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FOREWORD BY DIRECTOR



A very warm welcome to the sixth edition of the Ocean Quest Newsletter, the last for the year 2017. We have had a busy quarter at the Institute with several workshops and talks being given by eminent scientists in their respective fields.

In view of developing the Ocean Economy, the MOI has been re-prioritising its research areas to further enable the sustainable and ethical development of our marine resources. To this end, we have embarked on an international collaboration with the Ocean Foundation (USA) to monitor ocean acidification around Mauritius. Additionally, we are actively researching on the possibility of tapping submarine groundwater discharges to meet ever-increasing potable water demands on the island.

The MOI is pursuing its studies of the marine biodiversity in our Exclusive Economic Zone (EEZ) which will enable not only us, but also potential investors, to sustainably develop/exploit our marine resources for biotechnological advances. Through this project, we

have thus far identified 180 species of commercial fishes and 19 species of sea cucumber using taxonomy and DNA-identification techniques. The latter confers an added advantage in species identification over taxonomy as detailed by our scientists in this newsletter. We also hosted a malacology workshop for participants in the Western Indian Ocean region to broaden our understanding on the taxonomy of molluscs.

The Monitoring for Environment and Security in Africa (MESA) project was also concluded within the last quarter and since this project proved very successful, we are looking into continuing the data collection and dissemination to help fishermen and other stakeholders. I am very proud to announce that the MOI has just been awarded a grant by the African Union Commission for the Global Monitoring for Environment and Security & Africa (GMES & Africa) project. As the Regional Implementation Centre (RIC) for this project, the MOI will play a very important role in coordinating the East Africa consortium which is going to implement the project in 14 countries in the region, which over the next three years will address the need to enhance not only the usage of Earth Observation (EO) systems, but also help in decision making for sustainable development. This project will complement the AMESD and MESA projects, which the MOI had been working on over the last nine years, and build on the intellectual and infrastructural capacities generated therein. More details on these exciting developments will be communicated in our next issue in the New Year.

Please read on to find out more about the research activities which have been selected for this edition of the Ocean Quest newsletter, which also includes a focus on climate change and ocean acidification as well as the assessment of marine living resources in Mauritius waters. A more exhaustive description of our research projects can be found on the Mauritius Oceanography Institute's website.

The past twelve months have been marked by noteworthy achievements and changes. I would like to thank the staff of the MOI for their incredible work, commitment and dedication throughout the year. Special thanks to the MOI's Board, its parent Ministry as well as its local, regional and international partners and collaborators.

As we wrap up 2017 we look forward with enthusiasm to an even more interesting and productive new year 2018.

I would like to take this opportunity to extend to you, dear readers, our warm greetings and best wishes for the New Year

Happy reading!

Dr Ruby Moothien Pillay
Director

PREFACE BY CHAIRMAN



Dear Reader

It is once again our pleasure to share with you some information on the valuable research work being undertaken by the MOI scientific staff with a view to contribute to the sustainable development of our unique island.

As per our mandate defined in the MOI Act 1999, and our area of expertise, you will see reports regarding some very useful, and very pertinent subjects such as the ground water discharges at sea. This is a subject of utmost importance because as per the Intergovernmental Panel for Climate Change report, there will be extreme changes in the climate with respect to the increasing recurrence of both drought and rainfall. Management of our water resources will be crucial

in the years to come. The research on groundwater discharges along the coast will provide the decision makers with the information to quantify the discharges, identify their flow paths, to strategize regarding its capture (e.g. through sub-surface dams, etc.) as well as to ascertain the impact of this water in the lagoon marine environment, specially the reefs.

Ocean acidification, also an effect of climate change, will have a major impact on the marine resources in our EEZ. To help tackle this, the MOI is taking part in an international project coordinated by the Ocean Foundation to monitor the level of acidity in our oceanic waters in order to guide future policies on this issue.

At the regional level, you will be able to appreciate the great contribution of the MOI for their coordinating role in the implementation of the Monitoring for Environment and Security on Africa (MESA) project, where we, along with various countries of the region, are capturing, analysing and sharing much needed information on the marine characteristics and resources of our waters, which has proven very useful to the fishing communities in the region.

