forum CRA Ocean sustainability call for proposals
• Papers (see list below with links/DOIs)

PROTECTED documents
• EOS articles for Plankton (in press) and Macroalgal (submitted) workshops
• PEGASuS 2 proposal and related documents (team composition / budget)
• Proposal to NASA (mangrove and seagrass observations through remote sensing)
• SCOR WG proposal (Seagrass) by Emmett Duffy
• OceanObs19 white papers
• POGO Working Group on Biological Observations – workshop outline

PAPERS (and their links/DOIs)
12. Visbeck et al. (2018). Ocean science research for sustainability. DOI: 10.1038/s41467-018-03158-3
ANNEX 3 - Annex Participants List

Third GOOS BioEco Panel Meeting
7-9 November 2018, St. Petes, Florida, USA

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