2nd International Indian Ocean Expedition 2015-2025

Newsletter

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

Volume-7, Issue-7
July, 2023

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.

Successful Completion of the KIOS 2023 Expedition

The Korea Institute of Ocean Science and Technology (KIOST) recently achieved a successful completion of the KIOS 2023 expedition. This cruise was a part of the KIOS (KIOST Indian Ocean Study), which received endorsement from IIOE-2 earlier this year (IIOE2-EP51: Korea-US Joint Observation Study of the Indian Ocean led by Dr. Dong-Jin Kang, PI/Chief Scientist, KIOST, djocean@kiost.ac.kr, funded by the Ministry of Oceans and Fisheries, the Republic of Korea).

Taking place from May 15th to June 11th, 2023, aboard the KIOST research vessel ISABU, the KIOS 2023 expedition covered a meridional transect from 65° E and 25° S to 5° N, stretching between Port Louis, Mauritius, and Malé, Maldives. The expedition was a collaborative effort, involving scientists, young researchers, students, documentary makers, and the ship's crews.

The primary goal of the KIOS scientific cruise was to gain insights into the physical, biogeochemical, and ecological characteristics of the Seychelles-Chagos Thermocline Ridge (SCTR) region, which is a significant open ocean upwelling region in the tropical Indian Ocean. This understanding would contribute to enhancing the predictability of global climate patterns.

Throughout the cruise, numerous oceanographic studies and sample collections took place. On R/V ISABU, a range of observations and analyses were conducted, such as CTD observations from the surface to the bottom, high-resolution nitrate observation with ISUS, dissolved oxygen, nutrients, dissolved inorganic carbon analysis, and primary productivity measurements. Moreover, researchers studied particles and dissolved organic carbon, nitrogen isotope of nitrate, and dissolved noble gas. Zooplankton samples were also collected using a multi-net. Furthermore, the deployment of a BGC-Argo equipped with a nitrate sensor and underwater glider observation further enhanced the data collection efforts.

Notably, NOAA PMEL staffs participated in the cruise, leading the RAMA moored buoy operations. Three RAMA moored buoys were successfully deployed at 12°S-65°E, 8°S-65°E, and 4°S-65°E, alongside one subsurface ADCP mooring and eight Lagrangian drifter buoys. Additionally, the RAMA mooring that had gone

adrift at 8°S, 67°E on September 18th, 2022, was successfully recovered. An exciting development is the establishment of the "RAMA-K study site" around 8°S, 65°E, where KIOST plans to relocate additional subsurface moorings in 2024.

Figure: Group Photo of the Participants

Adding to the significance of this expedition, a producer and cinematographer from EBS (Educational Broadcast System) in Korea accompanied the team to document the shipboard research. The coverage is scheduled to be broadcast in Korea early next year.

[Report Courtesy: Sujin Kang and Dong-Jin Kang, Korea Institute of Ocean Science & Technology, Busan, Korea; E-mail: sjkang@kiost.ac.kr]

GO-BGC and SOCCOM profiling floats in the Indian Ocean

The Global Ocean Biogeochemistry Array (GO-BGC; https://go-bgc.org) project is funded by the US National Science Foundation to deploy 500 BGC profiling floats as half of the planned 1000 float BGC-Argo array. The Indian Ocean has been one of the least sampled ocean basins in the BGC-Argo array. A priority of the GO-BGC project has been deployment of floats to improve our understanding of biogeochemical processes in the region. Over the past year, we have deployed 17 floats equipped with oxygen, nitrate, pH, chlorophyll fluorescence and optical backscatter sensors throughout the basin north of 30°S (Figure-1). Eight more floats are at sea on the GO-SHIP I05 cruise (Figure-1) and they will likely be deployed by the time this note is published. These 25 floats are one quarter of the ~110 floats needed in the region north of 30°S to achieve a global array of 1000 BGC floats with nearly even spacing. They represent an important step in achieving a global, biogeochemical observing system.

