



2nd International
Indian Ocean
Expedition
2015-2025

Newsletter

Volume-6, Issue-12
December, 2022

(A basin-wide research program co-sponsored by IOC-UNESCO, SCOR and IOGOOS)

To advance our understanding of interactions between geologic, oceanic and atmospheric processes that give rise to the complex physical dynamics of the Indian Ocean region, and to determine how those dynamics affect climate, extreme events, marine biogeochemical cycles, ecosystems and human populations.



Impact of Red Sea and Persian Gulf on the Arabian Sea and Bay of Bengal

The Indian Ocean is unique in many ways. Its northern extent, limited by the Asian continent, is divided into two contrasting embayments: the salty Arabian Sea and the less salty Bay of Bengal. The circulation and the interaction between the two regions are governed by the air-sea exchanges induced by the strong monsoonal seasonal forcing, along with interannual variability signals. In the upper kilometer, the thermocline stratification is affected by inflow of relatively less salty Pacific water, the Indonesian Throughflow (ITF) via the Maritime Continent. The ITF spreads westward within the South Equatorial Current near 12°S, with a branch headed southward along the western margin of Australia, within the Leeuwin Current. The western tropical Indian Ocean is affected by hypersaline water from the Persian Gulf (PG) and Red Sea (RS), which spreads eastward and southward. The ITF, PG and RS waters mix and eventually exit the tropical Indian Ocean into the southern Indian Ocean. The ITF has been extensively investigated and it is well known that it is a key component of the global ocean conveyor belt. However, the role of the PG and RS waters in upper ocean stratification and circulation of the northern Indian Ocean is less clear.

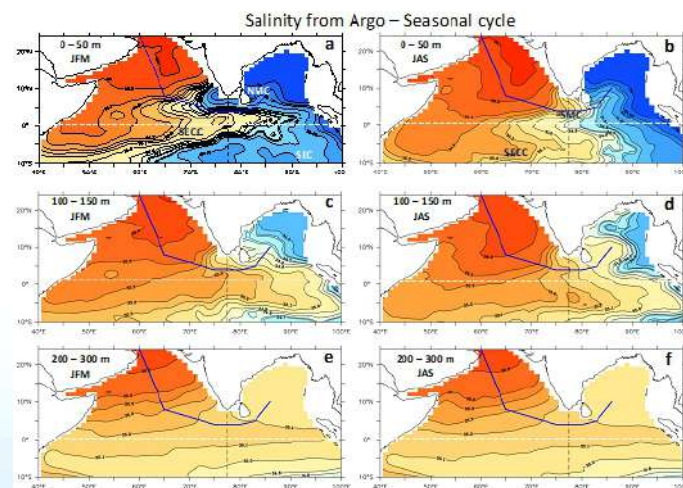


Figure: Salinity distribution in the Indian Ocean region to the north of 10°S, averaged in the layers 0–50m, 100–150m, and 200–300m, based on Argo data. In JFM. (Fig. 2 in Campos et al., 2022).

To understand the impacts of the hypersaline PG and RS waters in a scenario of global warming and other human-induced changes in those marginal seas, an investigation was started as part of a project funded by the American University of Sharjah, in the United Arab Emirates. As a first step, a set of numerical simulations were carried out to investigate the PG and RS spreading patterns in the tropical Indian Ocean, contrasting the difference in circulation and stratification with the PG and RS gateways opened and closed. The results, published in a recent paper (Campos et al., 2022) show that the absence of the PG and RS inflows leads to small but not completely negligible alterations of the stratification and circulation of the northern Indian Ocean. The larger differences occur at interannual scales, reflecting an effect of ENSO. The greater impact occurs mainly in the Arabian Sea, but differences are also detected in the northernmost sectors of the Bay of Bengal. The results show significant impact on the air-sea exchanges and in the upper layer's circulation. It is found that the upwelling system in the Sri Lanka Dome would respond differently to variability of the climate system in the absence of the two marginal seas. The closure of the PG and the RS is not a realistic situation. However, the results still contribute to understanding the relevance of those waters to the larger scale. If the reduction of the salt influx impacts processes in remote regions, one can hypothesize that, on the contrary, the increase would also be relevant. A more realistic scenario is under investigation, in which changes in riverine inflow, increased temperature, evaporation and salt content associated with climate change and human stressors in the two marginal seas are considered.