The MOI is also collaborating with various

national and international institutions of repute to broaden its sphere of research. This presents many advantages as our scientists get to share and learn from other scientists which will eventually help the MOI to carry out research work to international standards.

In the very near future, the MoU signed between the MOI and the National Institute of Oceanography of India will be implemented through a jointly agreed programme and this should take our Institute to a higher level of expertise, and help us to realise our ultimate aim, which is to make the MOI a Regional Oceanographic Centre of Excellence in the South West of the Indian Ocean.

Please enjoy reading this most informative Newsletter and we shall be back in the first quarter of 2018 with another edition full of other interesting news on novel and ongoing oceanography research at the MOI.

As is the tradition at the end of the Year, I wish you, your family and friends, a very Happy New Year 2018.

Raj Hemansing PRAYAG, PDSM, FIEM
Chairman

Ocean Acidification Workshop

To understand the impact of ocean acidification in the Exclusive Economic Zone (EEZ) of Mauritius, the MOI has initiated a novel project to monitor the changes in the trends and patterns of ocean acidity. In this context, a Memorandum of Understanding (MoU) has been signed with the Ocean Foundation (USA) for the capacity building of MOI scientific staff to investigate oceanic carbonate chemistry and to comprehend the impact of ocean acidification on marine ecosystems. The MoU also provided the MOI with a “GOA-ON (Global Ocean Acidification Observing Network) in a Box” that includes standardised monitoring equipment.

Through this MoU, the MOI is taking part in the Global Ocean Acidification Observing Network (GOA-ON) initiative which includes participants from more than 60 countries. This initiative is unique and novel as all the scientists involved in this global monitoring network will be using harmonized equipment, chemicals and standard operating procedures. The unprecedented dataset that will be generated will provide a solid platform to help understand the evolution of ocean acidification.

This unique effort directly addresses Sustainable Goal 14.3 of the United Nations, which is to: “Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels”. Furthermore, this consortium of international scientists provides a discussion platform for research planning in the field of ocean acidification.

In this context, a high level international practical training course organised by the Ocean Foundation, and

funded by the U.S. Department of State, the Heising-Simons Foundation, and the Swedish International Development Agency, was hosted at the MOI from the 12th to the 18th of August 2017. The purpose of this workshop was to provide advanced training on the applied use of ocean acidification monitoring equipment included in the “GOA-ON in a Box.” The course focussed on the deployment of sensors, the collection of samples, lab analysis of the pH and alkalinity of these samples, data quality control and reporting.

Dr. Christopher Sabine and Dr. Sophie Chu from the National Ocean and Atmospheric Administration (NOAA), and Alexis Valauri-Orton from the Ocean Foundation delivered hands-on training on the equipment provided in the OA-starter kit. Regional representatives from South Africa and Mozambique, along with local representatives from the Albion Fisheries Research Centre (AFRC), the University of Mauritius and the MOI (represented by Drs. Yashvin Neehaul and Danishta Dumur-Neelayya), took part in this workshop.



The carbonate chemistry of water samples were determined by laboratory measurements of pH and total alkalinity



Fieldwork included deployment of sensors and water sampling.



The iSAMI analyser was deployed in the lagoon of Albion. This equipment provides high resolution in-situ pH measurements

Talk on “Investigation of land-sea interactions through submarine groundwater discharge”

Submarine groundwater discharge (SGD) is an important and non-negligible route of chemical communication between land and sea. The MOI has identified twenty eight major SGD sites around Mauritius. Currently, scientists from our Chemical Oceanography Unit are evaluating the flux of fresh water from the submarine springs in the lagoon of Trou aux Biches. The primary objective is to assess the potential use of SGD as a potable source of fresh water for both domestic and industrial consumption.

In this context, the MOI hosted a talk on the 9th of October by Dr. Nils Moosdorf from the ZMT Leibniz Centre for Tropical Marine Research (ZMT), Germany. In addition to introducing the topic and the ZMT, Dr. Nils Moosdorf described the research of his working group in assessing the different aspects and effects of SGD on coastal ecosystems in the laboratory, as well as on the local, regional and global scales. The talk focussed on the importance of combining not only field-work and modelling, but also literature research and local knowledge into a holistic image of the processes

controlling the effects of SGD in coastal ecosystems in light of global change. The presentation highlighted the spatial and temporal impacts of SGD in tropical regions.



