UN DECADE OF OCEAN SCIENCE IN THE WIO: Opportunities for the WIO region

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This was part of a series of regional workshops aimed at consolidating regional positions and recommendations for the Decade, which was proclaimed by the United Nations (UN) General Assembly to run for the period 2021 to 2030. “The Decade” offers the ocean community a once-in-a-lifetime opportunity to join efforts, mobilize resources, create innovative partnerships, and engage governments in catalysing actions to achieve high-level scientific and technological breakthroughs.

The Intergovernmental Oceanographic Commission of UNESCO, which was tasked by the UN General Assembly to prepare the implementation plan for the Decade, joined forces with WIOMSA, and the Secretariat of the Nairobi Convention (UN Environment) to organize this regional workshop which was attended by over 150 participants. It emphasized the need to strengthen and build upon existing mechanisms and frameworks, and align with the African Union’s initiatives. This includes the Agenda 2063, which recognized the blue economy as a major contributor to continental transformation and growth, and the 2050 African Integrated Marine Strategic Plan of Action (AIMS 2050), which provides a roadmap for increased wealth creation from Africa’s oceans and seas by developing a sustainable, thriving blue economy.

Capacity development was identified as a priority, in particular the improvement of infrastructure.
and facilities for research, provision of training for scientific and technical staff, as well as translation of science to policy. Other issues highlighted include the role of youth and job creation, marine spatial planning (MSP), climate change impacts on the coastal zone, land-sea interactions and pollution, and innovative financing models for the ocean economy.

These are some of the key messages from the workshop:

i. Solutions need to be built in Africa but we are not starting with a blank page – the continent needs to build outwards, based on existing projects and programmes. In this regard, existing mechanisms, frameworks and strategies need to be built upon and be aligned with African Union initiatives. The African commissions and conventions already in place need to be harnessed to ensure smooth coordination and uptake of Decade-related activities, especially at a regional level, which may have different specific challenges and opportunities to address. In this way global processes can be domesticated to address African needs.

ii. Blue economy is a major priority for the region – but how can we better define what it means for governments, communities and scientists so that we are all speaking the same language? What are the major data and knowledge needs for a true blue economy? How can we move past the concept and get to the practical application of blue economy? MSP is one solution but there are other important research needs.

iii. Youth are the future. There needs to be sustained and continued investment in the next generation. Young people need to be encouraged to engage in ocean science. Jobs need to be created and practical obstacles need to be overcome.

iv. There are examples of innovative financing models that exist or that could be developed. We need to engage with a range of different actors – traditional donors, the private sector, banks and others – to make these innovative financing models a reality. We need to send unified messages to donors about the type of support we need so that there is a snowball effect and not a snowflake effect! Talking with one
Collating responses during one of the workshop’s breakout sessions discussions

The WIOMSA President, Dr. Jacqueline Uku giving a keynote presentation on “the future of capacity development for sustainable benefits in ocean science”

voice is particularly important in this regard, and especially for the different regions of Africa.

v. There is capacity in the region but it is unevenly spread between countries and between types of institutions and actors. Capacity development needs to be structured and inclusive and there needs to be monitoring and follow-up. Opportunities need to be developed to take advantage of south to south capacity development initiatives. Capacity development needs to include both scientific capacity for new research, capacity for using existing data, capacity for technical staff, and also capacity on translating science to policy.

vi. Poor governance and policy are constraints to effective management of marine resources. The “science” of governance and policy has been neglected. We need social science to understand why governance fails and how policies can be more effective. This is part of the ocean science that the Decade needs. To ensure that the science is used for action, the science-to-policy-to-practice nexus needs to be fostered though strengthening existing science to policy mechanisms (e.g. the Science to Policy Platform of the Nairobi Convention).

vii. Ocean literacy and communications should be a priority and targeted strategies will be needed for different groups. We need to encourage all people to care about the ocean. This will help on all levels from lobbying the governments to dedicated core financing to attract more young people to ocean science as a career.

viii. Data is a sensitive issue. “Fly-in-fly-out” research is not acceptable and better systems for curating and managing African data in Africa need to be developed, while still maintaining connectivity to the global data landscape. Clearing house mechanisms that provide a data curation function as well as inventorying information on training and professional opportunities need to be strengthened.

ix. Modeling was identified as an important tool for prediction and forecasting the behaviour of ecosystems, in support of management and policy decisions. Participants emphasized the need for high resolution modeling of the coast to shelf area and establishment of a network of African ocean scientists as well consideration of the proposal for an African research institute/university dedicated to ocean science.
The exchange of individuals between marine populations, commonly referred to as marine connectivity, is a fundamental ecological function that underpins the benefits derived from natural resources, and the persistence of ecosystems under changing climate.

Map of larvae sources (out-degree), sinks (in-degree), and corridors (betweenness centrality) gradients in coral reefs (top panel), MPA (middle panel), and seamounts (bottom panel)
So essential is connectivity that one of the main conservation policies pertaining to the protection of ecosystems – the Convention on Biological Diversity’s (CBD’s) Aichi target 11 – in explicit terms calls for its inclusion among the main criteria for spatial conservation planning. A recent study by a consortium of institutions including Macquarie University, WIOMSA, the United Nations Environment Programme and the University of Tasmania, identified gaps and opportunities for maintaining natural connections and connectivity corridors within marine protected area (MPA) networks and maritime zones as mediated by larval dispersal. The study found that the region is highly interconnected, with direct connections and potential larvae pathways between the high seas and territorial waters.

The study reports:

"Over half of the larvae released in the high seas settled within territorial waters and majority of these settled in Mauritius, Seychelles, and Madagascar."

"One way that countries can safeguard fisheries is through a regional planning approach using functional connectivity as a focus for identifying marine areas suitable for inclusion in the regional network of managed areas."

This suggests a significant contribution of the high seas to marine capture fisheries in nations’ coastal areas in the western Indian Ocean (WIO), with potential implications for coastal fisheries.

It was established that the region may need to do much more to ensure key network attributes, including the corridors, and both incoming and outgoing connections are adequately protected as envisaged in the CBD’s Aichi target 11. The study found that overall, a third of all MPAs in the region are completely isolated, with no incoming and outgoing connections. Fifty five MPAs do not have incoming connections from any other MPA, while half of all MPAs (approximately 62) do not have outgoing connections to another MPA. While these findings highlight significant shortcomings in the current protection arrangement in the region, they emphasize a need for the national and regional frameworks of conservation planning to explicitly consider connectivity in planning for the full benefits of protected areas to be realized. The study provides a transboundary spatial conservation planning scenario that focuses on connectivity, among other factors, and assumes the establishment of mechanisms for the management of areas beyond national jurisdiction.

