

IMBeR REPORTING FORM 2021

Please return completed form to imber@dal.ca by 2nd April.

REPORTING PERIOD:

PRIMARILY - What you have done since the annual report submitted for the SSC meeting held virtually in May/June 2020

BUT ALSO – Where indicated, highlights from last 5 years (i.e. 2016-2021)
to feed into SCOR's 5-year review of IMBeR

[Link to past annual reports](#)

PLANNED ACTIVITIES: extended to cover the next 5 years (until September 2025)

We understand that activities may not be planned this far ahead, but please provide as much information as you can about what you have planned over the next 5 years.

This will also feed into the SCOR 5-year review.

Thank you.



SIBER

**Sustained Indian Ocean Biogeochemistry
and Ecosystem Research**

Greg Cowie, Raleigh Hood and SIBER scientific steering committee members

As will be the case for other regional programmes and working groups, SIBER activities have been heavily curtailed by the COVID-19 pandemic over the past year, and many meetings, cruises and other research activities have been postponed or cancelled. Current circumstances around the world are such that we have also been unable to gather complete responses from the SIBER community. The following report is our best effort to provide an up-to-date compilation, but, due to the aforementioned issues, is not as complete as in previous years.

1. Ongoing activities, in line with the IMBeR Grand and Innovation Challenges *(Among other uses, information will be used to update the Grand Challenge Factsheets)*

1.a. Grand Challenge I

Understanding and quantifying the state and variability of marine ecosystems

This Challenge continues to be a central SIBER objective; to improve understanding of the Indian Ocean's role in global biogeochemical cycles and the interaction between these cycles and marine

ecosystem dynamics. While on-the-ground activities have been severely curtailed in the last year, the SIBER community has remained active in fostering and leading collaborations, and laying plans for renewed activity, including multiple rescheduled research cruises, once the COVID-19 situation permits. These will become central to the 2nd phase of the 2nd International Indian Ocean expedition, (IIOE-2) which was announced in 2020, and in which SIBER members remain heavily involved, both through research and in serving on steering committees and in working groups, and in chairing national IIOE-2 committees. Broader ongoing and continuing programmes relating to this Challenge include the IIOE-2's Eastern and Western Indian Ocean Upwelling Regime Initiatives (EOURI and WIORI, respectively). These are in addition to numerous individual projects (such as the SOLSTICE-WIO program; <https://www.solstice-wio.org/>) and national IIOE-2-related programmes and research cruises (India, Australia, France, South Africa, Germany, Japan, Indonesia etc). All have been led and/or involve scientists from the SIBER community and address biogeochemical and ecosystem research under goals of the SIBER science and implementation plans. As examples, the RV *Falkor* voyage to the Ningaloo canyons in March 2020 using the ROV *SuBastian*. This is an IIOE-2 endorsed project and focussed on canyon biodiversity especially benthos (first study of the deep-water biota) (<https://schmidtocean.org/cruises/schmidt-ocean-institute-2020-expeditions/>). Examples of ongoing German activities include the INDEX program devoted to understanding ecosystem functioning and change in the subtropical gyre and potential to proposed deep sea mining activities, and the MASCARA program focused on the oceanography and biogeochemistry on the Saya de Malha carbonate platform (WIO). Other examples of SIBER activities and plans are outlined below (in Section 2a).

1.b. Grand Challenge II

Improving scenarios, predictions and projections of future ocean-human systems at multiple scales

To date, this Challenge has not been central to SIBER activities, which have been heavily focused on open-ocean research relating to the IIOE-2. This may evolve with future activity associated with the 2nd phase of IIOE-2.

1.c. Grand Challenge III

Improving and achieving sustainable ocean governance

SIBER activities most relevant to this IMBeR Challenge have again been limited in the past year. As referred to in the 2019 and 2020 reports, central objectives of IIOE-2 are to improve scientific knowledge transfer to wider segments of society and regional governments, and to create educational and capacity development opportunities. These efforts all contribute directly to IMBeR's goal of improving and achieving sustainable ocean governance. The SIBER program helped to establish IIOE-2 and its governance structure, and SIBER members remain actively engaged, both through national IIOE-2 committees and by serving on IIOE-2 committees and working groups. This will continue with the extension of IIOE-2 to 2025 and beyond.

The ongoing *SOLSTICE-WIO program* (co-led by SIBER SSC member Mike Roberts; <https://www.solstice-wio.org/>), is focused on fisheries and food security in the western Indian Ocean, and combines environmental and socio-economic research with state-of-the art techniques and knowledge transfer, to develop policies for sustainable and resilient fisheries.

Other examples of relevant SIBER-promoted activity include French and South African IIOE-2 research cruises in the western Indian Ocean that will provide scientific knowledge on both pelagic and benthic ecosystems and fisheries, with facilitation of sustainable ocean governance as a central objective.

