IN THIS ISSUE

◊ Conference and Integrated Meetings 2
◊ Intergovernmental Oceanographic Commission Assembly 2
◊ Plankton Identification Workshop held in Zanzibar 2
◊ Walter Munk - A Founding Father of Modern Oceanography (1917-2019) 4
◊ R/V INVESTIGATOR Voyage- 110°E 4
◊ Is Carbon-to-Chlorophyll Ratio getting its due in the Indian Ocean? 5
◊ Boreal MJO induced coherent rise and fall of the tropical Indian Ocean 7
◊ Dynamics of the Arabian Sea High Salinity Water Mass and Hypoxic Zones along the South West Coast of India - A Modelling Approach 8
◊ Approach field trials of gillnets and fishing lines with alternate materials in the Arabian Sea 10
Conference and Integrated Meetings

The 3rd International Indian Ocean Science Conference (IIOSC) was held in Port Elizabeth, South Africa during 11-15 March 2019. It was hosted by Nelson Mandela University and was well-attended with over 100 delegates from 21 countries. The conference focused on providing exposure on the research being undertaken by Western Indian Ocean (WIO) institutions while promoting and facilitating new relationships with other IOOE-2 institutions. Countries in the WIO region include Somalia, Kenya, Tanzania, Mozambique, South Africa, and the island states of Comoros, Madagascar, Seychelles, Mauritius and Réunion.

Meetings of prominent ocean science committees were held under the umbrella of this conference including those of the:
- IOOE-2 Steering Committee
- Indian Ocean Global Ocean Observing System (IOGOOS)
- Indian Ocean's physical and biogeochemical monitoring network (IndOOS)
- Indian Ocean Regional Panel (IORP)
- Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER)
- IndOOS Resources Forum (IRF)

During the gathering, a South Africa-WIO showcase day was also held.

Plankton Identification Workshop held in Zanzibar

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With the advent of the IOOE-2, a number of research cruises have taken place in the Western Indian Ocean (WIO), including two regional training surveys off Mozambique, Tanzania and Comoros by the SA Agulhas II in 2017 and 2018, and a series of surveys from South Africa to the Seychelles by the RV Dr Fridtjof Nansen during 2018, as part of the EAF-Nansen Programme. These surveys have not only resulted in the collection of numerous zooplankton and ichthyoplankton samples in the territorial waters of the WIO countries, but also highlighted the fact that many of the marine and/or fisheries institutions in the WIO countries lack the expertise (and sometimes the appropriate equipment) to analyse these samples. Accordingly, a regional training workshop on “Identification of Zooplankton and Fish Larvae of the Western Indian Ocean” was held from 24th February to 2nd March 2019 at the Institute of Marine Sciences (IMS), University of Dar es Salaam (UDSM) at Zanzibar, Tanzania.

The workshop was hosted by the Institute of Marine Sciences (IMS), University of Dar es Salaam, Tanzania in collaboration with the Institute of Marine Research (IMR), Norway and the EAF-Nansen Programme of the Food and Agriculture Organization of the United Nations (FAO); as well as the Department of Environmental Affairs (DEA): Oceans & Coasts, South Africa and Kenya Marine and Fisheries Research Institute (KMFRI). Sponsorship was provided by WIOMSA, through the Marine and Coastal Science for Management (MASMA) Programme, with additional financial and/or material support from IMR and the EAF-Nansen Programme; IRD and the University of Aix-Marseille (France); DEA: Oceans & Coasts, Nelson Mandela University (NMU) and the University of the Western Cape (UWC, South Africa).

The workshop was organized by Dr Margaret Kyewalyanga (Director of IMS), assisted by Dr Jenny Huggett (DEA), who had the challenging task of selecting 20 participants from over 200 applications. The objective was to represent as many WIO countries...
and institutions as possible, prioritising those with existing samples to analyse, particularly from recent surveys in support of the IIOE-2. The final “Top Twenty” came from Comoros (1), Kenya (3), Madagascar (1), Mauritius (1), Mozambique (4), Seychelles (2), South Africa (1) and Tanzania (7), 12 of whom were females, and 8 males.

