"Hard Coral Cover and Composition" Essential Ocean Variable Workshop Report

GOOS Biology and Ecosystems Panel / GCRMN

Dar es Salaam, Tanzania, 3-4 November 2017

The goal of the workshop was to bring together coral reef scientists with recognized monitoring expertise to discuss and initiate the development of an implementation plan to strengthen global coral reef observations as part of the Global Ocean Observing System (GOOS) and the Global Coral Reef Monitoring Network (GCRMN).

The main goals that the GCRMN wants to achieve and that GOOS endorses are:

Goal 1. To improve understanding of coral reef status and trends, regionally and globally

Goal 2. To communicate coral reef status and trends in support of policy development, environmental management and public awareness

Goal 3. To enable and encourage greater utilization of coral reef data, including in research

The coral reef monitoring programs represented at the workshop were the Great Barrier Reef Long Term Monitoring Program (GBR-LTMP) of the Australian Institute of Marine Science (AIMS), NOAA Pacific Reef Assessment and Monitoring Program (Pacific RAMP), French Initiative for Coral Reefs (IFRECOR), Coastal Oceans Research and Development in the Indian Ocean (CORDIO), and the GCRMN-Caribbean. Additional national programs represented were Madagascar, Tanzania, South Africa and there was the remote participation of the NASA Coral Reef Airborne Laboratory or CORAL from Bermuda (See Appendix 1 – list of participants).

Australia was represented at the meeting by Marine Biodiversity Hub director and GOOS Biology and Ecosystems Panel chair, Nic Bax, the AIMS Research Manager David Souter, and the International Project Officer of the GOOS Biology and Ecosystems Panel based at the University of Tasmania, Patricia Miloslavich.

The workshop was supported by the Intergovernmental Oceanographic Commission (IOC) of UNESCO (GOOS programme office), the UN Environment, ICRI/GCRMN and the Ministry of the Environment and Energy of Sweden. CSIRO and AIMS (Australia) and CORDIO East Africa (Kenya) provided travel support for some of the participants.

The first half day of the workshop was used to detail the current monitoring efforts in the regions including target data, institutional capabilities, methods and technologies, data management, and examples of management applications, followed by presentations on the most recent GCRMN regional report to be launched at the ICRI General Meeting in December 2017 (West Indian Ocean).

In partnership with the Foundation for Research on Biodiversity (FRB)

The remainder of the meeting was used to develop the implementation plan for the EOV 'Hard Coral cover and composition' using the template designed by the GOOS BioEco Panel. The agenda, background documents, implementation plan template, and presentations can be downloaded from the GOOS website at:

http://goosocean.org/index.php?option=com_oe&task=viewEventRecord&eventID=2116

The main topics discussed in the workshop were:

Hard Coral **Cover and Composition**	1. The mission and short and long-term vision 2. The scientific and societal requirements: how to make it "fit to purpose" 3. The current state of monitoring: inventory of current programs, infrastructure, geographic distribution, methods and protocols (best practices), institutional and funding partners 4. Societal and scientific impact: plans to engage stakeholders and inform global assessments, to engage developing countries, to develop capacity and transfer technology, for data management and delivery 5. Actions to achieve the plan: regional intensification, geographic expansion, development and use of new technologies, coordination and integration across networks and programs, securing funding

Main outcomes of the workshop were:

1. An overall assessment of the variability across regions and programs of the capacity and requirements related to coral reef monitoring.
2. Content and ideas to draft a joint GOOS/GCRMN implementation plan to improve monitoring of the world's coral reefs which will include each of the points discussed (1 to 5). Emphasis was given to methods to collect the EOV, new technologies (e.g. photo quadrat images), the need for capacity and the need to improve the communication strategy to inform the outputs of the GCRMN to the people and to policy makers, starting with a new website. The plan will be delivered to ICRI in March 2018.
3. Results from monitoring/reports and EOV's developed can be used as indicators to assess progress towards achieving international goals including UN Sustainable Development Goals and CBD Aichi targets.
4. The plan will include a tiered monitoring capacity assessment framework, which will be used to classify monitoring programmes based on their capabilities, from 'entry/basic' to 'advanced' levels. The framework will provide measurable criteria for programmes to improve their classification, allowing improved standardization for reporting purposes.
5. The commitment from participants and their institutions or associations to help facilitate and develop a coordinated global coral reef observation network that provides guidance on best practices and protocols, develops capacity, and allows for data/information integration across the different stakeholders, from science to policy.
6. An abstract ("***Roadmap for strengthening and coordinating global coral reef monitoring***") was submitted to the special session on "Sustained observations of life as an integral component of coastal and ocean observing systems" within the theme "Biodiversity in a changing ocean" at

the 4th World Conference on Marine Biodiversity (Montreal, May 2018) as well as to a special issue in Frontiers of Marine Science aligned with the conference, titled "Monitoring Marine Biodiversity from Microbes to Apex Predators: Why, What, and How" (see Appendix 2).