Citation: Campos et al., 2022. Impacts of the Red Sea and Persian Gulf on the Northern Indian Ocean in Numerical Simulations, *Ocean and Coastal Research* 2022, v70:e22050.

<http://doi.org/10.1590/2675-2824070.22019ejdc>

[Report Courtesy: Edmo J. D. Campos, Universidade de São Paulo - Instituto Oceanográfico (Praça do Oceanográfico, Brazil; E-mail: edmojdcampos@gmail.com; edmo@usp.br]

BLOOFINZ-IO (IIOE-2 Endorsed Project IIOE2-EP46) conducts successful cruise in the eastern Indian Ocean

The eastern Indian Ocean (IO) off NW Australia is a globally significant, but poorly understood region. It lies downstream of the Indonesian Throughflow, through which excess heat flux from the western Pacific has contributed to rapid IO warming. It is also the only reproductive area for Southern Bluefin Tuna (SBT), a highly valued top ocean predator that migrates thousands of kilometers each year from rich high-latitude feeding grounds to spawn in this tropical oligotrophic habitat. Funded by the US National Science Foundation, project **BLOOFINZ-IO** (Bluefin Larvae in Oligotrophic Ocean Foodwebs, Investigations of Nutrients to Zooplankton) successfully explored the physical, chemical and biological characteristics of this region on R/V Roger Revelle cruise RR2201 in February 2022. Following COVID protocols, participants isolated in Guam before transiting to Darwin, Australia to begin and end the cruise and transit back to Guam.

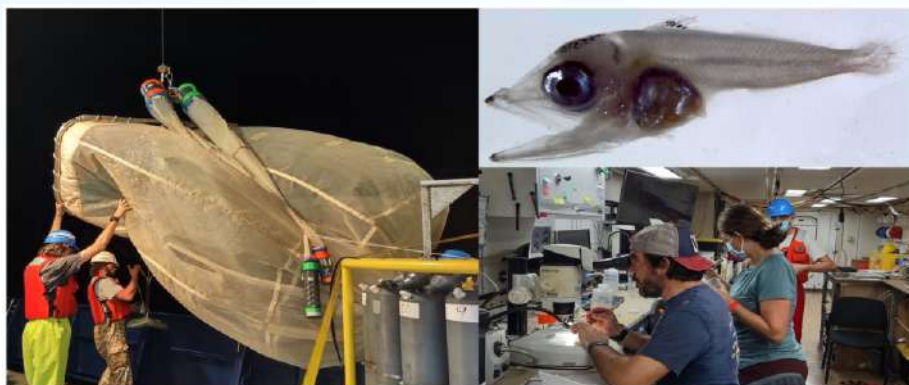
The major objectives of BLOOFINZ-IO are to determine: 1) the main source of nitrogen nutrients to the system (deep mixing vs nitrogen fixation); 2) the magnitude, variability and controls of primary production; 3) the biomass, composition and trophic structure of the lower (planktonic) food web; 4) the pathways and rates of trophic transfer; 5) the export of particulate C and N to the deep sea; and 6) the abundance, feeding, growth and survival rates of tuna larvae, their dependencies on specific food-web pathways and their potential vulnerabilities to climate change. Despite the study's regional and tuna emphasis, the core science addresses issues of broad oceanographic relevance (diazotrophy, shallow nitrification, new production, food-web structure and function, export) using an integrated biogeochemical-ecological approach. Shipboard sampling comprised two major activities:

Continuous/Underway: Mesoscale spatial variability of surface waters along the cruise track was continuously monitored by flow-through instruments measuring: temperature, salinity, Chla fluorescence, microbial populations (FlowCam and FlowCytobot imaging), group-specific pigments (ALFA laser fluorometry), phytoplankton photophysiology and primary production (FiRE/FRRF fluorometry, Equilibrium Inlet Mass Spectrometry), nitrogen fixation (FARACAS, Flow Acetylene Reduction Assays) and atmospheric fluxes of trace elements. On longer transects, continuous instrument measurements were augmented by underway point sampling for trace elements, POC/PON, cytometry, DNA sequencing, thorium-234 (particle export), and a Continuous Plankton Recorder was also towed for fine-scale spatial sampling of zooplankton community composition.

Process Experiments: Multi-day Lagrangian process studies were conducted at four locations along the southern slope margin of the Argo Basin following satellite-tracked drift arrays. This allowed for repeat sampling of the same water for integrated euphotic-zone assessments of community composition, biomass structure, stable isotopes, nutrients, nitrate uptake, N₂ fixation, primary production, phytoplankton growth, micro- and mesozooplankton grazing, passive and active (diel migrant) export, and larval feeding, growth and survival. Integrated sampling and incubation studies were also

done at numerous individual stations along the cruise track to characterize regional variability. Biogeochemical and food web elements of the study will be linked by compound-specific isotopic analyses of amino acids (N source, trophic position), ^{15}N -constrained budgets and modeling.

BLOOFINZ-IO, led by Michael Landry (PI/Chief Scientist, SIO), has a diverse science team from 8 US institutions, 8 institutions in Australia, Spain, France, China and New Zealand and multiple collaborative grants from NSF, the Spanish Ministry of Science (INDITUN, R. Laiz) and the Hong Kong Fund. Research results of will become publicly available at BCO-DMO (Biological and Chemical Oceanography Data Management Office) site <https://www.bco-dmo.org/program/819631>, which also hosts data from BLOOFINZ-GoM (Gulf of Mexico), which will allow habitat comparison of Atlantic and Southern Bluefin species.



*Figure: Tuna larvae were sampled by double bongo nets to collect larvae (large coarse nets) and microplankton prey (small fine nets) on the same tows (upper 30 m). One side of the larger bongo was sorted immediately on shipboard; the other preserved in EtOH. Southern bluefin larvae (*Thunnus maccoyii*, upper right) were abundant and dominant throughout the study region, with samples including a recently spawned egg mass (genetically identified). Larvae of four other tuna species were collected for ecological comparison.*

[Report Courtesy: Michale Landry, Scripps Institution of Oceanography, University of California, San Diego, USA; E-mail: mlandry@ucsd.edu]

SCOR Working Group 167, Reducing Uncertainty in Soluble aerosol Trace Element Deposition (RUSTED)

Quantifying the transfer of micronutrient trace elements and pollutants across the air-sea interface is a current research priority. The newly-established, SCOR WG 167 (RUSTED), bring together experts from the ocean biogeochemistry, atmospheric chemistry and modelling communities to focus on assuring the quality of trace element solubility data produced from aerosol leaching schemes and to provide advice on their use in Earth System models. This will help constrain how atmospheric deposition of soluble iron and other trace elements modulates marine biological activity and, ultimately, the oceanic sequestration of atmospheric CO_2 . Key deliverables include: (1) Standard Operating Procedures for frequently used aerosol leaching schemes; (2) a comprehensive, open-access database of atmospheric trace element data, following FAIR (Findable, Accessible, Interoperable, and Reusable) data principles aimed to facilitate easier evaluation and calibration of global models than is currently possible; (3) a glossary of terms addressing terminology inconsistencies across communities. In addition, a workshop-seminar series will be held in India in 2025. Participation from the IIOE2 community is encouraged.