Their movement up and down in the water is timed with day–night cycles. They may move down during the day to hide in the dark depths from predators, only to swim up to the surface again at night where they feed on nourishing phytoplankton. The phytoplankton is located close to the surface because it needs light to photosynthesise.

Although they are very small and often overlooked, copepods are actually one of the most abundant multicellular organisms in aquatic environments. And they form the secondary base of the marine food web (phytoplankton are first) and serve as food for growing the fishes that feed us. No wonder then that scientists want to understand where they’re found.

As part of my doctoral study, I wanted to know if there are different assemblages of copepods associated with different water masses in the Western Indian Ocean (WIO). Understanding the geographic distribution of organisms is known as biogeography, and the present distribution of a species reflects historical processes of evolution as well present processes acting on survival. The the latter are subject to climate change, which, given the pivotal position of copepods in pelagic food webs could ultimately threaten food security. In order to map copepod assemblages in the WIO, I had to dig into the published literature detailing records on the distribution of copepods from warm to cold waters in the WIO. Historical records dating back to 1904 reveal four copepod assemblages in the region (Fig 1).

The most distinctive assemblage is found in tropical and subtropical waters off the Somalian, Kenyan, Tanzanian and northern Mozambican coastlines and it is located relatively close to shore. This come as no surprise as the currents determine where copepods are to be found, allowing them to form an assemblage. Just south of this assemblage, I found a subtropical to temperate copepod assemblage which exists from southern Mozambique to the northeast of South Africa.

The separation doesn’t end there: around the eastern coastline of South Africa, we found a copepod assemblage that is pushed offshore by warm waters, southwards into cold sub-Antarctic waters. Here, day-to-day mixing of warm and cold water causes sudden changes in seawater temperatures. These shifts can lead to the demise of copepods. Such areas often act as barriers to plankton distributions. From the north, then south, two open ocean copepod assemblages unify the dynamic oceanic processes in the WIO region. These copepod distributions reflect the surface circulation patterns of gyres in the region.

While this study generates new insights into the biogeography of copepods in the WIO, range...
shifts in plankton communities are more than likely: tropical species will displace subtropical species southwards and these in turn may force temperate species southwards. As seen for other marine life, copepods are vulnerable to anthropogenic influences such as ocean warming and ocean acidification: factors that will potentially cause extensive changes to ecosystems, including to key marine invertebrates at the base of marine food webs. Most importantly, there is currently little or no data available on the impacts of ocean acidification on a range of biological organisms in sub-Saharan Africa, let alone the WIO region, which is projected to be hit hardest by ongoing ocean change. Given the likely changes to circulation prompted by climate change, it seems that the untapped potential of copepod biology, which offers pathways to truths of climate change, is yet to be explored in the WIO.

Figure 1.
Map of four copepod assemblages in the Western Indian Ocean (for interpretation of the references to colour in this figure legend, the reader is referred to the Internet version of this article).

Group A e.g. Scolecithricella abyssalis, Anallatheca teniserrata, Pseudomanotheia ovata, Claisocalanus farrarai

Group B1 e.g. Eucyclops media, Eucyclops longicornis, Caicobolamis pauper, Pleuromamma indica

Group B2 e.g. Gaetanus miles, Heterorthodes spinifrons, Metridia venusta, Claisocalamus parvus

Group B3 e.g. Claisocalamus lateops, Calanus similimus, Calocamis teneris, Claisocalamus ingens

Group B4 e.g. Parnaichonea californica, Pseudochiarella hirsuta, Lucicutia grandis, Gaetanus kruipii

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Fisheries managers and development practitioners struggle with the questions:

What ails small-scale fisheries (SSF)? What are the solutions? Which problem or solution is more important than the other? Unfortunately, the answers to these questions are not so straightforward.

If you visit any fish landing site or market in East Africa and ask actors what their problems and solutions are, a long list of answers will be provided. These answers in most cases do not explicitly inform fisheries managers. Not much is empirically documented, particularly about value chain-related constraints and opportunities in fisheries, especially through the lens of the actors themselves.

To narrow this gap, a recent study was conducted in Kenya at Malindi, Mayungu, Shimoni and Vanga. The study sought to empirically analyze key constraints facing SSF actors, and their proposed solutions. It targeted fishers according to the gear they use, middlemen and women, and small-scale fish processors.

The study used one of the multi-criterion decision analysis (MCDA) tools – analytical hierarchical process (AHP). The mechanics behind AHP is simply a comparison between two pairs of choices at a time, and ranking them. The end result is usually a score-based ranking of all choices, from the most important to the least important. Therefore, it is useful in attaining an empirical and unbiased view.

A total of 23 constraints and 18 solutions were listed and ranked within broad value chain themes referred to as “value chain dimensions” in the study. These included: capital, markets, resource, costs, equipment and infrastructure, governance, labour, training and trust.
So, what is most important from actors’ point of view?

1. **Inadequacy of capital and unaffordable credit within the capital value chain were the most severe constraints amongst all actors.** Despite the availability of loans from banks, the lending conditions – such as requirements for collateral, guarantors and high interest rates – were not compatible with actors’ fluctuating incomes. Lack of assets, religious beliefs and fear of losing investments due to non-payment also prevented access to credit. As a solution, actors proposed the establishment of interest free loans that take into consideration the seasonal nature of fishing and erratic incomes.

2. **Market-related constraints were ranked as the second most pressing problem amongst fishers and middlemen and women.** Fluctuating fish prices and low demand were identified as the key constraints. These resulted from unpredictable seasonal changes and an influx of local and foreign migrant fishers in the Northeast Monsoon season, leading to erratic supply and demand. The prolonged tourism slump resulting in the closure of hotels that often absorbed most of the fish also contributed to low demand. Actors’ solutions were to expand geographical reach to improve market demand.

3. **Scarcity of fish amongst processors.** This was a constraint particularly experienced by processors. They faced scarcity mainly because fishers preferred selling to middlemen and women who buy bulk quantities without much price negotiation. This occasionally causes processors to return home without fish, thus eroding their capital due to transport costs. Interestingly, unlike fishers and middlemen and women, processors highly prioritized the resource (the availability of fish supply) compared to capital. They suggested that facilitation of access to fish supplies e.g. provision of boats would regulate supply and prices. They also suggested easing migrant fishers’ entry and movement, since migrants supplied processors with cheap fish.

4. **Other less severe constraints included** the high cost of operations, lack of equipment and inadequate infrastructure, inadequate training, low level of trust, insufficient fishing labour, low access to fishing technology, adversarial price competition, low skills in fish handling and hygiene practices, among others.

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*Small-scale fish processors scrambling to buy fish in times of lean harvest (the Southeast Monsoon season at Mayungu in Kenya)*
These findings can help to bridge actors’ perspectives with those of managers and other value chain development agents, and thus help to define appropriate interventions.