The training format comprised parallel sessions on the identification of zooplankton and ichthyoplankton, held over seven days in two spacious, air-conditioned classrooms at the IMS Buyu Campus, located south of the international airport. One classroom was used for lectures while the other was dedicated to microscope work, with the participants switching venues each day after lunch. Zooplankton training was provided by Dr Jenny Huggett (DEA; zooplankton convenor), Prof Mark Gibbons and Dr Riaan Cedras (UWC), Prof Delphine Thibault (France), and Dr Margaux Noyon (NMU). Ichthyoplankton training was provided by Dr Stamatina Isari (IMR; ichthyoplankton convenor), Prof Nadine Strydom (NMU), Dr James Mwaluma (KMFRI) and Dr Shael Harris (University of Zululand). The immediate legacy of the workshop, in addition to the knowledge gained by the participants, is three new high resolution stereomicroscopes suitable for zooplankton and ichthyoplankton analysis, as well as a camera and monitor for training purposes. Two of these microscopes will remain at IMS, where they will be available for use by WIO researchers lacking suitable microscopes at their home institution, in support of building regional capacity in marine biodiversity; the third was donated to the Tanzania Fisheries Research Institute (TAFIRI). Two additional stereomicroscopes were donated to IMS and TAFIRI, by DEA and NMU respectively. Each workshop participant also received small tools for microscope work such as fine forceps, needles, petri dish, and a counting tray, plus a data stick loaded with reference material and the course lectures.

Plans are underway for the production of an "Introductory, Teach-Yourself Guide to the Zooplankton of the WIO region" to be led by Mark Gibbons, and for a “Manual for Identification of Offshore Fish Larvae from the Western Indian Ocean” to be led by James Mwaluma. A Facebook group has been created as a support platform for participants to share images and obtain advice from the trainers and invited experts on zooplankton and ichthyoplankton identification. This will supplement the informal network already created through the contacts made during the workshop, including the convivial, twice-daily bus ride to and from the Buyu campus, passing through busy urban and lush rural neighbourhoods, past a fruit-laden baobab tree, and the tantalizing ocean vista from a fishing village with dried porcupine fish hanging from the trees.

At the end of the workshop, all trainees were requested to complete an online evaluation form. All trainees provided positive feedback about the workshop, and all (thankfully!) noted an improvement in their knowledge by the end of the training. From the feedback it is clear there is a need for further workshops to continue building regional skills in zooplankton and ichthyoplankton identification, while other training requests included courses on phytoplankton identification (including nano- and picophytoplankton), identification and analysis of marine debris and microplastics, benthic meiofauna, biomarkers for foodweb dynamics, fish identification and statistical analysis. The IMS and the WIOMSA secretariat are warmly thanked for the excellent logistical support prior to and during the workshop, and the hospitality on site. And of course, Zanzibar – the birthplace of Freddie Mercury – has its own kind of magic!
Walter Munk- A Founding Father of Modern Oceanography (1917-2019)

The oceanography community lost one of its most ardent and enthusiastic contributors on 8th February of this year at the age of 101. Prof. Walter Munk was born on October 19, 1917 in Vienna, Austria-Hungary. He moved to New York in 1932, where he decided to leave a career in banking and pursue research, graduating with a degree in physics from the California Institute of Technology, in 1938.

He completed his PhD at Scripps Institute of Oceanography, La Jolla, California, USA under the guidance of oceanography legend, Harald Sverdrup. After becoming a U.S. citizen he worked with the U.S. Navy Radio and Sound Laboratory, developing methods and techniques for marine warfare by US troops. The Sverdrup & Munk wave prediction technique was successfully used in the 1944 D-Day landings at Normandy, the largest naval invasion. He along with Sverdrup and coastal engineer, Bretschneider developed the SMB theory which laid down the foundations for research that led to the development of today’s sophisticated ocean models. He studied wave grouping (sets) and was also the first to study wave surges that hit the coast during large swells and storms naming them— infragravity waves.

Prof. Walter Munk attained a full professorship in geophysics in 1954 at Scripps where he continued working till his death.

