The Global Ocean Observing System

GOOS – Biology & Ecosystems Panel

Second Panel meeting

19-21 September 2016

IODE Offices, Oostende, BELGIUM

MEETING REPORT

Participants:

Nic Bax, Samantha Simmons, Patricia Miloslavich, Ward Appeltans, Albert Fischer, Frank Muller-Karger, Raphael Kudela, Sanae Chiba, Sonia Batten, David Checkley, David Obura, Lisandro Benedetti-Cecchi, Emmet Duffy, Yunne Shin, Bernadette Sloyan, Artur Palacz, Glen Nolan, Gabrielle Canonico, Pieter Provoost.

Proposed goals of the meeting:

- Update on GOOS BioEco activities since February 2016: status of proposed EOVs, collaborations, survey results, communication/engagement, contribution to new GCOS IP, etc
- Update from panel members on their GOOS related activities through a SWOT analysis
- Discuss/visualize survey results on state of biological ocean observations: What other product can be developed with this data?
- Revise paper draft: Identifying biological global EOVs
- Continue to develop EOV specification sheets: re-assess proposed EOVs (specifically Phytoplankton-HABs and Apex predators)
- Strengthening collaboration within the biological community (MBON, EMBRC, WAMS, CBD, ICES….) and across disciplines (Multi-Disciplinary Sustained Ocean Observations Workshop)
- Provide input for GOOS Strategic and Implementation Plans
- Discuss governance aspects (e.g. Terms of Reference)
- Discuss communication and outreach strategy [Newsletter? Additional information on Web page (http://goosocean.org/)? Social networks? Meetings to target?]
- Update work plan: identify goals, activities, challenges, strategy at short (12 months), medium (24 months), and long term (5 years).
- Discuss funding sources and propose strategy

Expected products of the meeting:

- Revised (near to completion) drafts of the specification sheets for the proposed biological EOVs
- Summary of activities and plans of the panel (to provide feedback to GOOS office in IOC and GOOS SC)
- Revised action plan including strategy to implement EOVs, coordination and collaboration among observing systems, communication, papers, meeting participation, funding (proposal submission) and schedule
- Near to submission draft of paper: Identifying biological global EOVs
- From survey data: identify observation coordination needs with the broader community for each of the EOV areas (including setting of standards and sharing of best practice) and ideas on how to encourage organization of common databases and data streams.
- Revised Terms of Reference for Panel

1) Introduction and update

Panel members and other participants were welcomed by chairs Samantha Simmons and Nic Bax and host Ward Appeltans. After a brief round of introductions from each of the participants, Project Officer Patricia Miloslavich provided an update of activities and review of progress since the New Orleans Panel meeting in February 2016 as well as the goals and expected outputs of this meeting.

One of the slides of the presentation showed the impact/feasibility graph generated with the results of the DPSIR analysis. This analysis identified the drivers and the pressures as addressed by international bodies/conventions to support biological ocean monitoring as well as the current state of observations as compiled by an on-line survey with more than 100 responses from observing programs and networks. This

slide generated a very productive discussion on data sharing, especially for fisheries, to be summarized in the section corresponding to the EOV/DPSIR paper.

2) Specification sheets

Bernadette Sloyan, chair of the GOOS Physics Panel summarized the process followed by this panel to select their EOVs. She explained how the physics oceanographic community came together in the 90s through the World Ocean Circulation Experiment WOCE) which was initially driven by science and had the support of the countries. The WOCE led to advances in technology such as the CTD and ARGO. With regard to what is measured, where and how, Sloyan also pointed out that some variables may be monitored at the global level and some may not, and that not all measurements fit into an international coordination framework. In the case of the Physics Panel, built on the OOPC (Ocean Observations Panel for Climate), EOVs had been pre-determined within societal benefit areas (earth energy, carbon, and water cycles) and framed within scientific questions. “Climate” to be considered as anything beyond the 7-day forecast for weather.

This introduction was followed by an overview of the GOOS specification sheets. This overview was largely based on discussion held on the previous days during the “GOOS cross-panel meeting” held on the 16-17th of September in which definitions for the different terms contained in the specification sheets were discussed across the three panels and developed in a consistent and standardized way (e.g. EOV, phenomena, sub-variables, supporting variables, derived products, platforms and networks, etc., see definitions below). The “GOOS cross-panel meeting” was attended by chairs and secretariat of the three GOOS panels. During the discussions that followed with the GOOS BioEco Panel, the definition of EOV was further refined to also reflect the relevance of the local scale and to address the wording of the UN-SDGs. This will facilitate the gradual connection between the BioEco Panel and major groups of societal interest such as the CBD and the BIP (Biodiversity Indicators Partnership). Albert Fisher pointed out that there should be some product showing how the EOVs can deliver to certain kinds of indicators, and this maybe could be the opportunity to interact with the IPCC.

Definitions
A GOOS ***Essential Ocean Variable*** is a sustained measurement or group of measurements necessary to assess ocean state and change of a global nature, universally applicable to inform societal benefits from the ocean at local, regional, and global scales.
Sub-variables are components of the EOV that may be measured, derived or inferred from other elements of the observing system and used to estimate the desired EOV.
Supporting variables are other EOVs or other measurements from the observing system that may be needed to deliver the sub-variables of the EOV.
Complementary variables are other EOVs and/or EBVs that are necessary to fully interpret (describe?) the phenomena or understand impacts on the EOV of natural and anthropogenic pressures.
Derived products are calculated from the EOV and other relevant information, in response to user needs.

A ***phenomenon*** is an observable process, event, or property, measured or derived from one or a combination of EOVs, having characteristic spatial and time scale(s) that addresses the GOOS Scientific Questions.