**Fishers’ catch of a black marlin at Mayungu in Kenya. Sometimes it’s challenging for fishers to sell large fishes at once to one buyer**

**Fish trading at Shimoni**

In new research from Seychelles, James Robinson and colleagues find that fishers who had more diverse catches had larger catch weights and higher revenues. This positive effect of having a diverse catch was detected for offshore handline fisheries that are in long-term decline, with an average 65 percent decrease in catch rates since 1990.

Many tropical fisheries are currently unregulated and increasing their exploitation pressure, including some Western Indian Ocean small-scale fisheries. This new research suggests that natural resource managers should consider how catch diversity could be used as a management tool to protect fish stocks, catch rates and fishing revenues.

The research is the result of a collaboration between Seychelles Fishing Authority and academics in the UK and Australia, using long-term data on Seychelles’ small-scale fisheries, including catch weights, fishing effort and revenues. The study focuses on the offshore fishery, which lands approximately 40 percent of catches for all Seychelles’ domestic fisheries and mostly targets pelagic and demersal species. Using small boats with inboard motors that can fish for several days at sea, fishers bait handlines to catch different species, including red snappers, groupers and barracuda. By changing fishing technique, fishers can diversify their catches – for example fishing cooperatively to catch semi-pelagic species and also fishing at night to target barracuda.

With Calvin Gerry and Rodney Govinden of Seychelles Fishing Authority, Robinson et al. analysed catch and effort data that were collected from 1990 to 2016. In the offshore
handline fisheries, catches declined from 330 kg to 115 kg per day. For all species groups, catches reached their lowest recorded levels in 2016, leading to an overall 50 percent reduction in landed catches between 2000 to 2016 (from 200 metric tonnes to 100 metric tonnes per month).

**As catches declined, the fishing grounds were expanded and the fishing fleet increased from 16 to 82 vessels. Fishers spent longer at sea and used more fuel. The effort increases and catch declines suggest that the targeted fish stocks have declined.** The research also highlights large differences in fishing capability within the offshore fleet – small 3 m boats caught approximately 50 kg per day, whereas large 13 m boats caught over 300 kg per day. To regulate this fleet, fisheries managers will need to consider implementing different rules for different boats.

**But across the offshore fishing fleet, Robinson et al. also found that fishing success was related to catch diversity. Catching species across different fish stocks is thought to help make fishers resilient to environmental change, as fishers can switch between species depending on their availability.** The long-term data from Seychelles now also show that catch diversification can buffer fishers to fisheries declines. This effect also raised fishing revenues, particularly in years when fish prices were high – diverse catches were more likely to include high-value species like red snappers and groupers.

Tropical fisheries face an increasing demand for seafood and threats from global climate change. Many fisheries are heavily exploited and unregulated, which limits efforts towards sustainability. Robinson *et al.* identify the importance of diversity in determining catch sizes and fishing revenues – introducing regulations that promote diversification strategies is one way that tropical nations can move towards sustainable fisheries, so long as reductions in effort are also implemented where necessary.

**Graph 1:** Catch rates (kg per day, or CPUE) from 1990 to 2016 for total catches (A) and each species group (B).

**CATCH DIVERSIFICATION IN TROPICAL FISHERIES**

What ails small-scale fisheries?

**...continued**

READ THE FULL PAPER:


The R data scripts and statistical models are freely available on Github.
ON-GOING RESEARCH

Coral Restoration Project in Mauritius

By Nadeem Nazurally

As the global climate changes and our ocean continues to warm, coral reefs around the world are being negatively impacted. Mauritius has not been spared and its coral reefs have been touched by bleaching events over the past years, causing a significant decrease in coral cover.

Consequently, a coral farming and reef restoration initiative was launched in 2018 in Mauritius. The project is led by WIOMSA’s country coordinator for Mauritius, Nadeem Nazurally, and funded by the Higher Education Commission of Mauritius.

The project benefits from the partnership of world-renowned collaborators, notably Baruch Rinkevich of the University of Haifa, Israel, a pioneer in coral farming techniques and a member of the Coral Reef Consortium (CRC) and the University of Western Australia. The project has also garnered the support of Sun Resorts, a local hospitality group.

Table nursery in Mauritius that was built in 2016 for another research project: with farmed corals came the natural recruits.

A photograph of another successful coral farming initiative that was funded by the Global Environment Facility/Small Grants Programme through local non-governmental organization ELI AFRICA and coordinated by Nadeem Nazurally in 2013/2014. The coral farming venture is still being monitored.
In August 2019, the team built two types of nurseries, a table nursery (2 m water depth) and a floating nursery (10 m water depth), on the west coast (Flic en Flac) and the southeast coast (Pointe aux Feuilles) of Mauritius. To date, approximately 15 000 coral fragments have been grown in the nurseries, among which >7 000 have started to be transplanted back to the reef. Among the species successfully grown are Pocillopora damicornis, the staghorn Acropora muricata, Acropora selago (IUCN-listed as near threatened), the fire coral Millepora spp., and even the massive Porites lutea and Porites lobata (IUCN-listed as near threatened) is faring well so far.

Apart from being a restoration tool, the team uses the nursery as an important education and outreach tool. Local students are gaining hands-on opportunities to learn and gain practical experience in coral farming.

The project has also attracted the attention of international students that are taking the opportunity to learn successful techniques for coral farming in Mauritius. The project team also welcomes groups of young people for education and discovery sessions where they raise awareness of the impact of climate change on coral reefs. Similar awareness activity is organized for visitors to the country to sensitize them to the fragility of the Mauritian ecosystem.
When 10 African cities met in Cape Town to learn about climate change adaptation action planning and coastal resilience, they didn’t expect to participate actively, draw on walls and create mazes out of string. But by doing so, they went home with practical tools and a new drive for making their cities climate-ready.

During a very windy week in February, 10 coastal cities from across sub-Saharan Africa met in Cape Town to learn about climate change adaptation, coastal resilience and adaptation action planning. The aim: to equip the cities’ town planners, environmental teams and engineers with practical knowledge and tools to build climate resilience.

The methods were hands-on and more practical than what I am used to, so we had more chance of taking theory into practice – Noyoliso Walingo, Ugu District Municipality, South Africa.

Sharing stories around lived experience.

Cities had the rare chance to share lived experiences of the localized impacts of climate change. Participants told stories of the climate hazards they had experienced historically and shared what they’ve been doing to overcome the challenges these impacts bring. Telling stories like this elicited new questions and solutions not previously considered. The stories allowed for space to build relationships and foster connections to be harnessed long after the city engagement came to an end.
Understanding key concepts and learnings through interactive games

One particularly insightful session was an active workshop to learn about key concepts used globally around climate change, such as climate vs. weather, adaptation vs. mitigation and coastal natural assets.