His main contribution to Indian Ocean studies was through a special experiment that he led in 1991 near Heard Island, in the southern Indian Ocean. This wide-scale experiment tracked 12 major swell events from storms in the Southern Ocean all the way up to Alaska swells, using a system of 6 wave-measuring stations in the Pacific Ocean. The experiment proved that the California summer swell can originate all the way from the Indian Ocean. Another significant contribution was his study of how winds drive currents and his coining of the term ‘wind-driven gyres’. He also made important tidal measurements with pressure sensors on the deep-ocean floor. His research interests went beyond oceanography and he helped to prove ‘tidal locking’ (the same side of the Moon always facing the Earth).

His illustrious progress earned him many significant awards throughout his career, such as the National Medal of Science (1985), Kyoto Prize (1999), Prince Albert I Medal (2001), Crafoord Prize (2010), Explorers Medal (2014). In 1993, he was the first recipient of the award instituted in his name— the Walter Munk Award given “in Recognition of Distinguished Research in Oceanography Related to Sound and the Sea”.

R/V INVESTIGATOR Voyage - 110°E

Around 60 years ago, during IIOE -1 marine scientists aboard ships from 14 countries combined their efforts to explore the deep waters and seabed of the Indian Ocean, which collected a vast amount of information that formed the basis of scientific understanding about the Indian Ocean basin.

From 14 May to 14 June 2019, an Australian voyage, following in the wake of HMAS Diamantina (IIOE-1), retraced one of the historic transects seeking to reveal the effects of climate change on the physics, chemistry and biology of the waters of the south-east Indian Ocean. The expedition led by Professor Lynneath Beckley from Murdoch University, in capacity of Chief Scientist, is a major part of Australia’s contribution to the ongoing IIOE-2 mission and this research was supported by a grant of sea time on RV Investigator from the CSIRO Marine National Facility. Forty researchers from 18 institutions participated in 32 days of sea sampling along the 110°E longitudinal meridian in the deep ocean, approximately 500-600 km offshore off the west coast of Australia. Focus studies included those on physical processes, bio-geochemistry, nitrogen sources, microbes, primary production, zooplankton, mesopelagic fishes, food webs and whales. Considering high technological advancement since the first expedition, the team also aimed to discover how microbes contribute to the functioning of the Indian Ocean, using current genomics techniques. Also bio-optical methods were used to confirm the accuracy of ocean colour observations by satellites and to then evaluate production by algae and carbon sequestering on an ocean basin scale.

The team included scientists and postgraduate students from 7 Australian universities - Murdoch University, Curtin University, University of Tasmania, University of Technology Sydney, Macquarie University, University of New South Wales and University of Western Australia along with researchers from the University of Auckland, University of Maryland Center for Environmental Science, Scripps Institution of Oceanography, Spanish National Research Council, Alfred Wegener Institute, NOAA, CSIRO, Australian Institute of Marine Science, Centre for Whale Research (WA) Inc., and...
Is Carbon-to-Chlorophyll Ratio getting its due in the Indian Ocean?

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I am obviously not an ecosystems-BGC guy but I have a great fascination for them. Ocean colour satellites have revolutionised ocean ecosystem-BGC understanding, modeling, predictions and projections. However, I find that mysterious parameters remain in models, typically due to a lack of observational evidences for constraining them. Phytoplankton growth rates, photoacclimation and carbon-to-chlorophyll ratio are among the most important of these mysterious parameters.

Way back in 2006, Rob Armstrong warned us that models need to be able to predict phytoplankton growth rates and carbon-to-chlorophyll ratios for accurately modeling ocean carbon cycle (Armstrong 2006; doi:10.1016/j.dsr2.2006.01.020). As I stare at some of the large-scale features related to ecosystem-BGC in the Indian Ocean, it seems like C:Chl still has a long way to go.

Look at the figure on the left, of oxygen saturation at 150m depth and mean chlorophyll from MODIS. The Indian Ocean is notorious for its anoxic regions but chlorophyll would make you think it’s still a fairly productive ocean. Well, at least to the north of the equator. Chlorophyll of course is not phytoplankton biomass. Models always compare their simulations to satellite chlorophyll and claim victory but again it’s impossible to observationally constrain carbon export and so on. This underscores the importance of C:Chl ratio which can hardly be overemphasised. What are the relative controls of light, temperature and nutrients on C:Chl over the Indian Ocean?