Water sampling in a SGD spring in Trou aux Biche. Due to the difference in salinity of the spring and seawater, the surrounding is blurred. This phenomenon is also known as a halocline.

Regional Training Workshop on the Taxonomy of Marine Molluscs

As part of its on-going project on the assessment of marine living resources in the EEZ of Mauritius, the MOI initiated the assessment of a new group of marine organisms: the molluscs. Funded through the Indian Ocean Commission's (IOC) Biodiversity Project, a regional training workshop was organised for the training of both local and regional participants on the taxonomy of marine molluscs. The training was facilitated by malacologist, Dr Mathew Kosnik, a senior lecturer from Macquarie University, Australia under the MOU the MOI had signed with Macquarie University in 2016.

The objective of the workshop was to strengthen the skills of the local and regional participants in malacology, with the view of setting up local and regional partnerships which would be essential for the:

- 1 conservation and protection of marine biodiversity and genetic diversity; and,
- 2 prevention of local and regional species' extinction.

The four-day workshop, which was held from the 16th to the 20th of October 2017 at the MOI in Albion, was officially opened by the Hon. Premdutt Koonjoo, Minister for Ocean Economy, Marine Resources, Fisheries and Shipping. The Australian High Commissioner to Mauritius, Her Excellency Ms. Jenny A. Dee, as well as a representative from the IOC, Mr Said Ahamada, also addressed the audience on the importance of biodiversity and its protection in the face of global threats. Interestingly, the opening of the workshop coincided with the launch of the octopus fishing season, itself a mollusc.



Group Photo after the Opening Ceremony at MOI, Albion

The work programme for the training workshop comprised both lectures and practical sessions. Lectures introducing molluscs as a taxonomic group were further developed to focus on two major sub-groups: the gastropods and the bivalves. Field activities were conducted at Le Bouchon public beach, where the participants were divided into several groups to survey different habitats, e.g., sandy beach, rocky shore, mangrove, seagrass beds and coral reefs. The different groups were then tasked with the collection of molluscs from each of the above habitats, as per the guidelines and instructions provided during previous lecture sessions. Following the sampling activities, the specimens were transported back to the MOI where they were sorted into the two major sub-groups. Throughout the workshop, the participants were initiated to sorting techniques as well as techniques for the morphometric assessment of the different specimens and the recording of any additional information required for a proper survey. The participants were then invited to identify the different specimens based on the relevant lecture notes and identification keys that had been distributed during the lectures.

The last day comprised a session on the “Biodiversity Data Quality Control – Tools and Techniques”, which included a demonstration on how to upload scientific data on databases such as AfrOBIS. The highly interactive nature of this workshop, through its various lectures and activities, was much appreciated by the participants. This workshop helped initiate a local and regional network on the study of mollusc that we hope to develop over time.

The training workshop was attended by 24 participants from the Indian Ocean region, including Mauritius. The regional participants were from Comoros Islands, Kenya, Tanzania and Madagascar and local participants included representatives from the MOI, the Albion Fisheries Research Centre (AFRC), the University of Mauritius (UOM), the Rodrigues Regional Assembly (RRA), ECOSUD, the Seashells Museum, and the IOC.



Sampling of molluscs in seagrass ecosystem at Bel Ombre



Sorting of Molluscs specimens during workshop



Taxonomy expert identification of Marine molluscs

Climate Change and Ocean Acidification

Since the early 1900s and the discovery of fossil fuel as a source of energy, anthropogenic carbon dioxide (CO₂) in the atmosphere has increased significantly and also coincides with the industrial era. Coupled with a global and on-going deforestation, the amount of gaseous CO₂ is constantly increasing. This shift (Figure 1) in the atmospheric composition is called climate change. The symptoms are numerous: global warming, ice melts, sea level rise, salinity changes, catastrophic events, and ocean acidification.