On another front, there is a growing interest in the management of seamounts of the Southwestern Indian Ocean (SWIO) both in waters under national jurisdictions and in the Areas Beyond National Jurisdiction (ABNJ). New scientific knowledge has been gathered through various oceanographic cruises during the past decade, and new agreements are under consideration globally, in the United Nations framework (BBNJ process) to promote conservation and sustainable use of the biodiversity in the ABNJ, where the deep sea ecosystems associated with seamounts are a growing matter of concern. SWIO seamounts have attracted the interest of fishermen since the 1960s, and contracts for mining exploration have been granted recently. Seamounts shelter rich, fragile, poorly resilient ecosystems whose important ecological functions are threatened by anthropogenic pressures. Whereas many seamounts and shoals are located in national waters, many others fall in the ABNJ, with no current legal status *per se*. To ensure conservation of their habitats and biodiversity, it is essential that protection measures are instigated under an internationally recognized legal and institutional framework. This must be founded on robust science on several essential components of these ecosystems, such as quantitative biodiversity assessments, the identification of corridors of connectivity between seamounts, and physical processes associated to the seamounts and leading to local biological enrichment. A recent study has been published in 2020 using an emblematic seamount located in the ABNJ, South of Madagascar, to discuss how it could become a fully protected space. Guidelines are proposed to encourage dedicated seamount governance under a new legal framework under UNCLOS, in a regional seas organization under UNEP, the Nairobi Convention, which has a management competence over this region.

MARSAC, F., GALLETTI, F., TERNON, J-F., ROMANOV, E., DEMARCO, H., CORBARI, L., BOUCHET, P., ROEST, W.R., JORRY, S.J., OLU, K., LONCKE, L., ROBERTS, M.J., MENARD, F. (2020). Seamounts, plateaus and governance issues in the southwestern Indian Ocean, with emphasis on fisheries management and marine conservation, using the Walters Shoals as a case study for implementing a protection framework. . *Deep-Sea Res. II* 176, 104715

1.d. Innovation Challenge 1

To enhance understanding of the role of metabolic diversity and evolution in marine biogeochemical cycling and ocean ecosystem processes

This IMBeR Challenge is not an explicit goal of the SIBER regional program, but SIBER promotes studies that include assessment of metabolic diversity and evolution in the Indian Ocean and their role in marine biogeochemical cycling and ocean ecosystem processes. Multiple projects and cruises carried out or planned as part of IIOE-2 have incorporated these science elements. Examples include the recent *RV Investigator* 110° cruise (details below), which addressed microbial processes and gene expression in relation to nitrogen and sulphur cycling, and multiple aspects of ocean food webs, including microzooplankton grazing and feeding of mesopelagic fishes. Others examples are recent and planned *RV Falkor* voyages

that are focused on an assessment of carbonate chemistry and deep-sea coral communities in the Ningaloo and Bremer Canyons; (<https://schmidtocean.org/cruises/schmidt-ocean-institute-2020-expeditions/>).

1.e. Innovation Challenge 2

To contribute to the development of a global ecosystem observational and modelling network that provides essential ocean variables (EOVs) and to improve marine data and information management

This IMBeR Challenge represents one of the central goals of the SIBER regional program. As previously reported, the most relevant SIBER activities have involved development of collaborations between biogeochemical and ecosystem research scientists, physical oceanographers and atmospheric scientists, which has been facilitated through close ties between SIBER and the CLIVAR Indian Ocean Regional Panel (IORP). SIBER emerged as a result of the potential opportunity to leverage the CLIVAR/GOOS Indian Ocean mooring array (RAMA/IndOOS) and associated measurements and cruises for doing biogeochemical and ecological research. This opportunity continues to be realised through deployment of biogeochemical sensors on the RAMA mooring array and the deployment of bio-Argo floats in the northern and southwestern Indian Ocean. SIBER was actively engaged throughout the recently completed IndOOS decadal review process (<http://www.clivar.org/indoos-decadal-review-2006-2016>). Plans are being developed for the deployment of many more biogeochemical sensors in the Indian Ocean as part of the continuing IIOE-2 and the second phase of IndOOS.

Other examples include Australia's Integrated Marine Observing System (IMOS; <http://imos.org.au/>), which has now led 15 years of observations around Australia, and the deployment of biological and biogeochemical sensors as part of the EIOURI and Indian IIOE-2 programs (e.g. MOSAIC; <http://www.ocean-partners.org/marine-observation-system-along-indian-coast-mosaic-new-initiative>). These efforts are focused on biogeochemical EOVs that contribute to the development of a global ecosystem observational and modeling network.

Recent development of DNA metabarcoding protocols has the potential to transform marine biodiversity research. Metabarcoding of marine zooplankton has now been successfully undertaken in South Africa (Singh et al., in press) and the methodology is expected to facilitate high resolution monitoring of zooplankton biodiversity in pelagic ecosystems and accelerate the discovery of new species. DNA barcoding projects are underway to contribute to a validated DNA barcode reference library for calanoid copepods and other zooplankton taxa in the Indian Ocean off South Africa, which will be fundamental for future monitoring of zooplankton biodiversity in this region. This is a collaborative initiative between researchers at the Oceanographic Research Institute (ORI, Durban), South African Environmental Observational Network (SAEON, Port Elizabeth/Gqeberha), the University of the Western Cape and the Department of Forestry, Fisheries and the Environment (Cape Town).