Figure 1: Oxygen Saturation

Figure 2: Links between marine nitrogen fixation and denitrification. Nitrogen gas dissolved in the sea is ‘fixed’ by microorganisms in the upper 100 meters to form nitrogen compounds that are used by other organisms to sustain life. The reverse process - denitrification - occurs at depths of 100-1000m in the Indian Ocean and the eastern tropical Pacific Ocean (red seas). Nutrients in waters upwelling from the denitrification zones have very low ratios of nitrogen to phosphorus (N:P). A geochemical method known as the P* approach inferred that most nitrogen fixation occurs close to these denitrification zones, but Wang and colleagues’ analysis now suggests that it occurs mainly in the subtropical gyres (yellow areas) downstream of the tropical upwelling regions. The high levels of nitrogen fixation in the gyres contribute to the formation of biomass that has high N:P ratios, which sinks to the oceans interior (blue arrows) and compensates for the loss of nitrogen caused by denitrification.
Especially nitrate vs iron controls?

The other ecosystem-BGC mystery is N₂-fixation. Low DO always brings up denitrification. The old paradigm was that N₂-fixation and denitrification are closely coupled. Based on putative impact of N₂-fixation on surface water N:P ratios, Deutsch et al. (2007; doi:10.1038/nature05392) produced a map that indicated that the eastern Pacific and Arabian Sea would be dominant N₂-fixation regions. But a brand new study by Wang et al. (2019; https://doi.org/10.1038/s41586-019-0911-2) uses an inverse and a forward model to present a new map of N₂-fixation regions over the World Ocean. Their results are considered better constrained. They pick out subtropical gyres as the regions of high N₂-fixation.

Gruber (2019; doi: 10.1038/d41586-019-00498-y) provides a nice summary of Wang et al. (2019)’s most salient findings which are summarised in his figure. (Figure 2)

In the modified CESM model Wang et al. (2019) employ, denitrification and N₂-fixation are decoupled mainly because of grazing! They use carbon export as one of the constraints but it is unclear if the role of variable C:Chl was considered in this study. C:Chl is clearly critical for determining phytoplankton biomass and hence carbon export.

C:Chl typically decreases with depth because of photoacclimation. But phytoplankton growth rate, nutrients and temperature also have strong controls on the C:Chl ratio. For example, Wang et al. (2009; www.biogeosciences.net/6/391/2009/) present a C:Chl model based on light, nutrient and temperature dependence. Their model simulations argue that nitrate is responsible for the high C:Chl ratio in the western warm pool while iron determines the displacement of the HNLC front but light is primarily responsible for the vertical decrease of phytoplankton C:Chl ratio. Temperature seems to have a relatively small effect on the C:Chl ratio in the Equatorial Pacific in this model. More interestingly, Wang et al. (2012; doi:10.1016/j.jmarsys.2012.03.004) report that while surface Chl is higher in the equatorial Pacific, the euphotic zone phytoplankton biomass is higher in the equatorial Atlantic. These counter intuitive results are attributed to iron limitation and the large C:Chl ratio in the Pacific and the higher nitrate and subsurface biomass maximum in the equatorial Atlantic. Such studies are also needed in the Indian Ocean for a better region-specific aspects of N₂-fixation and carbon export.

Modeling and estimate C:Chl from observations still produce dramatically different numbers as seen above in the comparison of a new C:Chl model with a satellite-derived estimate. Jackson et al. (2017; doi: 10.3389/fmars.2017.00283) compares C:Chl from their new model with Sathyendranath et al. 2009. Roy et al. (2017; http://dx.doi.org/10.1016/j.rse.2017.02.015) produce a map using ocean colour which differs from both of the above estimates. (Figure 3.)

Circling back to N₂-fixation, if subtropical gyres are the hotspots for N₂-fixation, then how does the complicated gyre dynamics in the Indian Ocean differ? The seasonality of the circulation shown below so nicely depicted by Schott and McCreary (2001; DOI: 10.1016/S0079-6611(01)00083-0) raises some interesting questions. (Figures 4a&b)

How do the regional and seasonal gyres in the Indian Ocean impact N₂-fixation? What is the role of any aeolian deposition of iron over this region? Are the coupling between denitrification and N₂-fixation and the impact of grazing distinct over the Indian Ocean?