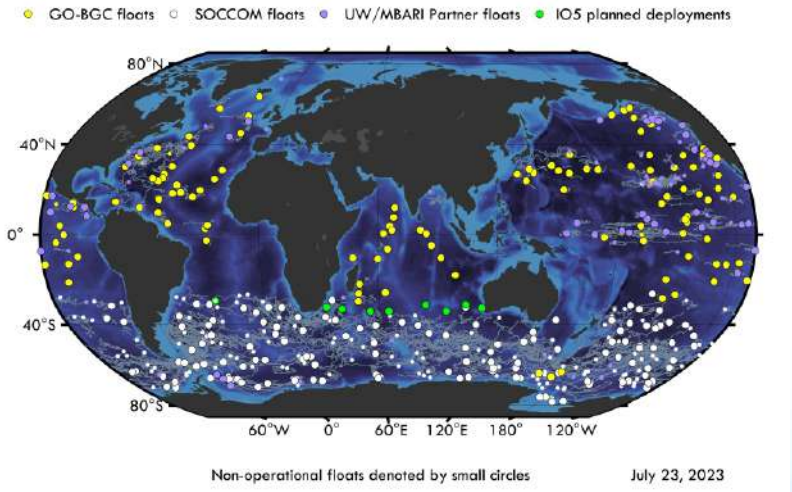


Figure-1: Location of GO-BGC (yellow), SOCCOM (white, large circles indicate active floats, small circles indicate inactive floats), and the upcoming GO-BGC deployments planned on the I05 cruise (green circles). GO-BGC floats in the Indian Ocean have been deployed in the past year.

In addition to the GO-BGC floats, the Southern Ocean Carbon and Climate Observations and Modeling (SOCCOM; https://soccom.princeton.edu) project has deployed 44 BGC-Argo floats in the Indian Ocean sector of the Southern Ocean (25°E to 120°E) since 2014. These floats have collected over 5000 vertical profiles from 30°S, through the seasonal ice zone, to the Antarctic margin. Twenty-one of these floats are currently operating and the remainder have exhausted their batteries. SOCCOM is funded by the US NSF Office of Polar Programs.

All of the data from these floats are immediately available with automated and delayed quality control through the Argo data system and at the GO-BGC and SOCCOM websites. Figure-2 shows an example of temperature, chlorophyll, oxygen, nitrate, and pH values observed over 3.5 years by SOCCOM float WMO 5906204, as well as derived pCO_2 and Dissolved Inorganic Carbon. This float was deployed at 30°S, 55°E. It has since drifted west and is now sampling the Agulhas Current at 36°S, 31°E.