A call will be released shortly to invite researchers to contribute aerosol trace element data produced within the last few decades for inclusion in the database. Beyond its use in understanding the impacts of air-sea exchange, this dataset also has value for other fields including public health and climate sciences.

RUSTED addresses several of the UN Decade of Ocean Science for Sustainable Development Priority Challenges (<https://www.oceandecade.org/challenges/>) helping to align our goals towards the realization of a healthy future ocean. We look forward to working together as SCOR Working Group 167 to realise our common goals.

The Terms of Reference and list of members can be found at the below link:

<https://scor-int.org/group/reducing-uncertainty-in-soluble-aerosol-trace-element-deposition-rusted/>

For further information please contact Rachel Shelley (rachel.shelley@uea.ac.uk), Morgane Perron (morgane.perron@univ-brest.fr) or Douglas Hamilton (dshamil3@ncsu.edu).

12th International Conference and Workshop on Lobster and crabs 22-27 October 2023 in Fremantle, Western Australia



The Organising Committee of the 12th International Conference and Workshop on Lobster and crab is pleased to announce the go ahead of this workshop that was originally planned for October 2020 for the **22-27 October 2023**. Please check the website (<https://icwl2023.com.au>) for updates on the conference. This will be updated over the next month with more details on the program. We will be accepting abstracts and registrations from the 24 January 2023. This workshop is being planned as a face-to-face meeting.

The overall theme for the 2023 workshop is '**ecosystem-based fisheries management (EBFM)**' as this generally represents best practice for fisheries management and reflects that fisheries research and management focus is now broader than just sustainability. Therefore we hope to attract presentations that cover a wide array of subjects under the EBFM banner including biology, stock assessment, management, ecosystem effects of fishing such as interaction with whales, habitat, economics, social, governance and management compliance.

We will be holding a **2-day EBFM workshop** which will be sponsored by the OECD Co-operative Research Programme: Biological Resource Management for Sustainable Agricultural Systems. This will occur on the first two days of the 5-day conference.

While this conference comes back to Western Australia where the 1st International Lobster Workshop was held in 1978, we have adopted the approach of the 2nd lobster conference in St Andrews in 1985 where **crab presentations** were welcome. We look forward to their participation in this conference.

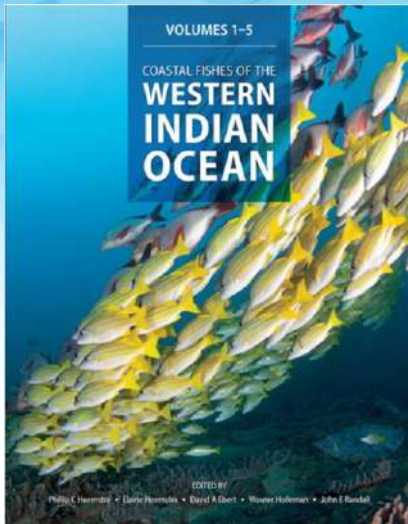
An **industry day** is also planned for Thursday 26 October and this is an important component of the program so we are looking forward to strong support from lobster and crab industry participants around the world. We are also keen to attract papers on **lobster and crab aquaculture** as this has been an important developing industry in Asia.

Students can apply for the **Paul Kanciruk Student award** for financial support to attend the conference.

The Department of Primary Industry and Regional Development (DPIRD) and the Western Rock Lobster (WRL) council are looking forward to hosting scientists, managers and industry participants in Western Australia in 2023. Don't hesitate to contact us or the conference organisers, Arinex, if you have any questions.

Co-hosts of the workshop Nick Caputi, DPIRD (nick.caputi@dpird.wa.gov.au) & Nic Sofoulis, WRL (sofs1@bigpond.com).