May be I am way off in the way I am thinking about this. But I am sure the real ecosystem-BGC guys in IIIOE - II can straighten me out. Maybe we can use the same CESM model or another model to carry out a nice study focused on the details of these processes over the Indian Ocean and drive some data needs as well.
Until recently, the sea level, at intraseasonal time scales, in the tropical belt has been known to be primarily influenced by baroclinic processes. A recent study (Rohith et al 2019), however, has challenged this long-held perception. It has shown, through bottom pressure recorders (BPR) and numerical simulations, that there exist significant barotropic sea level variability in the tropical Indian Ocean during boreal winters. The strong winds associated with boreal winter Madden-Julian Oscillation (MJO) at the North-west Australian Basin (NWAB) initiates an ocean response that penetrates all the way down to the ocean bottom thereby producing a barotropic response. This barotropic response subsequently radiates out as a continental shelf wave (CSW), a barotropic planetary Rossby wave (PRW) and a barotropic topographic Rossby wave (TRW) that eventually invades the entire tropical Indian Ocean within tens of hours. The variabilities associated with these barotropic waves ranges from 6-8 cms which explains about 30-60% of the standard deviation of the total observed intraseasonal sea level variability. The barotropic sea level of the entire North Indian Ocean therefore coherently rises and falls at intraseasonal time scales (30-80 days period) and is supported by observational evidence of coherent bottom pressure variability at three widely separated locations of Bay of Bengal, Arabian Sea and East Indian Ocean as well as satellite gravimetry. Systematic sensitivity studies using ocean general circulation models reveal that the interplay of stratification and gradients in topography in the source region, counterintuitive to textbook barotropic dynamics, plays an important role in determining the initial perturbation. The topography of the Indian Ocean is vital to these basin-wide fluctuation. The Ninety East Ridge (NER) steers the planetary wave north-westwards while the southeast Indian ridge (SEIR) acts as a wall and prohibits these waves from venturing into the Southern Ocean.

The existence of these intraseasonal barotropic waves presents fundamental implications. The remote sea level excitations due to MJO was earlier associated with baroclinic dynamics that envisaged a response time of a few weeks. The discovery of these barotropic waves, which propagates with a phase speed in tens of meters per second, reduces the response time to a few hours. This study also convincingly argues that this barotropic variabilities should be accounted for while interpreting sea level signals from space altimetry - an exercise ignored in multiple previous studies (Nagura et al 2012; Suresh I et al 2013; Han 2005; Cheng et al 2013). This study also has implications for operational purposes. Any regional model used to determine the ocean state of the Indian Ocean should encompass the source region of these barotropic waves. Otherwise, a high frequency exchange of boundary information is paramount to resolve these fast barotropic waves which is a computationally expensive exercise. These barotropic waves carry significant energy and momentum and likely play a significant role in the energy and momentum budget. The peak value of this barotropic kinetic energy contained in the North Indian Ocean at intraseasonal time scale is ~ 20 petajoules which is about 5% of the global mean barotropic kinetic energy (Aiki et al., 2011). 20 peta Joules at intraseasonal time scales is significant in terms of magnitude and it is of consequence because it has its origin in a relatively small area (compared to the global ocean area) located in north-west Australian Basin. It is imperative to know how this energy is eventually dissipated. This energy might act as a reservoir for deep ocean intraseasonal variabilities. The mean vertically integrated velocity of the flow during December-April turns out to be non-negligible ~ 2 cm per second and therefore challenges the age old notion of the existence of the level of no motion.