The ANIBOS (Animal-Borne Ocean Sensors) network, an “emerging network” of the Ocean Coordination group of GOOS, continued its activities in the Southern Indian Ocean. The network is using the elephant seals in the colonies of Kerguelen, to perform observations across the Southern Ocean to investigate the changes affecting the pelagic ecosystems. Among the numerous sensors deployed on elephant seals, the most recent ones are the CTD-Oxy and the Active acoustic, adding to the 6 other sensors which have been used since 2004, denoting a continuous technological developments in animal-borne sensors. The data collected include physical, biogeochemical data (oxygen, chlorophyll) and mid-trophic levels observations, which complement satellite or ship-borne observations.

1.f. Innovation Challenge 3

To advance understanding of ecological feedbacks in the Earth System

1.g. Innovation Challenge 4

To advance and improve the use of social science data for ocean management, decision making and policy development

To date, this has not been a core SIBER activity. However, as reported previously, a primary example of emerging SIBER-driven projects that address this IMBeR challenge is the ongoing SOLSTICE-WIO program (co-led by SIBER SCC member Mike Roberts). It involves case studies of threatened, emerging and collapsed fisheries, in Tanzania, Kenya and South Africa, respectively, including socio-economic as well as environmental research through to outreach and briefs to stakeholders and policy makers (<https://www.solstice-wio.org/>). More widely, collection and use of social science data are written into the IIOE-2 Science plan and implementation strategy, overseen through IIOE-2 Science Theme 1 (“Human Benefits and Impacts”) and Working Group 6 (“Translating Science for Society”) (<https://iioe-2.incois.gov.in/IIOE-2/index.jsp>).

2. Selected highlights

2.a.i. Selected scientific highlights since last report (1-3)

One major highlight of what has otherwise been a difficult year is that Lynnath Beckley, a key member of the SIBER community since the beginning, and a good friend, received the prestigious Australian Marine Sciences Association (AMSA) Jubilee Award for her career contribution to marine research in Australia. (<https://www.murdoch.edu.au/news/articles/murdoch-marine-scientist-receives-prestigious-career-award>). **We owe Lynnath a great deal, and congratulate her.**

- *IIOE-2 and cruise activity* – due to the COVID-19 situation, numerous scheduled cruises, some to be led by SIBER community members, and as described in the last SIBER report, have been cancelled or postponed. This has included, but is far from limited to:
 - * SEAmester V & ASCA Line cruise (sampling across the Agulhas Current) scheduled for July 2020 on the *SA Agulhas II*, cancelled, (Huggett et al).
 - * US BLOOFINZ cruise (Landry et al) appears to be rescheduled to 2022
 - * Various German, Indian, Japanese and other IIOE-2 cruises have been postponed, with dates TBC.

Indonesian Throughflow Monitoring Program (R. Dwi Susanto, Univ of Maryland)

Scientists from the Indonesian Institute of Sciences (LIPI) led by Dr. Nugroho Hananto, First Institute Oceanography (FIO-China) led by Dr. Zexun Wei, and the University of Maryland, led by Dr. R. Dwi Susanto (SIBER SSC) have an international collaborative program called "TRIUMPH: Throughflow Indonesian Seas, Upwelling and Mixing Physics." In November – December 2019 four subsurface moorings to measure Indonesian throughflow (ITF) were deployed, as well as two subsurface moorings south of Java to measure upwelling variability, and one surface mooring south of Java/Sumatra to monitor real-time climatic condition of Indian Ocean Dipole. In addition, three bottom-mounted ADCPs were deployed in the shallow Bali, Badung, and Alas Straits. All four moorings deployed in the Lombok and Makassar Straits were equipped with the McClain sediment trap to estimate biogeochemical fluxes associated with ITF. Water samples are collected at CTD stations along the cruise tracks. *All moorings will remain at sea for at least three years with turn-around recovery/redeployment every 1.5 years.*

- *Special issues:*

- * Volume 3 of our DSR2 Special Issue Series on IIOE-2 appeared in September 2020 with 12 articles.



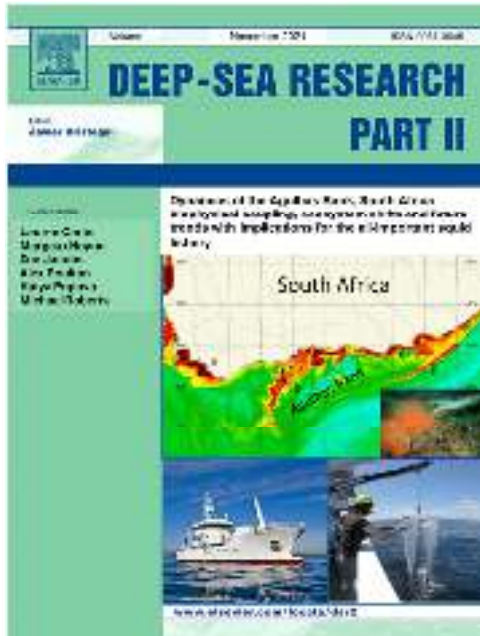
- * Volume 4 has manuscripts in various stages of review, revision and production.

