

Changing Ocean Biological Ecosystems (COBS)

Annual report from COBS (Formerly SCOR WG149)

Accomplishments from the past year (in the context of our terms of reference)

In the last 12 months we have made substantial progress in achieving the goals and objectives set out in our Terms of Reference (ToR, see Appendix). We now have three new members (Jason Hall-Spencer (UK), Paul Renaud (Norway)) of the WG (including one ECR, Mridul Thomas (Switzerland)).

Major efforts this year included:

Raising awareness of the availability of the www-based BPG through a suite of national, regional and international presentations and 1 day workshops.

For example, in February 2020, working group members led a 1-day MEDDLE workshop following the 13th New Zealand Ocean Acidification Conference. This workshop attracted 17 early career researchers, who used MEDDLE resources to design experiments to study the impact of environmental change on New Zealand's green-lipped mussel

For example, WG member Dave Hutchins gave a 30 minute tutorial on the www-based BPG at the 2020 Ocean Sciences meeting in San Diego. We also had posters at the SCOR booth throughout the week.

We also sought out national advocates for the www-based BPG (from countries not represented by our WG membership). We now have advocates in Spain, Mexico, Portugal and Israel. The BPG continues to be popular based on data from both Google Analytics and You-Tube.

We also worked closely with the IOC as they develop multiple drivers as a key strand of their UN Decade of Ocean Science. Several members of WG149 are leading the development of a Guide for policy makers for the IOC (as part of the UN Decade of Ocean Science, see "About" on <https://en.unesco.org/ocean-decade/>). This guide also involves other groups we regularly liaise with such as Denise Breitburg (GO2NE). This forms our ongoing work on ToR's 2 and 7.

Sinead Collins is revising a Perspective entitled "Novel experimental frameworks are essential to reveal the rules shaping ocean global change biology". This Perspective (ToR #6) was written with both other WG members (Hutchins, Boyd, Havenhand) and with other scientists from a range of disciplines such as Francis Chan (coastal ecology), Naomi Levine (biogeochemical modelling) and Tatiana Rynerson (molecular biology) and so helps us attain ToR 2 (Raise awareness across different scientific communities).

Bridge-building with disparate disciplines including eco-toxicology, epi-genetics, and paleo-oceanography continues through a number of fora, including the Ocean Global Change Biology Gordon Research Conference (<https://www.grc.org/ocean-global-change-biology-conference/2020/> postponed due to COVID-19) and Early Career

event (Gordon Research Seminar) that will be chaired by WG member Sinead Collins.

We also maintain and regularly update our website (<https://scor149-ocean.com/>) by adding new research papers and partners every 3-4 months to provide a useful repository of information on multiple drivers.

Plans for the coming year

The Annual meeting will be virtual this year, and we plan to have it in mid July 2020 as planned. We will try to use a rolling meeting format where we have three groups

Europe (am) and Pacifica (pm);
Europe (pm) and the Americas (am);
Americas (pm) and Pacifica (am)

With short summaries being delivered to the next group so that we maintain continuity.

Europe – Sinead, Jon, Jason, Paul, Mridul, Marion, Marcello, Hans, Goran, Sam
(Haimanti is in between)

Pacifica – Christina, Philip, Catriona, Haruko, Kunshan, Katharina

Americas – Dave, Aurea, Uta

A key focus of this year's meeting will be to review the new suite of ToR's (listed below and drafted at the 2019 annual meeting in Brest).

Revision of our original terms of reference, with several of the goals such as #4 (www BPG now complete) to be replaced with new activities and other more generic ToR's such as #2, #3 and #6 to be continued.

A number of events – such as the Gordon Research Conference on Ocean Global Change Biology (to have been curated and chaired by WG member Sinead Collins) have been put back to mid 2022. Also, Christina McGraw was to have run a training workshop at the Oceans in a high CO₂ World meeting in Peru (rescheduled 2021).

We will also talk with the programme officers at NSF to explore continuation of our funding of the SCOR project. (NSF funding means that we can continue as a WG until at least August 2022, given the rollover of funds from SCOR due to the COVID-19 crisis).

Thanks to Ed Urban for support and advice since the inception of this WG, to Patricia Miloslavich for her help during the 2020 Ocean Sciences meeting (we look forward to working with you this year!). To NSF for ongoing support, to Axel Durand (IMAS) for maintaining the www site, and to the members of WG149 (Jean-Pierre, Ulf and Jorge) who have been so generous with their time and energy in 2018 and 2019.

Philip Boyd (on behalf of the WG149)

Appendix

Terms of Reference of the current working group

1. Assess the current status of emerging research themes by reviewing the literature to assess the dominant research foci, their relative coverage, and identify any major gaps and/or limitations. Publish this review in an open-access peer-reviewed journal. (Completed in 2017/18, Boyd et al., Global Change Biology Review paper)
2. Raise awareness across different scientific communities (evolutionary experimental biologists, ecologists, physiologists, chemists, modelers) to initiate better alignment and integration of research efforts.
3. Co-ordinate thematic transdisciplinary sessions to attract and assemble experts from other fields such as paleoceanography and marine ecotoxicology to learn from the successful approaches their fields have developed to address multiple drivers.
4. Develop a multi-driver Best-Practice Guide (BPG, or other tools) as one potentially valuable way to help this research field move forward in a cohesive manner. Completed April 2019 <https://meddle-scor149.org/> and comprises three components – decision support for design, MEDDLE (Multiple Environmental Driver Design Lab for Experiments) experimental simulator, and a library of video tutorials.
5. Mentor early-career scientists in the design process for complex multiple driver manipulation experiments, familiarize them with BPG, and teach them practical methodologies for the analysis of their experimental findings. Ongoing – we are running courses internationally and nationally (see above). A handbook is available to step the reader through the BPG (<https://doi.org/10.25959/5c92fdf0d3c7a>).
6. Publish a series of short articles in both the scientific media and with scientific journalists to disseminate the challenges and opportunities surrounding multiple drivers and ecosystems. Ongoing - Sinead Collins is currently revising a Perspective piece entitled "Novel, coordinated experimental frameworks are essential to reveal the rules shaping ocean global change biology"
7. Engage with policy-makers and science communication experts to produce a glossary of terms and an implementation guide for policy-makers to better understand the role of multiple drivers in altering marine living resources and ecosystem services. Ongoing – several members of WG149 are leading the development of a Guide for policy makers for the IOC (as part of the UN Decade of Ocean Science).

Proposed ToRs from 2019 Annual meeting in Brest – as the WG is now to transitioning into a SCOR project

1. Develop resources based on the Best Practice Guide and MEDDLE to train scientists in multiple driver research within connection with existing programs, e.g. MSc programmes, summer schools (e.g. IMBeR, SOLAS) and training sessions.
2. Advocate coordination by providing guidance on how to maximise overlap between experiments and analysis to allow intercomparison.
3. Progress the science towards a more holistic approach to address how multiple drivers will reshuffle marine ecosystems at a decadal scale. To do this, we will develop a strong conceptual framework around a subset of key questions. This will allow us to bridge disjoints between models, experiments and observations.
4. Publish a series of short articles in both the scientific media and with scientific journalists to disseminate the challenges and opportunities surrounding multiple drivers and ecosystems.
5. Link to societal questions, such as food security, by expanding multiple driver research to include higher trophic levels.
6. Engage with IOC-endorsed and other initiatives to promote an interdisciplinary process-based approach linking observations, models, and experiments within the UN Decade of Ocean Science for Sustainable Development.