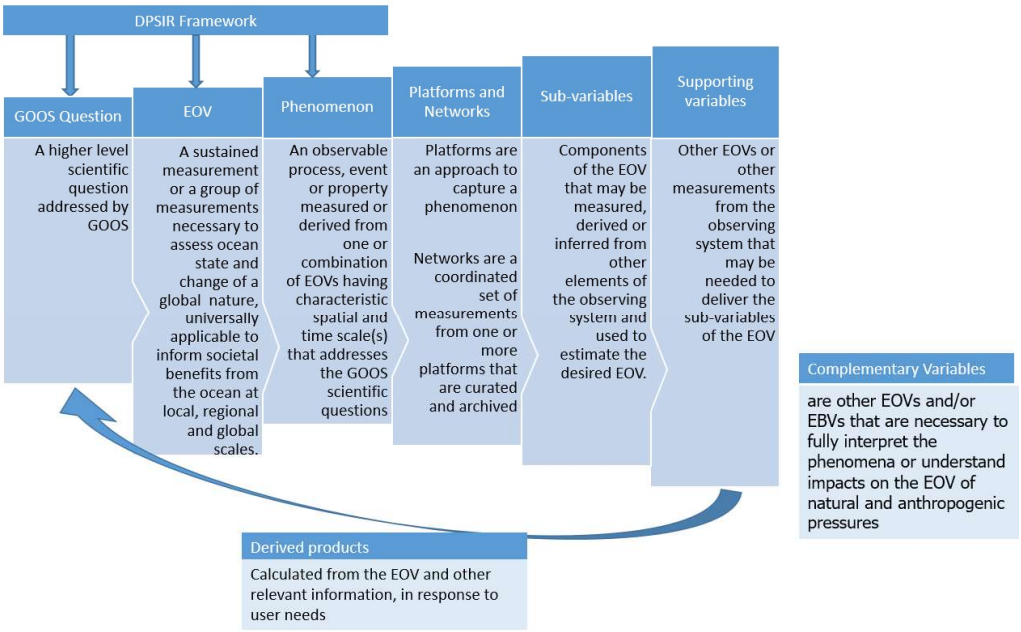

Figure 1. Schematic of EOV associated definitions and levels

Based on the morning discussions and the provided definitions and guidance, the Panel started working on our specification sheets. Initial focus was on defining major questions that could be considered as initial rallying-calls. Questions were to be framed within the drivers and pressures identified within the international conventions, and within the three GOOS themes (Climate, Operational Services, Ocean Health):

- *Drivers*: Knowledge, Sustainable use of biodiversity, biodiversity conservation, capacity building, economic growth, management, environmental quality, threat prevention, food security.
- *Pressures*: Loss of resources (habitat/biodiversity/overfishing), climate change, pollution, coastal development, invasive species, solid waste, ocean acidification, extreme weather events, noise, mining

Other points considered:

- The Census of Marine Life framework – What lived in the oceans? What lives in the oceans? What will live in the oceans? This was noted as very powerful in terms of the simple and strong message.
- What is the (current) measurable baseline for life in the oceans?
- Important to think about how EOVs/phenomena feed into management/decision making and international and national/local reporting requirements
- How is society impacting life in the oceans?

Overarching questions:

- What is the current status of life in the ocean?
- How is life in the ocean changing?
- What are the natural and anthropogenic drivers of changing life in the oceans?
- How does the changing life in the ocean affect ecosystem function, (health and services)?

These overarching questions then may have different levels of information. For example, for the question "What is the current status of life in the ocean?" the next level would be to ask about specific variables to define this status such as biodiversity, distribution, and abundance.

GOOS	**Physics**	**Biogeochemistry**	**Biology**
Current state of oceans	What is required for the regular assessment of the current ocean state and its evolution?	Ocean carbon content How large are the ocean's dead zones Is the biomass of the oceans changing	What is the current status of life in the ocean?
Predictions of future conditions	Operational ocean services	How is ocean carbon content changing? How fast are ocean dead zones growing? Is the biomass of the oceans changing?	How is life in the ocean changing?
Projection of trends	Projection of ocean state and its variability on society (sub-seasonal, inter-annual, decadal)	Carbon content Dead zones Biomass	What are the natural and anthropogenic drivers of changing life in the oceans?
Human impact on oceans	Society's impact on the oceans	How do eutrophication and pollution impact ocean productivity and water condition	What are the anthropogenic drivers of changing life in the oceans?
Impact of changing oceans on societal benefit	Ocean knowledge for climate forecast and projection	What are the rates and impacts of ocean acidification	How does the changing life in the ocean affect ecosystem function, (health and services)?
Interactions with other components of global observing system	Physics links to Biogeochemistry and Ecosystems	How does ocean influence cycles of non-CO2 greenhouse gasses	Understanding why life in the oceans is changing.

Phenomena:

As background for discussion in this section, biological oceanographic phenomena had been synthesized by considering 1) general oceanographic processes, 2) phenomena as proposed in the specification sheets drafts, and 3) those addressing pressures as identified in the international conventions (see Table below).

Specification sheets drafts	Pressures	Biological processes	All combined
Resource availability in higher trophic levels Ecosystem damage and health threat by high-biomass blooms Acidification Climate change Status of marine ecosystems	Climate change Ocean acidification Extreme weather events "Loss of resources": habitats / biodiversity (including overfishing) Pollution / eutrophication	Primary production Secondary production Trophic interactions Biodiversity Connectivity Ecosystem services	Production: primary, secondary, biomass, abundance, resource availability, food security …. Biodiversity: species diversity, trophic interactions, quality of resources…. Distribution: connectivity.. Ecosystem health: environmental quality… Human impact: acidification, climate change, ecosystem damage ...

Each participant considered this list as well as their area of expertise and proposed their top five major phenomena. This exercise led to a list of phenomena that were then grouped within seven categories or themes: biology, shifts, production, extreme events, movement, species / populations, environment (see file “Phenomena Post-its Sept2016.xlxs”). For each EOV, experts could then select from this list of phenomena those that could be addressed by the EOV and its sub-variables (see file: “specsheet topfive combined.xlxs”). Panel members will continue to work on the specification sheets in the next two weeks following the meeting. Some of the required visions include a clear distinction between phenomena and derived products and noting in the introduction which drivers and which pressures are being addressed by each particular EOV. Once the spec sheets are completed by the appointed panel expert (s), these will be exchanged for internal review among other panel members of different expertise and then go to a first external review by experts (see list below). For these initial external reviewers, it was agreed that a one-two pager explaining what the EOVs are, and what purpose the spec sheets serve would be provided as background material. It was also suggested that after this, all spec sheets should be reviewed internally within the GOOS community by one member of the GOOS SC. After these reviews, the specification sheet authors (GOOS BioEco panelists) would have the opportunity to revise and address all feedback, which will then posted on the GOOS website for public, wide external review by the scientific community. Ideally, the wide external review through the GOOS website should be scheduled after the publication of the EOV/DPSIR paper.

EOV	Responsible (s)	Panel Reviewer	External Reviewer (suggested)
Phytoplankton biomass and diversity	Frank, Raphael	Sonia, Dave	Peter Thompson, Todd O’Brien

Zooplankton biomass and diversity	Sonia, Sanae, Dave	Raphael, Dave	Anthony Richardson, Tony Koslow
Fish abundance and distribution	Yunne, Dave	Frank, David	Francis Marsac, John Gunn, Kevin Weng
Turtles, birds, mammals abundance and distribution	Sam, Nic	Sanae, Yunne	Dan Costa, Bryan Wallace, Henri Weimerskirch
Live coral	David	Sanae, Emmett, Lisandro	Jorge Cortés, Aldo Croquer, Hugh Sweatman, Rusty Brainard
Seagrass cover	Emmett	Frank, Sonia, Lisandro	L.J.McKenzie, Carlos Duarte, Fred Short
Macroalgal canopy cover	Lisandro	Raphael, Emmet, David	JJ Cruz, Sergio Navarrete
Mangrove cover	TBD	TBD	TBD

David Checkley suggested to contact Octavio Aburto, assistant professor at SIO to provide advice on how to move forward the mangrove EOV.