- * Lynnath Beckley is leading Volume 5, which has been approved by Elsevier and will focus on the 2019 IIOE Cruise.

- * A special issue of DSR-II focused on shallow seamounts (Marsac, Roberts (SIBER SSC members) et al, eds, see previous report) was published with 14 articles in June 2020.



- * A further DSR II special issue focused on the SOLSTICE- Agulhas bank program is in the works, with 23 articles identified:



Working Title: *Dynamics of the Agulhas Bank, South Africa — biophysical coupling, ecosystem shifts and future trends with implications for the all-important squid fishery*

Project: GCRF-SOLSTICE - Sustainable Oceans, Livelihoods and food Security Through Increased Capacity in Ecosystem research in the Western Indian Ocean.

This Special Issue publishes the South Africa component of GCRF SOLSTICE project. Another Special Issue in *Ocean and Coastal Management* deals with the East Africa Case study.

Pls: Prof Michael Roberts (SA) and Dr Katya Popova (UK)

Project Duration: 2018-2021

Anticipated full publication date: November 2021

2.a.ii. Selected scientific highlights over last 5 years (1-5) (2016-2021)

1. The outstanding SIBER highlight of the last 5 years has been the 2nd International Indian Ocean Expedition (IIOE-2), which SIBER has been intimately involved with at every stage, from conception through the writing of its science plan to its day-to-day management and, above all, through direct involvement in forging international collaborations and leading research. SIBER also helped to establish IIOE-2 joint project offices (INCOIS Hyderabad India, Bureau of Meterology Perth NW Australia). The Expedition ran from 2015 to 2020, and involved 43 endorsed Indian Ocean research projects. The SIBER community was actively involved in pressing for renewal by sponsors SCOR, IOC and IOGOOS for a second phase, through 2025 and potentially beyond.
2. One specific SIBER highlight was the 110°E voyage in SE Indian Ocean in May/June 2019. Following is description from the 2020 SIBER report to IMBeR:
As part of the second International Indian Ocean Expedition, the 110°E voyage with the RV Investigator entitled “A coupled bio-physical, ecosystem-scale, examination of Australia’s International Indian Ocean Expedition line” was successfully completed from 13 May to 14 June 2019 in the south-eastern Indian Ocean. The scientific complement for the voyage consisted of 29 scientists from 18 Australian and international institutions and was led by SIBER SSC member Prof Lynnath Beckley (Murdoch University). Other SIBER SSC members, namely, Profs Michael Landry and Raleigh Hood participated in the voyage.
The voyage encompassed 20 stations along the 110°E meridian from 39.5°S to 11.5°S revisiting many historical sampling stations last examined in 1962/63 during the first International Indian Ocean Expedition. In view of documented warming of the surface waters off Western Australia, the aim was to assess change in the physical, chemical and biological properties of the water column at these

locations. In addition, using an array of modern techniques, we investigated, for the first time, other important aspects such as distribution of microbes, microbial gene expression, biogeochemistry (especially related to nitrogen and sulphur cycling), pelagic food webs (including meso-pelagic fishes) and bio-optics related to satellite-based ocean colour radiometry of the south-east Indian Ocean. The voyage also provided opportunity to train post-graduate students, deploy autonomous Argo floats (IMOS and JAMSTEC) and drifting weather buoys (NOAA and BOM), measure underwater sound and examine eastward flows feeding into the anomalous Leeuwin Current which flows along the west coast of Australia.

3. A further major SIBER accomplishment has been establishment of Western Indian Ocean science as part of IIOE-2, which has taken shape as major projects led by SIBER community members, most notably as the SOLSTICE-WIO program (Mike Roberts) and the WIOURI Seamount surveys (Francis Marsac). These are both ongoing, but already have special journal issues published or planned (see above), and will spawn further activity as part of the 2nd phase of IIOE-2.
4. We view another major SIBER accomplishment to be the multiple special journal issues focused on IIOE-2 (DSR2, see above) as well as synthesis papers (EGU journals) focused on SIBER science themes, all edited/led by SIBER community members. These are further key examples of the many roles SIBER has played in fostering, carrying out and promoting Indian Ocean scientific research.
5. Finally, we view SIBER engagement with other Indian Ocean research groups as another highlight. Most notably, this has included regular and active interaction with the Indian Ocean Research Panel (IORP) and the Indian Ocean Global Ocean Observation System (IOGOOS) group, as well as the Indian Ocean Resources Forum (IRF), and has led to important advances such as the procurement of biogeochemical sensors and their inclusion as part of the Indian Ocean Bio-Argo program.

2.b. Publications since last report

Please add all publications since last report to the table below (see notes for details on “Class” and “Activity” fields).

NOTE: The following is an incomplete list of publications from the last year, with priority on those that directly involved members of the SIBER community. There were countless further publications on Indian Ocean studies focused on SIBER-related themes of biogeochemical and ecosystem research.