For example, “a hot day today” would pertain to weather, whilst “average annual temperatures” would pertain to climate. Similarly, “switch from using cars to walking” would pertain to mitigation whilst “changing crops to their more drought resilient counterparts” would pertain to adaptation. Moving key words around allowed participants to deeply engage with the concepts, and overlaps or indecision inspired much conversation and debate. Already, participants were not only learning from the ICLEI Africa facilitators, but also learning from each other, all the while deepening their own relationships.

When learning about coastal natural assets and the value they bring to climate adaptation action planning, participants engaged in a tried and tested exercise known as “The jungle of jeopardy”. Standing in a circle, with each person representing either a coastal natural asset (mangroves, coral reefs, etc.) or an ecosystem service (storm surge protection, fish nursery, etc.), they tossed a ball of twine across to each other to understand how connected and complex these natural assets are and how nature can address many different aspects in the community.

Starting work on a climate change adaptation plan

A key selling point of the training was that participants would go home with a skeleton climate change adaptation plan with a coastal focus. This is why two full workshop days were dedicated to drafting this skeleton and the ICLEI facilitators were at the ready to answer questions.

Participants were guided through a series of practical, tailored exercises which not only provided them with a clear understanding of what to include in a climate change adaptation action plan, but also supported them through the process of developing this information for themselves. The practical nature of the process allowed these cities, in most cases for the very first time, to take ownership of developing an action plan.

Through the workshop we learnt how important it is to coordinate, to communicate, to work in integrated partnerships and involve everyone. Otherwise our efforts will not succeed

– Zeina Mohammed, Kili County, Kenya

The cities shared the outcomes of each stage of the development of their skeleton climate change adaptation action plan with each other. This allowed them to see that they are facing similar
challenges and created space to discuss how to share solutions to address these challenges.

On returning home, with remote support from ICLEI Africa, each of the cities will go on to further flesh out their skeleton climate action plan into a full climate action plan to be included in their land use planning mechanisms. Once these climate action plans have been embedded into local and national planning, they can become eligible for financing, turning actions into on-the-ground change.

**Deepening connections**

One should never underestimate the value of covering a wall with film and covering people with coloured markers. Once the skeleton adaptation action plans were complete, the cities worked together to find synergies between the climate hazards they experience on a day-to-day basis and the individual actions they each came up with to respond to these hazards. Apart from creating a colourful maze of connections, this also taught the valuable lesson that, whilst African cities face similar challenges, they can come up with innovative solutions to address these challenges; and by sharing these solutions, resilience can be collectively enhanced across the continent.

**Celebrations, selfies and drive to take action**

It was a full, intense week of hands-on learning, yet instead of petering out, the energy and enthusiasm remained right to the end and peaked when the ICLEI Africa team presented participants with their certificates of participation along with a beautifully designed training manual to guide them in their home language (English, Portuguese, French or Swahili). Participants can refer to this document for guidance when completing their climate change adaptation plans in their home countries.

Long after the formalities ended, new found friendships were cemented over ice cream and selfies before a final shopping opportunity at the V&A Waterfront and the flights home. Participants left inspired to tackle climate change and get the rest of their city officials on board in creating cities that are resilient, inclusive and thriving.

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This training was so different because we got to network with people from all around the world, and we got to share practical experiences and our ideas on how to overcome the collective challenges facing our cities. I am excited to take this forward and I hope our local governments will receive our work in an equally positive way because we know we are facing many challenges related to climate change. I am really motivated and excited to be part of this change.

– *Najma Yusuf Lelei, Mombasa, Kenya*
WIO server has approved a project which will result in the compilation of a manual for the identification of off-shore fish larvae from the Western Indian Ocean (WIO).

The proposed manual was motivated by the need to develop regional capacity in larval fish identification and learn more about the systematics and early life history of coastal and offshore fishes. The proposed new guide will feature samples collected from deeper offshore Kenyan and Tanzanian waters by the research vessels Mtafiti and Dr Fridtjof Nansen. A special effort will be made to include photographs of fish larvae at different stages of development for the identified specimens. These will be supported with drawings. The manual will be used by scientists, students and technical staff to aid in identification of offshore fish larvae from the WIO region and will assist in developing capacity in fish larval identification.

An inception meeting for the project was held from 20 to 24 January 2020 at the Kenya Marine and Fisheries Research Institute (KMFRI) in Mombasa. The meeting was convened in order to plan for the archiving and identification of samples for photography and drawing in Kenya and Tanzania; identifying suitable format and layout for the manual; and the assignment of tasks for the development of the book.

Project participants were Dr James Mwaluma of KMFRI, Professor Nadine Strydom from Nelson Mandela Metropolitan University, South Africa, Dr Shael Harris from the University of KwaZulu Natal, South Africa, Dr Stamatina Isari from the Institute of Marine Science, Norway, Dr Margreth Kyewalyanga from the Institute of Marine Science, Zanzibar-Tanzania; and Alphine Mbodze, a Master’s student from Pwani University, Kenya.

After evaluating the sampling stations and the mode of sample collection in the two countries, the eventual tentative working title agreed on was: An Identification Guide to Larval Fishes from Western Indian Ocean - Off Kenya and Tanzania. Most importantly the book will include important information about each larvae: meristics, photographs, life history and drawings. It was also agreed that initial identification, description and drawing will be done at NMMU which has the necessary equipment.
Of the 149 researchers who applied to participate in a regional workshop on stock assessment held in Zanzibar in March, the large majority were from the Western Indian Ocean (WIO), which highlights the great need for this kind of training in the region.

Applicants came from the WIO and other regions

The need to train fisheries scientists and managers in stock assessment methods in the WIO region is one of the core objectives of the FIDEA (Fisheries Data East Africa) project implemented under the MeerWissen initiative and funded by the German Federal Ministry for Economic Cooperation and Development.

Accordingly, a two-week training course on the assessment of stock status and the estimation of the Sustainable Development Goal (SDG) 14.4.1 indicator (the proportion of fish stocks within biologically sustainable levels) was jointly organized by the Leibniz Centre for Tropical Marine Research Bremen, the Food and Agriculture Organization of the United Nations (FAO), WIOMSA, the National Institute of Aquatic Resources in Denmark and the Institute of Marine Sciences in Zanzibar.