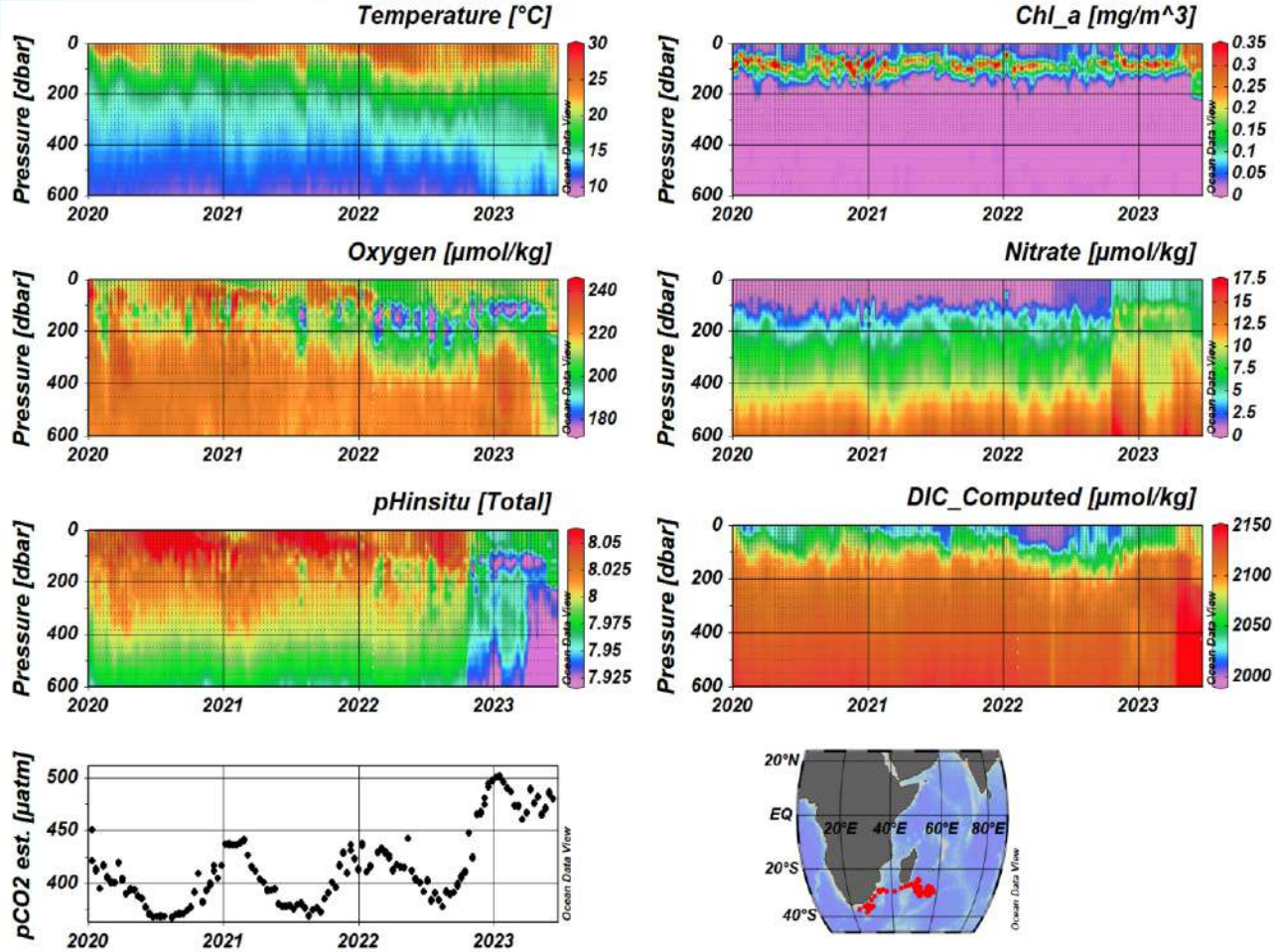


Figure-2: Section plots for SOCCOM float WMO 5906536 showing temperature, chlorophyll, dissolved oxygen, nitrate, and pH observed by the float since it was launched in October 2022. Concentrations of dissolved inorganic carbon (DIC), and the partial pressure of CO_2 (pCO_2) at the surface, which were computed using carbon dioxide thermodynamics and an estimate of total alkalinity using the LIAR algorithm (Carter et al.,2018), are also shown.

Float 5906204 was deployed by UK Research Vessel Discovery. It exemplifies the international collaboration needed to implement a global array. Many of the GO-BGC floats were deployed from the South African Research Vessel Agulhas II on a cruise coordinated by France and funded by Monaco. A number of additional French and Canadian BGC-Argo floats, funded by the EU REFINE project, were deployed on this cruise. The US, EU, and Canadian floats significantly increase the BGC-Argo observations within the Indian Ocean. SOCCOM floats in this region have been deployed on cruises using ships from, or led by scientists from, Australia, France, Germany, India, Japan, South Africa, Switzerland, and the United Kingdom, as well as the US.