Coastal Fishes of the Western Indian Ocean



This remarkable 5-volume publication on the fishes of the Western Indian Ocean was launched at the annual Smith Memorial Lecture on 29 September 2022 in South Africa. **Coastal Fishes of the Western Indian Ocean** took 25 years to complete and involved almost 100 contributors from many parts of the world. It includes descriptions of 3500 species of fishes and has generated much interest in the diversity of coastal fishes in the Western Indian Ocean. It covers the region from Cape Point, South Africa to the Red Sea and east to Kanyakumari, India.

Searchable pdf versions of each volume have been created and for more information go to:

<https://www.saiab.ac.za/coastal-fishes-of-the-western-indian-ocean.htm>

[Report Courtesy: Lynnath Beckley, Environmental & Conservation Sciences Murdoch University, Western Australia; E-mail: L.Beckley@murdoch.edu.au]

DEEP-SEA RESEARCH PART II



THE SUBMISSION PORTAL FOR VOL. 6 OF THE DEEP-SEA RESEARCH II SPECIAL ISSUE SERIES ON THE IIOE-2 IS NOW OPEN

Submission of manuscripts that describe the results of studies related to the physical, chemical, biological, and/or ecological variability and dynamics of the Indian Ocean (including higher trophic levels) is encouraged.

Submission of manuscripts from students and early career scientists is also encouraged.

If you are interested in submitting a manuscript, please contact Raleigh Hood (rhodd@umces.edu).

Indo-Pacific Fish Conference and the Australian Society for Fish Biology 20-24 November 2023, Auckland, New Zealand

The Indo-Pacific Fish Conference will be held in Auckland, New Zealand from Nov 20-24 2023 in partnership with the Australian Society for Fish Biology. Submission of abstracts is open from 10 Feb - 11 June 2023. Registration opens 20 April 2023. Closing date for nominations for the associated IPFC Bleeker Awards in fish Systematics and Taxonomy is 30 April 2023.



For more details visit Conference Website: <https://www.ipfc11-asfb.ac.nz/>

Endorse your projects in IIOE-2

Don't miss the opportunity to network, collaborate, flesh out your research project and participate in IIOE-2 cruises!!

The endorsement of your scientific proposal or a scientific activity focusing on the Indian Ocean region is a recognition of the proposal's or activity's alignment with the mission and objectives of IIOE-2, of its potential for contributing to an increased multi-disciplinary understanding of the dynamics of the Indian Ocean, and of its contribution to the achievement of societal objectives within the Indian Ocean region. Over 50 international, multi-disciplinary scientific projects have already been endorsed to date by the IIOE-2. Yours could be the next one!

Visit <https://iioe-2.incois.gov.in/IIOE-2/EndorsementForm.jsp> for further details and for projects already endorsed by IIOE-2 https://iioe-2.incois.gov.in/IIOE-2/Endorsed_Projects.jsp.

CLIVAR December 2022 Bulletin is available online



The International CLIVAR Project Office distributes a monthly bulletin with announcements, funding opportunities, meeting notifications relevant to the ocean/climate science community.

The latest CLIVAR Bulletin December, 2022 is available at:

<https://mailchi.mp/clivar.org/clivar-december-2022-bulletin>

Call for Contributions

Informal articles/short notes of general interest to the IIOE-2 community are invited for the next (January-end) issue of the IIOE-2 Newsletter. Contributions referring IIOE-2 endorsed projects, cruises, conferences, workshops, "plain language summary" of published papers focused on the Indian Ocean etc. are welcome. Articles may be up to 500 words in length (Word files) accompanied by suitable figures, photos.(separate.jpg files).

Deadline: **25 January, 2023**



Access the latest issue of Indian Ocean Bubble-2

<https://iioe-2.incois.gov.in/IIOE-2/Bubble.jsp>



Enroll yourself with IIOE-2 Community

<https://iioe-2.incois.gov.in/IIOE-2/Signup.jsp>

Follow us:



iioe-2.incois.gov.in

The IIOE-2 Newsletter is published online by:



@IIOE2



@iioe_2



Feedback? iioe-2@incois.gov.in