The workshop took place from 2 to 13 March in Zanzibar. Its objectives were to provide both the purpose and theoretical basis of stock assessments and hands-on application of how to choose and apply appropriate tools for assessment for the estimation and reporting of SDG indicator 14.4.1. It was officially opened by Dr Omar Amir, Deputy Principal Secretary in the Ministry of Agriculture, Natural Resources, Livestock, and Fisheries, Zanzibar and Julia Hannig, the head of Development Cooperation in the German Agency for International Cooperation (GIZ), Tanzania. It was attended by 30 participants drawn from 12 countries, including observers from the WorldFish Center and the Minderoo Foundation in Australia.
The workshop was held in two sessions and comprised a series of lectures interposed with hands-on practical use of stock assessment tools. The first session, held from 2 to 4 March, provided an opportunity for policymakers from Kenya, Tanzania and Mozambique to discuss the current national fisheries data systems, their strengths and weaknesses and suggestions for improvements. The second session, from 4 to 13 March, concentrated on the concepts and monitoring process of the SDG Indicator 14.4.1 and the data needs for estimation and reporting.

Key highlights from the workshop include the official launch of the FAO E-learning course on SDG indicator 14.4.1 and the Stock Monitoring tools in the Virtual Research Environment, which all participants were able to register with and are currently using for self-paced learning.

In addition, the participants were introduced to some classical stock assessment tools and data-limited approaches, including ELEFAN+, LBSPR, CMSY and SPICT, allowing them to apply these tools to the data from their respective countries. At the end of the workshop, all participants presented their reports with the results of the stocks analysed for their country.

Action plans were also developed at the country level for indicative planning for follow-up activities to ensure that participants get started and translate their learning into practice to help their countries monitor and report on the status of their fish stocks. Among the activities to be implemented is a commitment by the participants to share and disseminate the acquired skills with working groups and colleagues at their home institutions. They promised to continue with the SDG 14.4.1 eLearning course and to involve stakeholders to review and set up the reference list of stocks to be assessed with the introduced tools and to revise and resubmit their report to FAO on their countries’ status in reporting on the SDG 14.4.1 indicator. The consensus was that a follow-up workshop/training should be conducted within six months to maintain momentum, review progress and share good practices.
In the run up to the African Union Summit in February 2020 and Ocean 2020 Summit in June, a Western Indian Ocean (WIO) regional meeting was hosted in Kenya on 2 to 3 December 2019. The aim of the meeting, which drew participants from different sectors of the WIO as well as other African States, was to create awareness and update regional stakeholders on ongoing global discussions on the work of the High-Level Panel for a Sustainable Ocean Economy and the United Nations (UN) Ocean Conference 2020.

The High-Level Panel for a Sustainable Ocean Economy is a group of leaders from around the globe committed to developing, catalyzing and supporting solutions for ocean health and wealth in policy, governance, technology and finance. Members of the Panel include heads of state from Australia, Canada, Chile, Fiji, Ghana, Indonesia, Jamaica, Japan, Kenya, Mexico, Namibia, Norway, Palau and Portugal. They represent countries that are at different stages of development and whose communities rely on the ocean for their survival. By coming together, the heads of state from these countries hope to inspire change in the way the world values that ocean. They hope to inspire countries around the world to take actions that will lead to a sustainable ocean economy.

The Mombasa meeting consolidated various issues that are important to the WIO. The issues were aligned to the thematic areas of protect, produce and prosper and these were amplified by case studies from different African countries which served as examples of how best to champion these thematic areas.
To anchor these actions on scientific findings, experts around the globe are working on “Blue Papers” with the support of the World Resources Institute. The Blue Papers summarize the latest science and state-of-the-art thinking about innovative ocean solutions in technology, policy, governance and finance that can help to accelerate growth towards a sustainable and prosperous relationship with the ocean. More information on the Panel and Blue Papers can be found on [https://www.oceanpanel.org/](https://www.oceanpanel.org/)

In the area of protecting our oceans, it was recognized that the coastal ecosystem is under increasing pressure from rapidly growing populations, resulting in increased demand for goods and services, rapid urbanization, industrialization and associated problems of solid waste and effluent discharge in urban centers.

Expansion of agricultural activities in the rural hinterland areas has opened up indigenous forest cover and riparian zones of rivers, causing soil erosion through runoff and extensively reducing the forest cover, further compromising the carbon sinks. It was recognized that the coastal ecosystem is intricately linked with the hinterland through rivers, coastal forests and beaches and human activities in the terrestrial ecosystem significantly affect marine life in the oceans.

Protection of the marine ecosystem is critical and key challenges that prevent us from adequately protecting ocean resources in the WIO are weak collaborations, ineffective ocean governance systems and maritime security. A case study of Mikoko Pamoja (The Blue Carbon Initiative in Kenya) was highlighted as a unique way of protecting the critical mangrove habitats of the region, through sustainable use and preservation whilst generating resources and benefits through carbon trading.

Lessons learned from the successful management of plastics in Rwanda were also shared as a case study of waste management that can be adopted by countries in the region.

In promoting production from our oceans, key contributors to the decline in fish stocks were seen to be illegal, unreported and unregulated fisheries (IUU) as well as harmful fisheries subsidies. Key challenges were a lack of enforcement of...
monitoring, control and surveillance mechanisms and opportunities to strengthen these mechanisms were discussed by members.

The prosperity of the WIO was also deliberated on by members and they noted that the expansion of aquaculture and other ocean-based production systems, impact ocean ecosystems and this requires efforts for sustainable development in the WIO.

The work of WIOMSA was presented as a case study to demonstrate the use of science to support ocean development. Emphasis was placed on the need for knowledge creation in areas that can lead towards the sustainable development and prosperity of coastal populations.

For prosperous ocean systems there is a need for robust ocean predictions and it was stressed that the institutions in the WIO need to grow expertise in predictive science and have access to databases and technologies that provide for early warning systems for drought and disease outbreaks. The promotion of a sustainably harvested and productive ocean involves putting in a concerted effort to define the safeguards and thresholds of relevant models for our systems. Emphasis was also placed on the communication of science to national populations and to the policymakers for the creation of dialogues to support the protection and prosperity of our oceans. It was noted that as WIOMSA continues to help scientists to align their work with national, regional and global agendas it is clear that the blue economy requires a new set of skills to tap into the vast array of opportunities in the ocean.

In the WIO region, the anchor for the blue economy is seen to be the fisheries sector and the meeting issued a call to action for African fisheries. The call to action consists of critical actions for the High-Level Panel and the African Union to consider to save Africa’s fisheries, and to present as recommendations/commitments to the United Nations Ocean 2020 Conference. These actions include: ratification and full implementation of the FAO Port State Measures Agreement; enhancement of Africa’s surveillance and prosecutorial capacity; maintainance and publication of records of fishing vessels for tracking purposes; expansion and enhanced accountability.
in fisheries access agreements; support for the Fisheries Transparency Initiative; enhancement of regional collaboration to combat IUU; phasing out of harmful fisheries subsidies; development of sustainable aquaculture and mariculture; strengthening of the blue-green economy nexus through conservation of terrestrial and mangrove forest ecosystems; adoption of a circular economy for the management of plastic waste to ensure environmental protection; mapping of the ocean and undertaking appropriate marine spatial planning; development of early warning systems and relevant models that can guide future investments in the blue economy; strengthening of the research and policy nexus in ocean management; and development of practical tools to strengthen law enforcement capacity to address organized crime in the fishing industry.