7. The recognition of the need to urgently prepare (e.g. outreach material) for the Third International Year of the Reef (IYOR 2018), declared at the 31st General Meeting of ICRI (November 2016 in Paris, France).

8. The need to contact the Ocean Biogeographic Information System (OBIS) for advice on the best way to contribute data (or subsets of data), and make use of the overarching collaboration agreement between OBIS, GOOS and the Marine Biodiversity Observation Network (MBON).

9. The need to create and secure funding for a full-time project officer position to lead the coordination of the GCRMN and to build a nominal budget around the various components of the GCRMN (coordination regional/global, capacity, workshops, monitoring, reporting, communication)

Follow up actions of the workshop:

- David Obura will draft the implementation plan of the GCRMN based on this feedback. The IP will be delivered to ICRI and UN Environment in March 2018.
- the GCRMN/GOOS alliance will seek for more formal endorsement from the CBD by taking the Plan to the next SBSTTA. In addition to the CBD, the plan should consider what the GCRMN can do to help achieve goals of the LMEs and Regional Seas programs related to coral reef health.
- To inform the GOOS and the coral reef observing community of the outcomes of this workshop and that an implementation plan for global coral reef monitoring facilitated by the GCRMN and GOOS, and supported by UN Environment and ICRI, will follow in early 2018.
- Participants to actively seek for funding to support a full Project Officer position to coordinate implementation activities.

Some lessons learned:

- To implement the biological GOOS EOVs, it is very useful to have a pre-existing structure to build on (e.g. the GCRMN)
- To achieve global coverage will be difficult - there is a big challenge in having representation of all regions of the global ocean.
- Standardization of data collection and analysis within a region may be achievable but very challenging across regions. Rather than focusing on standardization, it may be more realistic to try to achieve inter-regional comparability of the EOV.
- The readiness levels for the three components of an observing system (requirements, coordination of observations, and data management and information products) is very variable across regions and even within a region, and this needs to be taken into consideration and reflected in the IP so that the network is as inclusive as possible.
- Automated image analysis and autonomous vehicles were identified as efficient new survey technologies, but monitoring capacity remains an issue for many countries – capacity and technology transfer along with a significant budget will be required to bring observations up to a desired level.

APPENDIX 1: List of participants

Conveyors: David Obura (CORDIO), Nic Bax (GOOS/ CSIRO), Patricia Miloslavich (GOOS), and Gabriel Grimsditch (UN Environment)

Participant	Institution / Country	email
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Appendix 2. Abstract submitted to the 4th WCMB and to be potentially published in the journal *Frontiers of Marine Science*

Authors: David Obura, Patricia Miloslavich, Nicholas J. Bax, Jerker Tamelander, Claire Bissery, Russell Brainard, Aldo Cróquer, Mishal Gudka, Gabriel Grimsditch, Eric J. Hochberg, Sean Porter, David Souter, Saleh Yahya and Ihando Andrianjafy.

Roadmap for strengthening and coordinating global coral reef monitoring

Coral reefs are exceptionally biodiverse and human dependence on their ecosystem services is high. They are under significant direct pressure from human activities, and provide a sensitive indicator of coastal ocean health, climate change and ocean acidification, and their implications for society. Monitoring coral reef status and trends will clarify their extent and rate of change, to better inform science, management and policy, including future options.

"Hard coral cover and composition" has been identified as one of the Global Ocean Observing System (GOOS) Essential Ocean Variables (EOVs) (see www.goosocean.org/eov). GOOS and the Global Coral Reef Monitoring Network (GCRMN) are working together to implement a sustained, coordinated, and global coral reef observing system to enhance and expand existing capacity, including provision of bes practices and international standards, that will support global coordinated reporting for maximum impact in ongoing international agreements. The principle variable for measurement will be percent live coral cover, along with sub-variables (including taxonomic composition, colony size and condition and relevant ecosystem variables (including fish, macroalgae and sea urchin measures). Best practice (cost-effective, standardized) methods include line and belt transects and quadrats (live or photographic), while innovative technologies that will greatly improve cost-effectiveness, consistency and sample sizes (e.g. automated image processing, satellite detection of cover) are near-operational. Delivering the resulting information through open access, integrated and quality controlled databases a priority to support timely management decisions and address relevant science and societal needs. To date only coral cover has been measured routinely and in a relatively cost-effective manner in the GCRMN, and the data and information readiness level is still on a concept level for most of the world's coral reef regions. The major challenge in maturing the GCRMN to become a part of GOOS will be to strengthen and expand its current capacity, from observations, to data management and modeling, for which significant capacity development and funding will be required.