[Report Courtesy: Kenneth S. Johnson, Monterey Bay Aquarium Research Institute (MBARI) and GO-BGC and SOCCOM teams, ; E-mail: johnson@mbari.org]

SoVeAt - A tool for visualizing sound velocity data for Naval applications

Spatial variations of sound speed cause acoustic rays to bend according to Snell's law (Urick, 1983), and sound is partially reflected and refracted as the sound speed varies sharply. This results in formation of "shadow zones" where sound waves cannot penetrate. In general the maximum mean sound speed values are observed in the surface layers of 0 – 50 m in the ocean, the sound speed values decrease in the deeper layers. This could be attributed to the fact that the deeper water is relatively cooler than that at surface. Temperature being a major contributor, this accounts for the low sound speed values in the deeper layers. The high sound speed core that is well formed till 100 m depth, starts dissipating, and the contours of sound speed of then found to increase from equator towards north. Beyond ~ 100 m the meridional gradients in sound speed start changing into zonal gradients.

Acoustical properties of the ocean environment largely determine the submarine operations and operational characteristics. Sonic Layer Depth (SLD) derived from Sound Velocity is having important potential applications for global underwater communications and for the anti-submarine warfare (ASW). SLD is defined as the depth of maximum sound speed above the deep sound channel axis and is obtained from Sound Velocity Profile (Udaya Bhaskar et al. 2010; Etter 1996). A submerged object goes undetected by surface sonar at a depth of SLD plus 100 m and beyond. SLD plays an important role in determining the angle of refraction of sound rays traveling in the ocean and hence in identification of the shadow zones. In general, the deeper the sonic layer, the stronger and wider the duct and the less steep the angle of refraction. Due to this, more of the sound is trapped producing longer detection ranges. A decrease in sea state results in less mixing. This causes the SLD to shallow, which in turn refracts the sound rays at a sharper angle, thus producing shorter detection ranges. Conversely, an increase in sea state results in more of the mixing and deepening the SLD. Sound rays then refract at a less steep angle and Sonar detection ranges increase.