The most memorable parting shot was expressed by the Ugandan delegate to the meeting, who said that:

“the threat to our ocean is real and this conversation must be brought to our dinner tables and a call made to the whole WIO community and the globe to take action to save Africa’s fisheries”
It is imperative to transform the way humankind impacts and relies on the oceans, and ocean governance needs to assume a transformative role.

In order to do so, ocean governance needs to be transformed. The Institute for Coastal and Marine Research (CMR), The South African Research Chairs Initiative (SARChI) Law of the Sea and Development in Africa and the SARChI Marine Spatial Planning at the Nelson Mandela University, in collaboration with the One Ocean Hub (OOH) and International Ocean Institute (IOI), hosted the Transformed and Transformative Ocean Governance Conference.

This event took place from 22 to 24 January 2020 at the Nelson Mandela University’s North Campus Conference Centre, and the cocktail function on the evening of the first day presented the perfect opportunity to showcase the Ocean Sciences Campus. A total of 90 delegates representing seven countries attended this event.

The aim of the conference was to provide a forum for a wide range of ocean experts and stakeholders to engage with the latest developments impacting ocean governance from development, ecosystem-based and human rights-based approaches, before starting to reflect and give direction on what transformed and transformative ocean governance means and requires.
Dylan McGarry and Taryn Pereira Kaplan co-chaired the civil society panel discussion. This panel was made up of Sherelee Odayar (South Durban Community Environmental Alliance & GroundWork), Khalid Mather (WildOcean), Christian Adams (small-scale fisher representative) and Kira Erwin (Urban Future Centre). Claire Roussell did a fantastic graphic harvesting job, where she summarized each talk and discussion through artwork and text.

The CMR was delighted to have a fantastic group of international presenters – all experts in their ocean governance-related fields:

- Professor Christina Hicks – Lancaster University
- Dr Wesley Flannery – Queen’s University Belfast
- Mr Paul Holthus – World Ocean Council
- Dr Kimberley Peters – University of Liverpool
- Dr Daniela Diz – University of Strathclyde
- Professor Philip Levin – University of Washington
- Professor Kevern Cochrane – Rhodes University
- Dr Peter Jones – University College London
- Professor Patrick Vrancken – Nelson Mandela University
- Professor Amanda Lombard – Nelson Mandela University
- Dr Bolanle Erinosho – University of Cape Coast Ghana
- Professor Lena Gipperth – University of Gothenburg

The conference was run as a single-use plastic free event. A representative for the Giving them Wings foundation had an exhibit at the conference, detailing its school outreach programmes and environmental education activities. In an attempt to offset carbon footprints for travelling to the conference, delegates were urged to donate funds towards this foundation to assist them in planting trees and gardens around underprivileged schools.
What happens when about 20 marine and lacustrine students-scientists from 14 countries are released (with their varied lecture room and practical-based knowledge) in the ‘field’?

The field here is a real-life set of connected ecosystems, from coral reefs over a sandy shore, to mangroves, into the catchment. Within a given number of days they must come up with a science-based view on issues of ecosystem management and conservation. This brings about much creativity, good ideas and even more questions... but mostly it is an eye opener to all involved.

From 9 to 23 February 2020, the Monsoon School of the MSc programme ‘Oceans & Lakes’ took place in Kenya, in Gazi Bay and in Mida-Watamu. This Monsoon School is a course in the Master of Science in Marine and Lacustrine Science and Management (‘Oceans & Lakes’), which is organized by the Vrije Universiteit Brussel, Universiteit Gent and Universiteit Antwerpen in Belgium, with partners in Kenya, many of which are alumni trained in Belgium. A group of 14 students from Oceans & Lakes, as well as 3 students from the Technical University of Mombasa, and 2 students of University of Western Cape participated in this 2-week summer school. The Monsoon School is a project course funded by VLIR-UOS, and is a part of the ‘south’ component of Oceans & Lakes.

With the goal of translating academic theory and training into practice and real-life cases, students are divided into groups; each group is assigned a tender to work on, related to a local topic, writing a report as a consultant for a specific stakeholder. Each group is a mix of students of different
backgrounds, interests and cultures, to prepare for future real-life professional situations. In this Monsoon School, these tenders involved topics such as plastic waste in marine and coastal environments, impact of tourism on megafauna, sustainable aquaculture, conservation of coral reefs, coastal erosion, mangrove restoration and conservation; all based on real-life situations in the coastal areas of Gazi and Mida-Watamu, Kenya.

Students first make a reconnaissance visit to the location of their topic, to get a sense of the situation. They then dive into the scientific literature on their topic, they consult experts, often alumni of Oceans & Lakes, now professionals. After this, they interview different stakeholders of the particular case that have access to the environment and its resources, such as community people, decision-makers and NGOs. Here they hear different voices, sometimes contradictory, but always with various perspectives. After brainstorming, working out scenarios, listing knowledge gaps, they prepare a field visit for their fellow students to introduce their topic, its scientific problem, the constraints, and the possible solutions. At the end of the Monsoon School, they present a draft report on the tender to the entire group of fellow students and experts, these now in the role of critical stakeholders. They also make up a first draft of a campaign to raise awareness about the topic (to be elaborated after their return to their university).

Before heading to Kenya, the students had to thoroughly prepare, so they were introduced with their new surroundings, and so that they could understand the different actors involved locally and the dynamics on the
Monsoon School of the MSc programme ‘Oceans & Lakes’ took place in Kenya

REGIONAL EVENTS

Monsoon School of the MSc programme ‘Oceans & Lakes’ took place in Kenya. Once there, the 2 weeks were used for different assignments. For the most part of the stay, the groups stayed in an ecological villa, that is based on a sustainable business model in relation to the local economy.

Part of the goal of the project is to teach students about the practical constraints of research application in a real-world context. Next to that, they are shown how research and training in the field must be done with respect to the environment and to actors and stakeholders, such as local communities. Students also learn how to report to an audience of different stakeholders, academics, peers, policy makers, local people, which will prove them very useful in their future career.

Local partners as well as alumni of the programme were invited to contribute. Experts from Technical University of Mombasa, Kenya Marine and Fisheries Research Institute, UNEP, Conservation International, Coastal and Marine Resource Development were there, but also experts linked to Universidad Central del Ecuador, Terra Nuova and San Luis Gonzaga National University of ICA. Indeed, many local problems are found elsewhere in a very similar way. They often need combined expertise and good practices for solutions. Lessons learnt are taken back to home countries after graduation, where our graduates will start their contribution to a network spanning the globe for wide-ranging issues.