Ocean acidification is an undisputed fact as documented by scientific research. It is generally accepted by the worldwide scientific community that the pH of the ocean has decreased from 8.2, registered at the beginning of the industrial era, to the current level of 8.1. Although this change appears minimal, ocean surface acidity has increased by almost 30% as the pH levels are described in logarithmic values. The ocean impressively absorbs a quarter of all atmospheric CO₂ emission. Upon solubilisation and dissolution in the ocean, carbon dioxide reacts with water to form carbonic acid, changing the system and shifting the equilibrium of inorganic carbon species to a system with less carbonate ions and more bicarbonate ions as seen in Figure 2.

Since carbonates are the building blocks of coral reefs and most shelled organisms, ocean acidification is directly impacting on the marine ecosystem. Although we are not expecting to see corals reefs dissolving per se, the rate of calcification and the formation of carbonate solids have considerably decreased. In addition, with the advent of global warming and the increasing occurrence of El Niños worldwide, the regeneration potential of coral ecosystems post-bleaching is diminishing.

Since climate change is a global phenomenon, the impacts being observed locally are not isolated, and certainly not limited by geographical boundaries. Both mitigative and adaptive measures are urgently required. For a local response, a sound management of the ocean should take into consideration this additional stress on the marine environment. The first foundation step is the availability and the production of sound scientific data. Globally, the response is simple: a significant decrease in CO₂ emission is critical.

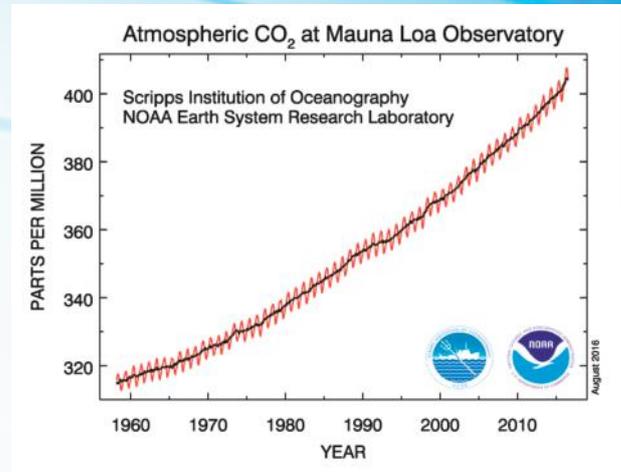


Figure 1: Change in atmospheric carbon dioxide since the 1960's. Source: Scripps Institution of Oceanography.

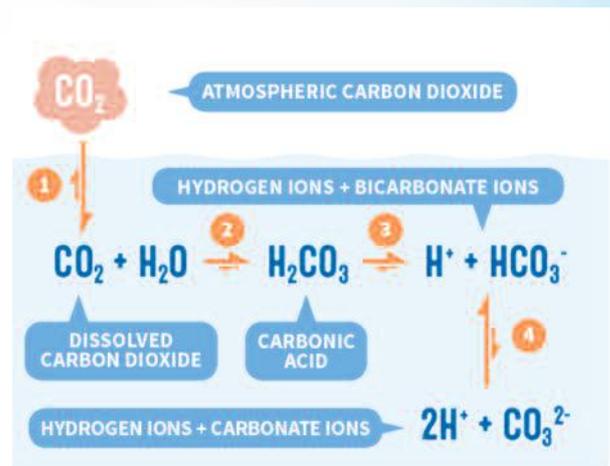


Figure 2: Schematic representation of the oceanic carbonate chemistry.

Over the past few years, several high profile reports have highlighted the urgent need to better understand the impacts of carbonate chemistry changes on marine organisms and their ecosystems. Back in 2007, the Nobel Peace Prize was jointly awarded to the Intergovernmental Panel on Climate Change and to Al Gore Jr., for their efforts in building up and disseminating greater knowledge about man-made climate change. Ocean acidification has also been addressed in the Sustainable Development Goals of the United Nations, Goal 14.3: "Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels."

Assessment of marine living resources in the EEZ of Mauritius

Faced with global threats including over-exploitation, habitat loss, pollution, disease, invasive species and climate change, bio and genetic diversity need to be properly assessed and conserved. Species are going extinct before they have even been documented and since species are the basic units of measurement of biodiversity, their accurate definition is critical in all studies of living systems. The degradation of the coastal habitats and over-exploitation of fisheries resources pose a real threat to the very existence of all marine species. In this context, the MOI initiated in 2010 an inventory of marine organisms in the Republic of Mauritius using both traditional taxonomy and DNA-based techniques. The project is in line with the Government programme 2015-2020 as well as with its Vision 2030, wherein the protection and the preservation of marine living resources are key to the establishment of a sustainable Ocean Economy.