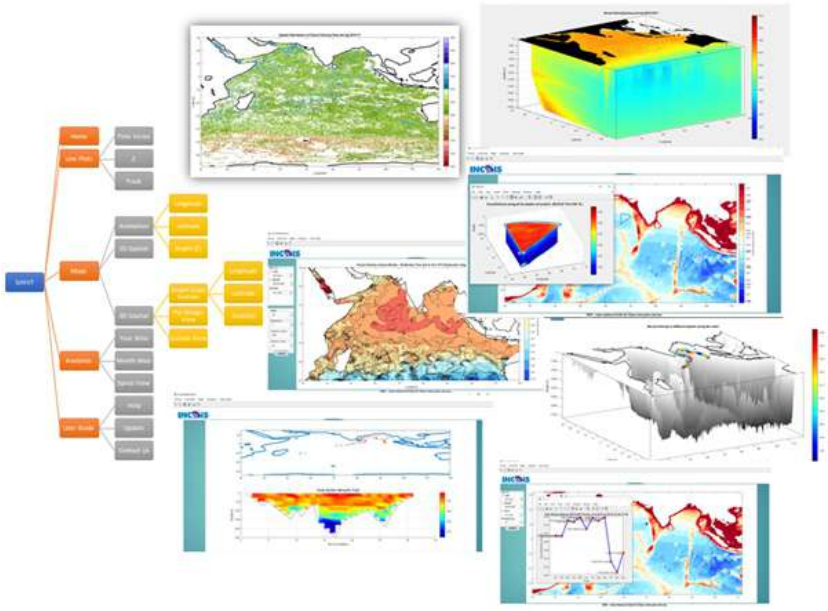


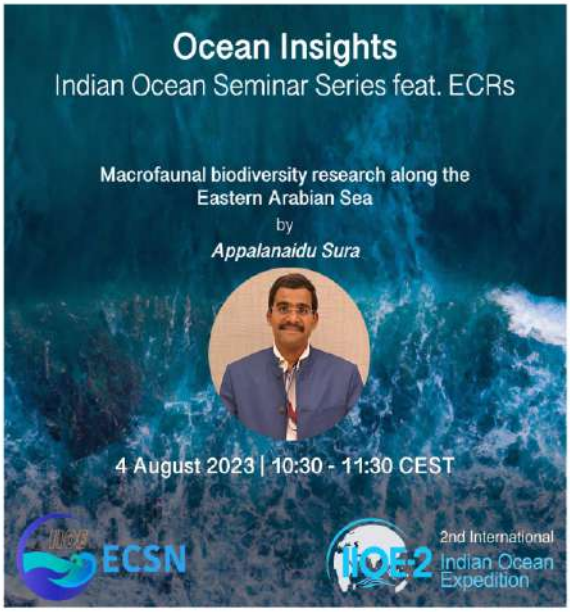
Figure-1: Various modules of the GUI built in to extract, visualize and download the data and products pertaining to sound velocity, temperature and salinity.

A need was felt for building a dynamic tool for generation, extraction and visualization of sound velocity data which can be used for strategic operations and also for general purpose research. With this idea in mind, Sound Velocity Atlas (SoVeAT) tool was developed. The subsurface profile data of temperature and salinity (T/S) from Argo profiling floats encompassing the period 2000 – 2020 were used in developing this tool. All the profiles are passed through 19 automatic Real Time Quality Control (RTQC) procedures as prescribed by the Argo Data Management Team (ADMT). All the eligible profiles were passed through Delayed Mode Quality Control (DMQC) and corrected mainly for the salinity degradations. In addition to these, all the profiles are visually checked for any leftover spikes and unusual gradients using VQC tools developed in house (udaya bhaskar, 2012). Leroy et. al., (2008) equation is used derive sound velocity from these temperature and salinity profiles. Sound Velocity climatology of Indian Ocean (30E - 120 E and 69 S - 30 N) was generated using all the data. With this sound velocity data derived from Argo T/S, Graphic User Interface (GUI) based tool is built for visualizing parameters viz., Sound Velocity, Temperature, Salinity and bathymetry (Figure-1). This tool has capability to generate climatology dynamically between any chosen periods apart from visualizing various plots which are useful for Navy and general researchers particularly while at sea. Also provision for adding newly observed T/S data is provided making this most robust sound velocity tool for use by the Indian Navy.

[Report Courtesy: J Pavan Kumar, TVS Udaya Bhaskar and E Pattabhi Rama Rao, INCOIS, Hyderabad, India; E-mail: uday@incois.gov.in]

Join us for the Ocean Insights – Indian Ocean Seminar Series feat. ECRs. !

The IIOE-2 Early Career Scientist Network is thrilled to present yet another exciting talk of "Ocean Insights – Indian Ocean Seminar Series feat. ECRs", designed especially for early career scientists focusing on the Indian Ocean to share about their research. This captivating seminar series offers a unique opportunity for ECRs to showcase their work, build connections, and explore collaborations within the marine sciences community.



Whether you are an early career researcher, an experienced scientist, or simply an enthusiast seeking to broaden your knowledge of marine science in the Indian Ocean, **ALL ARE INVITED!**

Why Should You Join?

- Engaging presentations from early career marine scientists.
- Interactive Q&A sessions to delve deeper into research topics and foster innovative ideas.
- A platform to connect with like-minded researchers and experienced scientists.

Don't miss out on the opportunity to enhance your understanding of marine science in the Indian Ocean and connect with fellow researchers. Register now and mark your calendars!

Details on the talk are given below:

Key Details:

Title: Ocean Insights – Indian Ocean Seminar Series feat. ECRs

Region: Indian Ocean

Format: Online

Link: https://zoom.us/meeting/register/tJUudOGsrzkiHNzP_5mFIjstUxlUQBhS6Z-_

Date: Every first Friday of the month, starting on **04th August 2023**

Time: 10:30-11:30 SAST
14:00-15:00 IST
16:30-17:30 AWST

We look forward to your participation in this exciting Seminar Series.