Further discussions raised the question on how often would the spec sheets need to be revised once they are permanently posted on the GOOS website and by whom? In this regard, the general agreement was that the spec sheets should be open to receive comments anytime through the website, and then once a year, the Panel would revise these on their annual meeting. The specifications sheets should reflect some version control or indicate a “date last updated” to track these revisions.

3) SWOT analysis from the observation programs and networks

Panel members provided an update of their GOOS related activities as well as a SWOT analysis (internal strengths and weaknesses, external opportunities and threats) within the context of how each of the programs they represent may interact better with GOOS.

-Frank Muller-Karger: Global MBON

-Raphael Kudela: Harmful Algal Blooms (HABs)

-Sonia Batten: Global Alliances of CPRs (GACs)

-Sanae Chiba: BIP-indicators

-David Checkley: CALCOFI

-Emmet Duffy: Smithsonian Marine-GEO

-Lisandro Benedetti-Cecchi: EMBOS

-David Obura: Coral MBON / GCRMN

-Yunne Shin: IndiSeas

-Nic Bax: NERP Marine Biodiversity Hub and links to the CBD

-Sam Simmons: Animal Telemetry Network

Marine Biodiversity Observation Network (MBON) – Frank Muller-Karger

Strengths	**Weaknesses**
Build on historical efforts: • Census of Marine Life • GOOS Interest in concept: Many people willing to help Conceptual framework for collaborative MBON: • Academic entities • National government and NGO programs • International programs (GEO BON, IOC (GOOS, OBIS), SBSTTA/CBD, GCRMN, Tennenbaum/MarineGEO) • Building decision-support tools to answer user requirements Technologies: • Automated image and video classification methods • eDNA: collection and extraction methods • Satellite-based, dynamic seascape products • Biodiversity field monitoring program Visibility	EBV-EOV not linked to SDG indicators (SDG-14) or Aichi Targets Complex communications/coordination • Massive task nationally, internationally • Slow in communicating benefits to operational groups that could support Common problem: lack of willingness to share data Operational MBON – no clear path to sustainability Lack of a data archive
Opportunities	**Threats**
Evolve from and build on Census of Marine Life Link EOV with EBV Work with and through GOOS Bio-Eco Panel GOOS observation network to 'deploy'/test MBON concepts OBIS network and infrastructure • Can OBIS serve community with a data archive? Building critical international partners and linkages for Pole-to-Pole Data system / visualization tool eDNA development and validation, implementation	Rapid bureaucratic growth Limited funding and short time to define sustainability Competition between programs complicated finding resources (i.e. Future Earth/Future Oceans elements can be an opportunity or a threat) Unwillingness of people and agencies to collaborate Time is ticking…

Curation and permanent archive of biological datasets Communications: coordination, news, outreach Integrating MBON observations with other operational programs Operational MBON - path to sustainability is a possibility	

Global Harmful Algal Blooms (Global-HABs) – Raphael Kudela

Strengths	**Weaknesses**
Phytoplankton Diversity/Productivity highly ranked and/or measured by multiple programs • International support/coordination OBIS, WORMS, HAEDAT Recognition that chlorophyll (biomass) is not sufficient Well-defined baseline technology, emerging automated systems Easy to justify in terms of DPSIR	Complicated question—very little standardization on measurements/reporting Automated analysis is expensive and still an emerging technology No requirement for reporting
Opportunities	**Threats**
Many groups moving forward in parallel Emphasis on biodiversity at an international level requires moving beyond chlorophyll Enumeration of plankton diversity addresses needs of multiple groups: • HABs • Biodiversity	The single biggest threat is that it is easy to go back to coarse-resolution, global estimates of chlorophyll and productivity While groups are enthusiastic they are primarily scientific, not driven by intergovernmental mandates For HABs specifically, the HAB community may not support “Phytoplankton Diversity” if they feel it doesn’t address needs (i.e. not specific enough)

Global Alliances of CPR (GACs) – Sonia Batten

Strengths	**Weaknesses**
CPR Surveys are a “mature” strategy for large-scale biological ocean monitoring. • Could be initiated anywhere, now, with high chances of success While not completely global, many of the world’s regions have CPR time series.	CPR Surveys are not global; tropical and Arctic regions barely sampled Sampling does not capture the whole plankton community Labour intensive (currently) to work up the samples and requires taxonomic training

• Enables large scale, inter-ocean comparisons Provide taxonomically resolved data. • Essential for biodiversity-related studies Have a sample archive for new analyses/techniques (e.g. molecular studies, stable isotopes) • Increased future applicability, but backwards-compatible Cost-effective sampling • Using commercial ships, sampling is essentially free. The CPR is an adaptable platform for other instrumentation	• Expensive, in most countries. • Takes time to learn skills and time to process samples Large amounts of taxonomic data are cumbersome to handle and require synthesis to produce informative and relevant indicators. "Global" survey is comprised of independent local surveys • Different funding strategies required • Different levels of vulnerability • Coordination (GACS) required which has additional resource implications
Opportunities	**Threats**
The push towards understanding and including biodiversity by global conventions – needs taxonomic resolution Similarity between satellite data and CPR • Near-surface, large scale horizontal coverage by both offers synergies Utilising the ever-increasing global shipping industry • "Greening of the fleet" should be attractive - mitigates emissions-effects, provision of social responsibility.	Newer technologies may be more "attractive" to funders, even if more costly • Cool tech. may be more easily funded by wealthy, often tech-based, Foundations Investment in autonomous technology by CPR "competitors". Digital data increasingly more visible/attractive • No need for hard-to-acquire taxonomic skills • More "operational" data delivery in modern times • No expensive archive to maintain International funding is generally in decline due to global economy and political events (e.g. BREXIT)

Global Zooplankton Indicator (BIP) – Sanae Chiba

Strengths	**Weaknesses**
High score against BIP Indicator Criteria (Temporal & spatial coverage, Scientific credibility, alignment for AT	Quasi-global => spatial gap Coordination of regional monitoring programs Budgetary issues
Opportunities	**Threats**
Open the link of GOOS-EOVs to policy/society Partnership with BIP	?