Publication with DOI	Class 1, 2, 3	Activity*
VON AMMON, U.E., JEFFS, A., ZAIKO, A., VAN DER REIS, A., GOODWIN, D., <u>BECKLEY, L.E.</u> , MALPOT, E. & POCHON, X. 2020. A portable Cruising Speed Net: expanding global collection of sea surface plankton data. <i>Frontiers in Marine Science</i> , doi.org/10.3389/fmars.2020.615458	1	SIBER led or SIBER involvement
BERNAL, A., OLIVAR, M.P & <u>BECKLEY, L.E.</u> 2020. Dietary composition of myctophid larvae off Western Australia. <i>Deep Sea Research Part II</i> , 179, doi.org/10.1016/j.dsr2.2020.104841	1	SIBER led or SIBER involvement
<u>HOOD, R.R.</u> , <u>BECKLEY, L.E.</u> , VIALARD, J. & GAYE, B. 2020. The Second International Indian Ocean Expedition (IIOE-2): Motivating new exploration in a poorly understood Ocean Basin (Volume 3). <i>Deep Sea Research Part II</i> , 179 doi.org/10.1016/j.dsr2.2020.104876	1	SIBER led or SIBER involvement
COHEN, D.L. & <u>BECKLEY, L.E.</u> 2020. Diet and prey selectivity of the mesopelagic lanternfish <i>Myctophum asperum</i> from the Perth Canyon, Western Australia. <i>Ichthyological Research</i> , doi.org/10.1007/s10228-020-00782-2	1	SIBER led or SIBER involvement
McCOSKER, E., DAVIES, C.L. & <u>BECKLEY, L.E.</u> 2020. Oceanographic influence on coastal zooplankton assemblages at three IMOS National Reference Stations in Western Australia. <i>Marine & Freshwater Research</i> .	1	SIBER led or SIBER involvement

https://doi.org/10.1071/MF19397		
Bhadra, Sudhira R, and Rajeev Saraswat. 2021. 'Assessing the effect of riverine discharge on planktic foraminifera: A case study from the marginal marine regions of the western Bay of Bengal', <i>Deep Sea Research Part II: Topical Studies in Oceanography</i> : 104927.	3	SIBER science theme
Dalabehara, HB, and VVSS Sarma. 2020. 'Physical forcing controls spatial variability in primary production in the Indian Ocean', <i>Deep Sea Research Part II: Topical Studies in Oceanography</i> : 104906.	3	SIBER science theme
Harms, Natalie C, Niko Lahajnar, <u>Birgit Gaye</u> , Tim Rixen, Ulrich Schwarz-Schampera, and Kay-Christian Emeis. 2021. 'Sediment trap-derived particulate matter fluxes in the oligotrophic subtropical gyre of the South Indian Ocean', <i>Deep Sea Research Part II: Topical Studies in Oceanography</i> : 104924.	1	SIBER led or SIBER involvement
Huang, Z, and M Feng. 2021. 'MJO induced diurnal sea surface temperature variations off the northwest shelf of Australia observed from Himawari geostationary satellite', <i>Deep Sea Research Part II: Topical Studies in Oceanography</i> : 104925.	3	SIBER science theme
Jayaram, Chiranjivi, TVS Udaya Bhaskar, Neethu Chacko, <u>Satya Prakash</u> , and KH Rao. 2021. 'Spatio-temporal variability of chlorophyll in the northern Indian Ocean: A Biogeochemical Argo data perspective', <i>Deep Sea Research Part II: Topical Studies in Oceanography</i> : 104928.	1	SIBER led or SIBER involvement
Prasanth, R, V Vijith, V Thushara, Jenson V George, and <u>PN Vinayachandran</u> . 2021. 'Processes governing the seasonality of vertical chlorophyll-a distribution in the central Arabian Sea: Bio-Argo observations and ecosystem model simulation', <i>Deep Sea Research Part II: Topical Studies in Oceanography</i> : 104926.	1	SIBER led or SIBER involvement
Annasawmy, P., Ternon, J-F., Lebourges-Dhaussy, A., Roudaut, G., Cotel, P., Herbertte, S., Ménard, F., & Marsac, F. (2020). Micronekton distribution as influenced by mesoscale studies, Madagascar shelf and shallow seamounts in the south-western Indian Ocean: an acoustic approach. <i>Deep Sea Res II</i> 176, 104812 https://doi.org/10.1016/j.dsr2.2020.104812	1	SIBER led or SIBER involvement
Annasawmy, P., ChereL, Y., Romanov, E., Le Loc'h, F., Ménard, F., Ternon, J-F., & Marsac, F. (2020). Stable isotope patterns of mesopelagic communities over two shallow seamounts of the south western Indian Ocean. <i>Deep Sea Res II</i> 176, 104804 https://doi.org/10.1016/j.dsr2.2020.104804	1	SI SIBER led or SIBER involvement BER-led research
Crochelet, E., Barrier, N., Andrello, M., Marsac, F. , Spadone, A., & Lett, C. (2020). Connectivity between seamounts and coastal ecosystems in the Southwestern Indian Ocean. <i>Deep Sea Res II</i> 176, 104774 https://doi.org/10.1016/j.dsr2.2020.104774	1	SIBER led or SIBER involvement
Harris, S.A., Noyon, M., Marsac, F. , Vianello, P. & Roberts, M.J. (2020). Ichthyoplankton assemblages at three shallow seamounts in the South West Indian Ocean. <i>Deep Sea Res II</i> 176, 104809 https://doi.org/10.1016/j.dsr2.2020.104809	1	SIBER led or SIBER involvement
Roberts, M.J. , Ternon, J-F., Marsac, F. , Noyon, M., & Payne, I.L. (2020). The MADRIDGE project : bio-physical coupling around three shallow seamounts in the South West Indian Ocean. <i>Deep Sea Res II</i> 176, 104813 https://doi.org/10.1016/j.dsr2.2020.104813	1	SIBER led or SIBER involvement
Vianello, P., Ternon, J-F., Demarcq, H., Herbertte, S., & Roberts, M.J. (2020). Ocean currents and gradients of surface layer properties in the	1	SIBER led or SIBER