If you are enthusiastic about sharing your contributions, please reach out to us at the email address: ecsn.iioe@gmail.com

Eighth National Conference of Ocean Society of India (OSICON-23) during August 23- 25, 2023, Hyderabad, India

The 8th edition of the Biennial National Conference of the Ocean Society of India (OSICON-23), scheduled to be held at INCOIS, Hyderabad, India from August 23 - 25, 2023.

The conference website may be accessed here: https://osicon23.incois.gov.in/

The focal theme for OSICON-23 is 'Operational Oceanography - Science to Services,' which is a critical topic for the oceanographic community. It focuses on the translation of scientific knowledge into practical applications. The conference aims to bring together experts and researchers from around the world to discuss the latest advancements in operational oceanography, share knowledge, and promote collaboration among the ocean community.

Focal Theme
Operational Oceanography - Science to Services

OSICON-23 is expected to be attended by around 350 researchers from all over India to review and discuss the recent advances in Operational Oceanography and will help scientists and students involved in ocean-atmosphere studies to benefit from interactions with the experts in the following various sub themes:

Sub Themes

1. Ocean Information and Advisory Services
2. Ocean Observations (In-situ & Satellite)
3. Ocean Modelling and Data Assimilation
4. Coastal and Open Ocean Processes
5. Air-sea Interactions
6. Biogeochemistry of the Ocean
7. Biodiversity and Ecology
8. Ocean and Climate Change
9. Ocean Engineering and Technology
10. Marine Geology and Geophysics
11. Polar Science and Cryosphere Studies
12. Blue Economy
13. Marine Resource Management
14. IMS Special Session on Importance of Ocean Observations to Monsoon Weather and Climate Forecasting

Important Dates

Notification of Selected Participants for PreConference Tutorial: **August 01, 2023**
Last date for Online Registration is extended upto **August 03, 2023**

Please register at https://osicon23.incois.gov.in/osicon23/registration.jsp

Kindly note those who have successfully completed and paid the conference registration fee, their abstracts will be included in the program schedule and in the conference proceedings.

To reserve the hotel for your accommodation,
please visit https://osicon23.incois.gov.in/osicon23/accommodation.jsp

The rooms are available on first come, first basis. Hence, please HURRY UP AND BOOK the ACCOMMODATION immediately.

Contact Details

Mr. E. Pattabhi Rama Rao
INCOIS
Convener

Dr. P. G. Remya
INCOIS
Co-Convener

Prof. P. Sreenivas
Univ. of Hyderabad
Co-Convener

E-mail: osicon23@incois.gov.in
Website:https://osicon23.incois.gov.in/

ICES - PICES 7th International Zooplankton Production Symposium during Autumn17-22 March 2024, Hobart, Australia

SCOPE

We are living in the Anthropocene. Our oceans are warmer, more acidic, have widespread plastic and other pollution, and are subjected to increasing exploitation including overfishing. Zooplankton play a pivotal role in our oceans, as grazers of primary production, as drivers of carbon and nutrient cycles, and as prey for higher trophic level consumers including both harvested fish species and iconic marine mammals and seabirds. How zooplankton will respond to the dramatic changes in our marine ecosystems will impact the health and productivity of our oceans and our planet.

To better understand zooplankton in a changing world, ICES and PICES are holding the 7th International Zooplankton Production Symposium as a forum to discuss the latest zooplankton research. The ICES/PICES Zooplankton Production Symposium will bring together the top zooplankton researchers globally, showcasing recent advances. Understanding the current and evolving role of zooplankton will require new insights provided by:

- Assessing the impact on zooplankton of climate change, fishing, and pollution such as microplastics
- State-of-the-art sampling techniques such as DNA, imaging, and bioacoustics
- Biochemical methods applied to unravelling complex trophic ecology
- The application of cutting-edge approaches in zooplankton modelling, including size and trait-based biogeochemical and ecosystem models
- Revealing the role of microzooplankton in biogeochemical cycling and food webs
- Exploring the structure and functioning of macrozooplankton communities and their impact on carbon sequestration and trophic ecology
- Examining zooplankton in fisheries science, including dynamics of fish larvae, the impact of zooplankton on fish larval mortality and growth, and the commercial harvest of zooplankton
- Elucidating the vital role of zooplankton in polar environments
- Understanding the role of gelatinous filter feeders and jellyfish in carbon sequestration and trophic ecology
- The use of zooplankton as ecosystem indicators in a changing ocean

Our Symposium will be held over five days in the historic waterfront district of Hobart, Australia, during Autumn, from 17-22 March 2024. This event will be held in-person and provide the first opportunity since 2016 for zooplankton researchers to meet, build networks, and hear the latest science. We are monitoring the COVID-19 situation closely and will adapt our plans as needed.

The Organizing Committee invites proposals for sessions to be held during the Symposium. Proposals are welcome for sessions incorporating talks and posters, panel discussions and/or workshops. Sessions could cover, but are not limited to, the key areas listed above.

The symposium website may be accessed here: https://meetings.pices.int/meetings/international/2024/zps7/scope

Proposals may be submitted here: https://meetings.pices.int/meetings/international/2024/zps7/proposals

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 **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.

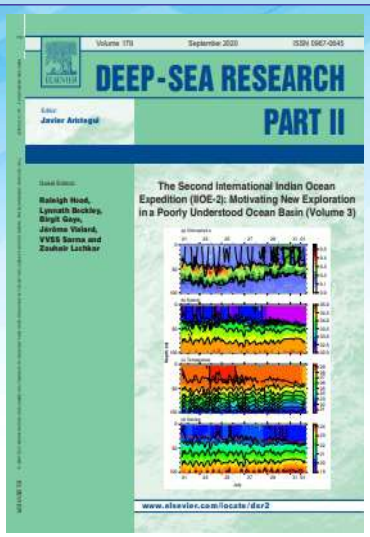
An **industry day** is also planned for Thursday 26 October and this is an important component of the program so we are looking forward to strong support from lobster and crab industry participants around the world. We are also keen to attract papers on **lobster and crab aquaculture** as this has been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

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 (rhood@umces.edu).

XI Indo-Pacific Fish Conference to be held in Auckland, New Zealand during 20-24 November 2023

A session entitled Larval fishes - solving phylogenetic, life-cycle and ecological questions will be part of the XI Indo-Pacific Fish Conference to be held in Auckland, New Zealand from 20-24 November 2023.

Most marine bony fishes have a two-phase life history with pelagic larvae that differ in morphology, ecology and habitat from the adults. These phases operate in separate evolutionary theatres, and ecologically, effectively function as separate species. Larval morphological features provide characters for phylogenetic analysis and aspects of life history are determined during the larval phase, including recruitment and scale of genetic and demographic connectivity. Although larval survival is necessary for persistence of species, larvae are often neglected by researchers and managers focused on adults. This session will address many of the unanswered questions about the pelagic larval phase of Indo-Pacific fishes.

The session will be co-chaired by
- Jeff Leis (University of Tasmania; jeffrey.leis@utas.edu.au)
- Lynnath Beckley (Murdoch University; L.Beckley@murdoch.edu.au) and
- Ainhoa Bernal (Institut de Ciències del Mar; bernal@icm.csic.es)

Those interested in contributing to the larval fish session should contact one of the session co-chairs.

Authors notified of abstract acceptance on 12 July 2023

The conference website is 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 51 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 July 2023 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 July, 2023 is available at:
https://mailchi.mp/clivar.org/april-2023-bulletin-17057160?e=526ed2c9ae

Call for Contributions

Informal articles/short notes of general interest to the IIOE-2 community are invited for the next (August-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 August, 2023**

The Indian Ocean Bubble 2

Access the latest issue of Indian Ocean Bubble-2
https://iioe-2.incois.gov.in/IIOE-2/Bubble.jsp

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