Indicators for Other Programs Financial support may be available Increase communication bw conservation biology and oceanography communities	

California Cooperative Oceanic Fisheries Investigations (CalCOFI) – Dave Checkley

Strengths	**Weaknesses**
Time series Breadth of observation (P, C, B) Staff skill, work quality Motivations, goals Cooperation (academia, state, federal) Relevance to fisheries Ancillary programs Climate change attribution	Increasing cost Space-time resolution Lack of uses and users Aging staff Limited types of observations
Opportunities	**Threats**
New director New funding sources New observing technologies New relevances (CC) New agency needs (EBFM, CC) Education and outreach New ships International cooperation	Budget cuts Reorientation to stock assessments Underappreciation of time series and spatial extent Overestimation of new technologies

Smithsonian Marine GEO – Emmett Duffy

Strengths	**Weaknesses**
Stable base funding Strong brand Biodiversity expertise Institutional commitment Some mature elements (?)	Biodiversity is hard! Dispersed governance Funding for partners Data not yet integrated Lack of standardization
Opportunities	**Threats**
Converging interests	Effective messaging

New technologies	Mission creep
Crowdsourcing	“Monitoring fatigue”
Educational engagement	Short-term thinking
Public interest	Crowded field

A pan-European Marine Biodiversity Observatory System (EMBOS) – Lisandro Benedetti-Cecchi

Strengths	**Weaknesses**
Research capacity	Missing expertise
Resources available	Lack of team cohesion
Relevant questions (the wisdom of the crouds)	Lack of long-term vision
Opportunities	**Threats**
Innovative approaches	Insufficient financial capacity
New/broader questions	Political / legislative changes
Expand/integrate with other networks	Large infrastructures with legal status recognized by the EU

Global Coral Reef Monitoring Network (Coral MBON) – David Obura

Strengths	**Weaknesses**
A globally distributed monitoring community	Low funding in national and local processes
Relatively easy access in the coastal zone of many reefs/most-used reefs	Variable methods and ‘drift’
Public awareness and interest in coral reefs as a flagship ecosystem	Remote reefs costly to access
Relatively low cost observational and image-based methods	Low and variable capacity across many teams; high turnover of monitoring observers
Increasing relevance of IT and computational tools (image analysis, earth observation data)	Distributed and broad network of teams and stakeholders challenging for coordination/integration
	Coordination mechanisms have been loose and not well supported
Opportunities	**Threats**
Clearer and renewed global commitments for biodiversity and sustainable development	Inexorable growth in threats and worsening condition of reefs may undermine support and commitment for monitoring
Imminent deadline (2020) for Aichi Target 10 reporting	Weak governance and regulatory environments (International/national)
Natural capital and blue economy frameworks provide funding/commitment opportunities	Economic valuation done in a narrow way may undermine commitments

Networking/partnering with GOOS/GEOBON ad others Growing public interest in coral reefs, including in private sector, development banks, etc. Growing data/analytics capabilities enable database development to suit multi-scale and multi-stakeholder needs	Intellectual property issues undermine data inputs Attraction of new/tech methods can undermine support for 'traditional' teams and data sources Competition between programmes and attachment to acronyms/attribution/etc

Indicators of the Sea (IndiSeas) – Yunne Shin

Strengths	**Weaknesses**
local expertise survey data (fisheries-independent data) conducted on a regular basis scientific credibility allow inter-system comparison	spatial gaps data availability standardization issues performance of indicators 30 ecosystems with data time series
Opportunities	**Threats**
some indicators in IPBES list of core and highlighted indicators commitment in national reporting >30 ecosystems with data time series	sensitive data complexity of data analysis in support to decision-making

Animal Telemetry Network (ATN) – Sam Simmons

See data portal: http://oceanview.pfeg.noaa.gov/ATN/

Strengths	**Weaknesses**
Data Assembly Center is well under development Have financial support for other development ofor the next 4 years Full-time Network Coordinator on board	Additional buy-in still needed from the community
Opportunities	**Threats**
Development of a global data standard is underway JCOMM interested to hear if the community is ready to be considered a "network" delivering at least the environmental variables into that system There is a relatively newly formed Biologging Society that may facilitate these opportunities	Funding beyond the 4th year is uncertain

CBD – Nic Bax

Strengths	Weaknesses
Easy to be locally relevant Clear link between developing monitoring and capacity building	Global relevance much harder Reporting at international levels at very aggregated level which does not show clear link to national and global reports Not a 'traditional' avenue for developing science
Opportunities	**Threats**
Reports will be produced regardless of lack of data and communication of uncertainty is rare	GEF does not explicitly support monitoring

NESP Program: Marine Biodiversity Hub– Nic Bax

Strengths	Weaknesses
stable funding direct link to government top-down management National coverage –> national leadership opportunities	Can't include everybody Data->visualisation->uptake very difficult
Opportunities	**Threats**
National standards –>regional ->international Support national government in international negotiations (CBD, BBNJ, Pacific Oceanscape)	Ministerial fiat Funds not for international work Cutting edge vs bleeding edge (research vs monitoring)

4) EOV / DPSIR draft manuscript

Data sharing

Yunne Shin pointed out the importance of having the fisheries data. By having such data included in the impact/feasibility graph, "fish" as an EOV would have a much higher rank. While most of the countries actually hold data on fish catch (and even by-catch and discard), these data are usually restricted and not of the public domain nor open access. A discussion followed on the benefits that governments would have by sharing their fisheries data. In this regard, Albert Fischer stressed that the IOC may provide the arguments and framework to encourage data sharing for a greater value, but the IOC does not have the same leverage as would the CBD or the UN through the SDGs. There was general agreement that maintaining an open channel of communication with governments highlighting the value and benefits of data sharing (e.g. to meet their reporting requirements to address the Aichi Targets and the SDGs) is needed, but the sensitivity around economic values was also recognized. It was

suggested that maybe FAO could be considered a potential partner for the GOOS BioEco Panel, but this idea needs further thinking and ideally some feedback from engaged scientists such as Jake Rice and Serge Garcia, who chaired the CBD/FAO workshop on reporting against Aichi Target 6, where it was decided that established FAO national reporting mechanisms could also support individual countries reporting against Target 6..

Dave Checkley informed about a program on fish landings led by Daniel Pauly independent from FAO and that building up on successful stories is very useful to show benefits. One of the recognized problems with fish data, in addition to not being publicly available, is that it relies on fisheries (captures), and mostly of commercial species, while there is very little on natural communities. As a contact person in FAO for fisheries, David Checkley suggested his colleague Manuel Barange (Manuel.barange@fao.org) who began in May 2016 as Director of the Fisheries and Aquaculture Resources and Policy Division of FAO in Rome. Manuel Barange was head of exec office of GLOBEC and most recently headed QUEST-Fish project (http://www.quest-fish.org.uk/). Nic Bax noted that the outputs of this program have received a very variable response. Modelling was recognized as a tool to fill in the gaps of information, which could provide with a justification to incorporate more natural data. Yunne Shin pointed out that there other non-governmental survey fisheries data but these are not publicly available. Frank Muller-Karger stressed that the IOC through the GOOS BioEco Panel should be working more closely in strengthening its relationship with the CBD and the UN-SDG to promote and facilitate the sharing of data, building on the fact that the SDG14a explicitly mentions the IOC.