References:
Dynamics of the Arabian Sea High Salinity Water Mass and Hypoxic Zones along the South West Coast of India - A Modelling Approach

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Ms Varna is Project Scientist at INCOIS. Her article summarizes in short, her report submitted to Cochin University of Science and Technology as a part of her MSc Project dissertation under Mr Muraleedharan K.R, Senior Scientist, NIO, Kochi

Abstract
A 3 dimensional 1/12° resolution model developed with ROMS-AGRIF was used to study the dynamics of the Arabian sea high salinity water mass and hypoxic zones by coupling the model to a NPZD type biogeochemical module. The model was validated with results from remotely sensed data (AVHRR), in situ data (MR-LR cruise data) and other validated model data (HYCOM). Major processes along the southwest coast of India viz coastal upwelling, advection of high saline Arabian Sea waters, warm pool and the fag phase of the upwelling were able to be represented using the model output. The future scope of the work would be to use a more developed biogeochemical model and to use more strict biogeochemical lateral boundary conditions.

Introduction
The Indian Ocean is different from other ocean basins because of it being bounded by the Indian subcontinent in the North separating it into two arms which are forced by seasonal forcings. The general ocean surface circulation in the Northern Indian Ocean is thus driven by Monsoonal circulation. The Arabian Sea, the western arm of the Indian Ocean serves to be as a complex system in which both physical and biological forcings counter-interact to form a suitable domain for study of complex physico-biogeochemical processes in the tropical ocean. The formation process of the high saline water mass in the Northern Indian Ocean due to winter cooling and its spreading towards south under various forcings has been studied well. The present study aims to identify the dynamics of the Arabian Sea High Salinity water mass and hypoxic zones along the southwest coast of India through numerical modelling studies.

Data and Methodology
In this study OGCM ROMS-AGRIF is coupled to a nitrogen-based biogeochemical model named NPZD that calculates source and sink terms for both biological and chemical components which in turn was coupled to a oxygen module in such a way that the oxygen concentration is influenced by other biogeochemical variables but oxygen did not have an effect on them. The physical model ROMS-AGRIF was forced by surface boundary conditions from NCEP Reanalysis 2 data and lateral and initial boundary conditions from ECCO phase II model. The NPZD model initial and boundary conditions were supplied by the climatological data set World Ocean Atlas 2009(Garcia et al., 2010b) and SeaWIFS respectively. The hydrodynamical model was set up by running an inter-annual simulation for a moderate resolution (1/12°) regional configuration of the ROMS for the Arabian Sea region. The domain was configured to have 32 vertical sigma levels and an area of around 2500 X 2500 Km (5°N-30°N, 60°-80°E).

Figure 1 (a) 8°N Longitudinal Sections - March
Figure 1 (b) 14°N Longitudinal Sections - March
Figure 2 (a) 8°N Longitudinal Sections - July
Elemental View - Chemistry
Validation was done by comparison with remotely sensed data (SST from AVHRR), in situ databases (MR-LR cruise data) and other validated model data (SSS from HYCOM).

**Results**

The validated model output was analysed by plotting vertical sections of temperature, salinity, nitrate and oxygen. During spring pre-monsoon (March) [Figure 1a,b], waters below 120m were strongly stratified due to weak winds. Temperature showed a gradual increase from coastal to open ocean waters and SST increased towards south. A high saline water tongue was visible in the section due to the existence of ASHSW. However coastal SSS was lower. Flow down of high salinity water to the coast is also visible. The surface waters were saturated with the presence of high quantities of dissolved oxygen (DO). An Oxygen Minimum Zone (oxygen contours of values 0.5ml/l were used for demarcation) was observed at intermediate depths. Deeper waters have comparatively higher nitrate concentration as compared to surface waters, which shows that the surface waters were oligotrophic. During the summer monsoon [Figure 2a,b] cooler waters from higher depths upslopes towards the coast serving as an upwelling signature. However the degree of upsloping decreases towards Northern latitude. Upsloping of salinity, nitrate and DO contours also occurs towards the coast. At the surface, concentration of DO showed a gradual decrease towards the coast due to higher production. The intermonsoon fall [Figure 3a,b] represents a retreat phase of the south west monsoon. The temperature decreases from open ocean to coast. Due to the prevailing South West winds and existing upwelling thrust there is an increase in the nitrate concentration in near-surface water along the coast. The increased nitrate concentration coincides with low DO. Though it is a fag phase, isolines of temperature, DO and nitrate upslope towards the coast. There is also evidence for the intrusion of ASHSW from the west. During the spring intermonsoon, a transition period from winter to summer, the entire region becomes oligotrophic. A similar scenario exists during September to October, transition of summer to winter monsoon characterised by warm, shallow mixed layer depths and strong stratification. Nitrate which is the main limiting nutrient is at undetectable levels in the surface waters. Even after fag phase of upwelling, low oxygen concentrated waters exist along the shallow regions due to density stratification. With the onset of summer monsoon, the southwesterly winds move the surface waters away from the coast and are replaced by colder, nutrient rich and oxygen deficient waters from the subsurface. This leads to phytoplankton blooms and increased productivity. The upwelled water further depletes and forms hypoxic zones along the coast due to oxidation of high organic load.