vicinity of the Madagascar Ridge (including seamounts) in the South West Indian Ocean. <i>Deep Sea Res II</i> 176, 104816 https://doi.org/10.1016/j.dsr2.2020.104816		involvement
Demarcq, H., Noyon, M., & Roberts, M.J. (2020) Satellite observations of phytoplankton around seamounts in the South West Indian Ocean with a special focus on the Walters Shoal. <i>Deep Sea Res II</i> 176, 104800 https://doi.org/10.1016/j.dsr2.2020.104800	1	SIBER led or SIBER involvement
Vianello, P., Herbette, S., Ternon, J-F., Demarcq, H., & Roberts M.J. (2020). Observation of a mesoscale eddy dipole on the northern Madagascar Ridge: consequences for the circulation and hydrography in the vicinity of a seamount <i>Deep Sea Res II</i> 175, 104815 https://doi.org/10.1016/j.dsr2.2020.104815	1	SIBER led or SIBER involvement
Marsac, F. , Annasawmy, P., Noyon, M., Demarcq, H., Soria, M., Rabearisoa, N., Bach, P., Cherel, Y., Grelet, J., & Romanov, E. (2020). Seamount effect on circulation and distribution of ocean taxa in the vicinity of La Pérousen a shallow seamount in the southwestern Indian Ocean. <i>Deep Sea Res II</i> 176, 104806 https://doi.org/10.1016/j.dsr2.2020.104806	1	SIBER led or SIBER involvement
Cherel, Y., Romanov, E., Annasawmy, P., Thibault, D., & Ménard, F. (2020). Micronektonic fish species over three seamounts in the southwestern Indian Ocean. <i>Deep Sea Res II</i> 176, 104777 https://doi.org/10.1016/j.dsr2.2020.104777	2	SIBER/IIOE-2 associated research
Marsac, F. , Galletti, F., Ternon J-F., Romanov, E., Demarcq, H., Corbari, L., Bouchet, P., Roest, W.R., Jorry, S., Olu, K., Loncke, L., Roberts, M.J., & Menard, F. (2020). Seamounts, plateaus and governance issues in the Southwest Indian Ocean, with emphasis on fisheries management and marine conservation, using the Walters Shoal as a case study for implementing a protection framework. <i>Deep Sea Research II</i> 176, 104715 https://doi.org/10.1016/j.dsr2.2019.104715	1	SIBER led or SIBER involvement
Noyon M, Rasoloarijao Z, Huggett, J. , Ternon J-F, & Roberts M.J. (2020) Comparison of mesozooplankton communities at three shallow seamounts in the South West Indian Ocean. <i>Deep Sea Research Part II</i> 176, 104759 https://doi.org/10.1016/j.dsr2.2020.104759	1	SIBER led or SIBER involvement
Rocke, E., Noyon, M., & Roberts, M.J. (2020) Picoplankton and nanoplankton composition on and around a seamount, affected by an eddy dipole south of Madagascar. <i>Deep Sea Research Part II</i> , https://doi.org/10.1016/j.dsr2.2020.104744	1	SIBER led or SIBER involvement
Landry, M.R., R.R. Hood, and C.H. Davies. 2020. Biomass and temperature relationships for mesozooplankton grazing along a 110°E transect in the eastern Indian Ocean. <i>Mar. Ecol. Prog. Ser.</i> , 649: 1-19, https://doi.org/10.3354/meps13444 .	1	SIBER led or SIBER involvement
McCosker, Davies, C.L. & Beckley, L.E. 2020. Oceanographic influence on coastal zooplankton assemblages at three IMOS National Reference Stations in Western Australia. <i>Marine & Freshwater Research</i> . https://doi.org/10.1071/MF19397 .	1	SIBER led or SIBER involvement
Bernal, A., Olivar, M.P & Beckley, L.E. 2020. Dietary composition of myctophid larvae off Western Australia. <i>Deep-Sea Research II</i> 179: https://doi.org/10.1016/j.dsr2.2020.104841	1	SIBER led or SIBER involvement
Cohen, D.L. & Beckley, L.E. 2020. Diet and prey selectivity of the mesopelagic lanternfish <i>Myctophum asperum</i> from the Perth Canyon, Western Australia. <i>Ichthyological Research</i> DOI 10.1007/s10228-020-	1	SIBER led or SIBER involvement