Objectives

- To undertake an inventory of marine living resources using taxonomy and DNA-based techniques
- To establish and populate an online marine living resources and genetic database.
<http://moi.govmu.org/online-databases>
- To provide services to the seafood and aquaculture industries.
- To publish posters and field guides (used by various stakeholders, including aquaculture investors).

Importance

The identification of species has been traditionally based on their morphological characters. However, using morphological features solely to identify species is confounded by the phenotypic plasticity of skeletal characters, the lack of diagnostic features in larval forms, damaged or incomplete specimens and derived products. DNA-based identification helps:

- 1 to distinguish morphologically closely related species;
- 2 to identify specimens that are incomplete, damaged or immature;
- 3 to assess biodiversity;
- 4 to detect mislabelled seafood products and market substitutions so as to prevent economic deception;
- 5 to authenticate seafood in terms of food safety and certification;
- 6 to determine traceability of exported seafood and its products; and
- 7 to protect marine resources and their Intellectual Property Rights (IPR).

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Marine Diversity and Genetic Data Bank

Home
Fish
Sea cucumbers
Sponges
Molluscs
Crustaceans
Soft corals
User guide

Background

Species are the basic units of measurement of biodiversity and therefore their accurate identification is critical in all studies of living systems. Identification of species is important not only for documenting biodiversity but also for the management of resources, conservation of biodiversity, protection of critical habitats and response to climate change.

In 2010, the Mauritius Oceanography Institute (MOI) initiated a project to inventory and genetically characterise commercial marine organisms in the waters of the Republic of Mauritius. Identification of organisms is carried out by combining both traditional taxonomic identification tools and DNA-based techniques namely DNA barcoding, which employs patterns of sequence variation from the mitochondrial 5' region of the cytochrome c oxidase subunit I (COI) gene.

The morphometric and genetic data generated are stored on this custom-designed online searchable database, the Marine Diversity and Genetic Data Bank (MDGDB), which is continuously updated with new data as they become available. Here users are presented with both a DNA-based search approach and a query-based function. For the DNA-based technique, users can search the DNA data bank through the BLAST algorithm. In the query-based function, search can be performed using either the nomenclature or the common name (Local, English and French) of the organisms.

Screenshot of the marine living resources website
Source: <http://moi.govmu.org/online-databases>

Focus

In this project, DNA tools have proved to be very useful in the identification and delineation of:

a) genetically different but morphologically similar species (Figure 1)

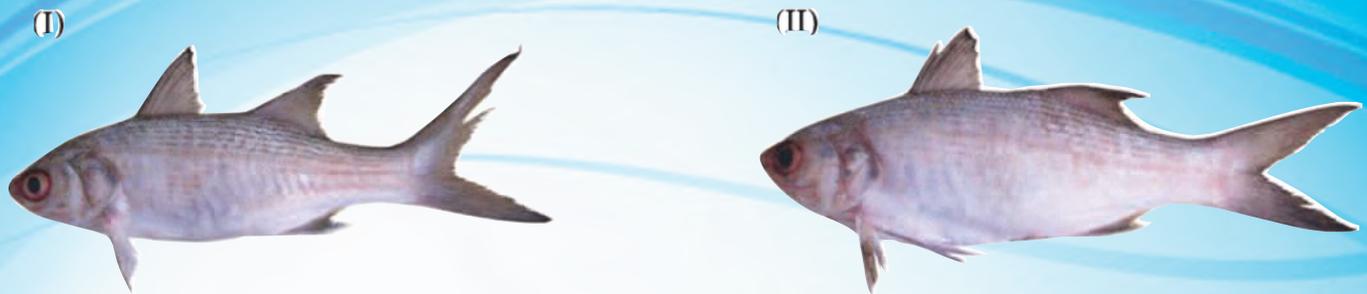


Figure 1: Two different species which are morphologically similar (i) *Polydactylus sexfilis* (Local name: Mulet / Mulet bâtard, English name: Sixfinger threadfish) and (ii) *Polydactylus plebeius* (Local name: Mulet / Mulet bâtard, English name: Striped threadfish)

b) sexually dimorphic fish, i.e., male and female fish showing morphological (colour) variation (Figure 2)