**Conclusions**

The modeling approach allowed an integrated view of the time and spatial variability of the various parameters of the system, especially the processes along the south west coast of India viz. coastal upwelling and transport of oxygen deficient waters.

The model was able to represent premonsoon warming which is denoted by Arabian Sea mini warm pool as a region with SST greater than 28°C, the upwelling of cold nutrient rich subsurface water during summer monsoon season, advection of Arabian Sea high salinity water and OMZ from west towards the coast and finally the fag phase of upwelling was explained with increase of temperature along the coast during fall intermonsoon period. Certain shortcomings are needed to be rectified by improving the model capabilities like use of improved lateral boundary conditions for biogeochemical variables, implementation of more complex biogeochemical model with more functional groups like PISCES (Aumont et al 2015).

**References**


The first author’s research is focused on improvements in fishing technology with an emphasis on conservation.

The experimental gill net trials, with new generation materials Sapphire (7x3), STAR (No.8) with control (Polyamide, 8x3) of mesh size 135 and 140 mm, were carried out on FV Sagar Harita. These trials in on board the departmental vessel for longlining and gillnetting were conducted beyond 1900 m depth to tap the resources off the eastern Arabian Sea. Results showed increased target catch in experimental nets and reduced bycatch (turtle and dolphin) compared to control nets. Even though tuna was the target (70-150 cm size range) catch, a number of other high-value fish species of commercial importance were also noted. The other large pelagics consisted predominantly of talang queenfish (Scomberoides commersonianus) followed by kingfish (Scomberomorus commerson), barracuda (Sphyraena spp.), dolphinfish (Coryphaena hippurus), Indo-Pacific sailfish (Istiophorus platypterus), threshed shark (Alopias superciliosus), silky shark (Carcharhinus falciformis), other requiem sharks and mantas.


Dare to Care- Conservation Measures
Multi location testing with another set of experimental and control nets with two high sea gillnetting groups of fishermen from Tamil Nadu (FIDO and SAFF) also showed similar results. In addition species like Indo-Pacific sailfish, marlin (Makaira indica), striped marlin (Tetrapturus audax), dolphinfish, thresher sharks and mako (Isurus oxyrinchus) were also caught in the same nets operated commercially.

During the fishing trial Tuna (70-150 cm size range) was the target catch but maximum contribution was by other high value fish species:

One turtle (Hawksbills) weighing 50 kg was caught in the control net which was released back to the sea:

STR and Sapphire gillnets each had contributed 37.5% of the total catch in experimental gillnets. STAR gillnets caught 25% of the catch.

<table>
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<th>STR</th>
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<td>Catch/h of soaking</td>
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One of the main objectives of this work was to evaluate the efficiency of the circle hook in comparison with the J-hook using three different types of baits. Preliminary observation did not show significant difference in "J" and "Circle" hooks. However experiments are being continued. Another set of experimental operations using advanced longline fishing systems, being operated by the high-sea fishermen groups from Tamil Nadu for large pelagics in comparative analysis also showed the same results. The efficiency of circle hook and J-hook in longline fishery were determined in different fishing stations in selected areas.
Informal articles are invited for the next issue. Contributions referring Indian Ocean studies, cruises, conferences, workshops, tributes to other oceanographers etc. are welcome. Articles may be up to 1500 words in length (MS-Word) accompanied by suitable figures, photos (separate .jpg files).

Deadline: 30th November 2019

Send Your Contributions as usual to iioe@incois.gov.in

Editorial Committee : Satheesh C. Shenoi, Satya Prakash, Celsa Almeida

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