In the zooplankton area, Sonia Batten mentioned that collaboration behind GACs was built on a framework aimed to work together, using common techniques and taking advantage of opportunistic funding.

General suggestions:

Visualize information in a way that each societal driver and pressure can be tracked back from each of the proposed EOVs, that is, to highlight how each of the proposed EOVs is addressing which drivers and pressures. In summary: to link each EOV back to the international conventions.

Use only the “pressures” as a proxy for the impact axis (currently it has both, the drivers and the pressures). For this, a new survey will be prepared and distributed to the panel members and co-authors of the paper (and other members within the GOOS community?) asking to respond for each of the biological variables that resulted as the most observed by a largest number of programs in the “state of biological ocean observations survey”, if they do/do not address each of the specific pressures, and to what degree (in a scale 0 to 4, in which 0= does not address, 1=low, 2=medium-low, 3=medium-high, 4=high, plus the option= “I don’t know”. Each of these will come with an operational definition to avoid subjectivity as much as possible). Another option to explore is through a literature search of the number of papers addressing the pressures for each of the variables (e.g. Scopus or Google Scholar).

Panel members to review the draft DPSIR paper and provide major and high level suggestions (no editorial work at this time) by Mid-October.

Publication journal: one of the journals suggested for publication was *Current Opinion in Environmental Sustainability* (Yunne Shin). This Elsevier journal has an impact factor of 4.766 and “aims to track the emergence of a new innovative sustainability science discipline by integrating across regional and global systems with their typical dimensions, human-environment interactions and management challenges….it emphasizes the actual interdisciplinary sustainability research approaches, the

solutions it provides and their dissemination and application." The process described in this paper will also serve as the basis for discussion in the "Framework for Ocean Observing: revisited 5 years later" proposed during the GOOS Cross-Panel meeting held the week before in Oostende.

5) Other visualization products of the "State of biological ocean observations" survey and data management issues (OBIS)

Ward Appeltans, OBIS project manager, briefly presented the status of OBIS and a number of new developments (portal, r-package etc) as well as the status of expanding OBIS to embrace sample/sampling information and include concurrent environmental data and any biological/ecosystem measurements. In essence, this prepares OBIS to serve new requirements for data sharing and product development arising from initiatives such as GOOS.

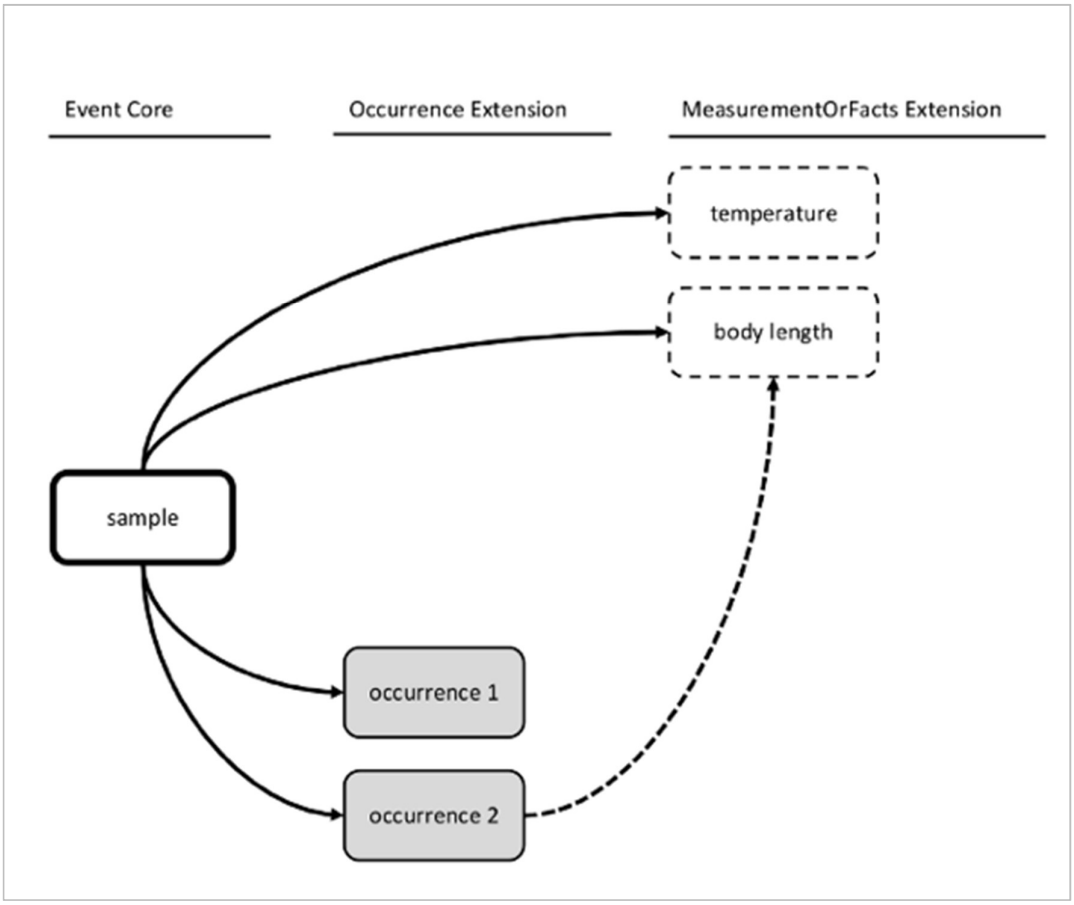

Figure 2. Simple schematic overview of the newly proposed OBIS-ENV-DATA standard, combining events, occurrences and concurrent measurements or facts related to the sample.

The results of the GOOS survey (responses) and the networks that contributed to it are available through http://dev.iobis.org/goos/. This provides an impressive amount of information. However, the survey was not designed in such a way that each variable could be described separately. Therefore, Ward proposed to develop a database where observing networks can describe each monitoring activity based on the selection of:

- EOV
- Phenomena
- application/science question
- Readiness level
- spatial and temporal coverage and resolution.
- Data systems
- Derived products
- Tools and techniques (incl readiness level)
- Habitat
- Expert contact information

The GOOS panel members will be responsible for managing the content of the tables on the right and left columns (see figure), and the observing networks are responsible for documenting their activities by selecting the right terms in the various tables. This database will serve as the GOOS Strategic Mapping Database for all GOOS panels. The delivery of the database and input interface is planned for end of 2016.