Participants visiting Gazi mangroves
WOMEN IN THE WIO: THEIR INDISPENSABLE ROLE IN SUSTAINABLE OCEAN GOVERNANCE

By Angela Joann Patnode (Note: elements of this story have appeared in IWLearn’s newsletter here)

As the world focuses on eliminating poverty and sustainably developing the oceans, the role of women – and the unique perspectives they can bring to ocean governance issues – has become increasingly important.

Yet, as the United Nations Environment Programme notes, historically:

“the contributions of women in onshore fisheries, aquaculture, processing and trading of marine products, in managing plastic and other waste from urban and tourist growth, and their important role in conservation and disaster-risk reduction initiatives in marine and coastal areas have been routinely ignored or underestimated in research, management and policy.”

Additionally, though women make up about half of the workforce in the fisheries sector, they are largely concentrated in low-skilled, low-paid, seasonal jobs without health, safety and labour rights protections. Women also earn approximately 64 percent of men’s wages for the same work in aquaculture and face the risks of ocean degradation with less resources on hand to build resilience. In other words, the consequences of ocean degradation – biodiversity loss, increased food insecurity, lost livelihoods – disproportionately impact women.

Gender is not embedded or mentioned in Sustainable Development Goal (SDG) 14 (life below water), as it is in most of the other SDGs. Yet strong action towards gender equality and the empowerment of women and girls in ocean-related sectors is essential if the world is to achieve both SDG 5 (gender equality) and 14 (life below water), as well as the African Union’s 2015–2025: Decade of Women’s Empowerment under Agenda 2063.

The Western Indian Ocean (WIO) region, with an estimated gross marine product of US$ 20.8 billion/year, provides food and livelihoods for 60 million people living along its coast. Women in the WIO have contributed substantially to helping their communities reap these economic benefits, whether it be in ocean governance, fishing, or resource management. In Madagascar, for example, women are members of locally managed marine areas, where more than 50 percent serve as leaders. At the Baraka Makongeni fish farm in coastal Kenya, women oversee mangrove nurseries and manage small ponds to sustainably harvest fish and in Zanzibar, Tanzania, approximately 15 000 women farm seaweed, harvesting about 11 000 tons per year and earning USD 8 million in 2012.

Women in the WIO are also instrumental in societal decision-making. Along the coastal WIO, local women do most of the trading at fish markets, playing an important role in the processing and distribution chain. Women’s roles in the development of alternative production systems, such as farming of seaweed, sea cucumbers, pearl oysters, and of crab culture has been critical for enhancing coastal resources management. In Zanzibar and Kenya, women-managed mangrove boardwalk projects promote ecologically sensitive uses of mangroves through community-based tourism.
Women leaders have significantly influenced decision making processes and ocean governance in different sectors, from academia, to business, to civil society. Whether it is becoming the first woman to take charge of a South African naval ship; being the first female marine pilot in Kenya; serving as heads of State departments; or performing ground-breaking scientific research, it is clear that women are trailblazing at the frontiers of ocean governance.

Associations such as Women in the Maritime Sector in Eastern and Southern Africa (Womesa), supported by the African Union and the International Maritime Organization; Network of Women in Marine Sciences, WIOMSA; Women’s International Shipping and Trading Association, among others, are moulding women to become sea cadets, lead port operations, captains of ships and expand their roles in shipping, fishing and other sectors of the marine industry.

The roles and responsibilities of women engaged in coastal and marine resource development and management is evolving in response to changing socio-economic contexts and the opportunities confronting them.

“Women have an unrivalled opportunity to drive the industrialization of Africa’s oceans,” said Dr Nkosazana Dlamini-Zuma, the African Union Chairperson (2012 to 2017) during the 2015 continental conference on the Empowerment of African Women in Maritime.

There is thus a growing need to equip women in the WIO region with leadership skills for better advocacy, inclusivity in management and for policy development. Leadership skills are necessary to formulate informed policies critical to sustainable ocean governance in the WIO region. Platforms where women can share practical experiences, lessons learned and recommendations for use in their socio-economic contexts are also of crucial importance.

In this vein, the SAPPHIRE project organized a training workshop on Leadership Renewal for Women Senior Officials and Policy Makers in Marine Policy and Ocean Governance in WIO Region in Mombasa, Kenya on 4 to 6 December.
2019. The training offered a platform to motivate and inspire the participants – offering an environment in which they could reflect on and share successes, failures and ideas on how to seize future opportunities.

“We (participants of the training) are discovering more about what a leader should be – that it's not about position – anyone, anywhere can be a leader,” said Nashreen Soogun, Focal Point of Mauritius for the SAPPHIRE project. “There are therefore many opportunities in ocean governance for women leaders in Mauritius, at all levels, and I would encourage them to go into this field.”

The SAPPHIRE project recognizes that concerted, coordinated efforts will be essential to take full advantage of women’s unique viewpoints and contributions. To this end, SAPPHIRE activities on harmonizing and reforming policies and institutions will continue to support country efforts to expand women’s role in ocean governance, the blue economy, and beyond.
I wondered how to dispel such a myth about the dugong (Nguva) that had stuck in the minds of these young students.

I requested two volunteers to take a dugong through a maze to its choice seagrass bed and as the volunteers deliberated about the best path to take, I worked to dispel the myth by elaborating the functions and importance of the dugong in our coastal waters. I spent time highlighting the fact that the dugong is one of the most endangered species in our coastal waters and that its conservation and survival is critical.

Dugongs, which are marine mammals, form one of the charismatic species in seagrass beds and their protection and conservation would also lead to the conservation of vital seagrass beds that are a critical carbon sink for the Western Indian Ocean Region. Seagrasses provide a vital economic link to the blue economy through the support of a vibrant fishing industry.

“we have been told that the nguva is a mermaid!” exclaimed the students who gathered around me as I explained aspects of marine animals to them during this year’s Agricultural Society of Kenya (ASK) show in Mombasa.
The children’s corner at the ASK show helped the Kenya Marine and Fisheries Research Institute (KMFRI) to win a first prize for the best organization in Community Projects/Services during the show, which has been set up to showcase the work of institutions to the public.

Upon further reflection, the engagement with children at the ASK show demonstrated a critical gap in building capacity for children on marine and coastal issues when they are still young. Many of us who work in the field of marine research first encountered the sea when we were undertaking our undergraduate studies.

There are opportunities to spread this knowledge through the new school curriculum and there are opportunities for an institution like the KMFRI to participate in breaking local myths about the dugong as part of the blue economy dialogue, through contributions towards a blue economy curriculum for schools in Kenya.