Figure 2: Same species but morphologically different: *Gomphosus caeruleus*, (I) male (II) female

c) phenotypic plasticity among species, i.e., colour pattern variation at different stages of growth (Figure 3)



Figure 3: Same species but morphologically different due to colour variation in growth stages, *Plectropomus laevis* (I) blacksaddled or barred and (II) blue spotted

Deliverables

- Freely accessible marine diversity and genetic database which can be used by various stakeholders including aquaculture investors;
- A list of marine species with their respective genetic markers, 186 species of commercial fish and 19 species of sea cucumbers;
- Market guide for 43 fish families in Mauritius;
- Provision of services to the seafood Industry for the DNA-based identification of frozen fish file samples;
- Preliminary techniques have been developed for the identification of marine sponges; and
- Hosting of a regional training workshop on the taxonomy of marine molluscs.



REGIONAL PROJECT – MONITORING FOR ENVIRONMENT AND SECURITY IN AFRICA (MESA)

4th MESA-IOC-MOI Regional Technical Working Committee Meeting

The 4th Regional Technical Working Committee Meeting of the MESA-IOC-MOI thematic action was held on the 18th of September 2017 in the conference room of the MOI in Albion, Mauritius. Eleven technical representatives from the beneficiary institutions in Comoros, Madagascar, Mauritius, Mozambique, Seychelles and Tanzania attended the meeting to discuss of the status of MESA station delivery and installation in the different countries, to examine the status of service implementation and usage at national level as well as to report on the main achievements, challenges and lessons learned.

The group of technical focal points also discussed of the sustainability of the services that were developed through this project. All the institutions present expressed their interest in continuing to generate products and the running of the MESA service beyond the project.



Presentation by The Technical representative at MOI Albion

4th MESA-IOC-MOI Regional Steering Committee Meeting

The fourth Regional Steering Committee Meeting of the MESA-IOC-MOI project was held at the Sofitel Mauritius Resort & Spa in Flic en Flac, Mauritius on the 20th September 2017. After the welcome address by the Director of the Mauritius Oceanography Institute, Dr Ruby Moothien Pillay, the meeting was officially opened by Mrs. Gina Bonne, Chargée de Mission at the Indian Ocean Commission (IOC) and Chairperson of the Committee, in the presence of Mr. Narci de Premegi, Permanent Secretary of the Ministry of Sea, Inland Waters and Fisheries of Mozambique, and the National Focal Points of the respective

countries participating in the IOC THEMA.

The objectives of this fourth meeting were to report on the implementation status of the MESA programme in the IOC region, to discuss the lessons learnt, to examine the sustainability plans of the different countries, and to come up with recommendations for future programmes.



Group photo of participant

MESA Closing Workshop



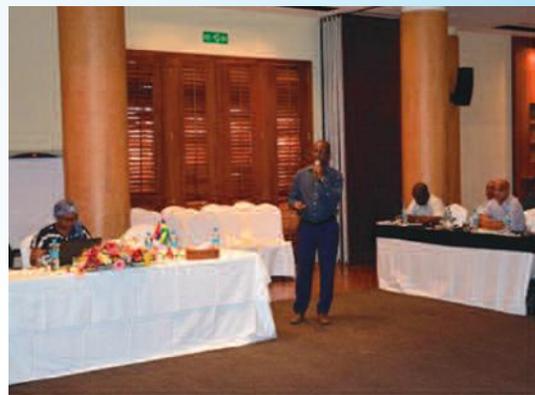
Speech by Honourable Mr. Premdut Koonjoo, Minister for Ocean Economy, Marine Resources, Fisheries and Shipping



Speech by His Excellency Mr. Hamada Madi, Secretary General of the Indian Ocean Commission (IOC)



Presentation by Dr John Bemiasa, IHSM – Madagascar



Presentation by Dr Baraka Kuguru, TAFIRI - Tanzania

To mark the end of the European Union (EU) funded Monitoring for Environment and Security in Africa (MESA) project, the MOI as the Regional Implementation Centre (RIC) of the project for the Indian Ocean Commission (IOC) region, organised the MESA-IOC-MOI Project Closing Workshop on the 21st of September 2017 at the Sofitel Mauritius L'Imperial Resort & Spa, Flic en Flac, Mauritius.