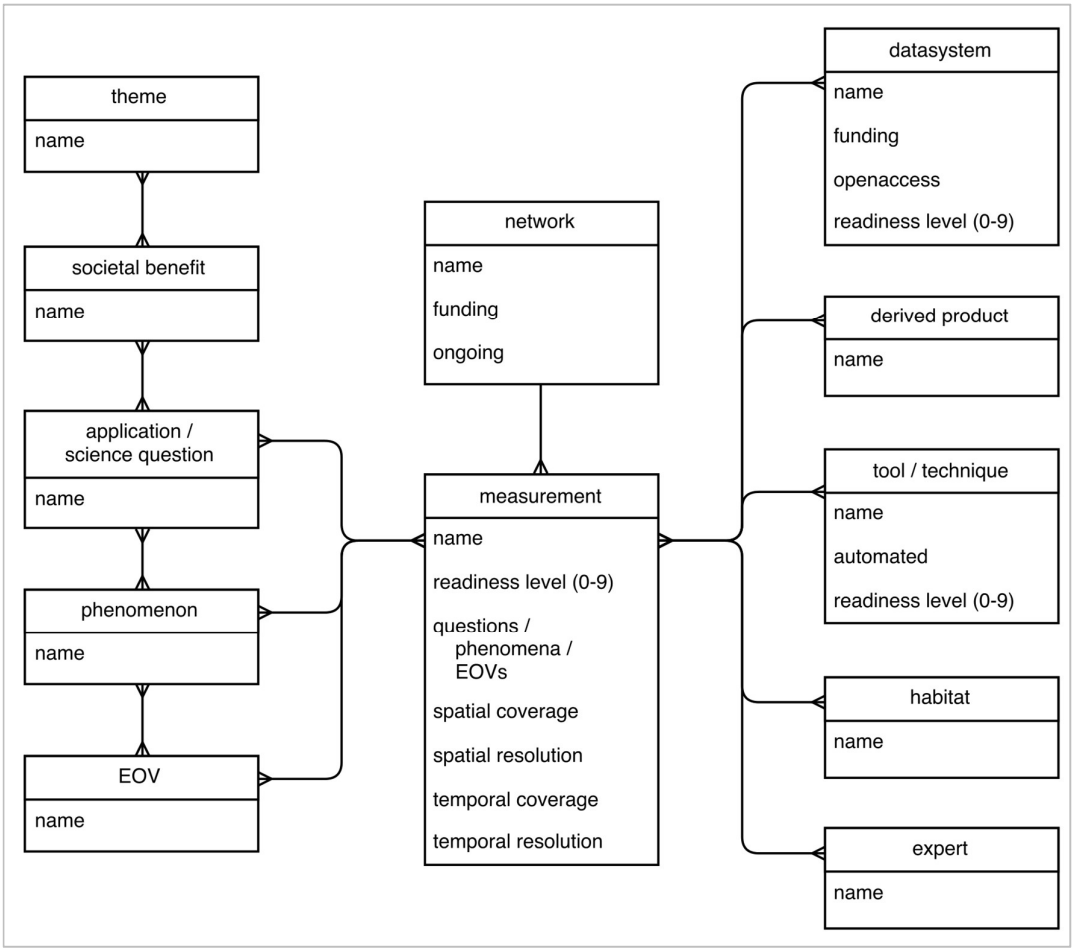

Figure 3. Simple schematic overview of the proposed GOOS Strategic Mapping Database, used the document the monitoring programmes of the ocean observing networks.

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6) Collaboration / partnership strategy (some actions and next steps)

Points discussed in this session were:

- How do we validate/develop the EOVs with the community?
    - Review process:
        - Expert review (by Nov)
        - Public review (by early 2017)
        - Publication: DPSIR; GOOS EOVs
    - Engagement through meetings: ICRI (nov 2016), PICES (nov 2016), Ocean Sciences Town Hall (2018), GEO Plenary (Nov 2016 messaging through GOOS, USA, Mexico, France (ICRI link), Australia; 2017: USA), CBD; ICES, IOC Assembly (June 2017), 4th World Conference on Marine Biodiversity May 2018 (Montreal), OceanObs'19.
    - Oct 2017: Marine Mammals; Biologging society meeting (2017, Germany), World Fisheries Congress (2017),
    - MPA congress 2017 Chile; IMCC (International Marine Conservation Congress, 2018); CERF Nov 2017 (Providence RI); international temperate reef symposium (2019)
    - IOC's ocean colour
    - Ecological Society of America and other regional analogues
    - AAAS and other regional analogues
    - Industry?
    - ACTION: Develop a generic GOOS Biology / Ecology presentation with speaking notes out of existing material (for Patricia to update the present one)
        - 10-min version: high level
        - 20-min version: more scientific audience
    - ACTION: update the poster template

- User community / conventions / agreements
    - CBD (Cancun, Dec 2016):
    - CITES:
    - LME: Sam to attend LME LEARN annual meeting (Dec 2016)
    - Future Earth (Oceans KAN):
    - BBNJ PrepCom (April 2017?)
    - UNEA (2018)
    - RAMSAR (May 2017) – re: mangroves, sea grass, coral reefs
    - GRA Forum in 2017
    - GRAs: opportunity to (not work EOV by EOV) but to work in a systematic way promoting integration of biological and ecological observations across all relevant observing networks
    - IIOE-2

- Observing Networks: build and expand from the 104 surveyed networks

    By EOV:
    - *Coral*: GCRMN: and links to regional activities, link to PI-GOOS and build capacity
    - *Zooplankton*: GACS, [regional: CalCOFI, etc.], databases (), GRAs? Fisheries agencies

- *Sea grasses, mangroves, coral reefs*: integrated systems – link to the GOOS Regional Alliances (e.g. IOGOOS),
- *Sea grass*: National Estuarine Research Reserve System [as a way of expanding the network]

Thematic:

- GOA-ON (biology WG)
- MBON (letter of collaboration to be signed between GOOS BioEco, MBON and OBIS –collaboration organization visualized below)

- **Organize around each EOV**? Standardize **observations** (hard), **data** system (more promising), products?
- Identify **champion(s)**
- Need to be focused and strategic
- [Panel shifts focus each year?: on an EOV – additional invited experts working on sampling platforms – identify opportunities for funding…]
- **Capacity development** (example of activity in 2017 with OTGA with coral reefs focused on an EOV)
- Regional Groups?