The KMFRI Seagrass Group consists of Jacqueline Uku, Anham Salyani, Lillian Daudi and Charles Muthama.
A MESSAGE FROM ARTHUR TUDA ON HIS APPOINTMENT AS EXECUTIVE SECRETARY OF WIOMSA

The past few weeks have been full of an outpouring of congratulatory messages following my appointment as the Executive Secretary of WIOMSA.

I have felt very welcome. I am also aware that many of you greatly appreciate the work of Dr Julius Francis, the outgoing Executive Secretary – just as I do. Therefore, I want to take this opportunity to thank Julius for the more than 20 years he has been the Executive Secretary of WIOMSA. He has led the association through a period of impressive growth and I would like, both personally and on behalf of WIOMSA members, to express my sincere thanks to him for all that he has achieved for WIOMSA, its members and stakeholders. I also want to thank the WIOMSA Board of Trustees for my appointment and the confidence they have placed in me.

I am very excited about our organization and its future. The staff in Zanzibar are doing a great job and bringing me up to speed on all the challenges and opportunities that WIOMSA has been facing.

The challenge ahead is a big one for all of us. We all know and sense how fast things are changing in the domain of ocean science and management. The challenges requiring solutions from us – scientists and managers – are increasing and the expectations are high from all sides, including those of local communities, governments, politicians and society at large.

WIOMSA has grown tremendously in many ways – in building lasting partnerships and in delivering products and solutions for marine science, while building a solid membership foundation. My mission is to extend this trajectory into the future and turn WIOMSA into a leading science association. The expertise and drive of WIOMSA members, a dedicated board, strong leadership at the Secretariat and supportive partners are what has contributed to WIOMSA’s success. I trust in the ability of this group and its many capacities. I will continue looking internally to make the best use of different talents and abilities we all bring to WIOMSA. Together we will achieve a lot.

We all know that WIOMSA has to develop further. This calls on all of us – particularly WIOMSA members – to be active participants. We have to work together and put collaborative working relationships at the heart of all we do. To unlock WIOMSA’s greatest potential we must all think more about how to collaborate better and support each other. This is what will make WIOMSA more successful. Because science and practice are enriched by collaboration between individuals with diverse but complementary perspectives, I will endeavour to create more opportunities for collaboration.

Our new strategic plan, currently under development, will lay out a concrete action plan that will steer WIOMSA into the next decade. The strategy will aim to fulfil the expectations of our stakeholders – members, partners, staff and the community in which WIOMSA operates. I seek to build long-term relationships to mutual advantage, fully aware of the needs of our stakeholders. Our stakeholders’ needs will guide WIOMSA’s mission to create, develop and nurture a unique brand. I am confident that WIOMSA can exceed the expectations of all stakeholders by carefully considering their respective interests.

Results will not just happen. Good results will require a dedicated commitment from all WIOMSA staff, but I am sure we will succeed in fulfilling the goals we have set for ourselves. I am supported by an incredibly strong and motivated staff which I am proud to lead. That is a key prerequisite for our success.

On that note, I’d like to ask for your full support for me, the staff and the WIOMSA Board of Trustees. I look forward to working with you all and I am keen to hear directly from you on how we can best move WIOMSA forward together. To all WIOMSA members and our valued partners, I thank you for your continued support.

Arthur Tuda, Executive Secretary, WIOMSA
In 2019 the **Save Our Mangroves Now!** initiative published a **pioneering global study** revealing challenges in legal and institutional frameworks affecting mangroves. The four case studies from the Western Indian Ocean region (Kenya, Tanzania, Mozambique and Madagascar) have now been distilled into **Policy briefs** to ease access of key audiences, including high-level political decision-makers.

One of the central weaknesses identified is that on most occasions mangroves are indirectly defined and governed by forest, fisheries, wetlands laws or other legal tools focused on specific areas. The lack of clarity on roles and responsibilities of different authorities and lack of capacity and legal power and authority on the part of local communities hampers the effectiveness of these systems. One main recommendation is to engage communities, the private sector and the public in mangrove management, restoration and governance. **Read more.**
Western Indian Ocean Journal of Marine Science

Volume 18, No 2 of the Western Indian Ocean Journal of Marine Science was published in December 2019. The issue contains eleven articles:

i) Francis P. Mmanda, Jan Erik Lindberg, Anna N. Haldén, Torbjorn Lundh – Mineral content in local feed ingredients used by fish farmers in four different regions of Tanzania


iii) Emmanuel Japhet, Mwita M. Mangora, Carl C. Trettin, Judith A. Okello – Natural recovery of mangroves in abandoned rice farming areas of the Rufiji Delta, Tanzania

iv) Timothy M. Kakai – Assessing the effectiveness of LED lights for the reduction of sea turtle bycatch in an artisanal gillnet fishery – a case study from the north coast of Kenya

v) Fridah D. Obare, Robert Chira, Dorcus Sigana, Andrew Wamukota – Biophysical factors influencing the choice of nesting sites by the green turtle (Chelonia mydas) on the Kenyan coast

vi) Deogratias P. Mulokozi, Matern S. Mtolera, Aviti J. Mmochi – Spirulina (Arthrospira fusiformis) as a potential protein source in practical diets for fry mariculture of Rufiji tilapia (Oreochromis urolepis urolepis)

vii) Nathan L. Mrombo, Chrisestom Mlewa, Cosmas N. Munga, Julius O. Manyala – Stock status and some biological aspects of Lethrinus lentjan (Lacapede, 1802) from the south coast of Kenya


ix) Bart Shepherd, Hudson T. Pinheiro, Luiz A. Rocha – Sometimes hard to swallow: Attempted feeding on a porcupinefish results in death of both predator and prey

x) Lola M. Massé, Armand Daydé, Mathieu G. Séré, Florence Trentin – Broadcast spawning in Porites lutea at Reunion Island (Western Indian Ocean)

xi) Bella S. Galil – Re-description and new records of a poorly known leucosiid crab, Merocryptus boletisculpta Zarenkov, 1994 (Crustacea, Decapoda, Brachyura)
Adapting to climate change and enhancing resilience: a guide to building adaptive capacity and resilience to the impacts of climate change in coastal urban areas.

This climate change adaptation guide offers political and technical leaders practical guidance on why it is necessary to respond to climate change and how to develop associated adaptation plans and actions. It provides a comprehensive overview of key climate change adaptation issues of relevance to African local governments and offers tangible examples of good practice.

Litter Catch Up

The second issue of the newsletter Litter Catch Up was published in December 2019. This newsletter reports on the on-going marine litter monitoring activities in seven WIO countries, including Kenya, Madagascar, Mauritius, Mozambique, Seychelles, South Africa and Tanzania.