00782-2		
Vijith, V., Vinayachandran, P.N. , Webber, B.G.M., A. J. Mathews, J. V. George, V.K. Kannaujia, A. A. Lotliker, P. Amol, Closing the sea surface mixed layer temperature budget from in situ observations alone: Operation Advection during BoBBLE. <i>Sci Rep</i> 10 , 7062 (2020). https://doi.org/10.1038/s41598-020-63320-0	1	SIBER led or SIBER involvement
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P. A. Francis, A. K. Jithin, J. B. Effy, A. Chatterjee, K. Chakraborty, A. Paul, B. Balaji, S. S. C. Shenoi, P. Biswamoy, A. Mukherjee, P. Singh, B. Deepsankar, S. Siva Reddy, P. N. Vinayachandran , M. S. Girish Kumar, T. V. S. Udaya Bhaskar, M. Ravichandran, A. S. Unnikrishnan, D. Shankar, A. Prakash , S. G. Aparna, R. Harikumar, K. Kaviyazhahu, K. Suprit, R. V. Shesu, N. Kiran Kumar, N. Srinivasa Rao, K. Annapurnaiah, R. Venkatesan, A. S. Rao, E. N. Rajagopal, V. S. Prasad, M. D. Gupta, T. M. Balakrishnan Nair, E. P. R. Rao, and B. V. Satyanarayana, High-Resolution Operational Ocean Forecast and Reanalysis System for the Indian Ocean, <i>Bull. Amer. Meteor. Soc.</i> (2020) 101 (8): E1340–E1356. https://doi.org/10.1175/BAMS-D-19-0083.1 .	1	SIBER led or SIBER involvement
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**If appropriate, please list the IMBeR activity through / by / from / during which the publication arose*

2.c. Events, Meetings, and Workshops

List all international and national events, meetings and workshops. Describe the level of participation: e.g. chairing session/workshop, organising meeting. Include Regional Programme / Working Group committee meetings and workshops.

The 2020 annual SIBER SSC meeting that was due to be held in Goa in March 2020 was cancelled due to the COVID-19 situation. It was due to follow the International Indian Ocean Science Conference 2020, jointly with the annual meetings of IIOE-2, IOGOOS and other Indian Ocean research groups. The IIOSC meeting has been pushed back to Spring of 2022, and the associated meetings will again follow. In the meantime, virtual SIBER Executive and SSC meetings are being held, the latest being in February 2021. A virtual IIOE-2 SC meeting is due to be convened in April 2021.

The 14th International Conference on Copepoda (Skukuza, South Africa) with special session on “Marine Copepods of the Indian Ocean: A contribution to the IIOE-2”, which was postponed by one year to 6-12 June 2021: waiting for confirmation of whether it will be a physical or virtual meeting (or a combination). Abstract submission/revision deadline was 16 November 2020. https://www.abevents.co.za/web_icoc2020/

3. International collaboration and links

The SIBER regional program continues to foster international collaboration and links with numerous Indian Ocean rim countries and also countries in Asia, Europe, and North America. It has led to countries such as Indonesia and Korea becoming actively engaged in EIOURI and IIOE-2, and has opened opportunities for international scientists on their research cruises. Indeed, all of the SIBER-related cruises outlined above, including the *RV Investigator* 110°E expedition and the SOLSTICE-WIO program, as well as US, Indian, German, French, and Japanese (etc) cruises planned for later in 2021 and beyond, involve extensive international collaboration. As examples, as part of the IIOE-2 EIOURI programme, the TRIUMPH project has involved cruises with a Chinese vessel and collaboration between Chinese, Indonesian and US scientists. Similarly, all upcoming Japanese- and French-led cruises (see below) will similarly have multinational science teams.

4. Input to management and policy

4.a. Input to management and policy over the last year

As outlined above, SIBER input to management and policy has been manifested primarily through its role in motivating and supporting the IIOE-2. See Grand Challenge III above.

4.b. Input to management and policy – Highlights from past 5 years

- SIBER played a leading role in the development of the 2nd International Indian Ocean Expedition
- Helped to establish IIOE-2 joint project offices (INCOIS Hyderabad India, Bureau of Meteorology Perth NW Australia)
- Completed the first 5-year phase of IIOE-2
- IIOE-2 renewed by sponsors SCOR, IOC and IOGOOS for second 5-year phase through 2025
- IIOE-2 has sponsored 43 Indian Ocean research projects over the last 5 years

5. Education and outreach

Education and training continue to be important elements of the SOLSTICE-WIO program link), and planned South African SIBER/IIOE-2 activities, including *SEAmester V* & *ASCA Line cruise* with the *RV Agulhas II* (nominally scheduled for July 2020) (see 2019 report for details of previous South African training activities).

The US IIOE-2 Science plan (R. Hood et al. 2015) lays out guidelines and multiple examples for education and outreach activities for current and planned US IIOE-2 projects, and provides guidance for how such activities could be facilitated by linkage to University of Maryland organisations that provide diverse services in science communication and training and curriculum development, and with NOAA-, IOC-, SCOR- and POGO programs that are pursuing a range of capacity development, training, education and outreach activities in the Indian Ocean region.