- Observation systems flowing into Data systems
  - Including documentation on observing technique (the metadata)
  - OBIS

  Examples from Australia: finding a **level of common reporting** - interoperability

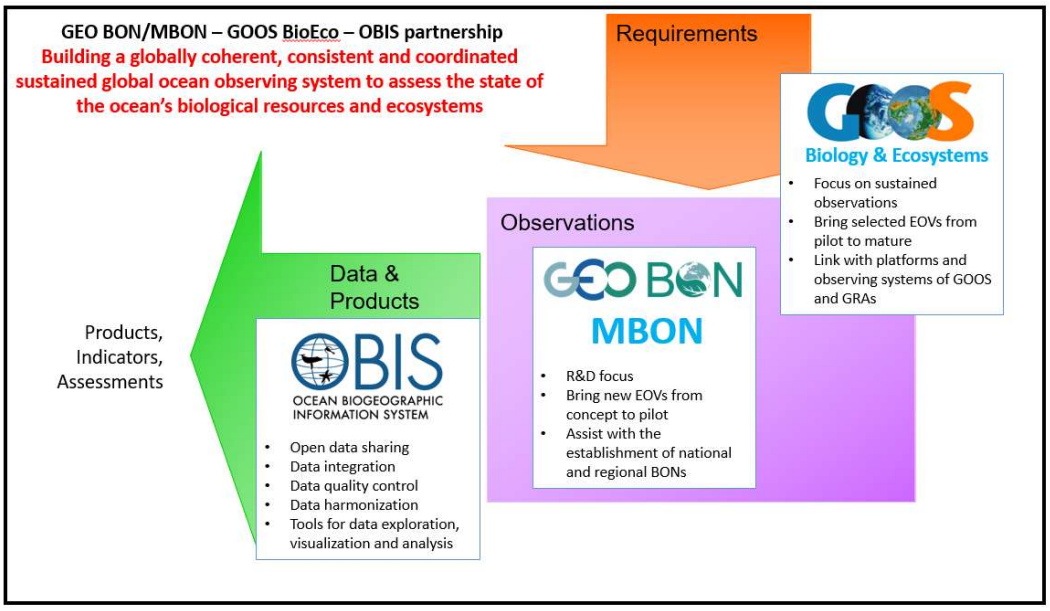

Figure 4. Schematic representation of collaboration between GOOS BioEco, MBON and OBIS within the Framework for Ocean Observing (FOO)

7) Communication strategy

This session was focused on how to reach better to the community and improve communication with the scientific, policy, and general public sectors. Strategies to achieve this included both internal and external communication. Each of the panel members to champion the EOVs within their areas of expertise, geographic range, networks of collaboration, etc.

- Phytoplankton and primary productivity: Frank Muller-Karger and Raphael Kudela
- Zooplankton: Sonia Batten and Sanae Chiba
- Benthic habitats: David Obura (coral reefs), Emmett Duffy (seagrasses), Lisandro Benedetti-Cecchi (rocky shores), TBD (mangroves: contact has been initiated with Llsa Feller from Smithsonian and Lisa Maria Rebelo from IWMI-Laos)
- Fish: David Checkley, Yunne Shin
- Marine turtles, birds, mammals: Sam Simmons

Internal communication	***External communication***

• MEETING FREQUENCY
  ○ IN-PERSON
  ▪ Governed by deliverables (one per year -up to two a year)
  ▪ Cross-panel opportunities
  ○ TELECONFERENCE
  ▪ Quarterly
  ▪ Focus on an EOV or GRA
• COMMUNICATION WITH OTHER PANELS & GRAs
  ○ THROUGH CHAIRS
  ▪ SC once a year
  ▪ Executive as required
	• COVERED BY MEETINGS, OR?
	  ○ GOOS 'Quarterly' newsletter
	  ○ email capacity to reach 1000
	  ○ "CHIRP" style – weekly posting of one short paragraph for each panel, GRA, etc.
	  ○ Twitter?? Pass through Albert or tag GOOS#
	  ○ Release of all spec sheets through FOO paper or DPSIR paper provides opportunity for media release. Work with IOC new press officer to develop stories and quotes. (Albert)
	  ○ Panel members to provide short videos, or photographs to location to be specified by Ward.
	  ○ Timeline to release of EOVs

8) Funding strategy

At present, the Project Officer position has been supported by the University of Western Australia (UWA), the Australian Institute of Marine Science (AIMS) and the Commonwealth Science and Industry Organisation (CSIRO). Support was initially for a period of two years (March 2015-February 2017) and the position is currently held at UWA. Efforts are underway to secure the position for another 2 years, now based at the University of Tasmania at Hobart. For this position to be opened, funds to pay for salary for the full 2 year period have to be secured. For this new period, some funding

has been provided by AIMS, the Marine Mammal Commission, the MBON, the IOC, and potentially through CSIRO. The IOC has supported the two Panel meetings (New Orleans and Oostende) and will possibly be able to support one panel meeting per year.

As for future strategy, it was noted the importance of identifying what the funding needs are as there will be several levels including secretariat support (e.g. project officer position), panel meetings, and implementation of EOVs. With regard to a funding strategy to advance the development of EOVs, the panel discussed that these could be driven by individual EOVs. The OCB (Ocean Carbon and Biogeochemistry) call 2017 for scoping workshops (20-65k) was noted as an opportunity to submit a proposal jointly with the Biogeochemistry Panel (Deadline for submission December 1, 2016). Other opportunities to continue to explore are 1) SCOR working groups, 2) National funding opportunities – nationally relevant, globally significant, 3) Foundations, 4) Private Companies.

9) Wrap up and Assignments (within governance structure)

The final discussion of the meeting focused on what is expected from all participants, particularly their individual roles.

- ***Individual roles***
  - Identification of a strategy of the observing networks to be engaged and a time-frame
  - Communications leading to a formal agreement between main networks contributing to an EOV.
  - Specifying granularity of data products to be made available and time-frame covered
  - Periodic reporting (annual?) to GOOS Panel and other key groups
  - Leads to metrics of system performance
  - Implementation plan
  - Identify funding needs for developing EOV
- ***Resourcing***
  - Ward to provide support on what a data consensus model needs to contain
  - Advice on governance structures – sharing models eg. GCRMN, MBON
- ***Membership***
  - When does a network become considered as a contributing network and be listed as such.
- ***Succession plans***
  - 2yr calendar years
  - can rotate off, suggestion of replacement appreciated – Dave Checkley initially accepted to be in the Panel for one year due to his retirement (topic for discussion)

10) Summary of action items

Action item	Who	When
Specification sheets: Internal review of specification sheets (own experts: work on	Panel members	Tonight / Plane / Train….