The main objective of the last workshop was to report on the achievements of the MESA programme in the region, emphasising the use of the MESA-IOC-MOI services and products in support of decision making. Representatives from Tanzania and Madagascar showcased examples of how MESA data were being used to provide information to fishermen on the Potential Fishing Zones (PFZ) and the monitoring of Harmful Algal Bloom respectively. Furthermore, a representative of the IOC-SMARTFISH project showed how oceanographic products generated by the MOI were being used as a risk analysis tool for fisheries surveillance in the South West Indian Ocean region.

A total of 40 participants from Comoros, Madagascar, Mauritius, Seychelles, Kenya, Tanzania and Mozambique attended the workshop. The Hon. Mr. Premdut Koonjoo, Minister of Ocean Economy, Marine Resources, Fisheries and Shipping, officially opened this workshop in the presence of His Excellency Mr. Hamada Madi, Secretary General of the Indian Ocean Commission (IOC) and Mrs. Clara Osorio, Head of Cooperation from the European Union (EU) Delegation.

INTERNSHIPS/TRAININGS AT MOI

Timo Pisternick a postgraduate student from the ZMT Leibniz Centre for Tropical Marine Research, Germany is currently doing an internship at the MOI under the co-supervision of Dr Yashvin Neehaul and Nils Moosdorf. He is carrying out research work to investigate the biological and ecological aspects of the project "Investigation of land-sea interactions through submarine groundwater discharge".



Timo's investigation is focussed on the SGD springs in the lagoon of Trou aux Biches



This investigation uses underwater high resolution photography and videos to evaluate the influence of SGD on marine fauna and flora



GMES GMES Grant Award Ceremony AND AFRICA

The African Union Commission (AUC) officially awarded grants to thirteen successful consortia of institutions that will serve as Regional Implementing Centres for the Global Monitoring for Environment and Security and Africa (GMES and Africa) Support Programme during a ceremony that was held at the House of Entrepreneurship, Plateau, Abidjan, Côte d'Ivoire, on the 28th of November 2017 on the margins of the 5th AU-EU Summit. Mrs Anne Désirée Ouloto, Minister of Urban Sanitation, Environment and Sustainable Development of Côte d'Ivoire and Professor Sarah Anyang Agbor, Commissioner for Human Resources, Science and Technology at the African Union Commission were present on that occasion.

Following a Call for Proposals in May 2017, a number of African institutions operating in the areas of water, natural resources, marine and coastal areas, applied for the GMES and Africa Support Programme. After an evaluation exercise, the most suitable consortia of institutions that submitted proposals were finally selected. The award ceremony marked the official announcement of the thirteen consortia of institutions which have been chosen.

For the East Africa region, three consortia have been designated and the consortium led by the Mauritius Oceanography Institute has been selected for the Marine and Coastal Areas service.

GMES and Africa Support Programme is a 30 million Euro joint programme co-financed by the European Commission and the African Union Commission. It will use and adapt the Copernicus Programme data and services to the African context. It is designed to specifically respond to African needs with respect to services related to water, natural resources, marine and coastal areas and to address the global needs to manage the environment, mitigate climate change and ensure civil security.

The MOI will be the Regional Implementation Centre for the East Africa consortium consisting of the Tanzania Fisheries and Research Institute, the Kenya Marine Fisheries Research Institute, the Institut Halieutique et des Sciences Marines of Madagascar, the Seychelles Meteorological Authority and the Western Indian Ocean Marine Science Association. As such, the MOI will be the lead organisation in this partnership and will be in charge of the overall project management. Furthermore, the MOI will be involved in the development, implementation and operation of the various applications of the Marine and Coastal Management Service with the support and involvement of its regional partners.



Group Photo, Representative of the MOI, Mr E. Martial at the Award Ceremony