6. Planned activities up to September 2025

- Cowie, Hood and Prakash will continue to be active in preparation for the 2020 International Indian Ocean Science Conference to be held in Goa, India, now projected for March 2022. They and several other SIBER SSC members will be co-chairing sessions at the meeting (for which over 600 abstracts were submitted). The meeting will serve to highlight achievements of the first years of IIOE-2, and will also serve as a launch pad for the next 5 years. It will also be an opportunity for SIBER/IMBeR and the Indian Ocean marine science community to formulate contributions to the upcoming UN Decade of the Ocean. The conference will be followed by the annual joint meeting of the IIOE2, IORP, IRF and SIBER SSCs.
- Volumes 4 and 5 of the DSR2 special issue series on IIOE-2 will be published in 2021 and 2022 with volume 5 focused on the 110° E cruise on the R/V Investigator. Additional DSR2 special issue volumes on IIOE-2 research are planned. All of these volumes are being led by SIBER SC members.
- SIBER will publish an interdisciplinary Elsevier book in late 2021/2022 (co-edited by a SIBER SC member) that will contain 15 peer-reviewed synthesis papers/chapters on the Indian Ocean.
- IIOE-2 was renewed by sponsors SCOR, IOC and IOGOOS for second 5-year phase through 2025. IIOE-2 will therefore continue to be the main focus of SIBER activities up to September 2025.

Research cruises postponed due to COVID-19 include (dates TBC):

- **Biogeochemistry-Atmosphere Processes** in the Bay of Bengal (BIOCAT; GEOMAR, Kiel): The project will combine measurements of marine biogeochemistry, microbiology, physical oceanography and air chemistry with foci on (i) the efficiency of the biological pump, (ii) the nitrogen cycle processes in the OMZ, (iii) the ventilation of the OMZ as well as (iv) the air/sea exchange fluxes of trace gases across the ocean/atmosphere interface and (v) aerosol deposition
- **Biogeochemistry of carbon and nitrogen** in the Arabian Sea (BIOCAN; University of Hamburg): Aims of the project are to understand the impact of climate change and the anthropogenic

disturbances on biogeochemistry and ecosystems and to improve the representation of the region in earth system models and thereby improve climate predictions in the monsoon region

- Geotraces IO sections 3 and 4 (GEOMAR, Kiel): repeat WOCE sections IO3 and 4 to measure physical and chemical variables.
- US BLOOFINZ cruise (**Landry et al**) rescheduled to 2022, to study the food web dynamics that support a Bluefin Tuna spawning area between Java, Indonesia and NW Australia)
- A series of French-led projects and cruises are also pending; REACTION (Sofal bank, Mozambique; physics and biogeochemistry; *RV Antea Feb. 2022*), CYCLOPS (off east coast of South Africa; physics, biology and biogeochemistry; *RV Antea Mar. 2022*), SAYA DE MALHA (Seychelles/Mauritius; Blue Economy ecosystem and fisheries research; May-June 2022; **Francis Marsac PI**).

6.a. Activities and Outreach (including, but not limited to convening sessions, meetings, summer schools, workshops, etc) and how they link to the Challenges

6.b. Upcoming papers (Community-Position-Review-etc)

- **Hood RR**, Coles VJ, **Huggett J**, **Landry M**, Levy M, Moffatt JW, **Wiggert J**. (in prep, 1st draft complete) Indian Ocean Biogeochemistry: Nutrients, Phytoplankton and Zooplankton Variability and Limitations. In: Ummenhofer CC, Hood RR (Eds) *The Indian Ocean and its role in the global climate system*.
- Singh S, Groeneveld J, **Huggett J**, D Naidoo, R Cedras, Willows-Munro S (accepted) Metabarcoding of marine zooplankton in South Africa. *African Journal of Marine Science*.
- **Vinayachandran, P. N. M.**, Masumoto, Y., **Roberts, M.**, **Huggett, J.**, Halo, I., Chatterjee, A., Amol, P., Gupta, G. V. M., Singh, A., Mukherjee, A., **Prakash, S.**, **Beckley, L. E.**, Raes, E. J., and **Hood, R.** (in review). Reviews and syntheses: Physical and biogeochemical processes associated with upwelling in the Indian Ocean. *Biogeosciences Discuss.* [preprint], <https://doi.org/10.5194/bg-2020-486>.
- **Marsac, F.**, Everett, B., Shahid, U., & Strutton, P. (in prep, 1st draft complete) Indian Ocean primary productivity and fisheries variability. In: Ummenhofer CC, Hood RR (Eds) *The Indian Ocean and its role in the global climate system*.

Papers recently submitted to EGU special issue (Biogeosciences)

8. Changes to Organisational Structure (e.g. SSC) of RP / WG / IMECaN

NA

9. Images / Figures

We suggest use of one or more of the special issue volume covers presented above.

10. Update on Action Items from 2020 SSC meetings

Please update the [table of Action Items](#)

11. Anything not covered above

12. How to improve this form

Make it self-writing.

13. Appendices

Add appropriate meeting / workshop reports and include URLs (this helps to track where online content is missing)

NA