introductory paragraph to reflect drivers/pressures) Internal review of specification sheets (across panel members) External review of specification sheets (from a small group of experts + GOOS community – GRAs/SC) External review by broad audience	 Experts + GOOS community Open in GOOS website Broad scientific community (spec sheets to be posted on the GOOS website for review)	 2 weeks Late November After publication of DPSIR paper (?) After the Miami meeting (and after publication of paper)
DPSIR paper: Review of DPSIR paper and provide feedback on how to present results / discussion (not requesting editorial edits at the moment), journal, literature to be considered "Quantifying" impact (using pressures): survey. Defining level of how the variables address the pressures	 Panel members Patricia, Ward to send	 2 weeks Completed in 2 (3?) weeks
Collaboration/Communication Updated list of meetings 2017-2019 (for regional to global engagement) Reaching out to networks (inventory of programs by EOV and clean up active/not active) Ask panel members for quarterly updates: try to build a	 Patricia Patricia Patricia	 Request feedback to all expecting to have by late November Quarterly

"story" that is compelling and that shows applications (societal benefit)		
Survey data visualization Development of strategic mapping database	Ward, Pieter	Mid-December
Secretariat and reporting Meeting report 1-2 pager to support EOV/spec sheet process Update general GOOS presentations (a short – 10 minute and a long -30 minutes) Update general GOOS BioEco poster (for everyone to download as needed for conferences, etc) Clean/organize shared Dropbox	Patricia Patricia Patricia	Early-October

11) List of acronyms and abbreviations

AAAS: American Association for the Advancement of Science

AIMS: Australian Institute of Marine Science

ARGO: Array for Real-Time Geostrophic Oceanography

ATN: Animal Telemetry Network

BBNJ: Biodiversity Beyond National Jurisdiction

BIP: Biodiversity Indicators Partnership

CalCOFI: California Cooperative Oceanic Fisheries Investigations

CBD: Convention on Biological Diversity

CITES: Convention on International Trade in Endangered Species

CPR: Continuous Plankton Recorder

CSIRO: Commonwealth Science and Industrial Research Organisation (Australia)

CTD: Conductivity-Temperature-Depth

DPSIR: Drivers-Pressures-State-Impact-Response

EBFM: Ecosystem-Based Fishery Management

EMBOS: European Marine Biodiversity Observatory System

EMBRC: European Marine Biological Resource Centre

EOV: Essential Ocean Variable

FAO: Food and Agriculture Organization (United Nations)

FOO: Framework for Ocean Observing

GACs: Global Alliance of CPRs

GCOS: Global Climate Observing System

GCOS-IP: GCOS Implementation Plan

GCRMN: Global Coral Reef Monitoring Network

GEO: Group on Earth Observations

GEO BON: Group on Earth Observations – Biodiversity Observation Network

GLOBEC: Global Ocean Ecosystem Dynamics

GOA-ON: Global Ocean Acidification – Observation Network

GOOS: Global Ocean Observing System

GOOS BioEco: GOOS Biology and Ecosystems Panel

GRAs: GOOS Regional Alliances

HABs: Harmful Algal Blooms

HAEDAT: Harmful Algae Event Database

ICES: International Council for the Exploration of the Sea

ICRI: International Coral Reef Initiative

IIOE-2: International Indian Ocean Expedition 2

IndiSeas: Indicators of the Seas

IOC: Intergovernmental Oceanographic Commission (of UNESCO)

IOCCP: International Ocean Carbon Coordination Project

IODE: International Oceanographic Data and Information Exchange

IOGOOS: Indian Ocean GOOS

IPCC: Intergovernmental Panel on Climate Change (WMO)

JCOMM: Joint Technical Commission for Oceanography and Marine Meteorology

LME: Large Marine Ecosystem

Marine-GEO: Marine Global Earth Observatory (Smithsonian)

MBON: Marine Biodiversity Observation Network

MPA: Marine Protected Areas

NERP: National Environmental Research Program (Australia)

OBIS: Ocean Biogeographic Information System

OCB: Ocean Carbon and Biogeochemistry

OOPC: Ocean Observations Panel for Climate

OTGA: Ocean Teacher Global Academy

PI-GOOS: Pacific Islands-GOOS

RAMSAR: Convention Convention on Wetlands of International Importance Especially as Waterfowl Habitat

SBSTTA: Subsidiary Body on Scientific, Technical, and Technological Advice (of the CBD)

SCOR: Science Council for Oceanic Research

SDGs: Sustainable Development Goals

SIO: Scripps Institute of Oceanography

SWOT: Strengths – Weaknesses – Opportunities – Threats

TBD: To be determined

UNEA: United Nations Environment Assembly

UNESCO: United Nations Educational, Scientific and Cultural Organization

UWA: University of Western Australia

WAMS: World Association of Marine Stations

WMO: World Meteorological Organization

WOCE: World Ocean Circulation Experiment

WORMS: World Register of Marine Species

12) Appendix I: Meeting agenda

Click on document below to read the full pdf of agenda

18:00 Adjourn for the day

Ferry crossing back to town

Self-paid (with IOC approved per-diem rates) group dinner at 19:30. Restaurant TBD

WEDNESDAY, 21 SEPTEMBER: Next steps

Breakfast at Bero Hotel (7:30-8:00). Take ferry to IODE offices.

VII. COLLABORATION / PARTNERSHIP STRATEGY (9:00-10:30) Albert

Current collaboration / partnerships: MBON, GRAs, EMBRC, ICES, GCOS, WAMS, CBD, LME (in addition to the Panel member's networks). A central issue is to have the support of the scientific community (and observing networks) to validate the EOVs.

For discussion:

- How do we validate/develop the EOVs with the community?
- How do we contribute/engage better with JCOMM?
- How to improve these collaborations?
- What are the next steps? How to maximize efforts and avoid duplication?
- How to take advantage on the survey respondents to build a global network with EOVs as central themes?
- What governance structure supports this level of global collaboration?
- What difference could a combined monitoring program make to improve understanding and management of marine resources?
- What does the funding situation look like?
- Across discipline collaboration: "Promoting Implementation of Multi-Disciplinary Sustained Ocean Observations (IMSOO) Workshop"

Includes next steps to some degree.

Break 10:30-11:00

VIII. GOOS BIOECO GOVERNANCE: TERMS OF REFERENCE AND NEXT STEPS (11:00-15:00) Nic/Sam

Lunch 12:30-13:30

General discussion to revise the ToRs, action plan and revisit where we want to be by Ocean Obs '09 in light of the strategy and funding discussions. This will feed into the general GOOS Strategic / Implementation Plan.

Review ToR of the GOOS BioEco Panel:

- Vision, objectives, scope and deliverables (the what… to achieve)
- Chairs / members roles and responsibilities (the who….composition, selection, duration period, etc.)
- Resources (the how….funding plan)

12) Appendix II: Proposed graph of "information flow" of a global observing system of biological variables (draft)